

Maximum weight record of fruit carried by *Artibeus fraterculus*

Registro máximo de carga de fruto por *Artibeus fraterculus*

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Artibeus fraterculus Anthony, 1924 is a fruit bat of the family Phyllostomidae. It feeds primarily on soft fruits, including both native and cultivated species, although its feeding behavior remains poorly understood. This study was carried out in 2 localities of Cajamarca, Matibamba and Cangrejo, in the Seasonally Dry Forest of the Marañón, in the region of Cajamarca, Peru. Their feeding behavior was documented and fruits found in natural feeding (night) roosts were analyzed. During the observations, the bats consumed fruits such as guava (*Psidium guajava*), loquat (*Eriobotrya japonica*), plum (*Spondias purpurea*) and mango (*Mangifera indica*). Notably, an individual was observed carrying a guava fruit whose weight was estimated to be 105.88 % of the bat's body weight. These observations suggest that *A. fraterculus* plays a crucial role as a seed disperser of economically important and relatively large fruit, especially in disturbed landscapes. This work also expands existing knowledge on the diet of this species with the addition of *S. purpurea* and describes specific foraging behaviors at feeding (night) roosts. Insights gained from this work highlight how direct observations and analysis of fruits at feeding sites complements other approaches such as fecal analysis, providing valuable information on the feeding ecology and activity patterns of *A. fraterculus*.

Key words: Cajamarca; diet; feeding behavior; Marañón dry forest; Stenodermatinae.

Artibeus fraterculus Anthony, 1924 es un murciélago frugívoro de la familia Phyllostomidae, endémica de la región tumbesina en Ecuador y Perú. Este estudio se llevó a cabo en 2 localidades de Cajamarca, Matibamba y Cangrejo, en el Bosque Estacionalmente Seco del Marañón, en la región de Cajamarca, Perú. Se documentó su comportamiento alimenticio y se analizaron frutos encontrados en comederos naturales. Durante las observaciones, los murciélagos consumieron frutos como guayaba (*Psidium guajava*), níspero (*Eriobotrya japonica*), ciruela (*Spondias purpurea*) y mango (*Mangifera indica*); y en particular se observó a un individuo cargando un fruto de guayaba cuyo peso se estima representaría el 105.88 % del peso corporal del murciélago. Las observaciones sugieren que *A. fraterculus* juega un papel crucial como dispersor de semillas de especies de importancia económica y de tamaño relativamente grande, especialmente en paisajes perturbados. Este trabajo también amplía el conocimiento sobre la dieta de esta especie al incluir *S. purpurea*, una especie de importancia económica, y describe comportamientos específicos de forrajeo en relación con comederos. Finalmente, se destaca que las observaciones directas y análisis de frutos en comederos, complementa otros enfoques como el análisis de heces, proporcionando información valiosa sobre la ecología alimenticia y los patrones de actividad de *A. fraterculus*.

Palabras clave: Bosque Seco del Marañón; Cajamarca; comportamiento alimentario; dieta; Stenodermatinae.

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Plant and animal interactions play an essential role in the ecology and evolution of species and the preservation and restoration of balanced ecosystems ([Kunz et al. 2011](#); [Sil et al. 2023](#)). Mammals such as bats (Order Chiroptera) are fundamental in agricultural ecosystems, where they fulfill essential ecological roles such as pest control, plant pollination, and seed dispersal ([Laurindo et al. 2020](#); [Ocampo-Ariza et al. 2022](#)). Fruit bats in particular consume fruits completely or partially, allowing the seeds to pass through their digestive system and be dispersed through their feces ([Voigt et al. 2009](#)). For fruits with seeds too large for bats to consume, dispersal occurs as bats move between the food source and place of consumption, often

roosts ([Melo et al. 2009](#)). In both ways, bats contribute to the regeneration and propagation of plants with morphologically distinct fruits ([Melo et al. 2009](#)).

