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NOTES ON GEOGRAPHIC DISTRIBUTION

Five newly recorded species of bat (Mammalia, Chiroptera) from the UNESCO World Heritage Niah National Park, Sarawak, Malaysia, with an updated checklist of bats in the park

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Abstract. Five species of bat—*Myotis gomantongensis* Francis & Hill, 1998, *Murina suilla* (Temminck, 1840), *Kerivoula intermedia* Hill & Francis, 1984, *Phoniscus jagorii* (Peters, 1866), and *Miniopterus magnater* Sanborn, 1931—are newly recorded from Niah National Park, Sarawak, Malaysia. We also present an updated checklist of bat species compiled from seven sampling efforts conducted between 1958 and 2025. A total of 43 bat species from nine families have been recorded to date in the park. This species list serves as a baseline for bat conservation in this UNESCO World Heritage Site.

Key words. Biodiversity, conservation, range extension, species richness, Southeast Asia

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INTRODUCTION

Niah National Park, located in the Miri Division in Sarawak, Malaysia is internationally recognized as one of the important archeological and ecological sites in Southeast Asia (Ugong et al. 2024). The park is well known for its enormous limestone cave, prehistoric findings dating back to the Paleolithic and Neolithic ages, and its rich biodiversity. Niah National Park has become a globally important place for historical and ecotourism (Barker 2014; Ugong et al. 2024). In recognition of its outstanding universal value, Niah National Park was designated as a UNESCO World Heritage Site in 2024, reinforcing its global cultural and environmental significance.

In addition to its pristine rainforest, Niah National Park also encompasses an extensive and complex cave system that provides roosting sites for a rich diversity of bats. Fossil evidence of bats reported by Medway (1977) further highlights the park's long-term importance as a refugia for chiropteran diversity. Medway (1958) first documented bat species within the entire park and identified eight species. This was followed by Harrison (1966), who recorded 17 species and fossil records later added another three additional species to the list (Medway 1977). Subsequent surveys by Good (1991) and Hall et al. (2002) increased the total to 29, marking a significant increase from earlier records. A later study by Rahman et al. (2010), which investigated bat diversity in two protected limestone areas, including Niah National Park, further expanded the list to 38 species.

We report five species previously unrecorded from Niah National Park. Additionally, our study aims to compile a new and updated checklist of bat species in Niah National Park after more than two decades of published record. Our checklist of bats is based on a compilation of fossil records and published and unpublished surveys conducted between 1958 and 2025. This consolidated list provides a valuable baseline for future monitoring and conservation efforts, highlighting the park's long-term significance for bat biodiversity in the region.

