

Bats of Bako National Park and Additional Notes on the Rare Partial Albinism in Fawn Roundleaf Bat (Hipposideridae: *Hipposideros cervinus*)

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ABSTRACT

Bat survey was conducted in Bako National Park from 25th to 29th August 2013. A total of 107 individuals from 11 species of bats were recorded. *Hipposideros cervinus* was recorded as the most abundance species with 51 individuals while *Murina suilla* and *Rhinolophus affinis* were the least abundant with one individual each from total captures. This study has added *R. affinis* as another new species locality record for the national park. This brings up the total bat species known from the park now to 35 species of bats. Interestingly, an individual of *H. cervinus* with partial albinism was caught during this survey. This single bat was captured on the 27th August 2013 and will be the first albino bat reported in Borneo and possibly Malaysia. This specimen is an adult female that presents high degree of albinism over most of the body but lacking on the upperparts of the body and part of the wings. Detailed description based on 16 external and craniodental measurements are presented herein along with their species identification through genetic analyses. Further research on the genetic structure and behavior of an albino individual may help to identify the possible causes and consequences of albinism to the bats populations.

Keywords: Chiroptera, *Hipposideros cervinus*, mammals, melanistic, Southeast Asia, species inventory

INTRODUCTION

National park and forest reserves are important for the purpose of conservation and management of flora and fauna. This is especially important for those species that are threatened and endemic. In Sarawak, there are at least 30 national parks, 10 nature reserves and four wildlife sanctuaries. Bako National Park is the oldest national park in Sarawak and it is known as one of the main tourist attraction, given that it is closest to Kuching city and easily accessible. One of the major attractions in this national park is the opportunity to see Proboscis Monkey that is endemic to Borneo. The park consists of seven different major habitats which includes heath forest, mangrove forest, mixed dipterocarp forest, riverine forest, beach forest, grassland and cliff vegetation (Hazebroek & Abang Kashim, 2000).

Additionally, seasonal swamp forest also can be found around this park, as the intermediate between beach and mixed dipterocarp forest during the monsoon season (Khan *et al.*, 2007). Combination of these different habitats provides diverse ecological niches for high species richness especially among the wildlife including bats (Khan *et al.*, 2007).

Bats play a vital ecological role in the ecosystems. However this group of fauna is the most neglected order of land mammals worldwide and rarely featured on the priority list of any wildlife conservation program (Devkar *et al.*, 2010). For example, the long-tongued nectar bat (*Macroglossus minimus*) are known as one of the major pollinator for the mangrove trees which serve as the critical habitat for the iconic Proboscis Monkeys, besides birds and insects (Strahan, 1995;

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Bonaccorso, 1998; Lekagul & McNeely, 1977; Payne *et al.*, 1985;). Therefore attention should also be given to other fauna such as bats that ensure the stability of the ecosystem that is important for the popular iconic species (*e.g.* Proboscis Monkey and Orang Utan). Several bat studies including Start (1972), Francis *et al.* (1984), Churchill & Zborowski (1987), Hall (1992), and Khan *et al.* (2007) have been conducted in Bako National Park. These studies were designed to update the species list and also to generally assess the population status of bats in the park that may potentially change due to recent climate change and increase of other threats such as deforestation and hunting. None of these studies documented incidence or discuss on albino bats or other albino wildlife in this national park.

Albino is a birth defect that potentially caused by genetic or environmental factors that alter the genetics. Albinism is a hypopigmentary congenital disorder known to affect a variety of mammals and other vertebrates (Uieda, 2000). It can be partial (leucism) with hypomelanism resulting in a variable distribution of melanin on the body and animals displaying white spots on the skin or white fur tufts on the body (Herreid & Davis, 1960; Quay, 1970). Worldwide, only 70 complete-albino bats of 43 species have been recorded from 24 countries; with only a single albino bat has been noted in all the above cases (Brigham & James, 1993; Uieda, 2000; Charles-Dominique *et al.*, 2001; Barquez *et al.*, 2003; Sodre *et al.*, 2004; Aul & Marimuthu, 2006; Oliveira & Aguiar, 2008). In bats, partial and complete albinisms are quite rare (Sanchez-Hernandez *et al.*, 2010). Most species of bats which albino individuals were recorded, including present study, occupy sheltered roosts like caves, mines, galleries and buildings. Such roosts may be essential for the survival of albino bats, to protect them against sunlight, water loss and predation by visually oriented predators (Aul & Marimuthu, 2006).