Several studies have documented the ability of species in the genus *Artibeus* to transport fruits weighing comparable to, or even greater than, their own body mass. Individuals of *A. jamaicensis* and *A. lituratus* have been reported transporting or consuming guava (*Psidium guajava*) fruits weighing up to 50 g, and even avocado (*Persea americana*) fruits weighing an estimated 71.7 g ([Gardner 1977](#); [Hernández-Mijangos and Medellín 2009](#); [Duque-Márquez and Muñoz-Romo 2015](#)). The transportation of whole fruits in the mouth, without being completely ingested, is known

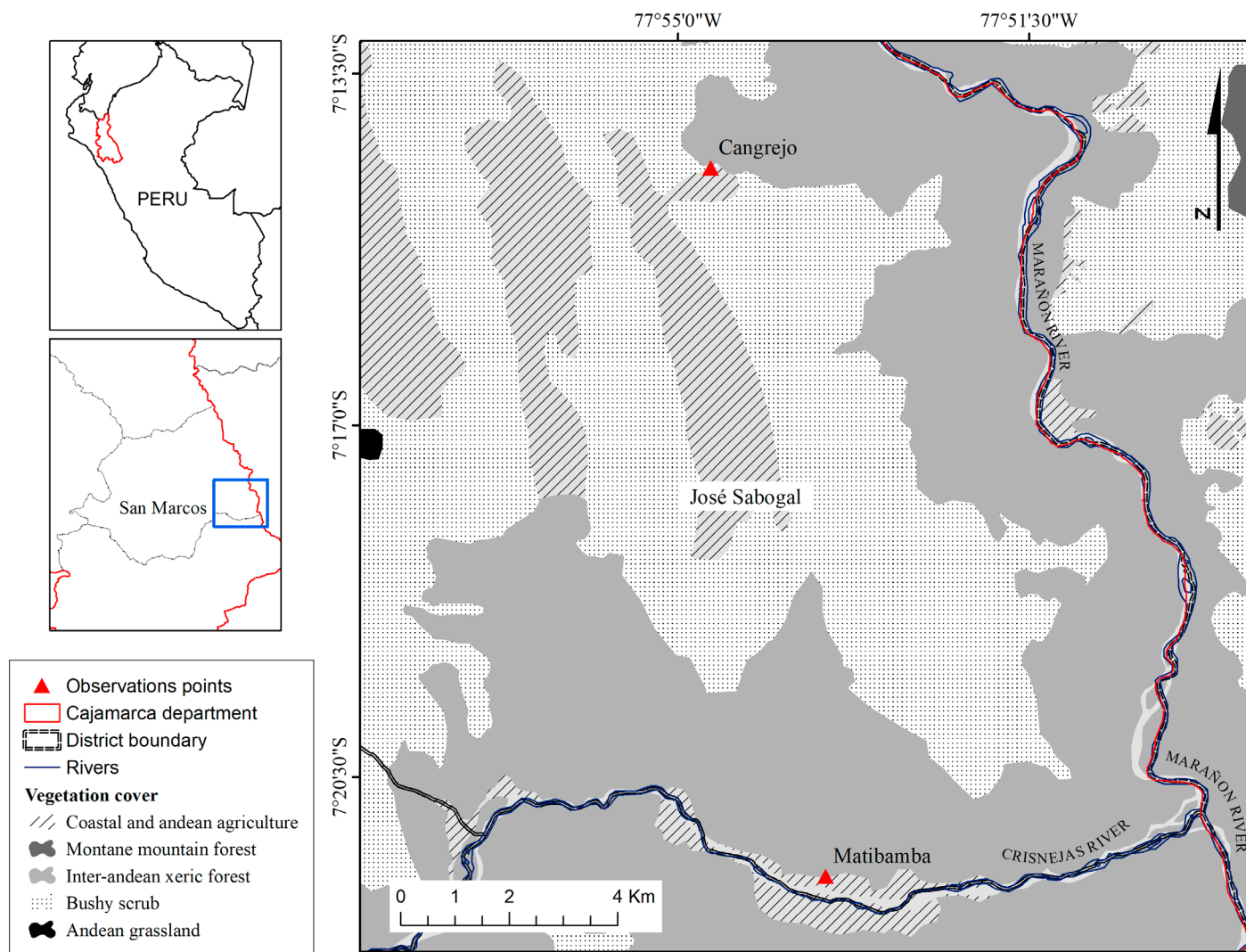


Figure 1. Geographic location of the observed night feeding roosts of *Artibeus fraterculus* in the localities of Matibamba and Cangrejo, Cajamarca, Peru.

as stomatochory (McConkey *et al.* 2024). This seed dispersal mechanism moves fruits or seeds from the source plant to a consumption or resting site, promoting plant regeneration at a distance (McConkey *et al.* 2024).