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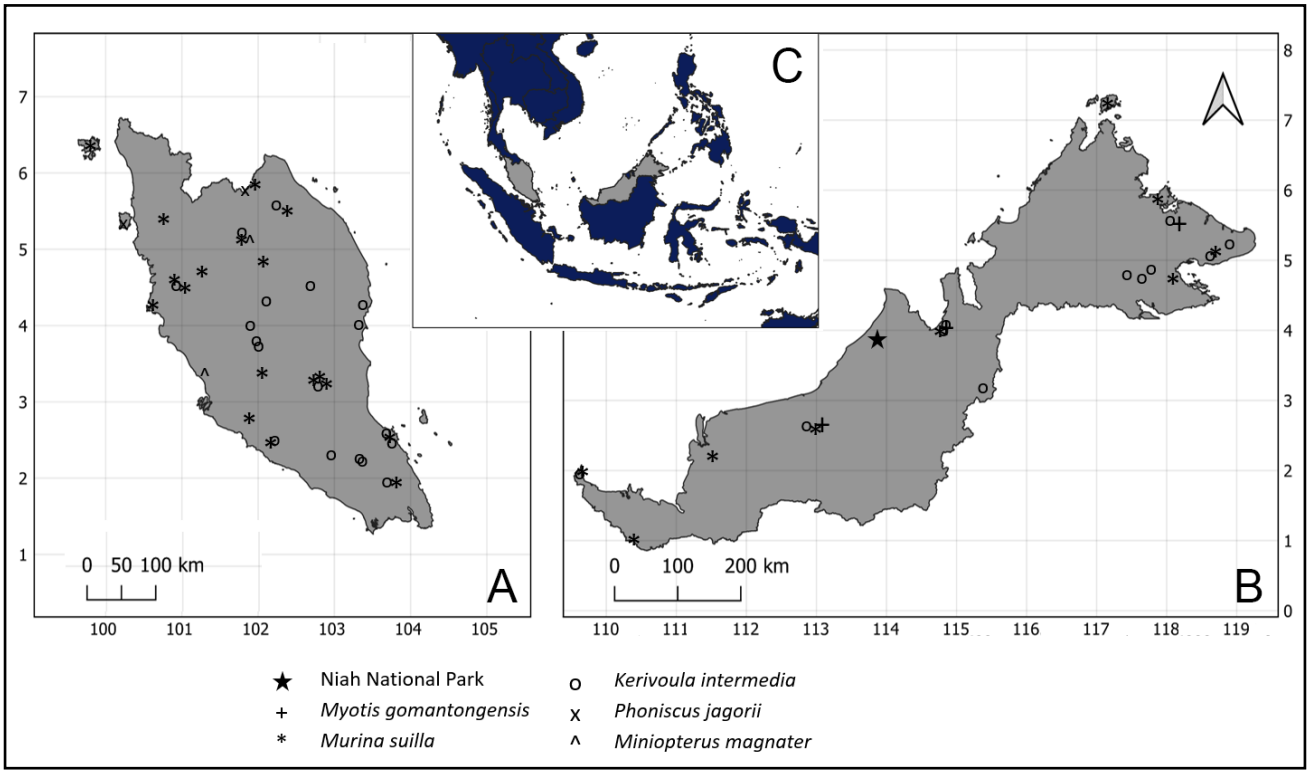

Figure 1. Maps of known localities of the bat species in Malaysia. **A.** Peninsular Malaysia. **B.** East Malaysia on the island of Borneo; the location of Niah National Park is marked with a star. **C.** Inset: map of Malaysia showing the two regions in gray.

STUDY AREA

Niah National Park (03°47′54″N, 113°46′54″E) is located in Miri Division, the northern region of Sarawak (Figure 1). It covers an area of 31.4 km^2 and reaches a maximum elevation of 394 m above sea level (Hazebroek and Abang Morshidi 2000; Said et al. 2013). The park is open to the public and accessible through wooden plank walks and forest trails. Niah National Park has various vegetation types which are shaped by its complex geology and hydrology. The major forest types include mixed dipterocarp forest, limestone forest, kerangas forest, seasonal swamp forest, peat-swamp forest, and riparian forest (Pearce 2004; Hansen 2005; Khan et al. 2008; Didge-Wan and Deng 2013; Sarawak Forestry Corporation 2025). There are two major rivers, the Niah and Tangap, which serve as ecological corridors between various vegetation communities.

METHODS

Surveys were conducted during three separate periods: 24 –27 May 2010, 27 November–2 December 2022, and 15–22 July 2025. During each survey, 10 mist nets and four sets of four-bank harp traps were deployed. The traps were set along bat flyways at sunset (approximately 18h30) and remained open for approximately 3.5 h, checked at 30-min intervals. Bats were identified using fields guides by Payne et al. (1985) and Phillipps and Phillipps (2018). The bats were released after external morphological measurements, weight, and sex were recorded (Table 1). QGIS v. 3.44 was used for spatial data processing and map creation (QGIS.org 2025).

RESULTS

Chiroptera, Vespertillionidae

***Myotis gomantongensis* Francis & Hill, 1998**
Figure 2A

New record. BORNEO — Sarawak • Niah National Park, Miri; 113.781°E, 003.814°N; 280 m alt.; 30.XI.2022; E. Ritta leg.; dipterocarp forest, mist netting; 3♀, NNP22053, NNP22054, NNP22065.

