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Fruit bats (Pteropodidae) in select green spaces of Davao City, Mindanao, Philippines: a preliminary assessment

Cyrell Ann Ruales[1], Christian Tripole[2], Joshua Donato[3], Marian Dara Tagoon[1*], and Elsa May Delima-Baron[1,4]

[1]*School of Business Management, Education, Arts and Sciences Department, San Pedro College, Davao City 8000, Davao del Sur, Mindanao, Philippines*
[2]*Davao Oriental State College of Science and Technology, Mati City, 8200, Davao Oriental, Mindanao, Philippines*
[3]*EGIP Foundation Inc, # 14 Alaminos St., Rolling Hills Subdivision, Bacaca, Davao City 8000, Davao del Sur, Mindanao, Philippines*
[4]*Research, Publication, and Innovation Center, San Pedro College, Davao City, 8000, Davao del Sur, Mindanao, Philippines*
[*]*Corresponding author*: *marian.tagoon@gmail.com*

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Abstract

Published data on bats in green spaces in Davao City, Mindanao, Philippines, remains scarce. This study provides an additional account of fruit bats of the family Pteropodidae occurring in green spaces both in the center of Davao City and its fringe communities. Our survey ran from January to April 2019. Mist nets were installed in possible flyways within select green spaces of bats and were checked from 6:30 pm to 4:30 am. Eight fruit bat species were documented, four of which are endemic to the Philippines. Two species, *Megaerops wetmorei* Taylor, 1934 and *Eonycteris robusta* Miller, 1913, are currently listed as vulnerable (VU), while the rest are considered non-threatened in the IUCN Red List of Threatened Species. The site in the Carmen Baguio district (Site 5) had the highest number of captures (n= 31), while the Mt. Talomo-Lipadas site (Site 6) had the highest species richness among surveyed green spaces. The inventory suggests that fruit bats occur in urban green spaces and could be supported by these urban green fragments. More studies are needed to determine how fruit bats utilize and benefit from urban green space fragments of the city.

Key words: Endemic, Pteropodidae, urban ecology, urban green space fragments, wildlife habitat

The unprecedented destruction of habitats, such as the expansion of urban areas and the conversion of forests to agricultural lands, leads to habitat fragmentation that can threaten bat populations (Park et al., 2012; Parkins and Clark, 2015). Despite the challenges of urbanization, fruit bats (Family Pteropodidae) are more prevalent in urban ecosystems than other bat families (Egert-Berg et al., 2021). Fruit bats provide ecosystem services in urban green spaces as they play a role in the dispersal of seeds of urban plants (de Araujo and Bernard, 2016). Green spaces, which include parks, wetlands, and wooded areas that facilitate relaxation, refuge from noise, and cooling of cities, are essential parts of the urban ecosystem (Songcayauon, 2022). Although habitat loss through urbanization presents a considerable threat to most chiropterans, green spaces in urban areas benefit this group as these fragmented green spaces may serve as both resting and foraging sites (Avila-Flores and Fenton, 2005). Urban landscapes can provide suitable habitats for various bat species (Jung and Threlfall, 2016).

Although this is a promising trade-off, there needs to be more detailed understanding of what constitutes suitable habitat in urban areas. The Philippines has at least 80 species of bat (Heaney et al., 2012), with 26 species belonging to the family Pteropodidae (Sedlock et al., 2020). More so, very little literature has reported on what species of bats are present in urban areas (Escarlos et al., 2019; Fidelino and Gan, 2019; Bacus et al., 2021).

To date, there are very few published scientific reports about bat species occurring in green spaces of Davao City (see Escarlos et al., 2019; Bacus et al., 2021). Thus, our research focused on pteropodid bat species utilizing green spaces in Davao City, situated in the southeastern part of Mindanao Island, Philippines.

