

## A preliminary record of fruit bats (Chiroptera: Pteropodidae) in CALSANAG Forest Reserve, Tablas Island, Philippines

Juniel G. LUCIDOS and Ace Kevin S. AMARGA

[juniel\\_lucidos@yahoo.com](mailto:juniel_lucidos@yahoo.com) (Lucidos), [ace\\_amarga061@yahoo.com](mailto:ace_amarga061@yahoo.com) (Amarga)

**Collaborators:** Almaiza Marie Rodeo, Hannah Gan, Reymark Manoy, Gregorio Florendo, Jr., Raymond Inocencio, Marjorie delos Angeles.

**Photographs by:** Reymark Manoy.

**Subjects identified by:** Ace Kevin S. Amarga, Juniel G. Lucidos.

**Location:** Tablas Island, Calatrava-San Andres-San Agustin (CALSANAG) Watershed Forest Reserve, Municipalities of San Andres & Calatrava, Romblon Province, Philippines.

**Elevation:** n/a

**Habitat:** Secondary lowland forest and agroforest ecosystems (including perennial orchards).

**Dates and times:** Barangay Balogo, Calatrava municipality (March 9-12, 2017; April 10-13, 2017; April 18-22, 2017) [specimens were retrieved from mistnets between 5:00 a.m. and 7:00 a.m.]

Barangay Marigondon Norte, San Andres municipality (September 17-23, 2019).

### Description of records:

Bats	Brgy. Balogo		Brgy. Marigondon-Norte	
	Forest	Agroforest	Forest	Agroforest
<i>Cynopterus luzoniensis</i> (Peters' fruit bat)	14 ind.	104 ind.	92 ind.	n/a
<i>Eonycteris spelaea</i> (Cave nectar bat)	-	37 ind.	-	n/a
<i>Macroglossus minimus</i> (Dagger-toothed long-nosed fruit bat)	5 ind.	5 ind.	2 ind.	n/a
<i>Ptenochirus jagori</i> (Greater musky fruit bat)	3 ind.	3 ind.	-	n/a
<i>Pteropus pumilus</i> (Little Golden-mantled flying fox)	-	4 ind.	-	n/a
<i>Rousettus amplexicaudatus</i> (Geoffroy's rousette)	-	24 ind.	3 ind.	n/a

Table 1. Bat species collected in forest and agroforest study sites in CALSANAG Forest Reserve

### Remarks and Species Account:

The Calatrava-San Andres-San Agustin Watershed (CALSANAG) is a protected area and the sole watershed in the island of Tablas, Romblon province, Philippines (Rodeo et al. 2019). It has a total land area of 2, 670 hectares and is primarily dominated by secondary forests, with 94 recorded tree species belonging to 44 families (Hernandez et al. 2020). Also, there are patches of grasslands, agroforest areas, and upland farms in the area (PENRO-DENR 2001; Rodeo et al. 2019; Landicho et al. 2020). To date, there are few published works concerning faunistic documentation in CALSANAG Watershed Forest Reserve (e.g., Fadri & Barrion 2019; Amarga & Supsup 2020; Amarga & Sy 2020). In addition to these, there is no published report regarding the bat fauna occurring in this area. Thus, to our knowledge, this is the first report of fruit bats (Pteropodidae) found in CALSANAG Watershed Forest Reserve.

During a biodiversity assessment in CALSANAG Watershed Forest Reserve, mist netting was used to collect fruit bats from collection sites such as flyways along streams and forest edges. All bats were released to the wild after identification and measurement of related morphometrics. Fruit bats were identified following the taxonomic keys of Ingle & Heaney (1992). Species names follow those listed in Giannini et al. (2019).

Pteropodidae is a family of bats belonging to the suborder Yinpterochiroptera along with Hipposideridae (Old World leaf-nosed bats), Megadermatidae (False vampire bats), and Rhinolophidae (Horseshoe bats) (Lei & Dong 2016). Pteropodid bats are native to the Old World (Almeida et al. 2011) and are primarily frugivores (Courts 1998), although some are nectarivores (Freeman 1995; Sritongchuay & Bumrungsri 2016) and a few have been reported to exhibit folivory (Kunz & Ingalls 1994; Nelson et al. 2005; Alcazar et al. 2019). Furthermore, pteropodid bats play a pivotal role in forest restoration via fruit and seed dispersion, vegetation succession, and pollination of important fruit crops in the tropics (Sheherazade et al. 2017; Aziz et al. 2021; Parolin et al. 2021).