Figure 2. Five newly recorded species from Niah National Park since Rahman et al. (2010). **A.** Gomantong Myotis (*Myotis gomantongensis*). **B.** Lesser Tube-nosed Bat (*Murina suilla*). **C.** Large Bent-winged Bat (*Miniopterus magnater*). **D.** Small Woolly Bat (*Kerivoula intermedia*). **E.** Greater Groove-toothed Bat (*Phoniscus jagorii*).

Identification. FA: 40–43mm. Ears moderately long and triangular at tips; tragus tapered, bluntly pointed and bent slightly forwards. Hairs on upperparts with dark-brown tips and blackish bases. Belly with golden-brown patch at center. Feet small (Payne et al. 1998; Phillips and Phillips 2018).

***Murina suilla* (Temminck, 1840)**
Figure 2B

New record. BORNEO — Sarawak • Niah National Park, Miri; 113.781°E, 003.814°N; 280 m alt.; 29.XI.2022; J. William-Dee leg.; dipterocarp forest, mist netting; 2♂, NNP22050, NNP2267.

Identification. FA: 28–31mm. Nostrils expanded into short tubes which protrude either side of muzzle. Ears rounded, not funnel-shaped; tragus long and pointed. Upperparts buffy brown to grey-brown; underparts greyish white. Feet small (Payne et al. 1998; Phillips and Phillips 2016).

***Miniopterus magnater* Sanborn, 1931**
Figure 2C

New record. BORNEO — Sarawak • Niah National Park, Miri; 113.781°E, 003.814°N; 280 m alt; 30.XI.2022; A. Aqilah leg.; dipterocarp forest, mist netting; 4♂, NNP22057, NNP22060, NN22061, NN22064.

Identification. FA: 47–52mm. Wing shape distinct, especially third finger which has a short first phalanx and a very long terminal phalanx. Ear short and rounded, with moderate posterior fold; tragus short, blunt, and curved slightly forwards. Fur generally dark blackish or brownish, occasionally with reddish patches or even completely reddish. This species is the largest of *Miniopterus* Bonaparte, 1837 (Payne et al. 1998; Phillips and Phillips 2018).

***Kerivoula intermedia* Hill & Francis, 1984**
Figure 2D

New record. BORNEO — Sarawak • Niah National Park, Miri; 113.781°E, 003.814°N; 280 m alt.; 27.V.2010; F. Khan leg.; dipterocarp forest, mist netting; 1♂, TK168410.

Identification. FA: 26.5–31mm. Ears funnel-like, with a large flap on outside; tragus long, narrow, and pointed. Fur long and woolly, often covering much of face. Nostrils small. Teeth relatively unspecialized, with no reduction in any cheek teeth. This species is distinguished from *K. minuta* Miller, 1898 by its weight; forearm length is not diagnostic (value overlap). Adults of *K. minuta* weighs under 2.5g, whereas *K. intermedia* exceed 2.5g (Payne et al. 1998; Phillips and Phillips 2018).

***Phoniscus jagorii* (Peters, 1866)**
Figure 2E

New record. BORNEO — Sarawak • Niah National Park, Miri; 113.781°E, 003.814°N; 280 m alt.; 27.V.2010; F. Khan leg.; dipterocarp forest, mist netting; 1♂, TK168405.

Identification. FA: 37–39mm. Fur with greyish-black hairs banded with black, white, and black, sometimes with a shiny, white tip; forearm and fingers with short, shiny, yellow hairs. Tragus white and notched. Canines grooved (Payne et al. 1998; Phillips and Phillips 2018).

