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# A Review of Pteropodids in the Mangrove Areas of Misamis Oriental, Philippines: basis for Conservation and Management of Coastal-Terrestrial Ecosystem Nexus

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**ABSTRACT** Mangrove habitats support a diversity of bats (Mammalia Chiroptera) however they are threatened due to human activities habitats. This study is a review and summary of bats in the mangrove areas in selected coastal municipalities of Misamis Oriental, Philippines. Mist-netting method considering the species-effort curve was used to determine the species composition, abundance and diversity of bats in mangrove areas with various level of conservation and management. Results showed that the highest diversity (1.47) of bats was found in Libertad while the most abundant captures (161) were in Gingoog because of the presence of large and mature old growth mangrove trees. This means that bats prefer large mangrove forest with high conservation and sustainable protection levels by the local government, community and other stakeholders. In addition, reforested mangroves areas are highly potential habitat for bats and thus needs long term protection initiatives by all stakeholders. This study recommends monitoring of the wildlife in the mangrove areas of Misamis Oriental since it provides enumerable ecosystem services to the community locally, nationally and globally.

**KEY WORDS** Bats; conservation; habitat; mangroves; management.

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## INTRODUCTION

Mangrove forests are tropical and subtropical coastal ecosystems dominated by trees and shrubs capable of tolerating saltwater. They provide a variety of ecosystem services to people and biodiversity. In particular, mangrove forests protect the coast from erosion, safeguard communities against disas-

ters and adverse weather conditions (McKenzie & Rolfe, 1986). They harbor incredible biodiversity providing shelter and nourishment to numerous animal species – such as fish, crustaceans, bats, and birds – at various stages of their lives. Mangrove area is a home to diverse species of bats which serve as roosting and foraging areas. This kind of habitat near the terrestrial ecosystem has low predators and competitors suitable for roosting of bats (McConville et al., 2013). However, mangrove ecosystems are affected by different anthropogenic and natural disturbances. Human activities such as forest clearing, deforestation, over-extraction and pollution are some of the identified threats of most mangrove areas in the Philippines (Agduma & Cao, 2023). Misamis Oriental (Philippines) has rich mangrove forest with various uses such as for ecotourism, fisheries and biodiversity conservation. Limited studies have been conducted in the mangrove forest in terms of wildlife conservation; hence, this review few studies on bats in the area.

The main objective of this study is to determine the species composition, abundance and diversity of bats in the selected coastal municipalities in Misamis Oriental.

## MATERIAL AND METHODS

### *Study area*

These studies were conducted in the mangrove areas in selected coastal municipalities such as Laguindingan, El Salvador, Gingoog, Kinoguitan, Jasaan, Libertad, Naawan, Alubijid and Gitagum, Misamis Oriental, Philippines (Figs. 1, 2).

These coastal municipalities have large, mature and old growth natural mangroves while some have reforested mangrove areas and others have both natural and planted mangroves.

### *Bat sampling and data analysis*

Mist-netting method were used during the surveys for five to seven consecutive nights until the species-effort curve was reached. Mist-nets were

Figure 1, 2. The Mangrove areas of Misamis Oriental, Philippines.