*Cynopterus luzoniensis* (Peters' fruit bat) is a small frugivorous bat, commonly found in lowland secondary forests as well as agroforests and agricultural areas (especially orchards) (Rosell-Ambal et al. 2019). Due to its ability to tolerate disturbance, it can also thrive in urban areas (Ramadhan and Winarni 2015). This species is part of the *Cynopterus brachyotis* species complex, a cryptic species lineage native to South and Southeast Asia (Campbell et al. 2004). Furthermore, according to the assessment of Rosell-Ambal et al. (2019), this species inhabits Philippines and Indonesia (Sulawesi).

*Eonycteris spelaea* (Cave nectar bat) is one of the two nectarivorous species of the genus *Eonycteris* present in the Philippines (the other one is *E. robusta*, an endemic species) (Heaney et al. 2010). This bat is widespread in mainland and maritime SE Asia; it has also been reported in southern China and scarcely in southern Asia (Waldien et al. 2020). In forest ecosystems, *E. spelaea* inhabits lowland secondary and agroforest areas (especially orchards). In caves, it can form large roosts and can cohabit with other cave-dwelling species such as Geoffroy's rousette (*Rousettus amplexicaudatus*) (Esselstyn et al. 2004; Waldien et al. 2020). In Southeast Asia, it is an important pollinator for commercially important plant species such as bananas (*Musa* spp.), durian (*Durio zibethinus*), jackfruit (*Artocarpus heterophyllus*), and Java cotton (*Ceiba pentandra*) (Acharya et al. 2015; Thavry et al. 2017; Lim et al. 2018).

*Macroglossus minimus* (Dagger-toothed long-nosed fruit bat) is the only representative of the genus in the Philippines (Heaney et al. 2010). This small, nectarivorous bat has a very wide distribution spanning across SE Asia extending to Australia (Francis et al. 2008). In the Philippines, *M. minimus* occurs in every faunal region and commonly inhabits lowland secondary forests, agroforests, and even urban areas (Heaney et al. 2010). Furthermore, it is an important pollinator of varieties of bananas as well as mangroves (Winkelmann et al. 2003; Diego et al. 2019; Thong et al. 2021).

*Ptenochirus jagori* (Musky fruit bat) is a widely distributed Philippine endemic, except in Greater Palawan Faunal Region and Batanes-Babuyan archipelago (Heaney et al. 2010). This species inhabits primary and secondary forests as well as agricultural lands and even urban areas (Widmann 1994; Roberts 2006; Duya et al. 2020). It also makes use of caves (Tanalgo & Tabora 2015; Bejec et al. 2021). In terms of its diet, *P. jagori* feed on at least 45 plant species (Luft 1998); it primarily prefers *Ficus* spp. (Relox et al. 2014).

*Pteropus pumilus* (Little golden-mantled flying fox) is native to the Philippines and Miangas Island (Indonesia). This bat prefers primary and secondary lowland forests (Heaney et al. 2010). Because of its currently declining population across its range, due to habitat degradation and hunting for bush meat, the IUCN lists this species as Near Threatened (Heaney et al., 2019). *Pteropus pumilus* have been reported to feed on *Calophyllum inophyllum* (Calophyllaceae), *Fagraea racemosa* (Gentianaceae), and *Ficus* spp. (Moraceae) (Luft et al. 2003).

*Rousettus amplexicaudatus* (Geoffroy's rousette) is an Old World species widespread in mainland and maritime Southeast Asia extending to New Guinea, Bismarck Archipelago, and nearby islands (Rookmaaker and Bergmans 1981; Waldien et al. 2019). This species is known to inhabit lowland secondary forests, agricultural areas (including agroforests), and caves (Heideman and Heaney 1989; Carpenter et al. 2014; Duya et al. 2020). Because of its frugivorous diet, *R. amplexicaudatus* plays a significant role in pollination and dispersion of tropical plant species including *Ceiba pentandra*, *Durio* sp., *Musa* spp., and *Sonneratia* spp. (Sritongchuay and Bumrungsri 2016; Zalipah et al. 2016).