Updated species checklist

Here, we present an updated checklist of bat species in Niah National Park. Notably, across eight sampling efforts conducted over 64 years, the number of bat species documented from the park has increased. To date, 43 species representing nine families have been recorded in Niah National Park. We newly report five species (see above; Tables 1, 2; Figures 1, 2). Most species in our list have been assessed as Least Concern by the IUCN (2025). However, three species have been assessed as belonging to one of two threatened categories: *Pteropus vampyrus* (Linnaeus, 1758) is Endangered; *Coelops robinsoni* Bonhote, 1908 and *Murina rozendaali* Hill & Francis, 1984 are Vulnerable. Additionally, four species—*Dyacopterus spadiceus* (Thomas, 1890), *Nycteris tragata* (Andersen, 1912), *Rhinolophus trifoliatus* Temminck, 1834, and *Kerivoula intermedia* Hill & Francis, 1984—are Near Threatened. *Rhinolophus arcuatus* Peters, 1871 is Data Deficient and not assessed (IUCN 2025).

Table 1. External measurements of new recorded species at Niah National Park. Sample size (n) is given after each species name. For species represented by more than one individual, measurements are presented as mean ± standard deviation and range (in parenthesis).

Characters	*Kerivoula intermedia* (*n* = 1)	*Phoniscus jagorii* (*n* = 1)	*Murina suilla* (*n* = 1)	*Miniopterus magnater* (*n* = 4)	*Myotis gomantongensis* (*n* = 3)
Forearm (FA)	31.0	38.0	30.58	49.32 ± 1.07 (48.53–50.85)	42.94 ± 0.83 (41.98–43.45)
Ear length (E)	12.0	14.0	10.08	10.81 ± 0.50 (10.07–11.16)	11.4 ± 0.87 (10.84–12.40)
Head and body length (HB)	41.0	58.0	35.83	52.01 ± 1.79 (49.4–53.19)	44.78 ± 3.06 (41.45–47.47)
Tail length (TV)	40.0	39.0	27.35	54.98 ± 3.25 (51.42–59.26)	35.94 ± 4.14 (31.30–39.24)
Weight (Wt)	3.1	8.4	5.0	13 ± 3.56 (10–17)	9.67 ± 2.52 (7–12)

Table 2. Summary of bat species recorded in Niah National Park from past and present surveys. Medway (1977) refers to fossil record in Niah Cave.

Family, species	Medway 1958	Harrison 1966	Medway 1977	Hall et al. 2002	Rahman et al. 2010	This study			IUCN status (2025)	Roost dependency†
						2010	2022	2025		
PTEROPODIDAE										
Balionycteris maculata	✓	✓	—	✓	✓	✓	✓	✓	LC	Forest
Cynopterus brachyotis	—	✓	—	✓	✓	✓	✓	✓	LC	Forest
Cynopterus horsfieldii	—	—	—	✓	—	—	—	—	LC	Forest
Dyacopterus spadiceus	—	✓	—	—	✓	—	—	✓	NT	Forest/cave
Eonycteris spelaea	✓	✓	✓	✓	✓	✓	—	—	LC	Cave
Macroglossus minimus	—	✓	—	✓	—	—	—	—	LC	Forest
Penthetor lucasi	—	✓	—	✓	✓	✓	✓	✓	LC	Forest/cave
Pteropus vampyrus	—	✓	✓	—	—	—	—	—	EN	Forest
Rousettus amplexicaudatus	—	✓	✓	—	✓	—	—	—	LC	Cave
EMBALLONURIDAE										
Emballonura alecto	—	—	—	✓	—	✓	—	—	LC	Forest/cave
Taphozous melanopogon	✓	✓	—	✓	—	—	—	—	LC	Cave
HIPPOSIDERIDAE										
Hipposideros ater	—	—	—	—	✓	✓	✓	✓	LC	Cave
Hipposideros bicolor	—	—	—	—	✓	—	—	✓	LC	Cave
Hipposideros cervinus	—	—	—	✓	✓	✓	✓	✓	LC	Forest/cave

