

## Occurrence and abundance of fruit bats in selected conservation areas of North Cotabato, Philippines

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### ABSTRACT

A study on the occurrence and abundance of fruit bats (Pteropodidae) was done in two conservation areas in North Cotabato, Philippines: Portion of the Mt. Apo National Park ; Balabag, Kidapawan City and Cotabato Provincial Forest and Ecotourism Park (CPFEP), Amas, Kidapawan City. Seven species were recorded in CPFEP and six were noted in Balabag area identified from 449 individuals captured. Two species (*Eonycteris spelaea* and *Rousettus amplexicaudatus*) were unique to CPFEP while one (*Ptenochirus minor*) was found only in Balabag area. A total of eight species were recorded when accounting the species found in two areas in which, three are endemic to the country namely *Haplonycteris fischeri*, *Ptenochirus jagori*, and *P. minor*. Of these endemics, the first two were noted in CPFEP while all were found in Balabag area. More than half of the bats captured were *Cynopterus brachyotis* hence, considered as the most common species. Remarkable finding was the presence of *Megaerops wetmorei*, a threatened species, to have found in a new altitudinal record. Considering the importance of fruit bats in regenerating forest, urgent conservation measures are highly recommended.

**Key words:** Chiroptera, Diversity, *Megaerops wetmorei*, Pteropodidae, Reforested Area

### INTRODUCTION

Bats are the most diverse group of mammals in the Philippines. These are divided into two groups: megachiropteran (fruit bats) with 25 species in the country, and microchiropteran (insect bats), with 48 species (Heaney and Regalado, 1998). Of these, approximately 40% are endemic (Heaney, 1986).

Fruit bats belong to a single family, Pteropodidae. They serve as excellent indicator species in tropical rainforests because they are specious, tropically diverse, abundant, widespread, easy to sample, and often predictably responsive to habitat alterations (Medellin and Amin, 2000). They serve as important pollinators and seed dispersers (Patterson *et al.*, 2003) and play important roles in tropical rainforests because of their effects in structuring plant communities (Fleming and Heithaus, 1981). Habitat destruction, brought about by the conversion of forest to agricultural lands, is one of the most important threats to their survival in the country (McGinley, 2008). Extensive amounts of forest have been lost in the last 20 years due to rapid increase in the land devoted to commodity agriculture. The effects of these anthropogenic changes on mammals have been studied across several taxonomic groups (Gorresen and Willig, 2004). Among these groups, bats are regarded as one of the most vulnerable.

The study provides information on the taxonomy of bats in two conservation areas in North Cotabato. This paper also discusses bat diversity in Mindanao, in addition to the existing few studies of fauna in

the island most especially in lowland forests. The information could become a basis for response strategies designed to protect and preserve species especially those which are threatened. Basic taxonomic information can be converted into knowledge for biodiversity conservation policies relating to ecosystems for use in education and economic development. If areas of particular importance for biodiversity are maintained or conserved within protected areas and proactive measures are taken to protect threatened species, then the rate of species loss could be reduced.

The objective of the study was to determine the occurrence and abundance of fruit bats in some conservation areas in North Cotabato: Balabag (Part of the Mt. Apo National Park) and Cotabato Provincial Forest and Ecotourism Park (CPFEP), Amas, Kidapawan, City.

### MATERIALS AND METHODS

#### Study area

#### Balabag (Part of the Mt. Apo National Park) (Figure 1)

The first study site is a portion of the Mt. Apo National Park located at Balabag, Kidapawan City, Philippines with geographical grid coordinates of 7°00'48.16"N and 125°12'43.68"E. Elevation ranges from 987 to 1191 meters above sea level (masl). The area is considered as lowland montane forest dominated by *Ficus* spp. and moss. Leaf litter and humus cover were thick due to relatively low temperature in higher elevation, which retards faster decomposition. The

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forest canopy is dominated by dipterocarp trees (*Pterocarpus indicus*, *Shorea astylosa* and *Shorea contorta*) with heights of approximately 40-50 m. The emergent trees (*Artocarpus philippinensis*) reached 50-70 m. Canopy vines (pandan and rattan) are moderately common. Bamboo and epiphytes such as orchids are abundant. The understory is dominated by tree ferns (*Cyathea* sp.) where long strings of epiphytes similar to Spanish moss hang from the ferns. On the other hand, the ground cover is composed of ferns (ground and climbing), small shrubs and mosses. The river contains large exposed rocks. Caves were also noted. Fogs were observed throughout the day. The area was considered as one of the city's tourist spots visited by local tourists from nearby communities and neighboring provinces.



