Tropical Technology Journal ISSN: 1656-0264
Volume 11, No. 1-2, January-June 2008

FRUIT BATS DIVERSITY IN THE THREE SITES IN ARGAO WATERSHED,SOUTHERN CEBU, PHILIPPINES

Steve Michael T. Alcazar[1], Eva A. Agbay[1],Edgardo P. Lillo[1], Archiebald B.Malaki[1], Hemres M. Alburo[1], Rosalyn P. Opiniano[3], Leslie S. Obiso[2], Glenn B. Hoyohoy[2], Rachel Luz V. Rica[3] Rebecca C. Manalastas[3], and Rosalyn P. Opiniano[1]**

[1] Cebu State College of Science and Technology - Argao Campus
[2] Cebu State College of Science and Technology - Barili Campus
[3] Cebu State College of Science and Technology T- Main Campus

ABSTRACT

Field surveys were conducted at the three sites in Argao watershed between 2004 December to 2005 April. This watershed is covered by natural forest that develops in fragments. These patches of natural forests can be found in Mount Lantoy, Canbantug , and Cansuje .The bats were assessed using mist nets(1.22 m x 6 m) which were placed at different elevational gradients. A total of eight species of fruit bats were recorded across study sites. Four species were common to all sites: Cynopterus brachyotis, Macroglossus minimus, Ptenochirus jagori, a Philippine endemic, and Rousettus amplexicaudatus. Other species which is significant and of high conservation concern were also captured; namely, Nyctimene rabori, a Philippine endemic, which was captured in Canbantug, Haplonycteris fischeri, a Philippine endemic,was captured in Cansuje and Canbantug, Eonycteris spelaea was recorded in Mount Lantoy and Cansuje, and Pteropus pumilus was recorded in Mount Lantoy.

The presence and low relative abundance in the study sites of three Philippine endemic species; namely, H. fischeri, P. jagori, and P. pumilus indicate considerable conservation importance to concerned agencies and local communities. Thus, the planting of tree species which are favored by foraging fruit bats and building of a forest corridor should be undertaken because these entail an effect on fruit bat species composition and relative abundance. The undisturbed natural forest should also be protected from future disturbance, since it was noted that fruit bats were using undisturbed forest far more than disturbed forest.

This study was undertaken to gather information about fruit bats diversity in Mount Lantoy, Canbantug, and Cansuje, which will form part of baseline data of Argao watershed. We determined species composition and relative abundance of fruit bats in the three sites above- mentioned.

INTRODUCTION

Mammalian fauna is the most striking species in the Philippines including such animals as the dwarf Visayan spotted deer, tamaraw, the strikingly colored Philippine tube-nosed fruit bats, etc. It is interesting that in spite of publicity associated with Madagascar, the Philippines has more species of endemic mammals, 115 vs. 80 and the Philippines is only 1/3 as large as Madagascar.

The Philippines is one of the world's major centers of biological diversity (WCSP, 1997; Kennedy et al., 2000). Not surprisingly the country supports exceptionally rich unique species of mammals. In this country of extraordinarily high biodiversity and endemism, there is also high level of species endangerment that is why it is considered as one of the world's biodiversity hotspots. One of the highly diverse vertebrate faunal groups in the country with high endemicity are fruit bats (Heaney et al., 1998).

Cebu's forest is one of the most badly destroyed in the deforestation history of the country, which dates back to the Spanish period. Signs of over cutting were already evident in the late 1800's because trees were cut and made into ships (Vitug, 1993). Forest destruction in Cebu has almost zero forest cover (SSC, 1998). Balete (n.d) as cited by Vesilind (2002) reported that Cebu is 99% denuded with its few remaining forest patches growing over limestone. With the small sizes of forest patches left on Cebu, habitat restoration is vital to ensure long term survival of some endemic and other species on the island (Mallari, 2002).

The patterns of biological diversity have been strongly structured by the extent of Pleistocene islands; thus, the first and most important level of protection should be to document the fruit bat species in Cebu particularly the Argao watershed. It is therefore the purpose of this study to determine the composition and relative abundance of these species in the area.

Ecologically, fruit bats are strong interactors, or ecological "keystones" as pollinators and seed dispersers and play a key role in forest regeneration. As maintainers of the forest, they likely have indirect economic importance to an area.

However, many fruit bats are now facing a number of threats. These include habitat destruction by human disturbance at roost sites (e.g. hunting, guano extraction, and visits by people) and unregulated local or commercial hunting and trade (Mickleburgh et al., 1990; Heaney and Regalado, 1998; Mildenstein et al.).Thus, a collaborative and well coordinated initiative towards developing conservation program is absolutely needed to address these current problems.