Family, species	Medway 1958	Harrison 1966	Medway 1977	Hall et al. 2002	Rahman et al. 2010	This study			IUCN status (2025)	Roost dependency†
						2010	2022	2025		
Hipposideros cineraceus	—	—	—	—	✓	—	—	—	LC	Cave
Hipposideros diadema	✓	✓	✓	✓	✓	✓	✓	✓	LC	Forest/cave
Hipposideros dyacorum	—	✓	—	—	✓	✓	✓	—	LC	Forest/cave
Hipposideros galeritus	✓	✓	✓	✓	✓	✓	—	✓	LC	Forest/cave
Coelops robinsoni	—	—	—	—	✓	✓	—	✓	VU	Forest/cave
MEGADERMATIDAE										
Megaderma spasma	—	—	—	—	✓	✓	—	✓	LC	Forest/cave
NYCTERIDAE										
Nycteris tragata	—	✓	—	✓	✓	—	✓	✓	NT	Forest/cave
RHINOLOPHIDAE										
Rhinolophus borneensis	—	✓	✓	✓	✓	✓	✓	✓	LC	Cave
Rhinolophus creaghi	—	—	—	✓	✓	✓	✓	✓	LC	Forest/cave
Rhinolophus philippinensis	—	—	—	✓	✓	✓	✓	✓	LC	Cave
Rhinolophus trifoliatus	—	—	✓	—	✓	—	✓	—	NT	Forest
MOLLOSIDAE										
Cheiromeles torquatus	✓	✓	✓	✓	—	—	—	—	LC	Forest/cave
Mops plicatus	—	—	✓	—	—	—	—	—	LC	Cave
VESPERTILIONIDAE										
Glischropus tylopus	—	—	—	✓	—	—	—	—	LC	Forest
Kerivoula hardwickii	—	—	—	—	✓	✓	—	✓	LC	Forest
Kerivoula intermedia	—	—	—	—	—	✓*	—	✓	NT	Forest
Kerivoula papillosa	—	—	—	✓	✓	✓	✓	✓	LC	Forest
Kerivoula pellucida	—	—	—	✓	✓	✓	✓	✓	NT	Forest
Murina rozendaali	—	—	—	—	✓	—	—	—	VU	Forest
Murina suilla	—	—	—	—	—	—	✓*	—	LC	Forest
Myotis ater	—	—	—	—	✓	✓	—	—	LC	Cave
Myotis gomantongensis	—	—	—	—	—	—	✓*	✓	LC	Cave
Myotis horsfieldii	✓	✓	—	✓	✓	✓	✓	✓	LC	Cave
Myotis muricola	—	—	—	✓	—	—	—	—	LC	Forest/cave
Philetor brachypterus	—	—	—	✓	✓	—	—	—	LC	Forest
Phoniscus jagorii	—	—	—	—	—	✓*	—	—	LC	Forest
Tylonycteris robustula	—	—	—	✓	—	—	—	—	LC	Forest
MINIOPTERIDAE										
Miniopterus australis	✓	✓	✓	✓	✓	✓	—	✓	LC	Cave
Miniopterus magnater	—	—	—	—	—	—	✓*	—	LC	Cave
Miniopterus medius	—	—	✓	—	—	—	—	—	LC	Cave
Miniopterus schreibersii	—	—	✓	—	—	—	—	—	VU	Cave
No. of species documented from each study	**8**	**17**	**12**	**24**	**28**	**23**	**18**	**22**		
No. of newly documented species	**0**	**9**	**3**	**9**	**9**	**2**	**3**	**0**		
Cumulative no. of species documented	**8**	**17**	**20**	**29**	**38**	**40**	**43**	**43**		

✓=documented; -=no record, ✓*=new geographic record, †From published records; indicates where species are most often found

DISCUSSION

Our findings highlight the ecological significance of Niah National Park as a key reservoir of bat biodiversity in Sarawak. The increase in documented species richness, from eight species by Medway (1958) to 43 species at present, emphasizes the importance of long-term biodiversity monitoring in accurately assessing species composition and as well as their ecological requirement. Niah National Park is relatively small but has varied ecosystems, such as large limestone cave systems, mixed lowland forests, and riparian zones. These areas provide bats places to roost, breeds, and forage. The park's UNESCO World Heritage recognition and these unique natural features give it importance for bat conservation in Borneo.