| Species | Gingoog | Jasaan | Kinoguitan | Libertad | Naawan | Laguindingan | Alubijid | El Salvador | Gitagum | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| *Ptenochirus jagorii* (Peters, 1861) | 67 | - | 11 | - | - | - | - | - | - | **78** |
| *Ptenochirus minor* (Yoshiyuki, 1979) | - | - | - | 6 | - | 4 | 3 | 1 | - | **14** |
| *Rousettus amplexicaudatus* (E. Geoffroy, 1810) | 35 | - | - | - | 4 | - | - | - | 1 | **40** |
| *Cynopterus brachyotis* (Müller 1838) | 5 | 1 | - | 3 | 7 | 9 | 9 | 7 | 1 | **42** |
| *Eonycteris robusta* Miller, 1913 | 2 | - | - | 2 | 2 | - | - | - | 23 | **29** |
| *Eonycteris spelaea* (Dobson, 1871) | 3 | - | - | 2 | 1 | - | - | 3 | 11 | **20** |
| *Macroglossus minimus* (É. Geoffroy, 1810) | 49 | 12 | 5 | 14 | 1 | 4 | 3 | 1 | 25 | **114** |
| *Haplonycteris fischeri* Lawrence, 1939 | - | - | - | 2 | - | - | - | - | - | **2** |
| *Harpyionycteris whiteheadi* Thomas, 1896 | - | - | - | - | - | - | 6 | - | - | **6** |
| **TOTAL** | **161** | **15** | **16** | **29** | **15** | **17** | **21** | **12** | **61** | **347** |

Table 1. Species composition and abundance per bat species in the mangrove areas of Misamis Oriental, Philippines.

placed from landward, middle zone to seaward zone along the 500–1000 m transect line with an interval of 100–250 m depending on the area covered by mangroves and accessibility.

All bats collected were retrieved, measured, marked, photographed and released back to its habitat.

Species were identified using the Key to the Bats of the Philippines (Ingle & Heaney, 1992) using its morphometrics and external morphological features. Species composition, abundance and diversity index were determined, calculated, compared and analyzed.

### *Mangrove sampling and data analysis*

Mangrove species were sampled using a 10 x 10 m plot method from the landward, middleward and seaward zones (Taneo, 2021). Species were identified based on their leaves, flowers and fruits and compared to the list of Field Guide to the Philippine Mangroves by Primavera (2009).

## RESULTS

There were ten (10) species of bats under Order Chiroptera and Family Pteropodidae documented in the mangrove areas of Misamis Oriental (Table 1). A total of 347 specimens of bats of different species were found in the mangrove ecosystem. Among the sites, Gingoog had the highest number of bats documented while El Salvador had the least. The most abundant species (114) collected was *M. minimus* and the least is *H. fischeri* with two (2) specimens. As shown in Table 2, diversity index is

| Mangrove Areas | Shannon's Diversity Index |
|---|---|
| Gingoog | 1.30 |
| Jasaan | 0.67 |
| Kinoguitan | 0.62 |
| Gitagum | 1.18 |
| Naawan | 1.34 |
| Laguindingan | 1.02 |
| Alubijid | 1.28 |
| El Salvador | 1.07 |
| Libertad | 1.47 |

Table 2. Diversity indices of fruit bats in the mangrove areas of Misamis Oriental, Philippines.

highest in Libertad (1.47) while the least diverse area in terms of bats is in Kinoguitan (0.62).

## DISCUSSIONS

Among the bat species documented in the mangrove areas, *M. minimus* is the most abundant which can pollinate large number of mangrove flowers aiding the natural reproduction of mangroves. This species was also found in Vietnam since it is not endemic to the Philippines but have a big role in natural forest regeneration system in the coastal ecosystems (Thong et al., 2022). On the other hand, *H. fischeri* is rare in the mangrove area maybe because they are very sensitive to human disturbance (Duya et al., 2021).

Based on the area, Gingoog has the largest number of bats documented which can be attributed to large cover of mangrove forest. According to Abejo et al. (2022), the said area is composed mainly composed of eight (8) true mangrove species and three (3) mangrove associates. Bats' diversity index is highest however in Libertad with large, mature and old-growth natural forest. Based from the study of De Guia et al. (2025), five species of fruit bats were documented in Siargao island's mangrove forest reserve which implies that protected mangroves supports more species of mammals.

## CONCLUSIONS

Based also on our observations summarized in this work, bats are highly dependent on the mangrove areas in Misamis Oriental (Philippines) as source of food and shelter. Hence, this study supports mangrove reforestation in Misamis Oriental given its numerous ecosystem services to the local, national and global community.

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