Six green spaces in Davao City were surveyed (Figs. 1 and 2). These sites were specifically chosen based on their accessibility and the absence of published data on fruit bats. The green spaces were characterized to have vegetation that is horticultural, agricultural, secondary, or primary growth. Bat surveys at each site were conducted at least two nights from January to April 2019. Rain showers during the evenings occurred occasionally during the sampling duration. Mist nets measuring 2 m x 12 m were set in possible flyways of bats, similar to what Marques et al. did (2013). Mist nets were opened from 18:00 to 6:00 the following day (12 hours). The nets were checked every 15 minutes for the first four hours and then every two hours thereafter. Bats were immediately released after their measurements and photos were taken. The peak activity of bats is usually from 8:00 p.m. to 11:00 p.m., and the activity rate gradually declines thereafter. Standard morphometrics following the key of Ingle and Heaney (1992) and photographs were obtained after carefully removing trapped bats from the mist nets. Prior to release, the captured fruit bats were checked for possible injury, given sugar solution to provide an energy source. They were marked by trimming a small portion of their head fur for recapture determination (Escarlos et al., 2019). Descriptions of study sites are listed below:

Site 1 (7° 4' 44" N, 125° 36' 21" E, 18 m a.s.l.): This site is the school grounds of Davao City National High School (DCNHS), one of the largest public high schools in Davao City. It is sparsely lined with Mahogany trees (*Swietenia macrophylla*) and *Terminalia catappa*. The understory of the sampled sites lacked any vegetation. All sides of the sampling area have access roads where vehicular traffic is evident. The survey was conducted from 21–22 January 2019.

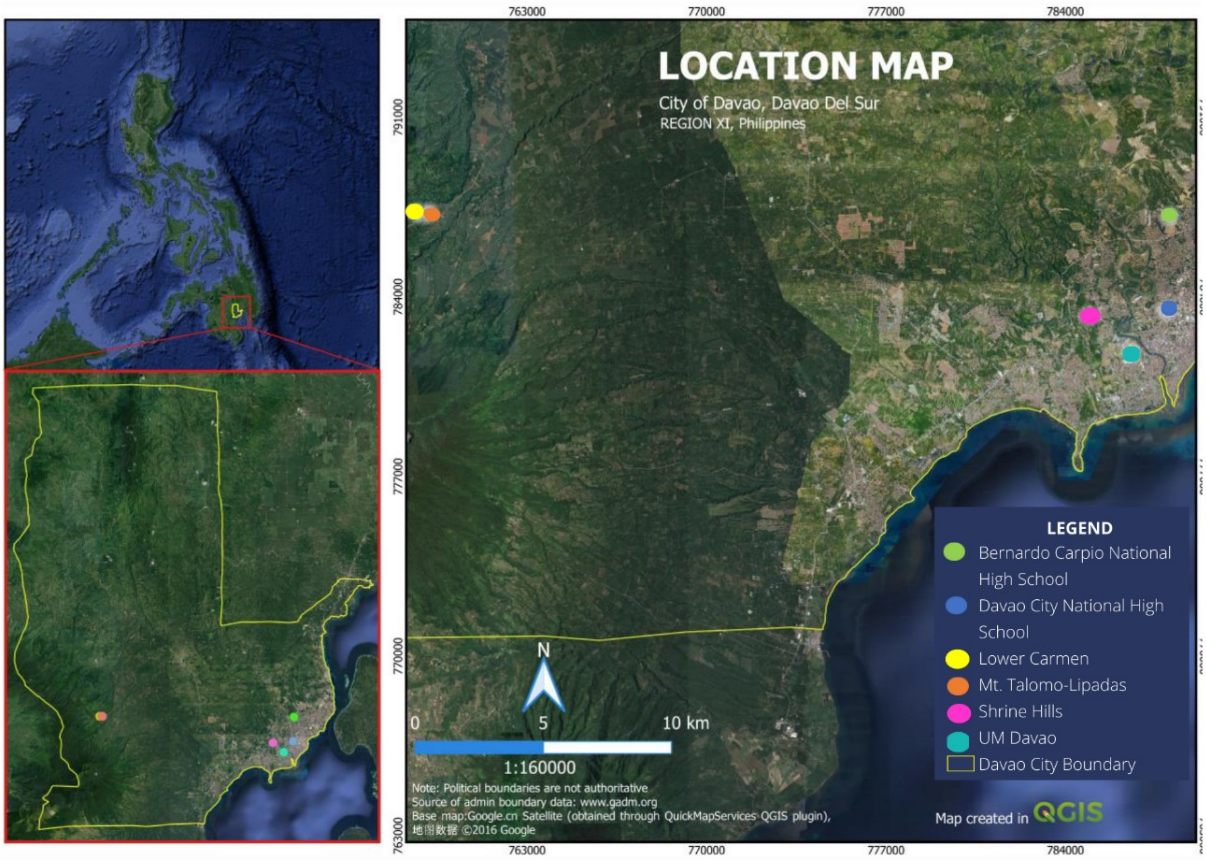

Figure 1: Location map showing green spaces surveyed represented by colored dots. Inset maps refer to the Philippine map and location of Davao City (map prepared through QGISv.3, T. Susulan).