Although albinism scenarios in bats are rare, it is important to document the natural history information of these bats when possible. In this study, we provide an updated summary of list of species recorded in Bako

National Park since the last study six years ago by Khan *et al.* (2007). To provide the natural history information of the albino bat, we measured the skull and provide genetic data for species identification. Herein we discuss the result of our bat survey.

MATERIALS AND METHODS

Study Area

Bat survey was conducted in Bako National Park (1.7167 °N, 110.4667 °E) in Kuching, Sarawak which covers an area of 2727 hectares. Bako National Park is located at Muara Tebas Peninsula on the north-eastern part of Kuching, about 37 kilometres away from Kuching city (Figure 1). The main access to the park is by 20 minutes boat-ride through Sungai Delima. Bako National Park is the oldest national park in Sarawak that was gazetted as a protected area on the 1st May 1957. The survey was conducted around the park headquarters, part of Lintang trail, Ulu Assam trail, Serait trail, Teluk Delima trail, Tanjung Sapi trail, Teluk Paku trail and Teluk Assam trail.

Field Methods

A sampling survey was conducted from 25th until 29th August 2013 in Bako National Park. There were 10 mist nets and four four-bank harp traps were set throughout the sampling period. Nets and harp traps were checked for every two hours from 1830 until 1200 midnight and 0600 in the morning. Samples were identified following Payne *et al.* (1985). For each individual, standard measurements (Ear, Hind Foot, Tibia, Ventral tail length, Forearm, and Total length) and weight were recorded and representative of five individuals for each species were collected as voucher specimens. The samples were prepared as skin, skull and skeletal or as fluid wet specimen. These voucher specimen was deposited to the Universiti Malaysia Sarawak (UNIMAS) Zoological Museum.

Laboratory Methods

The skull and dental characters were measure to evaluate species identification and any other morphological anomaly. The skull of the