Artibeus fraterculus is a species of bat in the Phyllostomidae family (Subfamily Stenodermatinae) endemic to the Tumbes region of Peru and Ecuador (Marques-Aguir 2008; Salas *et al.* 2018). In Peru, it has been reported along the Pacific coast from Tumbes to Ica, in the Andes, and in arid ecosystems in the Amazon basin in the Cajamarca and Amazonas regions (Ortiz de la Puente 1951; Tuttle 1970; Koopman 1978; Pacheco *et al.* 2007; Salas *et al.* 2018). In Ecuador, it has been reported in the central and southern coast from 0 to 1,600 m, with one report in an area of humid montane scrubland (Salas *et al.* 2018).

In situ and field observations remain important for understanding the biology and natural history of bats (Hernández-Mijangos and Medellín 2009; Carrasco-Escudero and Hughes 2025). For example, information on folivory in *A. fraterculus* has been reported primarily from observations in roosts or mist nets at the time of capture

(Ruiz-Ramoni *et al.* 2011; Duque-Márquez *et al.* 2019; Arias and Aguirre 2022).

There are several studies on the diet of *A. fraterculus* (Novoa *et al.* 2011; Pinto *et al.* 2013); however, very little or nothing is known about its feeding behavior despite the implications for seed dispersal and intraspecific interactions (Salas *et al.* 2018). In *Artibeus lituratus*, males defend their roosts while conducting short foraging sessions to consume food in the roost itself. In contrast, females travel to more remote foraging locations and are not observed feeding at or near roosts (Muñoz-Romo and Herrera 2010). Furthermore, there are no dietary studies of fruit bats in the Marañón Valley, a region with a climate and botanical diversity distinct from those of the coast (Marcelo-Peña *et al.* 2016).

The main objective of this study is to report the maximum recorded fruit weight carried by the fraternal fruit bat *A. fraterculus*. In addition, we report for the first time the location of a foraging roost and the fruits consumed on the eastern slope of the Andes in two locations in the department of Cajamarca.