Figure 1. *Cynopterus luzoniensis*  
(Peters' fruit bat)



Figure 2. *Eonycteris spelaea*  
(Cave nectar bat)



Figure 3. *Macroglossus minimus*  
(Dagger-toothed long-nosed fruit bat)



Figure 4. *Ptenochirus jagori*  
(Greater musky fruit bat)



Figure 5. *Pteropus pumilus*  
(Little Golden-mantled flying fox)



Figure 6. *Rousettus amplexicaudatus*  
(Geoffroy's rousette)

**Permit:** This report was part of Biodiversity Assessment and Monitoring System (BAMS) conducted in CALSANAG Watershed Forest Reserve through the Monitoring and Detection of Ecosystems Changes for Enhancing Resilience and Adaptation in the Philippines (MODECERA) Research Program of the Romblon State University - Odiongan Campus and the University of the Philippines Los Baños.

## References:

- Acharya, P.R., Racey, P.A., Sotthibandhu, S., Bumrungsri, S. (2015) Home-range and foraging areas of the Dawn bat *Eonycteris spelaea* in agricultural areas of Thailand. *Acta Chiropterologica* 17(2): 307-319.
- Alcazar, S.M.T., Malaki, A.B.B., Lillo, E.P., Nuevo, R.U., Rosales, R.C. 2019. First record of folivory in the Tube-nosed fruit bat, *Nyctimene rabori* Heaney & Peterson, 1984 in Mt. Lantoy Key Biodiversity Area, Cebu, Philippines. *Philippine Journal of Science* 148(2): 419-422.
- Almeida, F.C., Giannini, N.P., DeSalle, R., Simmons, N.B. (2011) Evolutionary relationships of the Old World fruit bats (Chiroptera, Pteropodidae): another star phylogeny? *BMC Evolutionary Biology* 11: 281.
- Amarga, A.K.S., Supsup, C.E. (2020) First report of *Tropidolaemus subannulatus* (Gray 1842) from Romblon Island Group, Central Philippines. *Southeast Asia Vertebrate Records* 2020: 47-49. ISSN 2424-8525.
- Amarga, A.K.S., Sy, E.Y. (2020) First record of *Boiga angulata* (Peters, 1861) (Colubridae) in Romblon Island Group, Central Philippines. *Southeast Asia Vertebrate Records* 2020: 40-41. ISSN 2424-8525.
- Aziz, S.A., McConkey, K.R., Tanalgo, K., Sritongchuay, T., Low, M.-R., Yong, J.Y., Mildenstein, T.L., Nuevo-Diego, C.E., Lim, V.-C., Racey, P.A. (2021) The critical importance of Old World fruit bats for healthy ecosystems and economies. *Frontiers in Ecology and Evolution* 9: 641411.
- Bejec, G.A., Bucol, L.A., Reyes, T.D., Jose, R.P., Angcog, A.B., Pagente, A.C., Rodriguez, J.M., Bejec, A.L.N., Paglinawan, N.F.P. (2021) Abundance and species composition of cave bats (Mammalia: Chiroptera) in selected Key Biodiversity Areas (KBAs) of Central Visayas, Philippines. *Jurnal Ilmiah Sains* 21(1): 73-84.
- Campbell, P., Schneider, C.J., Adnan, A.M., Zubaid, A., Kunz, T.H. (2004) Phylogeny and Phylogeography of Old World fruit bats in the *Cynopterus brachyotis* complex. *Molecular Phylogenetics and Evolution* 33: 764-781.
- Carpenter, E-S., Gomez, R., Waldien, D.L., Sherwin, R.E. (2014) Photographic estimation of roosting density of Geoffroy's rousette fruit bat *Rousettus amplexicaudatus* (Chiroptera: Pteropodidae) at Monfort Bat Cave, Philippines. *Journal of Threatened Taxa* 6(6): 5838-5844.
- Courts, S.E. (1998) Dietary strategies of Old World fruit bats (Megachiroptera, Pteropodidae): how do they obtain sufficient protein? *Mammal Review* 28(4): 185-194.
- Diego, C.E.N., Stewart, A.B., Bumrungsri, S. (2019) Pollinators increase reproductive success of a self-compatible mangrove, *Sonneratia ovata*, in Southern Thailand. *Tropical Natural History* 19(2): 88-102.
- Duya, M.R.M., Heaney, L.R., Fernando, E.S., Ong, P.S. (2020) Fruit bat assemblage in different lowland forest types in the Northern Sierra Madre Mountains, Philippines. *Acta Chiropterologica* 22(1): 95-112.
- Esselstyn, J.A., Widmann, P., Heaney, L.R. (2004) The mammals of Palawan Island, Philippines. *Proceedings of the Biological society of Washington* 117(3): 271-302.
- Fadri, M.J.A., Barrion, A.T. (2019) Inventory of spider (Arachnida: Araneae) diversity in CALSANAG Watershed Forest Reserve in Romblon, Philippines. *RSU Research Journal* 2(1): 1-17.
- Francis, C., Rosell-Ambal, G., Sedlock, J., Ingle, N., McKenzie, G., Richards, N. *Macroglossus minimus*. The IUCN Red List of Threatened Species 2008: e.T12594A3363390. Accessed 03 March 2022.
- Freeman, P.W. (2005) Nectarivorous feeding mechanisms in bats. *Biological Journal of the Linnean Society* 56: 439-463.
- Giannini, N., Burgin, C., Van Cakenberghe, V., Tsang, S., Hintsche, S., Lavery, T., Bonaccorso, F., Almeida, F., O'Toole, B. (2019) Family Pteropodidae (Old World Fruit Bats). In: Wilson, D.E. & Mittermeier, R.A. (eds.) *Handbook of the Mammals of the World* vol. 9. Bats, Lynx Edicions, Barcelona, Spain
- Heaney, L.R., Dolar, M.L., Balete, D.S., Esselstyn, J.A., Rickart, E.A., and Sedlock, J.L. (2010) *Synopsis of Philippine Mammals*. Field Museum of Natural History, Chicago, USA. Accessed 03 March 2022.
- Heaney, L.R., Rosell-Ambal, R.G.B., Tabaranza, B., Cariño, A., Garcia, H.J.D., Paguntalan, L.M., Ramala, S.P., Alcala, E. 2020. *Pteropus pumilus*. The IUCN Red List of Threatened Species 2020: e.T18753A22086307. Accessed 03 March 2022.