Site 2 (7° 6’ 48” N, 125° 36’ 26” E, 99 m a.s.l.): This site is the school grounds of Bernardo Carpio National High School (BCNHS). The sampling area inside the school grounds closely resembles the tree species found in Site 1. The site is far from the main roads but heavily surrounded by human dwellings. At the time of sampling (23–24 January 2019), a school building was being constructed.

Site 3 (7° 3’ 49” N, 125° 35’ 55” E, 21 m a.s.l.): This site is an isolated forest patch within the University of Mindanao (UM) Matina campus lined with many understory plants and endemic tree species including Kamagong (*Diospyros blancoi*) and Antipolo (*Artocarpus blancoi*). Several plant species were flowering or fruiting during sampling. A swamp within the University of Mindanao-Matina campus is adjacent to the forest. The site is situated at the southern end of the campus, quite distant from anthropogenic activities. The survey was conducted from 24–25 January 2019.

Site 4: This site (7° 4' 6" N, 125° 34' 45" E; 154 m a.s.l.) is located in the upper portion of the forest’s patch of the Shrine Hills on its Matina side. This area is considered one of the city's critical green spaces. Several tree species were present in the site, and the understory is covered by several shrubs and grasses. The endemic tree species Antipolo (*Artocarpus blancoi*) was present during sampling with the Southeast Asian native Narra (*Pterocarpus indicus*). During the first night of sampling (1830 to 2100 hours), the weather was relatively good, but heavy downpours lasting for about two hours occurred on the second night of sampling. Only a few trees were observed flowering or bearing fruits during the sampling period (28–29 January 2019).

Site 5 (7° 6' 55.5" N, 125° 20' 46.3" E, 154 m a.s.l.): Situated in Carmen Baguio District, this site is near one of the tributaries of the Carmen River and is one of the largest green spaces surveyed for this study. Although the site can be considered a patch of old-growth forest, several agricultural patches surround it, with a stretch of banana plantation on one side. Weather was generally good throughout the survey (8–10 March 2019). Trees bearing flowers or fruits were not very evident in the area at the sampling time except for a few stands of *Ficus* teeming with fruits.

Site 6 (7° 5' 31.36" N, 125° 20' 45.89" E, 1260 m a.s.l.): This site is near the entry point of the montane forest of Mt. Talomo-Lipadas. It is one of the important sub-urban green spaces of the city as it serves as a headwater source for significant river systems in the city. Tree species present in the site include *Acer laurinum*, *Clethra* sp., *Calophyllum* sp., *Mastixia* sp., *Shorea* spp., *Macaranga bicolor*, *Lithocarpus* sp., *Cinnamomum mercadoi*, *Astronia* sp., *Syzygium* sp., *and Tremma orientalis*. Trees bearing flowers or fruits were also not very prominent when the survey was conducted (26–29 April 2019).