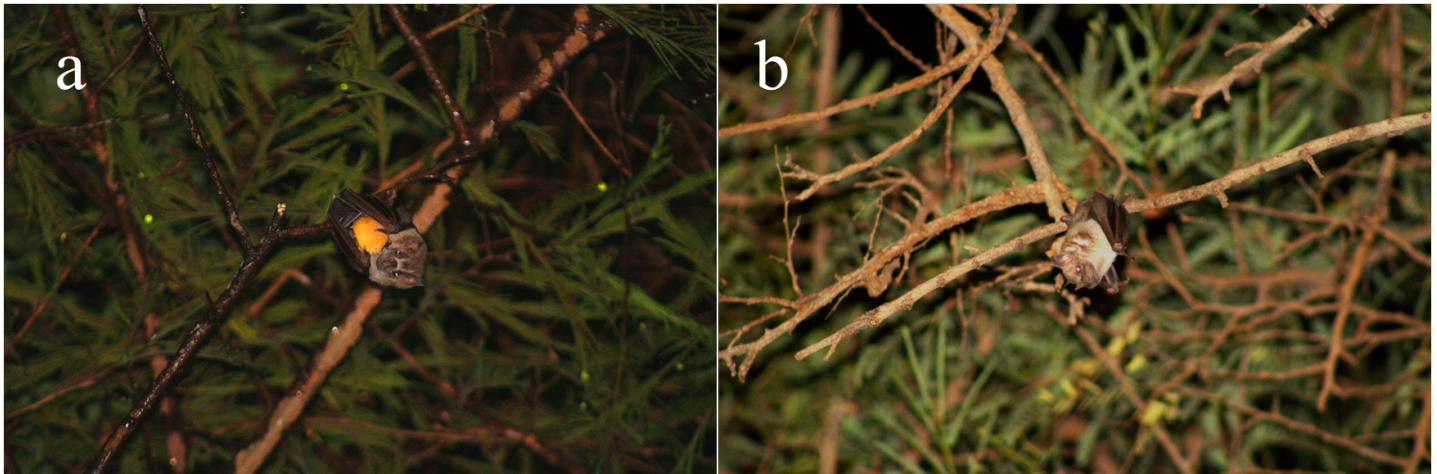


Figure 2. a). An individual of *A. fraterculus* perched and feeding on loquat (*Eriobotrya japonica*) in the locality of Cangrejo, Peru; b). An individual of *Artibeus fraterculus* perched on a tamarind tree (*Tamarindus indica*) in the locality of Matibamba

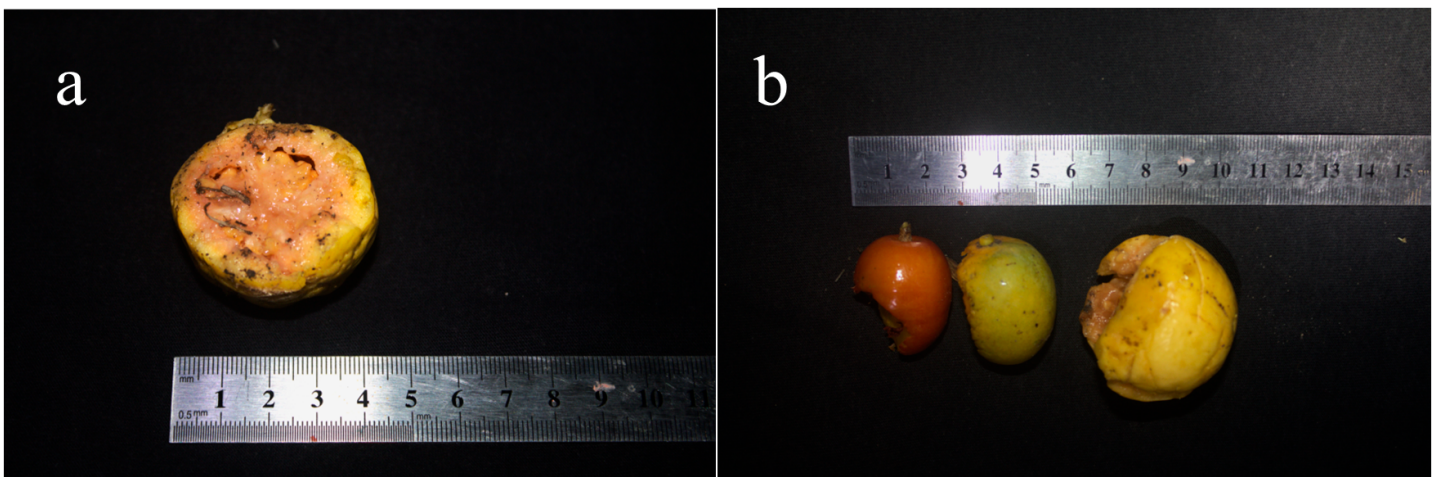


Figure 3. a). Guava (*Psidium guajava*) fruit dropped by an individual of *Artibeus fraterculus* after feeding; b). Remains of fruit partially consumed by *Artibeus fraterculus* at the night feeding roost, including, from left to right, *Spondias purpurea* (plum), *Mangifera indica* (mango), and *Psidium guajava* (guava), recorded in the locality of Matibamba, Peru.

Observations were made at two locations in the José Sabogal district, San Marcos province, Cajamarca region (Figure 1). The first, Matibamba (07° 21' 29" S, 77° 53' 32" W), is a populated center located in the extreme southeast of the district, with an average altitude of 1,160 m and an annual rainfall of approximately 670 mm ([Gobierno Regional de Cajamarca \[GRC\] 2020](#); [Fick and Hijmans 2017](#)). The second, Cangrejo (07° 14' 26" S, 77° 54' 40" W), is a populated center located 13.2 km north of Matibamba with an average altitude of 2,000 m and an annual rainfall of approximately 750 mm ([Fick and Hijmans 2017](#)).

