

The Diversity and Status of Bats in Quarry Cave, Poblacion, Kitaotao Bukidnon, Philippines

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ABSTRACT

Bats are mammals under Order Chiroptera, Greek for “hand wing”. They are fur-bodied flying mammals whose ears are very important for food hunting and survival. They are believed to be the source of SARS-Cov-2 Virus which caused the Global Pandemic faced today. The present study investigated the species of bats in Quarry Cave, its external features, diversity and conservation status. A purposive sampling design was used by setting-up nets. The external features of each species were noted and morphometric data were recorded. Captured bats were identified, classified and describe using the Ingle and Heaney (1992) taxonomic guide. Shannon diversity index was used to compute the diversity of bats in the study area. The IUCN 4 version 3.1 (2015) was used to for the updated conservation status of the bats observed. As a result, there were two (2) species of bats coming from two (2) families captured in the study area: *Miniopterus schreibersii* and *Hipposideros diadema* from Vespertilionidae and Rhinolophidae, respectively. The two (2) species of bats captured exhibits easy to distinguish features especially the morphology of the nose and the body size. The diversity of bats species in the area is noted to be less diverse. *Miniopterus schreibersii* has a conservation status of vulnerable while *Hipposideros diadema* is a bat species

with less concern conservation status. Moreover, the results of the present study imply a more rigid studies and investigations on bats species in the area to further contribute to the existing biodiversity data on flora and fauna in Mindanao.

Keywords: Bat Biodiversity, Conservation, cave-dwelling bats, fur-bodied mammals

INTRODUCTION

Bats are mammals under Order Chiroptera, Greek for “hand wing”. They are fur-bodied flying mammals whose ears are very important for food hunting and survival. They are a diverse order of mammals exhibiting varied physiological and ecological features. Bats play important roles in ecosystem. They provide ecological services specifically natural pollination, seed dispersal, forest regeneration, population regulation, and pest control. With these services, they were able to contribute to the maintenance and regeneration of forests and security of bat-dependent fruit trees (Mohagan, A., Bruno, A., Bonghanoy, A., & Balite, C., 2018; Del Socorro, M., Enguito, M. & Mapi-ot, E., 2018). Moreover, they are renowned dwellers of various ecosystems: forests, falls, deserts, caves, rivers, cities and other environment which provides adequate conditions for their survival. Their presence means quality ecosystem which also allow them to diversify. In addition, these species have been in the limelight at the moment because they are believed to be the source of SARS-Cov-2 Virus which is the cause of the Global Pandemic faced today. This has been one of the numerous reasons why bats are one of the most interesting research subjects even before Covid-19 era.

The Philippines is a megadiverse country and is a home several unique flora and fauna. In fact, the number of bats species in the country is 79 and is attributed to the geographical isolation, diverse habitats and high rates of endemism. Consequently, these bats species exist in different islands and ecosystems in the Philippines. In Mindanao, Philippines, there have been records of 53 species of bats from different habitats. One of the preferred habitats of this group of mammals are caves. It provides stable environment for hibernation and roosting of these species, and more than 40 species of Philippine bats are known to roost in caves (Nuñeza, O. & Galorio, A., 2014). Bukidnon is situated in the heart of Mindanao. Several studies on flora and fauna were conducted in this area. However, Kitaotao, Bukidnon, which is a home of quite a number of caves, some remained unexplored, still have very few records of its flora and fauna, specifically

on cave bats.

The present study investigated the different species of bats in Quarry Cave, Kitaotao, Bukidnon, Philippines using the described external features and morphometric data. Also, species composition, diversity and conservation status of the bats inhabiting Quarry Cave were also noted.