**Figure 1.** Balabag Natural Reserve, Mt. Apo.

The forests are inhabited by tribal groups like Bagobos, Manobos and Klata. They are usually farmers and beneficiaries of projects like livestock raising. They grow tiger grass for making soft brooms.

#### **Cotabato Provincial Forest and Ecotourism Park (CPFEP), Amas, Kidapawan City (Figure 2)**

The second study site is the Cotabato Provincial Forest and Eco-Tourism Park (CPFEP), geographically located at 7°02.843'N; 124°58.420'E. This area is classified as lowland secondary forest, protected and maintained through reforestation programs by the Provincial Government. It is a 645 hectare provincial reserve, situated at Amas, Kidapawan City, Philippines. However, anthropogenic activities such as logging, human settlement, forest clearing and conversion of forest areas into agricultural land were observed

resulting to forest patches. *Ficus* spp. and bamboo were the most abundant among plants. Mosses were mostly observed in rocks, fallen logs, soil and rocks on the riverside but were noted to be less dense in other semi-dried areas. Leaf litter in the area was thick with sandy type of soil. Forest canopy was wide due to dipterocarp and some fruit trees. The height of dominant and emergent trees was about 30-40 m and 50-70 m, respectively.

#### **Sampling Methods, Identification and Diversity Indices**

Mist nets were used to sample fruit bats. These were checked regularly and the captured individuals were



**Figure 2.** Cotabato Provincial Forest and EcoTourism Park (CPFEP), Amas, Kidapawan City.

processed immediately to reduce stress. A total of 102-net days were operated in each study area.

Captured bats were identified using the taxonomic guide by Ingle and Heaney (1992). Necessary morphometrics and other morphological characteristics were noted which were used as basis for the species identification. Unless voucher specimens were needed, all samples were tagged and released.

Diversity indices like relative abundance, Shannon-Weiner index ( $H'$ ) and Simpson's reciprocal Index ( $1/D$ ) were also calculated using Biodiversity Pro Software version 2.0.

#### **Conservation Status and Distribution**

The International Union for the Conservation of Nature (IUCN) Redlist (IUCN 2013) was used as reference for the updated conservation and distribution status of the identified bats.

## RESULTS AND DISCUSSION

A total of 449 individuals of fruit bat (Family Pteropodidae) were captured from two conservation areas in North Cotabato (Table 1). These belong to eight species in which three are endemic to the country namely *Haplonycteris fischeri*, *Ptenochirus jagori*, and *Ptenochirus minor*.

The result of this study is comparable to several researches conducted in Mindanao. There are 17 species identified in the island (Ingle *et al.*, 1999). Thus, the study recorded 47% of the fruits bats in Mindanao. The study also recorded 67% of the fruit bats compared to the recorded species in Mt. Sinaka, North Cotabato (Gomez *et al.*, 2005), which is one of the important areas for biodiversity in the province, and 80% of the fruit bats in Mt. Hamiguitan (Relox *et al.*, 2009), one of the biodiversity hotspots in Mindanao.