MATERIALS AND METHODS

Description of Study Sites

The study was conducted in the three sites; namely, Mount Lantoy, Canbantug, and Cansuje which were found within Argao watershed in Argao, Cebu. The watershed area has a type III climate (Corona type) which means that there is no pronounced dry and wet seasons. However, it is observed that the dry season occurs from February to April while the rainy season occurs from May to December. The watershed area is located approximately between latitude 9^{0} 48'58'' and 9^{0} 56' 3'' North, longitude 123^{o} 27' 00'' and 127^{0} 34' 27'' East. It lies in an approximate distance of 81 kilometers away from Cebu City and 15 kilometers from Argao town proper and is accessible by any type of land transportation. The remote areas can be accessed by foot through established foot trails.

The general topography of the area is steep to very steep slope with rugged terrain ranging from 12 %- 60% slope in any direction. The highest elevation is 1000 masl. The area has two different types of forest cover, the naturally grown trees which are indigenous species and the man-made forest which are the plantations, previously managed under Southern Cebu Reforestation and Development Project (SCRDP).

The area is one of the vital sources of water supply in the Southern part of the province of Cebu particularly Argao. By virtue of Presidential Proclamation No. 414 dated June 29, 1994, the area was declared as Argao Watershed Forest Reserve to ensure its protection and development; hence, became part of the NIPAS component as a protected area. However, at present it is disestablished as an initial component of the NIPAS due to some legal problems and impediments. Currently, it is reverted back to the category of forest land and the watershed area is under the control and management of Argao Watershed Management Council (AWMC) and no longer the Protected Area Management Board (PAMB).

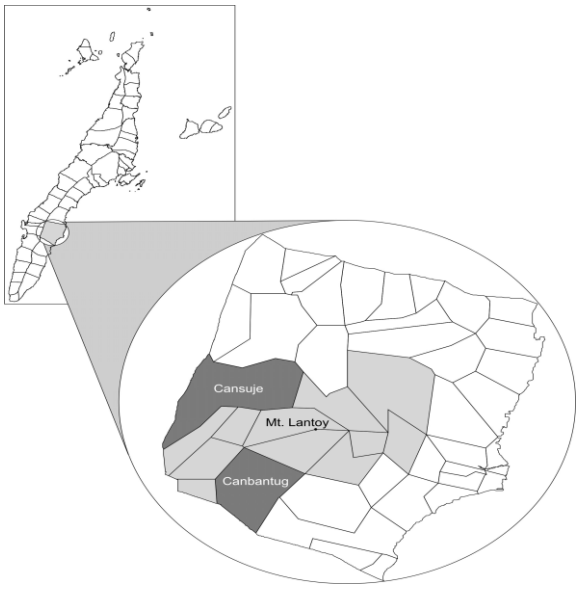

Figure 1. Map of Argao showing the study sites within the watershed area

Mount Lantoy. With an elevation between 200-700 masl, Mount Lantoy is located at coordinates 9^0 48' 58'' North and 123^0 34' 27'' East. Argao is 66 km Southeast of Cebu and the site is approximately 12 km from the town proper. The site is lying at the borders of four barangays namely Catang on the East, Conalum on the West, Tabayag on the South, and Usmad on the North. Based on the Corona type climatic classification (1920) the area is under type III.

It is described as having a karst limestone forest. Some tree plantations are present in the area. Most of these are monocultures of the exotic species like mahogany, Swietenia macropyhlla, yemane, Gmelina arborea, and teak, Tectona grandis. Yemane and teak species are planted at the lower elevation mixed with native species. However, mahogany is planted and distributed at different elevational gradients mixed with the native ones.

Canbantug. The area is located approximately 20 kilometers from the town proper. The general topography is steep to very steep slope with rugged terrain ranging from 12 %- 60 % slope in any direction. The elevation ranges from 300- 600 meters above sea level. Under the corona type of classification it falls within climatic type III. It consists mainly of timber land areas; however, there are some scattered patches of second growth forest and established plantation by SCRDP. It has also patches of brush lands and cultivated areas made by forest occupants majority of whom are holders of Certificate of Stewardship Contracts (CSCs) issued by DENR. It is accessible by all types of motor vehicles.

Cansuje. The site is approximately 18 km from the town proper. The general topography is hilly to mountainous with rugged terrain from 90- 120 % slope with limited flat lands utilized for Agriculture. It is located at an elevation ranging from 300-700 masl. It falls within climatic type III (Corona system).

The vegetative cover includes natural forest consisting of indigenous tree species and man-made forest mostly of exotic species which was established and previously managed by Southern Cebu Reforestation and Development Project (SCRDP).