Both locations are within the Marañón Seasonally Dry Forest ecosystem, characterized by a sub-humid and semi-warm climate, seasonally deciduous vegetation, and columnar cacti ([Ministry of the Environment \[MINAM\] 2018](#); [GRC 2020](#); [Linares-Palomino et al. 2022](#)). The average canopy height varies between both locations due to climate as well as current and historical land use. Canopy height averaged 13 meters in height in Matibamba and 27 meters in Cangrejo (data extracted from [Potapov et al. 2022](#)). Agricultural production in these areas includes coca, rice, cassava, corn,

and beans, as well as fruit trees such as mango, lemon, banana, plum, orange, and cocoa ([GRC 2020](#)).

During bat mist-net surveys at both locations, several individuals of the fraternal fruit bat (*A. fraterculus*) were observed perched on tree branches while feeding. These observations occurred coincidentally during the capture work and were documented using a handheld flashlight and camera. *A. fraterculus* is easily distinguished from other *Artibeus* species due to their faint facial lines, an overall grayish coloration with a paler ventral region, and a smaller size than other species in the *Artibeus* genus ([Tirira 2017](#); [Salas et al. 2018](#)). At these locations, *A. lituratus* and *A. planirostris* are the most similar species to *A. fraterculus*. *A. lituratus* is distinguishable by their larger size, more pronounced facial lines, and an overall browner coloration ([Tirira 2017](#)); while *A. planirostris* is more robust, and its facial lines may be less evident ([Hollis 2005](#)).

Additionally, we weighted fruits taken from the areas used as feeding grounds. For partially consumed *Psidium guajava* fruit, the missing portion was visually estimated by comparing its shape and volume with the expected

morphology of a whole fruit of the same species in order to estimate the original weight (Duque-Márquez and Muñoz-Romo 2015). Fruit was weighed using a Pesola Lightline dynamometer with a maximum capacity of 100 g to ensure accurate measurements.

On February 1, 2024, at 10:30 p.m., in the Cangrejo locality, individuals of *A. fraterculus* were observed perching and feeding on *Eriobotrya japonica* (loquat, Figure 2a) fruits. The fruits consumed had an average weight of $7.3 \text{ g} \pm 1.58 \text{ g}$. Individuals were perched 4 to 10 m from the nearest *E. japonica* tree.

In Matibamba, on February 8, 2024, at midnight, one *A. fraterculus* individual was observed perching on the branch of a tamarind tree (*Tamarindus indica*; Figure 2b), feeding on a guava (*Psidium guajava*) fruit. We observed the individual drop the fruit after feeding on it. The fruit displayed bite marks, and its weight was recorded at 31 g. It is estimated that approximately one-third of the fruit had been consumed (Figure 3a). Based on this estimate, the original fruit weight was calculated at 45 g. Weights of *A. fraterculus* range from 30 to 55 g (Salas et al. 2018), with the median weight of 42.5 g used as a reference here. Thus, the weight of the consumed fruit would represent approximately 105.88 % of the estimated average body weight for the species.

Additionally, at the Matibamba location, remains of other fruits showing signs of having been consumed by bats were found, including *Spondias purpurea* (plum, 9 g), *Mangifera indica* (mango, 14 g), and *P. guajava* (guava, 26 g; Figure 3b). These findings indicate a diverse frugivorous diet for *A. fraterculus* at the Matibamba locality and may indicate a partial dependence on agricultural species.

Other bat species were captured at each location on the same night. Individuals of *Sturnira giannae*, *A. planirostris*, *Promops davisoni*, *Glossophaga valens*, and *Carollia perspicillata* were recorded at Matibamba. At Cangrejo, *G. valens*, *C. perspicillata*, and *A. planirostris* were captured. Individuals of *Carollia* sp. and *A. fraterculus* were observed sharing a branch to feed.