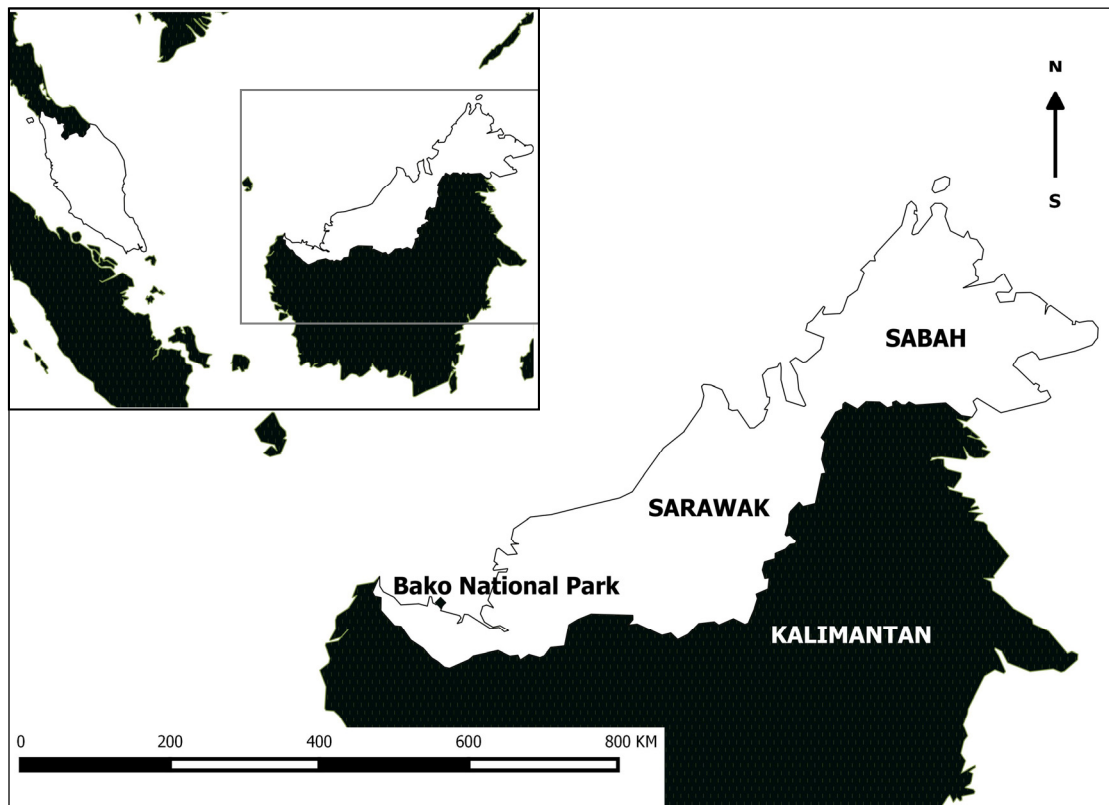


Figure 1. The figure show maps of Malaysia and the location of Bako National Park.

albino bat *H. cervinus* was extracted according to Nagorsen and Peterson (1980). The body, skull and dental measurements of the albino bat were measured following Kitchener *et al.* (1995) and Jayaraj (2008). Sixteen external characters and weight made using Mitutoyo digital caliper and Pesola, were recorded as follows; Forearm (FA), ear length (E), tibia length (TB), hind foot length (HF), Tail (T), Head body length (HB), second (D2MCL) and third digit metacarpal length (D3MCL), third digit first (D3P1L) and second phalanx length (D3P2L), fourth digit metacarpal length (D4MCL), fourth digit first (D4P1L) and second phalanx length (D4P2L), fifth digit metacarpal length (D5MCL), fifth digit first (D5P1L) and second phalanx length (D5P2L) and weight (WT).

Similarly, 17 craniodental characters were also measured using Mitutoyo digital caliper. The skull characters measured were the greatest skull length (GSL), postorbital width (POW), cranial width (CW), mastoid width (MW), zygomatic width (ZW), post palatal length (PPL), palatal length (PL), distance between cochlea (DBC), bulla length (BL),

greatest basal pit length (GBPL), dentary length (DL), canine tooth basal width (C1BW), breadth across both canine outside surfaces (C1C1B), breadth across both third molar teeth outside surfaces (M3M3B), canine molar length or maxillary tooth row length (C1M3L), second molar tooth crown length (M2L) and the second molar tooth crown width (M2W). Additionally, we have generated genetic data to compare mitochondrial DNA sequence with other similar species.

The tissue of the albino bat was extracted using DNeasy tissue kit (Qiagen). Then, the amplification of the mitochondrial cytochrome *b* (cyt *b*) was done using GenomiPhi DNA Amplification Kit (Amersham Biosciences/GE Healthcare) with the hot start PCR in a Biometra T-Gradient 96 thermal cycler in 25 μ l reaction volumes (1.0 μ l of DNA template was added to the initial mixture of 2.5 μ l of 10X buffer, 1.5 μ l of $MgCl_2$ (25 mM), 0.5 μ l of dNTP mix (10 mM) and 1.0 μ l each of both forward and reverse primers, LGL765 (100 mM) (Bickham *et al.*, 1995) and LGL766 (100 mM) (Bickham *et al.*, 2004). Lastly, 14 μ l of ddH₂O was added to complete the final

mixture and added later with 0.2 μl of *Taq* polymerase (5U / μl). PCR products were sent to private laboratory for DNA sequencing. The sequence result were blast using the NCBI, Blast Assembled Genomes.

RESULTS

A total of 107 individuals representing 11 species from four families: Pteropodidae, Rhinolophidae, Hipposideridae and Vespertilionidae were recorded during the five trapping-nights in Bako National Park. *Hipposideros cervinus* was recorded as the most abundance species with 51 individuals while *M. suilla* and *R. affinis* were the least abundance with one individual each from the total captures. *Rhinolophus affinis* represent a new species locality record for Bako National Park (Figure 2). We also collected the Bornean endemic, *H. coxi* during this sampling (Figure 3). Single individual of partial albinism *H. cervinus* is caught in the harp trap (Figure 4a and 4b), along Teluk Paku Trail (1.7167 °N, 110.4667 °E).

Data from previous studies were compared to show the species accumulation or reduction during different sampling occasions (Table 1). We have successfully recorded four families and 11 species of bats. In terms of species accumulation, it shows an increasing



Figure 2. Portrait photo image of *R. affinis* from Bako NP.



Figure 3. Portrait photo image of Bornean endemic *H. coxi* from Bako NP.