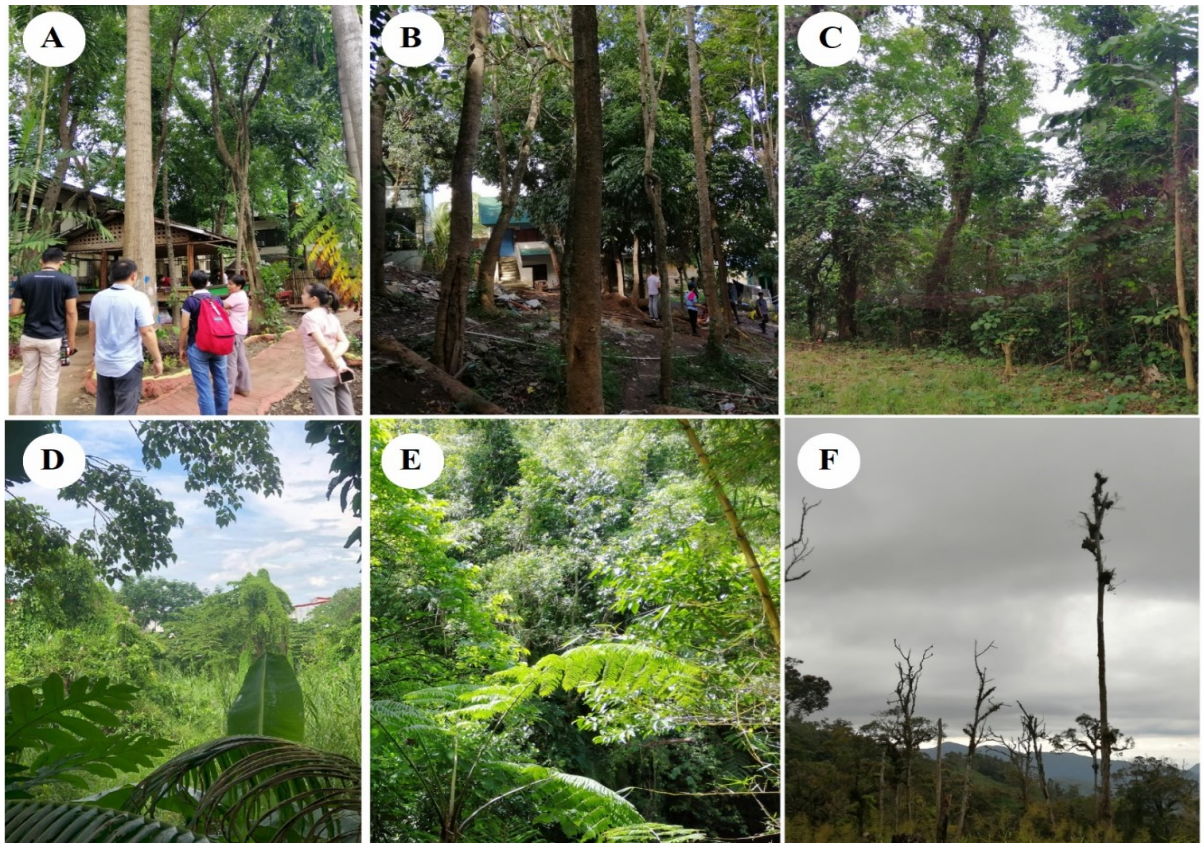

Figure 2: The six green spaces surveyed in Davao City, Mindanao Island, Philippines. (A) Site 1: Davao City National High School, (B) Site 2: Bernardo Carpio National High School, (C) Site 3: University of Mindanao Matina Campus, (D) Site 4: Shrine Hills Matina, (E) Site 5: Carmen Baguio District, and (F) Site 6: Mt. Talomo-Lipadas.

This study deviated from the usual practice of documenting bats in different localities as most conducted inventories in forested areas and conservation sites (see O'Malley et al., 2006; Van Weerd et al., 2008; Achondo et al., 2014). We documented fruit bats in green spaces of an urbanized city, which covered two man-made green spaces (Sites 1 and 2), fragmented forests of secondary growth (Sites 3, 4 and 5), and a single old-growth forest (Site 6).

Eight species of fruit bats (Pteropodidae) were documented from the six sampled green spaces of Davao City, Philippines (Table 1). Four species are endemic to the country (Table 2). Six of the eight species are currently listed under the Least Concern (LC) category of the Red List of Threatened Species of the International Union for the Conservation of Nature (IUCN). However, two species, *Megaerops wetmorei* Taylor, 1934 and *Eonycteris robusta* Miller, 1913, are currently placed under the Vulnerable (VU) category. Two of the eight bat species, *Cynopterus brachyotis* (Müller 1838) and *Ptenochirus jagori* (Peters, 1861), were encountered in all green spaces surveyed. However, four species: *Eonycteris robusta* Miller, 1913, *Eonycteris spelaea* (Dobson, 1871), *Haplonycteris fischeri* (Lawrence, 1939), and *Ptenochirus minor* Yoshiyuki 1979 were documented only in one of the six urban green spaces.

The documentation of eight species of fruit bats from these green spaces adds to the limited published references of fruit bats in green spaces of the Philippines (Fig. 3). The eight species documented are part of the current 26 species of pteropodids (Sedlock et al., 2020) out of the 80 currently recognized bat species in the Philippines (Heaney et al., 2010; 2012), 60% of which are endemic (Tanalgo and Hughes, 2018).