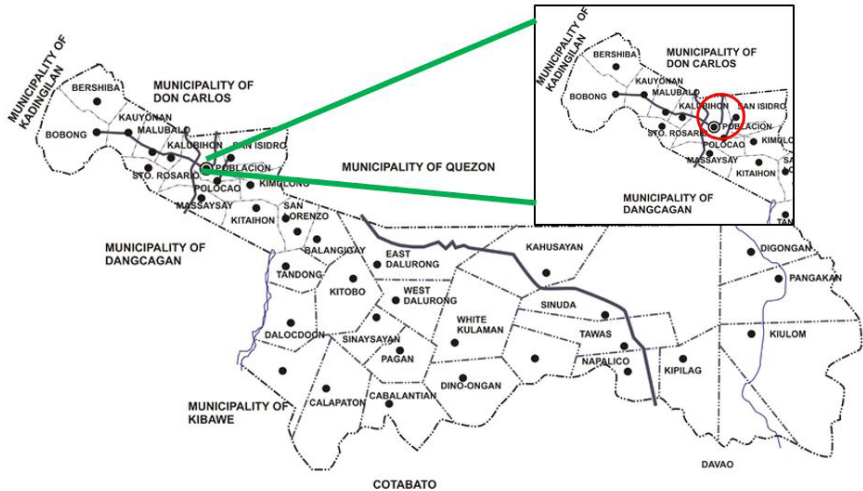
OBJECTIVES OF THE STUDY

The study was conducted to provide information about the flora and fauna in Kitaotao, Bukidnon specifically the diversity and status of cave-dwelling bats in Quarry Cave. The gathered data would contribute a lot in Chiroptology and Biodiversity as it adds new information in terms of the external and morphometric features of bats, as well as their conservation status. Also, ecological roles of the bats would be recognized and appreciated by the locals as they would value the importance of the existence of bats. The study would also lead locals to take part in the conservation and protection of these animals together with the Local Government Unit. Further, the results of this study would serve as a baseline for future researches on flora and fauna more specifically on bats and caves in Kitaotao Bukidnon and nearby places.

MATERIALS AND METHODS

Study Site and Sampling Method

A letter of permit to conduct this study was signed and approved by the Municipal Mayor of Kitaotao, Bukidnon. The study was conducted in Quarry Cave, Poblacion, Kitaotao Bukidnon. The cave is only one of the thirty (30) caves in Poblacion, Kitaotao, Bukidnon. It was noted that Kitaotao, Bukidnon recorded flora and fauna with few literatures. The study was conducted on May 13, 2021.



A purposive sampling design was done setting-up five (5) mist nets to capture the bats. The mist-nets were set up near the entrance of the cave between 4:30 – 8:00 PM. The nets were checked every 30 minutes to account the bats captured.

Data Collection

The captured bats were identified through the external features using the Ingle and Heaney (1992) taxonomic guide. The external features of each species observed and noted were: detailed structure of the ear and teeth, nose leaf, muzzle, tail, and wings. Also, the morphometric data were recorded using a tape measure: length of forearm, wingspan, length of ear, body length, tail length, and total body length. Captured bats were marked by tying a thread on the tarsus of the bats and were given sucrose solution before they were released to relieved them from stress of being captured. Shannon diversity index was used to compute the diversity of bats in the study area. Finally, the IUCN 4 version 3.1 (2015) was used to categorize the updated conservation status of the captured bats.

Photos of bats were taken using a cellphone camera. Features of the bats were recorded in the field notebook as well as the parameters of the study area.

RESULTS AND DISCUSSION

The following plates presented are the species of bats observed in Quarry Cave, Poblacion, Kitaotao Bukidnon. External features of each species such as the presence of two claws, detailed structure of the ear and teeth, nose leaf, muzzle and tail; morphometric data; and conservation status are hereby presented.