- Heideman, P.D., Heaney, L.R. (1989) Population biology and estimates of abundance of fruit bats (Pteropodidae) in Philippine submontane rainforest. *Journal of Zoology (London)* 218: 565-586.
- Hernandez, J.O., Pulan, D.E., Mardia, L.S., Lucidos, J.G. (2020) Tree species composition and diversity in Calatrava-San Andres-San Agustin (CALSANAG) Watershed Forest reserve, Tablas Island, Philippines. *Asian Journal of Biodiversity* 11: 35-54.
- Ingle, N.R., Heaney, L.R. (1992) A key to the bats of the Philippine Islands. *Fieldiana Zoology* 69: 1-44.
- Kunz, T.H., Ingalls, K.A. (1994) Folivory in bats: an adaptation derived from frugivory. *Functional Ecology* 8(5): 665-668.
- Landicho, L.D., Ocampo, M.T.N.P., Cabahug, R.E.D., Baliton, R.S., Andalecio, E.V., Inocencio, R., Servanez, M.V., Cosico, R.S.A., Catillo, A.K.A., Famisaran, L.D.J. (2020) Tiger grass (*Thysanolaena maxima*) cultivation in CALSANAG watershed in Romblon, Philippines: dilemmas and prospects for sustainable natural resources management. *Biodiversitas* 21: 2322-2330.
- Lei, M., Dong, D. (2016) Phylogenomic analyses of bat subordinal relationships based on transcriptomic data. *Scientific Reports* 6: 27726.
- Lim, V.-C., Ramli, R., Bhassu, S., Wilson, J.-J. (2018) Pollination implications of the diverse diet of tropical nectar-feeding bats roosting in an urban cave. *PeerJ* 6: e4572.
- Luft, S. (1998) Feldökologische Untersuchungen an Flughunden (Megachiroptera: Pteropodidae) auf der Philippinen-Insel Panay. Ruhr University, Bochum, Germany, MS Thesis.
- Luft, S., Curio, E., Tacud, B. 2003. The use of olfaction in the foraging behaviour of the golden-mantled flying fox, *Pteropus pumilus*, and the greater musky fruit bat, *Ptenochirus jagori* (Megachiroptera: Pteropodidae). *Naturwissenschaften* 90: 84-87.
- Nelson, S.L., Kunz, T.H., Humphrey, S.R. (2005) Folivory in fruit bats: leaves provide a natural source of calcium. *Journal of Chemical Ecology* 31(8): 1683-1691.
- Parolin, L.C., Lacher, Jr., T.E., Bianconi, G.V., Mikich, S.B. (2021) Frugivorous bats as facilitators of natural regeneration in degraded habitats: a potential global tool. *Acta Oecologia* 111: 103748.
- PENRO-DENR (2001) Draft Initial Protected Area Plan (IPAP) for the Proposed CALSANAG Protected Area Landscape. PENRO Odiongan, Romblon.
- Ramadhan, J., Winarni, N.L. (2015) Habitat comparison of *Cynopterus* bats at Lampung, Sumatra, Indonesia. *Taprobanica* 7(1): 62-65.
- Relox, R.E., Florece, L.M., Baril, J.A., Coladilla, J.O. (2014) Assessment of fruit bats and its food preferences in Mt. Apo Natural Park, Kidapawan City, North Cotabato, Philippines. *Journal of Environmental Science and Management* 17(2): 12-20.
- Roberts, T.E. (2006) History, ocean channels, and distance determine phylogeographic patterns in three widespread Philippine fruit bats (Pteropodidae). *Molecular Ecology* 15(8): 2183-2199.
- Rodeo, A.M.F., Lucidos, J.G., Gan, H.F., Manoy, R.F., Ambal-Formilleza, A.M., Andalecio, E.V. (2019) Socio-ecological resilience assessment: initial findings and results in CALSANAG Balogo Sub-Watershed. *RSU Research Journal* 2(1): 18-34.
- Rookmaaker, L.C., Bergmans, W. 1981. Taxonomy and geography of *Rousettus amplexicaudatus* (Geoffroy, 1810) with comparative notes on sympatric congeners (Mammalia, Megachiroptera). *Beaufortia* 31(1): 1-29.
- Rosell-Ambal, G., Kingston, T., Maryanto, I. (2019) *Cynopterus luzoniensis*. The IUCN Red List of Threatened Species 2019: e.T136798A22035092. Accessed 03 March 2022.
- Sheherazade, Yasman, Pradana, D.H., Tsang, S.M. (2017) The role of fruit bats in plant community changes in an urban forest in Indonesia. *Raffles Bulletin of Zoology* 65: 497-505.
- Sritongchuay, T., Bumrungsri, S. (2016) Specialized and facultative nectar-feeding bats have different effects on pollination networks in mixed fruit orchards in Southern Thailand. *Journal of Pollination Ecology* 19(14): 98-103.
- Tanalgo, K.C., Tabora, J.A.G. (2015) Cave-dwelling bats (Mammalia: Chiroptera) and conservation concerns in South Central Mindanao, Philippines. *Journal of Threatened Taxa* 7(15): 8185-8194.
- Thavry, H., Cappelle, J., Bumrungsri, S., Thona, L., Furey, N.M. (2017) The diet of the Cave nectar bat (*Eonycteris spelaea* Dobson) suggests it pollinates economically and ecologically significant plants in Southern Cambodia. *Zoological Studies* 56: 17.
- Thong, V.D. (2021) First record of bats (Mammalia: Chiroptera) from mangrove in Dam Nai area, Ninh Thuan province, central Vietnam. *Academia Journal of Biology* 43(2): 135-139.