Sampling Methods/Mist Netting Procedure

To capture the fruit bats nets were sited in areas that are believed to maximize capture success, either near or adjacent fruiting trees or in expected flight routes. The mist -netting sites were located at different elevational gradients.

Using tree climbers and/or sling shots, ropes were hung over tree branches, between 2-10 meters from the

ground. These ropes were used to raise the mist nets (1.22 m x 6m) up into the desired height. Nets were open from 6:00 PM to 6:00 AM (considered as one net- night) and checked from 7:00 PM to 12 MN and 3:00 AM to 5:00 AM the following day. As soon as a fruit bat was captured, mist net was immediately lowered and bats were removed to prevent injury. Captured bats were placed in bags and were identified following the "Key to the Bats of the Philippine Islands" by Ingle and Heaney (1992). Biometric measurements (forearm, hindfoot, tail,body length,tail length), sex, maturity, and weight were recorded and each animal was marked at the wings using white ink prior to release.

For Mount Lantoy, sampling lasted for eight days using 15 nets totalling 1440 net nights. The site was sampled on 20-27 December 2004. For Canbantug, the netting efforts lasted for eight days using the same number of nets. Between 28 March to 4 April 2005 sampling was conducted. For Cansuje, the sampling effort lasted also for eight days from 11-18 April 2005.

Habitat characterization

Preferential sampling was used in characterizing the vegetation of the mist-netting sites. Quadrats measuring 20 m x 20 m were established where mist net is located to determine the forest structure. The gathering for trees included common name, scientific name, total height, and diameter at breast height (DBH). The trees were identified using the revised Lexicon of Philippine Trees (Rojo, 1999).

Basic information on site characterization was gathered and made on sites where mist nets were located. The first five large trees in terms of the total height and diameter at breast height (DBH) and notes on the number of fruiting/flowering trees and their identification were recorded. The forms of disturbances present in the netting sites and adjacent areas were also recorded.

RESULTS AND DISCUSSION

Sampling adequacy

To determine if the data represented the entire fruit bat community, a sampling effort curve was plotted. A curve that reaches a distinct plateau indicates sufficiency of sampling effort beyond which additional sampling is unlikely to add additional species (Brower et al, 1990). Sampling is then considered adequate when a plateau is reached and further sampling may not produce a new species.

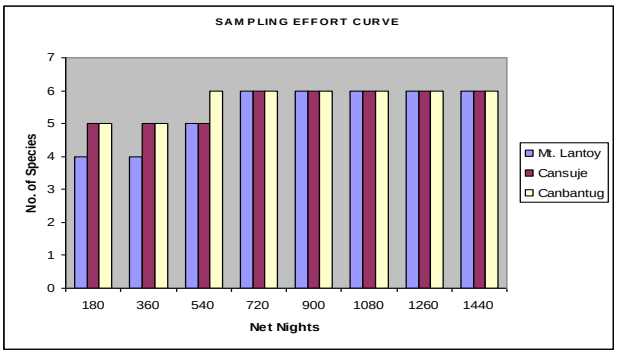

Figure 2. Sampling Adequacy of Fruits Bats

As shown in figure 2, the adequacy of sampling was met in the three sites. At Mount Lantoy, it started to leveled off on the second day (360 net nights) but there was a new species that was added on the third day (540 net nights). From the fourth day up to the last day of sampling, it reached its peak and had leveled off. At Cansuje, it leveled off as early as the first day (180 net nights) to third day (540 net nights) but on the fourth day (720 net nights) new species was added until it leveled off. Likewise, at Canbantug it leveled off as early as first day (180 net nights) to second day (360 net nights). On the third day (540 net nights) new species was captured. From then on until to the last day of sampling no species was added.

Species composition and relative abundance

At Mount Lantoy, results showed that *Macroglossus minimus* and *Cynopetrus brachyotis* were relatively abundant with 44.2 and 34.6 respectively in the area. Most of them were captured at low elevation near adjoining disturbed forest areas and cultivated lands. Some of them were netted around patches of banana plantation and few of them were also netted in a broad elevational range up to the ridge top. *Nyctimene rabori*, a Philippine endemic, was not captured in the area. This condition is alarming that needs conservation concern. The *Ptenochirus jagori*, a Philippine endemic was least abundant (9.6) and mostly captured at low to middle elevation. Likewise, *Haplonycteris fischeri*, a Philippine endemic was not netted in the area, *Eonycteris spelaea* was least abundant (1.9) including *Roussetus amplexicaudatus* (7.7) and Pteropus *pumilus* (1.9). The species poor showing in terms of their relative abundance would demonstrate that their population is declining.