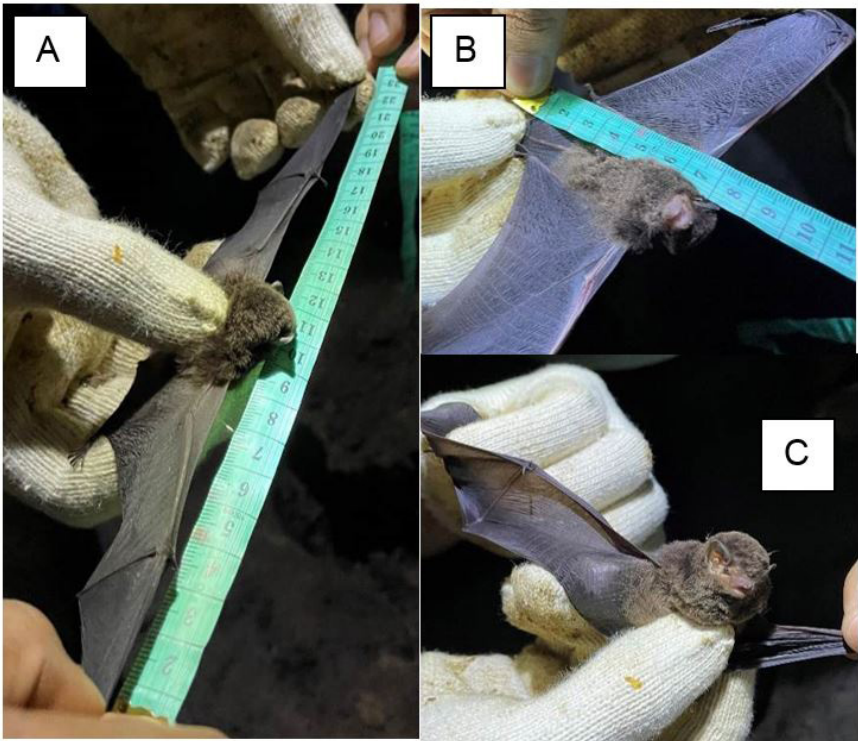


Plate 1. *Miniopterus schreibersii*

Family: **VESPERTILIONIDAE** (Evening Bats)

Species Name: *Miniopterus schreibersii*

Common Name: Common Bent-winged Bats

Description:

Miniopterus schreibersii has a (A) wingspan of 27 to 29 cm and 12-13 cm forearm length; (B) a total body length of 7 to 8 cm, and tail length of 3 to 4 cm which is completely enclosed within the interfemoral membrane and is proportionately longer than in many other medium sized bats; (C) It has a gray

to brownish color and an extremely long fingers which corresponds to broad wings; body hairs stand erect and a small tragus is visible in the ears. It has a short muzzle with simple nose.

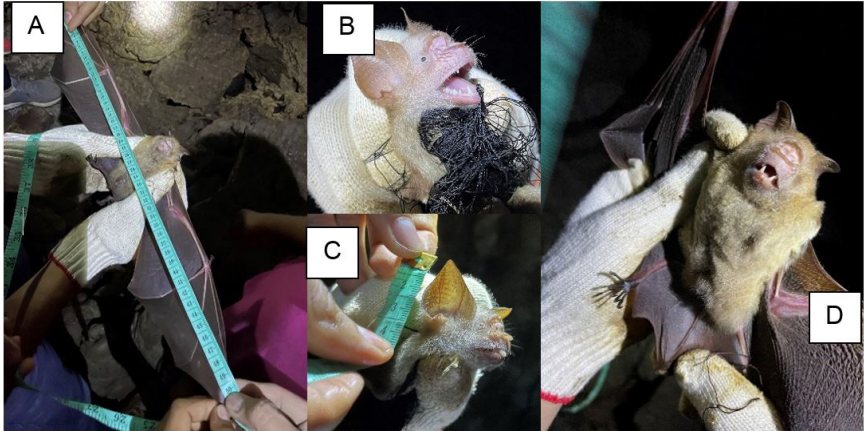


Plate 2. *Hipposideros diadema*

Family: **RHINOLOPHIDAE**

Species Name: *Hipposideros diadema*

Common Name: Leaf-nosed Bats

Description:

Hipposideros diadema has a (A) wingspan of 51 to 52 cm or 26 forearm length, and a body length of 19 to 20 cm, wings is simple; (B) it has a triangular shaped ears with small tragus, it has short muzzle having a leaf nose; (C) the ears have a length of 3 cm; (D) it has a brown to light brown color, body length measured 19-20 cm with tail having a length of 7-8 cm which is also completely enclosed within the interfemoral membrane (sheath-tailed).