Previous studies accounted for six of the reported fruit bats in this study. Heaney et al. (1989) reported the occurrence of *C. brachyotis*, *E. spelaea*, *H. fischeri*, M. *minimus*, *P. jagori*, and *P. minor* at wide range of elevations in the central Philippines, thus suggesting their tolerance to disturbance.

Ong et al. (1999) reported the presence of *C. brachyotis*, *P. jagori*, and *E. spelaea* in the green spaces of two large universities in the urbanized area of metropolitan Manila. In Davao City, Escarlos et al. (2019) recorded seven fruit bat species present in Baganihan, Marilog Forest Reserve, including all those reported in this study except *for E. robusta*. Bacus et al. (2021) reported the presence of *M. minimus*, alongside *C. brachyotis*, *P. jagori*, and *E. spelaea* from two green spaces of Davao City (Mintal and Malagos areas). Although previous publications documented similar spceies assemblages, *E. robusta* was newly added to the list of fruit bats occurring in green spaces of Davao City. The presence of *C. brachyotis* and *P. jagori* across all green spaces surveyed corroborates its wide distribution across varying habitat types (Tanalgo et al., 2017). Both species have been previously documented in anthropogenic habitats, including orchards, ornamental gardens, and urban parks, suggesting their ability to tolerate a certain degree of habitat modification (Tanalgo et al., 2018; 2021). Such ability gives these species a selective advantage against habitat modification as they can move from one area to another in response to environmental changes (Deligero et al., 2016). Further studies are needed to understand the value of urban green spaces to fruit bats, as this study did not look into the utilization of fruit bats in the trees present within the select urban green spaces.

Table 1: Number of individuals of the fruit bat (Pteropodidae) species accounted for from the selected green spaces of Davao City, Philippines.

Site Code	Site	Coordinates (Elevation)	No. of individuals	Species richness
1	Davao City National High School	7° 4' 44" N, 125° 36' 21" E (18 m a.s.l.)	10	2
2	Bernardo Carpio National High School	7° 6' 48" N, 125° 36' 26" E (99 m a.s.l.)	11	2
3	University of Mindanao - Matina	7° 3' 49" N, 125° 35' 55" E (21 m a.s.l.)	27	4
4	Campus Shrine Hills (Matina Side)	7° 4' 6" N, 125° 34' 45" E (154 m a.s.l.)	12	3
5	Carmen Baguio District	7° 6' 55.5" N, 125° 20' 46.3" E (930 m a.s.l.) 7°	31	4
6	Mt. Talomo-Lipadas	5' 31.36" N, 125° 20' 45.89" E (1260 m a.s.l.)	14	5
Total number of individuals			105	

Table 2: Observed species of fruit bats (Pteropodidae) in the sampled green spaces of Davao City, Philippines.

Bat species	Sites observed
Macroglossus minimus (E. Geoffroy Saint-Hilaire, 1810), LC	3,6
Ptenochirus jagori (Peters, 1861), *LC	1, 2, 3, 4, 5, 6
Ptenochirus minor Yoshiyuki, 1979, *LC	5
Megaerops wetmorei Taylor, 1934, VU	5, 6
Eonycteris robusta Miller, 1913, *VU	3
Eonycteris spelaea (Dobson, 1871), LC	3
Haplonycteris fischeri Lawrence, 1939, *LC	6
Cynopterus brachyotis (Müller 1838), LC	1, 2, 3, 4, 5, 6