**Table 1.** Fruit bats captured in some conservation areas in North Cotabato, Philippines.

Scientific Name	Common Name	Endemicity	Conservation status (IUCN, 2013)	Distribution	
				Balabag	CPFEP
<i>Cynopterus brachyotis</i>	Short-nosed Fruit Bat	Non-endemic	Least concern	☑	☑
<i>Eonycteris spelaea</i>	Common nectar bat	Non-endemic	Least concern	X	☑
<i>Haplonycteris fischeri</i>	Philippine Pygmy Fruit Bat	Endemic	Least concern	☑	☑
<i>Macroglossus minimus</i>	Dagger-toothed Flower Bat	Non-endemic	Least concern	☑	☑
<i>Megaerops wetmorei</i>	White-collared Fruit Bat	Non-endemic	Vulnerable	☑	☑
<i>Ptenochirus jagori</i>	Greater Musky Fruit Bat	Endemic	Least concern	☑	☑
<i>Ptenochirus minor</i>	Lesser Musky Fruit Bat	Endemic	Least concern	☑	X
<i>Rousettus amplexicaudatus</i>	Common Rousette	Non-endemic	Least concern	X	☑
<b>Diversity Index (H')</b>				<b>0.697</b>	<b>0.443</b>
<b>Simpson Index (1/D)</b>				<b>4.859</b>	<b>1.882</b>

Legend: ☑ - Present, X- Absent

### Diversity of Fruit Bats in Balabag and Amas Forest (CPFEP)

Table 1 shows that among the two sites surveyed, CPFEP forest had a higher number of fruit bat species accounting to seven species. The abundance of fruit-bearing trees including fig trees (*Ficus* spp.) and its low altitude compared to Balabag (6 species) might explain the higher species composition. However, number of endemic species showed higher in Balabag with three species. These findings conform with the results of Heaney (2001), that endemism in bats increases with elevation.

Diversity index consistently showed that Balabag ( $H'=0.697$  and  $1/D=4.859$ ) had higher diversity index value as compared to CPFEP ( $H'=0.443$  and  $1/D=1.882$ ). According to Heaney *et al.* (1998), fruit bats are highly abundant and diverse in regenerating forests with abundant fruit-bearing trees. They added that these are common from sea level up to mid-elevations. Its population decreases in higher elevations with less disturbed primary forest.

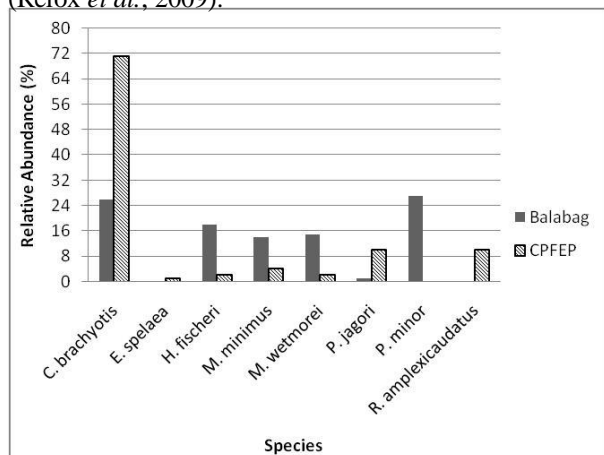
Two species of nectarivorous bats, *Eonycteris spelaea* and *R. amplexicaudatus* were recorded only in Amas reforested area (CPFEP) with a relative abundance of 1% and 10%, respectively. Corbet and Hill

(1992) stated that *R. amplexicaudatus* is commonly found roosting with *E. spelaea* and is abundant in vegetation up to 500 masl. However, the presence of these two species supports the observation that the once forested area is now disturbed with agricultural areas which is widely expanding. According to Heaney *et al.* (1999) these species are apparently absent in montane and mossy forests. Corbet and Hill (1992) also added that this species is abundant and widespread in agricultural and residential areas and rarely in the forest. Flight performance explains the preferred foraging area of the two species (Tanalgo *et al.*, 2012).

The most common species was *Cynopterus brachyotis*, which accounted for 59% of the bats captured. According to Storz and Kunz (1999), *C. brachyotis* is found in a variety of habitats frequently associated with secondary forests, fruit orchards and urban areas. It plays an important role in forest regeneration where it was found to be one of the most common seed dispersers in low-land forest (Tan *et al.*, 1998).