The two (2) species of bats captured in the area are cave dwelling bats which were among the thirty (30) species of bats that roost in caves and underground habitats as mentioned by Tanalgo and Hugnes (2018) from Ingle et al., 2011 and Sedlock et al., 2014. Also, the presence of *Hipposideros diadema* in the study area is supported by the study of Perez and Nuñez (2020) on Species Richness and Conservation Status of Cave Bats in Agusan Del Sur, Philippines which reported that among the bats collected, *Hipposideros diadema* is most abundant as it was found in the three (3) caves which was the scope of the study.

Table 1 presents the external features of the bat's species inhabiting Quarry

Cave. As depicted in the table, the two species observed in the cave exhibited distinguishable external features.

Miniopterus schreibersii has short, triangular ears with small tragus. It has a simple nose and small muzzle. It displayed sheath tail and its wings are bent. On the other hand, *Hipposideros diadema* exhibits a broad, triangular ears with visible tragus. It possesses a leaf nose attached to its short muzzle. It has sheath tail and its wings are simple.

Table 1

External Features

Bat Species	External Features				
	Ears	Nose	Muzzle	Tail	Wings
<i>Miniopterus schreibersii</i>	Short, Triangular With small tragus	Simple	Short Muzzle	Sheath Tail	Bent wings
<i>Hipposideros diadema</i>	Broad triangular, with small tragus	Leaf nose	Short Muzzle	Sheath Tail	Simple Wings

Table 2 shows the recorded morphometric data on length of forearm, body length, ear length, and tail length of the bats species.

As shown in Table 2, the species of bats are of different sizes in terms of length of: the forearm, the wingspan, the ear, the body, the tail and the total body length. *Miniopterus schreibersii* have a forearm whose length measures up to 12-13 cm, wingspan of 27-29 cm, ear of 1 cm, body length of 4-5 cm, tail of 3-4 cm and a total body length of 7-8 cm.

Table 2

Morphometric Data

Bat Species	Morphometric Data					
	Length of Forearm (cm)	Wing-span (cm)	Ear Length (cm)	Body Length (cm)	Tail Length (cm)	Total Body Length (cm)
<i>Miniopterus schreibersii</i>	12-13	27-29	1	4-5	3-4	7-8
<i>Hipposideros diadema</i>	26-27	51- 52	3	19-20	7-8	26-28

In contrary, *Hipposideros diadema* displays different morphometric data. Its forearm has a length that measures up to 26-27 cm, wingspan of 51- 52 cm, ear of 3 cm, body length of 19-20 cm, tail of 7-8 cm and a total body length of 26-28 cm.

Morphometrically, the two species of bats observed in Quarry Cave are of different proportions. *Miniopterus schreibersii* is a smaller species of bats than *Hipposideros diadema* which inhabits the place.

The diversity of these bats in the area can be quantified in table 3.

Table 3

Computed Diversity Indices

	Diversity Indices Values
Shannon Diversity Index (H)	0.693
Shannon Index of Evenness (E)	0.971

Note: Lower values indicate more diversity while higher values indicate less diversity.

As depicted in the table, the Shannon Diversity Index (H) of the bat's species in Quarry Cave is 0.693 which would tell us that the diversity of bats species in the area is noted to be less diverse. Likewise, the Evenness value of the bats species is 0.971. This indicates of an almost even distribution of the bat's species observed in the area base on the number of individuals accounted.

These values which equates to only two (2) bats species captured is lower compared to the study of Mohagan et al (2018) on Bat diversity and local conservation initiatives in the Montane Forest of MT. Kalatungan in Pangantucan, Bukidnon, Philippines, which revealed five (5) species were from the upper montane forest and four (4) species in lower montane forest. However, the result of the present study is the same with the result of the study of Esmalde (2014) which documented only two species in Sacramento Cave in San Fernando, Bukidnon.