Endemism: * – Philippine Endemic

Conservation Status: NT–Near Threatened; LC–Least Concern, VU–Vulnerable

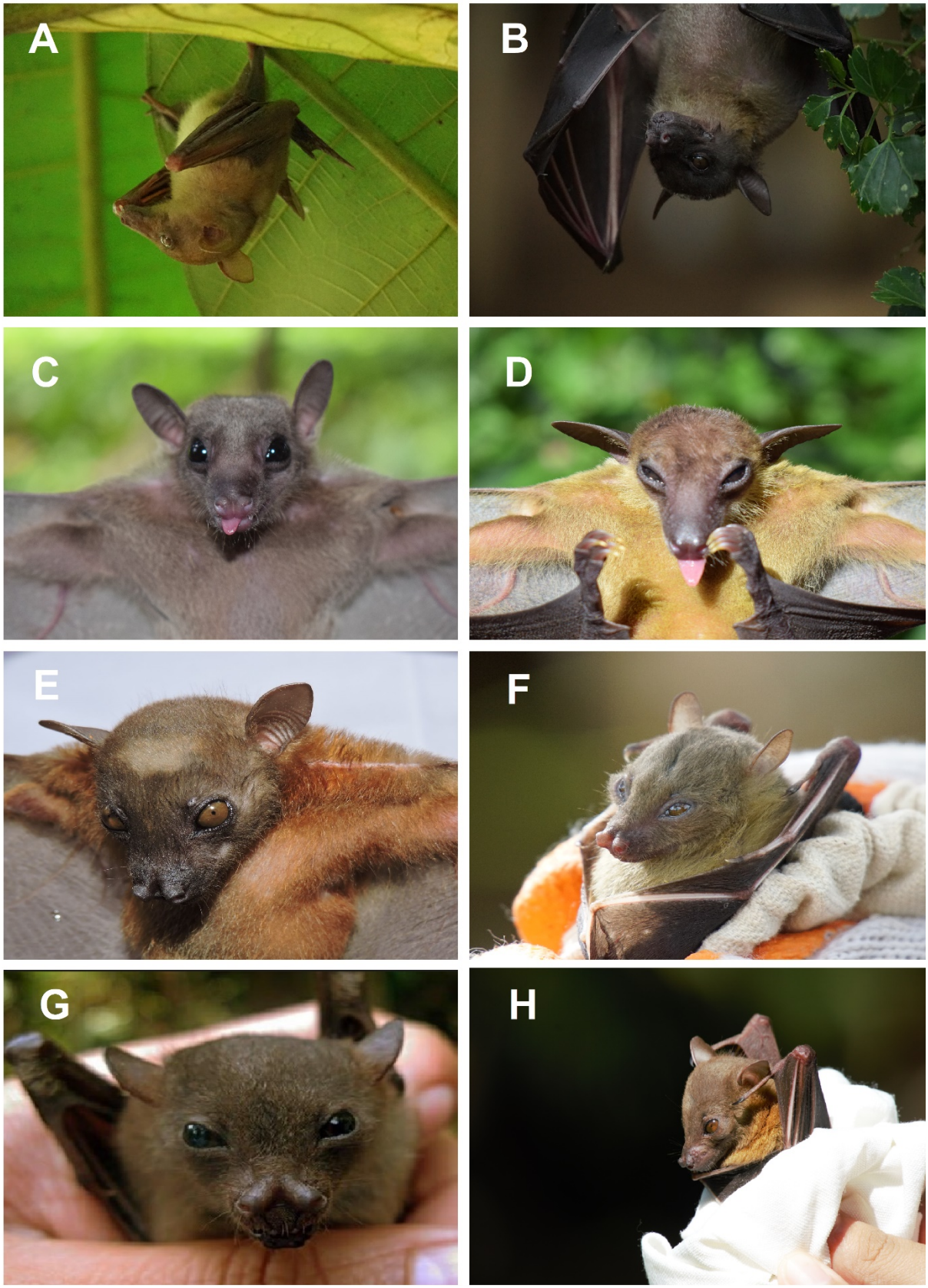

Figure 3: Captured bat species in select green spaces in Davao City: (A) *Macroglossus minimus* (E. Geoffroy Saint-Hilaire, 1810), (B) *Ptenochirus jagori* (Peters, 1861), (C) *Eonycteris robusta* Miller, 1913, (D) *Eonycteris spelaea* (Dobson, 1871), (E) *Ptenochirus minor* Yoshiyuki, 1979, (F) *Megaerops wetmorei* Taylor, 1934, (G) *Haplonycteris fischeri* Lawrence, 1939, and (H) *Cynopterus brachyotis* (Müller 1838).

Data obtained in this study, however, is very limited to the list of species and a select number of green spaces. Future endeavors should target surveys to include more green spaces.

Data to be collected must also add diversity values and compare these values with other parameters, including but not limited to green space size, vegetation type, vegetation composition and diversity, and anthropogenic factors.

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Conflict of interest

All authors declare no conflicting issues related to this short communication.

Author contributions

All authors were involved in the field survey and data collection. Specifically, C.A.R. and C.T. collected most data from all green spaces surveyed. J.D. also provided the logistics to the different urban green spaces. M.D.T. prepared the draft of the manuscript. E.M.D.B. took the photos, organized the data, interpreted the results, and prepared the draft of the manuscript.

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