At Canbantug, the study revealed that the site has resembled more or less similar patterns with Cansuje in terms of relative abundance of fruit bats indicating *Cynopterus brachyotis* (57.8) as frequently captured among other species. The next to have high capture success was *Macroglossus minimus* (23.1) which was believed to be abundant in the area. In addition, the *Ptenochirus jagori* has a relative abundance of 3.3, *Nyctimene rabori*, has 3.3, *Haplonycteris fischeri* has 9.1, and *Rousettus amplexicaudatus* has 3.3. Our sampling effort however, did not allow for the capture of *Pteropus pumilus* any more. It was really rare in the area. This means that the rarity of this particular species was closely associated with the existing type of forest habitat in the area.

At Cansuje, *Cynopterus brachyotis* was the frequently captured species. It was relatively abundant (48.6) in the study site considering that it is tolerant and generalist feeder. The result showed that this species could tolerate disturbance which allow them to dwell in a variety of habitats at different elevations and it seems that they can adapt to any anthropogenic conditions.

There were two Philippine endemic species that were captured; namely, *Ptenochirus jagori* and *Haplonycteris fischeri*. Though they were least abundant (2.8 and 1.4 respectively) in the area they were indicative of species diversity. The *Haplonycteris fischeri* was netted at the forest edge at low elevation. Further, the *Ptenochirus jagori* was least abundant in the area. This means that the abundance and composition of fruit bats species are associated by the type and quality of forest ecosystem they are in.

Endemism levels and diversity of fruit bats in the three sites in Argao watershed are still high but due to habitat destruction their population is threatened from endangerment and possibly to extinction if the problem continues.

Scientific Name Scientific Name	Three Sites Three Sites Three Sites Mount Lantoy	Cansuje	Canbantug
Cynopterus brachyotis	18 (34.6)	34(48.6)	70(57.8)
*Nyctimene rabori***	0	0	4(3.3)
Macroglossus minimus	23(44.2)	26(37.1)	28(23.1)
*Ptenochirus jagori **	5(9.6)	2(2.8)	4(3.3)
*Haplonycteris fischeri **	0	1(1.4)	11(9.1)
Eonycteris spelaea	1(1.9)	2(2.8)	0
Rousettus amplexicaudatus	4(7.7)	5(7.1)	4(3.3)
Pteropus pumilus	1(1.9)	0	0
N =	52	70	121
No. of species =	6	6	6
Total net nights =	1440	1440	1440

** Philippine endemic

CONCLUSION

The presence in the study sites of three Philippine endemic species namely, *Haplonycteris fischeri*, *Ptenochirus jagori*, and *Nyctimene rabori* are significant and of high conservation concern. Other fruit bat species of considerable conservation importance recorded was Pteropus pumilus. The low relative abundance of Philippine endemic species in the three sites and the capture of only one species of *P. pumilus* in one of the study sites indicate that conservation of habitat should be undertaken not only in areas of low and middle elevation but should also focus on areas with high elevation.

Larger areas support more species and more viable populations and diversity. The low capture success of fruit bats at ridge top or higher elevation is due to the decline of habitat areas on this type of elevation. This is also due to the fragmentation of habitats that resulted to the rapid change of the condition in the area. The decline of the forest habitat areas with increasing elevation has also indicated low relative abundance and diversity of fruit bats

RECOMMENDATIONS

1. Developing skills of local biologists and foresters in their interest in protecting the fruit bats and educating the local community about conservation will create a context in which fruit bat conservation is likely persistent in the long term.

2. Planting of tree species which are favored by foraging fruit bats and building a forest corridor should be undertaken because these entail an effect on fruit bat species composition and abundance.

3. Conservation of habitat should not only focus on lower elevation but also on areas with high elevation.

4. DENR, LGU's and other various stakeholders should collaborate in developing conservation programs.

5. Undisturbed natural forest should be protected from future disturbance, since it was noted that fruit bats were using undisturbed forest far more than disturbed forest.

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ACKNOWLEDGMENT

Our special thanks to the Commission on Higher Education RO 7 (CHED) for the endorsing the project. We are indebted to the Cebu Biodiversity Conservation Foundation, Inc. for the training and continuing support they provided

to the researchers. Particular thanks are due to Lisa Marie J. Paguntalan and Philip Godfrey C. Jakosalem. The Macroflora and Fauna research team of CSCST- Argao would also like to thank DENR-CENRO, Argao for their sustained interest in the project and for their support. We are grateful for the full support and assistance extended by the school administration in all aspects of the project work. Finally, our thanks to the Barangay captains, councilors, tanods, and the people in the community for welcoming us every time we conduct sampling in the study sites.