There are two *Ptenochirus* species in the Philippines, which, according to Heaney *et al.* (1998), are abundant in primary forest and common to uncommon in secondary forests. The present study recorded both *Ptenochirus minor* and *P. jagori*. *P. minor* which accounted for 27% of the captures in Balabag, while recorded to be

absent in CPFEP. The species is endemic to the Mindanao faunal region, which is common to lowland forest and uncommon in secondary and degraded forest (Heaney *et al.*, 1998). However, the study found that *P. minor* was common in Balabag, which is categorized as a secondary forest. This was also observed in a study conducted by Lobite *et al.* (2013) in a moderately disturbed forest in Cagayan de Oro. Meanwhile, *P. jagori* had a relative abundance of 1% and 10% in CPFEP and Balabag, respectively. This was also observed in a study conducted in the lowland dipterocarp forest in Mt. Hamiguitan, Davao Oriental in which *P. jagori* showed lower relative abundance as compared to other fruit bats (Relox *et al.*, 2009).



**Figure 3.** Relative abundance of fruits bats in selected conservation areas of North Cotabato, Philippines.

*Haplonycteris fischeri*, an endemic species, was recorded in both sites (14% in Balabag and 4% in CPFEP). This species is common in primary forest, especially at the middle elevation, moderately abundant in secondary forests and in mixed agricultural habitats up to second growth forest (Heaney *et al.*, 1998).

*Macroglossus minimus* was recorded in both areas, 14% in Balabag and 4% in CPFEP. This species was reported to inhabit disturbed areas in other parts of Mindanao (Heaney *et al.*, 2006a; Heaney *et al.*, 2006b). According to Heaney *et al.* (1998), this species is known to occur in almost all habitat types up to 2250 masl associated to cultured and wild Banana (*Musa* spp.).

*Megaerops wetmorei* (Figure 4), a threatened species, have a relative abundance of 15% and 2% in Balabag and CPFEP, respectively. This species is recently categorised as vulnerable by the IUCN Redlist (2013) threatened by habitat loss due to rapid deforestation of lowland forests in the country (Rosell-Ambal *et al.*, 2008). CPFEP, where the species is low in terms of capture, is presently inhabited by locals with some areas within the identified reforested area converted to agricultural lands.

Noteworthy finding was the presence of *M. wetmorei* in both areas. While Heaney *et al.* (1998) consider this species to be confined to primary and lightly disturbed lowland forest in Mindanao, it is worth mentioning that this species is indeed found in reforested

areas with anthropogenic disturbances. Heaney *et al.* (1998) reported that this species exists at elevation range of 800 masl to 1200 masl, 825-1200 masl in Mt. Kitanglad (Heaney *et al.*, 2006b), and 1220 masl in Mt. Daguma, Sultan Kudarat (Ibanez, 2010). The present study shows that *M. wetmorei* could actually inhabit an area with elevation as low as 58 masl (CPFEP). However, a recent study stated that the altitudinal distribution of this species is poorly known (Heaney *et al.*, 2006).



**Figure 4.** White-collared Fruit Bat (*Megaerops wetmorei*), a threatened species.

## CONCLUSION

The biodiversity study of fruit bats in North Cotabato, Philippines revealed the importance of conservation areas as a refuge of endemic and threatened species. The study showed that diversity of bats was found to be high in Balabag Area, a lowland montane forest, as compared to CPFEP, a secondary reforested area. Abundance of fruit bats also showed to be associated in lowlands as showed in the present study; however, it is low in terms of endemic species. It is highly recommended to conduct programs promoting biodiversity such as implementation of effective sustainable conservation measures, restoration and expansion of the existing secondary reforested area, planning of possible forest corridors among existing patches, and establishment of a community based conservation efforts.

The present study also suggests that *Megaerops wetmorei*, categorized as Vulnerable by IUCN, could inhabit area with elevation as low as 58 masl. However, the species is low in secondary reforested area (CPFEP) as compared to lowland montane forest (Balabag). More studies should be done to fully document the altitudinal range of the species and the factors affecting its diversity.

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