Several species of the genus *Artibeus* have been documented to be able to carry fruit that, in some cases, is comparable to their own body mass. For example, Gardner (1977) reported an individual of *A. jamaicensis* in Colombia carrying a guava fruit weighing 50 g. Similarly, Hernández-Mijangos and Medellín (2009) observed an individual of *A. lituratus* feeding on a guava fruit weighing approximately 50 g, while Duque-Márquez and Muñoz-Romo (2015) reported an individual of *A. lituratus* consuming a *Persea americana* (avocado) fruit with an estimated weight of 71.7 g. In addition, diameter measurements have been recorded on transported fruits including by Tuttle (1970) in Peru, where a female *A. jamaicensis* was carrying a fig fruit approximately 30 mm in diameter. These studies highlight that transported fruits can represent a weight equivalent to the bat's body mass (Duque-Márquez and Muñoz-Romo

2015). This behavior could reduce the frequency with which bats need to forage, optimizing their energy expenditure (Fleming 1982).

In this context, our study reveals that *A. fraterculus*, one of the smallest species in the large *Artibeus* group (Salas et al. 2018), could be capable of carrying fruits equivalent to 1.05 times its body mass, demonstrating its remarkable carrying capacity relative to its size. Furthermore, this species plays an important role in the dispersal of large seeds such as *S. purpurea* and *M. indica* through stomatocory (McConkey et al. 2024; Sánchez-Calderón et al. 2025). The ability of *A. fraterculus* to transport fruits to feeding (night) and day roosts, and to expel undigested seeds in different locations, promotes the connectivity of fragmented habitats. This is especially valuable in tropical ecosystems, where the natural regeneration of native fruit trees may depend on species such as *A. fraterculus* among others.

The role of fruit bats as dispersers of large seeds has significant implications for ecosystem regeneration (Fleming and Heithaus 1981; Heithaus 1982). Many tree species that produce large-seeded fruits, such as *S. purpurea* and *M. indica*, might rely on fruit bats for dispersal. For native species such as *P. guajava*, this behavior may be crucial for their reestablishment in disturbed landscapes, where plants face greater difficulties in dispersal by birds, rodents, or other mammals due to the loss of dispersing fauna and the tendency of these groups to avoid open areas (Gardner 1977; Kunz et al. 2011; Brändel et al. 2020). For non-native species such as *M. indica*, this behavior may increase the risk of their naturalization, posing a threat to native species in areas with high endemism (Jiang et al. 2022). However, since these non-native plants can provide alternative food sources for wildlife during the recovery period of native forest diversity, the risk of naturalization must be assessed on a case-by-case basis, considering the area's management objectives. These complex interactions between agriculture and native biodiversity highlight the importance of promoting collaborative discussions and developing integrated management plans for communities located within and near protected areas. These observations are consistent with the documented tendency of this species to feed on fruits available in each location, even if they are non-native or agricultural species (Salas et al. 2018).

Dietary studies of *A. fraterculus* have been conducted primarily through the analysis of fecal samples (Novoa et al. 2011) or fruits and seeds collected from shelters (Pinto et al. 2013). In this study, we collected large-seeded fruits from feeding (night) roosts, which may be too heavy to be transported to their shelters and, due to their seed size, may not be entirely ingestible. These fruits would not be reported through seed analysis in fecal samples.

Based on the observations and descriptions of *A. lituratus* by Muñoz-Romo and Herrera (2010), *A. fraterculus* would be expected to display sex-specific foraging

behavior, with males making short flights to return to their shelter to feed and defend it; while females forage farther away. If true, we would expect feeding (night) roosts to be utilized disproportionately by females while males are feeding in and near permanent day roosts. In the town of Matibamba, 1 km to the northwest, we found a cave inhabited by *A. fraterculus*. Fruit and seed remains of *S. purpurea* and *M. indica*, as well as leaf debris, were observed here, supporting the observations detailed here. However, additional studies to delve deeper into these behaviors are needed to fill the current gaps in knowledge about the natural history of *A. fraterculus*.

This information contributes to our understanding of the trophic ecology of fruit bats and provides evidence of how fruits with large seeds, which cannot be digested by bats, such as loquat, mango, and plum, can be dispersed by this taxa through stomatocory (McConkey et al. 2024; Novoa et al. 2011; Pinto et al. 2013). This could also occur with fruits of similar or larger size in environments not disturbed by human presence. The coexistence between human crops and native flora could benefit from the presence of *A. fraterculus*, reinforcing its role as a key seed disperser in tropical ecosystems including those subject to extensive fragmentation and agricultural development.

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