As justified by Mohagan et al (2018), the rich diversity of bats in montane forest was due to the presence of banana which served as food for fruit bats which are preferred food of bats. Also, the low temperature at high elevation allows species from lower elevation to move up as mentioned by Mohagan et al from Maselli et al, (2010) and added that in the lower montane, the existence of bats are less diverse due to disturbances by human activities and forest fragmentation.

The findings of Mohagan et al. (2018) is in contrast with result of the study of present study, but similar with the finding sof Esmelda (2014). This is perhaps

attributed to the study area which is a cave. Wherein only few species are noted to be cave-dwelling provided that the cave ecosystem and nearby ecosystem can sustain their existence. Also, the sampling area is located at a lower elevation area and with a high temperature and a forest ecosystem with few sources of fruits and insects as food sources of bats. Moreover, as observed, the sampling site exhibits marks of human and natural disturbances which would lead to the disturbances and threats to bats as well. This in consonance with the statement of Quibod, Alviola, de Guia, Cuevas, Lit and Pasion (2019), caves that are experiencing both natural and human-induced threats and disturbances can lead to cave-dwelling bats to be under similar threats.

Table 4

Bats Conservation Status

Bats Species	Conservation Status
Family: Vespertilionidae <i>Miniopterus schreibersii</i>	Vulnerable
Family: Rhinolophidae <i>Hipposideros diadema</i>	Less Concern

Table 4 reveals the Conservation Status of the bats species in Quarry Cave. As seen in the table, *Miniopterus schreibersii* from Vespertilionidae Family, has a conservation status of Vulnerable, which further indicates that this bat species is facing a high risk of extinction in the wild (IUCN RedList of Threatened Species). This would simply mean that this species of bats is decreasing in numbers in the wild. On the other hand, *Hipposideros diadema* from Rhinolophidae, is noted to have a conservation status of Less Concern. This would implicate that this species does not qualify to be endangered, critically endangered, vulnerable or near threatened. In this case, *Hipposideros diadema* is still recorded to have rich numbers of individuals existing worldwide.

The conservation status of these bats' species would further express that conservation practices is important to preserve the existence of these species as they play an important roles in the biosphere such as controllers of insects, pests, pollination, and dispersal of seeds as mentioned by Maas et al., 2016; Corlett, 2016; Costa et al., 2018. Similarly, they play an essential role in the regeneration of forests and considered as bioindicators of the quality of an ecosystem as mentioned by Stahlschmidt & Brühl, 2012 and role as prey and predator in the ecosystem (Barragán et al 2010) and maintain the balance in any ecosystem they may exist.

CONCLUSIONS

There were two (2) species of bats captured in Quarry Cave namely: *Miniopterus schreibersii* and *Hipposideros diadema* which are from two (2) families: Vespertilionidae and Rhinolophidae, respectively. These bats species are cave-dwelling species and can be found in almost all caves in the Philippines. The two (2) species of bats exhibit distinguishable and unique external features and morphometric data which are useful for their identification and classification. The external features and morphometric data of the captured bats in the area would tell that bats species came from different forms and sizes which would also reflect their activities and roles in the ecosystem.

The Shannon Diversity Index (H) of the bat's species in Quarry Cave is 0.693. Also, the conservation status of the bats species which is: *Miniopterus schreibersii* - vulnerable and *Hipposideros diadema* - less concern. These findings further elaborate the importance of conservation practices in the area.

Moreover, the results of the present study revealed that Quarry Cave is a home for two (2) species of bats. Also, this implies for a more rigid studies and investigations on bats species in the area and further contribute to the existing biodiversity data on flora and fauna in Mindanao.

RECOMMENDATIONS

The present study reported few species of bats. Thus, sampling method and sampling duration may be increased to collected reasonable number of bats. The external features and morphometric data are of great help in the identification and classification of bats. Thus, additional features and morphometric data may be added to investigate the bats further. The bats species captured exhibit a less diversity in the area. This finding could be possibly be evaluated and investigated to identify specific factors that may lead to such result. The conservation status of the bat's species may lead to promotion and strong implementation of conservation practices to save this important aspect of ecosystem. In general, similar studies may be conducted to same or different locations for further validation and verification of findings.

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