Figure 4(a). Portrait photo image of *H. cervinus* (albino) collected at Bako National Park. Redish eye could not been seen in the photo image but was observe in life specimens. The albino feature of *H. cervinus* has made the ears of *H. cervinus* appears to be translucent which is not observed in normal *H. cervinus*.



Figure 4(b). Full photo image of the *H. cervinus* (albino) from Bako National Park.

trend, while the number of individuals captured have decreased steadily over time. These result was tabulated and compared to previous studies on bats conducted in Bako National Park. Detailed description of the partial albino bat based on 16 external and craniodental measurements are presented herein (Table 2). The measurements are consistent with other *H. cervinus* from Sarawak (FA: 46.55 – 48.66; GSL: 17.66 – 18.68; DL: 11.54 – 12.31) as listed in Sazali & Juary (2012).

Additionally, our genetic analyses through Blast software also showed that our bat sequence matched *H. cervinus*. Then, the sequence was analyzed with MEGA using Kimura 2-parameter, with the available sequences on the cytochrome *b* *H. cervinus* in genebank. The genetic distance between the individuals shows a distance more than 5%. This might be a distinct species, but it is hard for us to confirm it as the other individuals are from different locality.

DISCUSSION

This study has captured another bat species in the park, making the total number of bat

species known from the park now to 35 species. Record of *R. affinis* in Bako National Park is not surprising as other bat species that are known roosting on rock crevices have been recorded before (e.g. *R. borneensis*; *Emballonura* sp.).

Therefore it is expected that many other rock or boulders roosting bats will be captured in the future. Record of *H. coxi* highlights the importance of Bako National Park as one their natural habitat as they are only known from Bau cave area (Wind Cave Nature Reserve, and Jambusan Cave; Ridwan *et al.*, 2010) and Padawan area (Mount Penrisen; Khan *et al.*, 2007). *Hipposideros coxi* is a rare species with data deficient status reported from IUCN Red List (Francis *et al.*, 2008).

Albinism is considered as rare in bats, and mammals in general. Record of the partial albinism in *H. cervinus* is a significant finding for Bako National Park. This single bat was captured on the 27th August 2013 and this will represent the first record of any albino bat reported in Borneo and possibly Malaysia at least for the species. Besides, this will be the first record for the *H. cervinus* as an albino. This specimen is an adult female that presents

Table 1. List of bat species and their respective percentage relative abundance from Bako National Park, Sarawak.