- Waldien, D.L., Adleson, S., Wilson, Z. (2002) *Eonycteris spelaea*. The IUCN Red List of Threatened Species 2020: e.T7787A22128326. Accessed 03 March 2022.
- Waldien, D.L., Wilson, Z., Adleson, S., Abdul Aziz, S., Bates, P.J.J., Bumrungsri, S., Furey, N., Ingle, N.R., Mildenstein, T., Phelps, K., Tanalgo, K., Soisook, P., Thong, V.D., Wiantoro, S., Tsang, S.M. (2019) *Rousettus amplexicaudatus*. The IUCN Red List of Threatened Species 2019: 3.T19754A22001514. Accessed 03 March 2022.
- Widmann, P. (1994) Bat survey in Alto Peak area, Leyte, Philippines. *Annals of Tropical Research* 16: 46-48.
- Winkelmann, J.R., Bonaccorso, F.J., Goedeke, E.E., Ballock, L.J. (2003) Home range and territoriality in the Least blossom bat, *Macroglossus minimus*, in Papua New Guinea. *Journal of Mammalogy* 84(2): 561-570.
- Zalipah, M.N., Anuar, M.S.S., Jones, G. (2016) The potential significance of nectar-feeding bats as pollinators in mangrove habitats of Peninsular Malaysia. *Biotropica* 48(4): 425-428.