Most bat species in the park have been assessed as Least Concern by the IUCN (2025). However, there are Endangered and Vulnerable species in the park. *Pteropus vampyrus*, in particularly, is highly susceptible to habitat degradation, disturbance at roosting sites, and in some cases, hunting pressure (Tsang et al. 2018; Mohd-Azlan 2022). The presence of these threatened species highlights the importance of Niah National Park as a critical refuge for more sensitive species of the bat community.

The ecological importance of Niah National Park is further supported by our discovery of the previously unreported species since Rahman et al. (2010). These additions demonstrate the value of continued survey efforts in revealing hidden diversity, even within long-established protected areas. The absence of these species in earlier surveys may be attributed to limited temporal sampling, variations in survey methodology, or their inherently low detectability (Meyer et al. 2010, 2011; Zwerts et al. 2021).

Furthermore, from a biogeographical perspective, the diverse assemblage of bat species observed comprising multiple representatives from Pteropodidae Gray, 1821, Hipposideridae Lydekker, 1891, Rhinolophidae Gray, 1825, Miniopteridae Dobson, 1875, and Vespertilionidae Gray, 1821 reflects the ecotonal richness of Niah National Park. The park is situated at the confluence of several distinct ecosystems, including mixed dipterocarp forest, limestone karst, kerangas forest, seasonal swamp forest, and riparian ecosystems (Pearce 2004; Hansen 2005; Khan et al. 2008; Dodge-Wan and Deng 2013; Sarawak Forestry Corporation 2025). These overlapping habitat types provide a range of ecological niches, supporting both generalist and specialist bat species (Beilke et al. 2021; Jinggong et al. 2022; Gaulke et al. 2023; Morni et al. 2025).

The protected status of Niah National Park has undoubtedly contributed to the observed diversity and stability of its bat populations. The presence of a wide array of species, including those of conservation concern, highlights the effectiveness of ongoing protection measures. However, sustaining this success requires adaptive and long-term management. Key priorities include maintaining the integrity of forest and cave habitats through regular enforcement and effective boundary management; monitoring and mitigating external land use pressures; implementing visitor education and site-specific guidelines to minimize disturbance at sensitive roosting sites; and supporting continuous research and monitoring programs to track shifts in species composition and habitat use (Morni et al. 2018; Rosli et al. 2018; Lindenmayer et al. 2022; Roy et al. 2022; Xiong et al. 2023). Together, these strategies will help preserve Niah's ecological function and safeguard its bat diversity in the face of mounting environmental pressures.

In conclusion, this study contributes to the growing species inventory of Niah National Park and underscores the need for consistent biodiversity assessments in tropical protected areas. Short-term surveys are clearly inadequate for capturing the full spectrum of bat diversity. Moving forward, conservation strategies should incorporate regular long-term monitoring, comprehensive threat assessments, and targeted habitat management, with particular attention to species of conservation concern.

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ADDITIONAL INFORMATION

Conflict of interest

The authors declare that no competing interests exist.

Ethical statement

All specimens were handled in accordance with the procedures for animal care and use recognized by the UNIMAS Animal Ethics Committee (UNIMAS/AEC/R/F07/056).

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Author contributions

Conceptualization: FAAK. Data curation: MAM. Formal analysis: MAM, MAIA, NIMB, MDHMK, AHMA, VLS. Funding acquisition: FAAK. Investigation: JWD, ERJ, NAS, NAAA. Methodology: FAAK, MAM, JWD, ERJ, NAS, NAAA, SPH. Resources: FAAK. Validation: FAAK, MAM, MAI. Writing – original draft: FAAK, MAM, MAIA, NIMB, MDHMK, AHMA, VLS. Writing – review and editing: FAAK, MAM, JWD, SPH.

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Data availability

All data that support the findings of this study are available in the main text.

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