#	FAMILY Species	Current Study (2015)	Khan <i>et al.</i> (2007)	Hall (1992)	Churchill & Zborowski (1985)	Francis <i>et al.</i> (1984)	Start (1972)
PTEROPODIDAE							
1.	<i>Pteropus vampyrus</i>	-	-	-	Sighted	-	-
2.	<i>Cynopterus brachyotis</i>	2.80	7.12	-	-	6.98	11.63
3.	<i>Penthetor lucasi</i>	10.28	12.54	-	0.96	11.63	11.63
4.	<i>Balionycteris maculata</i>	-	-	-	-	6.98	-
5.	<i>Eonycteris spelaea</i>	-	10.17	-	-	37.21	6.98
6.	<i>Macroglossus minimus</i>	-	2.37	-	3.85	2.32	54.65
EMBALLONURIDAE							
7.	<i>Emballonura alecto</i>	-	0.34	Recorded	0.96	9.30	-
8.	<i>Emballonura monticola</i>	-	0.34	-	-	-	-
9.	<i>Saccolaimus saccolaimus</i>	-	0.34	-	1.92	6.98	-
10.	<i>Taphozous melanopogon</i>	-	-	Recorded	-	-	-
MEGADERMATIDAE							
11.	<i>Megaderma spasma</i>	-	0.34	-	-	-	3.49
NYCTERIDAE							
12.	<i>Nycteris tragata</i>	-	0.68	-	-	-	3.49
RHINOLOPHIDAE							
13.	<i>Rhinolophus affinis</i> *	0.93	-	-	-	-	-
14.	<i>Rhinolophus borneensis</i>	-	-	Recorded	-	-	-
15.	<i>Rhinolophus philippinensis</i>	-	-	Recorded	-	-	-
16.	<i>Rhinolophus trifolius</i>	2.80	1.36	-	2.88	4.65	-
17.	<i>Rhinolophus luctus</i>	-	0.68	-	-	-	-
HIPPOSIDERIDAE							
18.	<i>Hipposideros ater</i>	-	0.68	-	-	-	-
19.	<i>Hipposideros bicolor</i>	-	2.71	-	-	-	-
20.	<i>Hipposideros dyacorum</i>	5.61	1.02	Recorded	0.96	-	-
21.	<i>Hipposideros cervinus</i>	47.66	30.85	Recorded	50.96	-	-
22.	<i>Hipposideros galeritus</i>	14.95	7.12	Recorded	2.88	6.98	3.49
23.	<i>Hipposideros coxi</i>	1.87	-	Recorded	4.81	-	2.33
24.	<i>Hipposideros larvatus</i>	10.28	19.32	Recorded	20.19	4.65	2.33
25.	<i>Hipposideros diadema</i>	-	0.34	Recorded	-	2.32	-
VESPRTLIONIDAE							
26.	<i>Myotis muricola</i>	-	0.34	-	-	-	-
27.	<i>Myotis ater</i>	-	0.68	-	-	-	-
28.	<i>Myotis horsfieldii</i>	-	-	Recorded	-	-	-
29.	<i>Myotis hasseltii</i>	-	-	-	1.92	-	-
30.	<i>Pipistrellus tenuis</i>	-	-	-	0.96	-	-
31.	<i>Pipistrellus vondermanni</i>	-	0.34	-	-	-	-
32.	<i>Murina suilla</i>	0.93	-	-	1.92	-	-
33.	<i>Kerivoula hardwickii</i>	1.87	-	-	4.81	-	-
34.	<i>Kerivoula pellucida</i>	-	0.34	-	-	-	-
35.	<i>Miniopterus australis</i>	-	-	Recorded	-	-	-
Number of families		4	7	4	5	4	4
Number of species		11	23	12	15	11	9
Number of individuals		107	295	Na	101	43	86
Trapping-nights		5	226	Na	64	39	72

* = New record from this study, Na = data not available, (-) = not recorded in the respective study, Recorded = identified based on echolocation call not captured.

Table 2. External and Craniodental measurements (mm) of the albino *H. cervinus* (*) individual and other *H. cervinus* individual (n=1) in Bako National Park from this survey.

External Characters	Measurements		Craniodental characters	Measurements	
	Albino*	Other		Albino*	Other
FA	44.06	47.80	GSL	17.50	18.23
E	14.06	14.92	POW	2.71	-
T	27.59	25.08	CW	7.77	7.76
WT	6.0	-	MW	8.26	9.28
TB	15.34	17.82	ZW	9.72	8.24
HB	46.27	-	PL	6.06	5.94
HF	5.67	6.20	PPL	8.10	25.46
D2MCL	37.11	-	DBC	3.67	4.97
D3P2L	15.24	16.47	BL	2.23	2.56
D3P1L	15.89	15.24	GBPL	4.62	7.51
D3MCL	33.67	36.83	DL	11.45	12.02
D4P2L	9.02	-	C1BW	1.20	2.50
D4P1L	10.42	-	C1C1B	3.81	3.77
D4MCL	32.19	35.10	M3M3B	6.47	20.18
D5P2L	9.23	-	C1M3L	6.25	6.48
D5P1L	12.69	-	M2L	1.41	4.50
D5MCL	29.22	31.12	M2W	1.67	1.74

a high degree of albinism over most of the body but lacking at the upperparts of the body and part of the wings. Record of this albino bats indicates that there was an important roosting site in Bako National Park for this individuals to survive because albino individuals are known to be not able to resist sunlight due to lack of melanin pigmentation.

Hipposideros cervinus is known from multiple fur colour variation within the species including brown, orange, and grey (Figures 5a-c). However record of white fur coloration here do not represent a new colour form for the species or a separate species. This only indicate the occurrence of partial albinism in that individual.



Figure 5(a). Portrait photo image of *H. cervinus* (Brown form).



Figure 5(b). Portrait photo image of *H. cervinus* (Orange form).



Figure 5(c). Portrait photo image of *H. cervinus* (Grey form).

CONCLUSION

This survey has documented 11 species of bats with the additional new record of *R. affinis* and also an albino *H. cervinus* individual. Further research should be done on the genetic structure and behavior of an albinism individual, and may help identify the possible causes and consequences to the bats populations.

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