

## NATURAL HISTORY NOTE

# New records of natural roosts used by bats (Mammalia: Chiroptera) increase knowledge of phyllostomids in southwestern Amazonia

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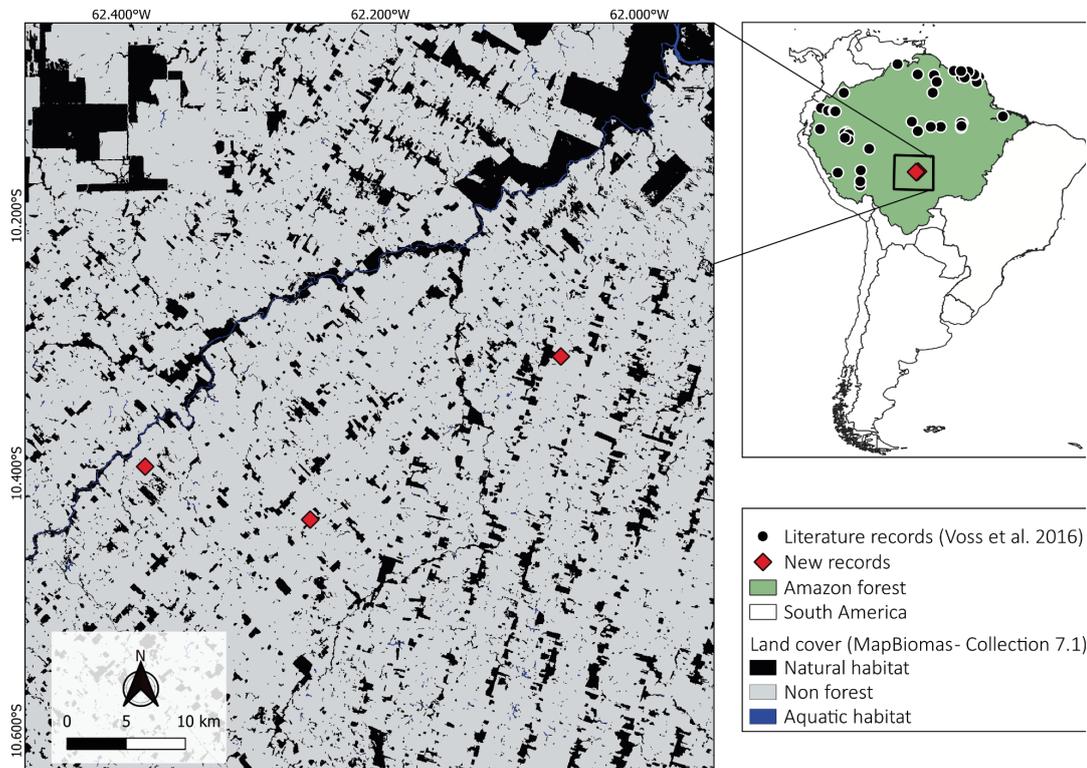
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### ABSTRACT

Bats of the family Phyllostomidae are known to use leaves and cavities, such as holes in tree trunks and caves for roosting. However, roosting preferences of bats in the Amazon are still poorly understood. Here, we describe the roosting types used by *Mesophylla macconnelli*, *Micronycteris* sp., *Lophostoma silvicola*, and *Phyllostomus hastatus* inserted in the arc of deforestation in the Brazilian Amazon. The species *Micronycteris* sp. was documented roosting in cavities of a standing tree, *L. silvicola* was cohabiting a termite nest with *P. hastatus*, and *M. macconnelli* used a roost made of leaves. Our study reports an important cohabitation between *L. silvicola* and *P. hastatus*. Furthermore, to our knowledge, we revealed the first record of the inverted boat architecture with modified leaves of *Heliconia* sp. used by *M. macconnelli*. These findings expand the ecological information on bats for the southern Amazon and provide insights into roosting availability in a severely fragmented region.

Bats are the most diverse mammal community in the Amazon (Voss & Emmons 1996, Velazco et al. 2021). Trophic resource partitioning has been proposed as one ecological mechanism that permits this high diversity (Giannini & Kalko 2004). The rich diversity of dietary habits among bats, ranging from species that feed on arthropods, vertebrates (e.g., fish, small mammals), fruits, nectar, and flowers, provides valuable ecosystem services (Kunz et al. 2011, Ramírez-Francel et al. 2022). Bats generate value in natural and human-dominated ecosystems, such as pollinating plants (Lim et al. 2018) and seed dispersal (Silva et al. 2024), suppressing populations of agricultural pests and insects that transmit pathogens (Kunz et al. 2011), contributing to the maintenance of ecosystem stability.

Some studies have highlighted that roosts may also serve as an important resource for bats (Voss et al. 2016, Garbino & Tavares 2018). Despite their importance, natural roosts used by bats in the Brazilian Amazon are poorly documented (Garbino & Tavares 2018, Appel et al. 2021, Page & Dechmann 2022). Most of the reports of roosts used by bats in the Amazonian region come from Peru and French Guiana (Koepcke 1984, Simmons & Voss 1998, Tello & Velazco 2003, Velazco et al. 2021). Accumulating records of bat diurnal roosts is essential to estimate parameters such as colony size and preferred type of roost, allowing the identification of patterns and more precise ecological inferences. In this natural history note, we describe diurnal roosts used by four species of bats in a fragmented landscape in the Rondônia endemism center of the Brazilian Amazon. These



**Fig. 1** - Records of bats using roosts in southwestern Amazon, Brazil. The black circles represent the known records compiled from the data by Voss et al. (2016), and the diamonds indicate the new records observed in the state of Rondônia, Brazil. The land use and land cover classifications were provided by the MapBiomas project (MapBiomas 2021).

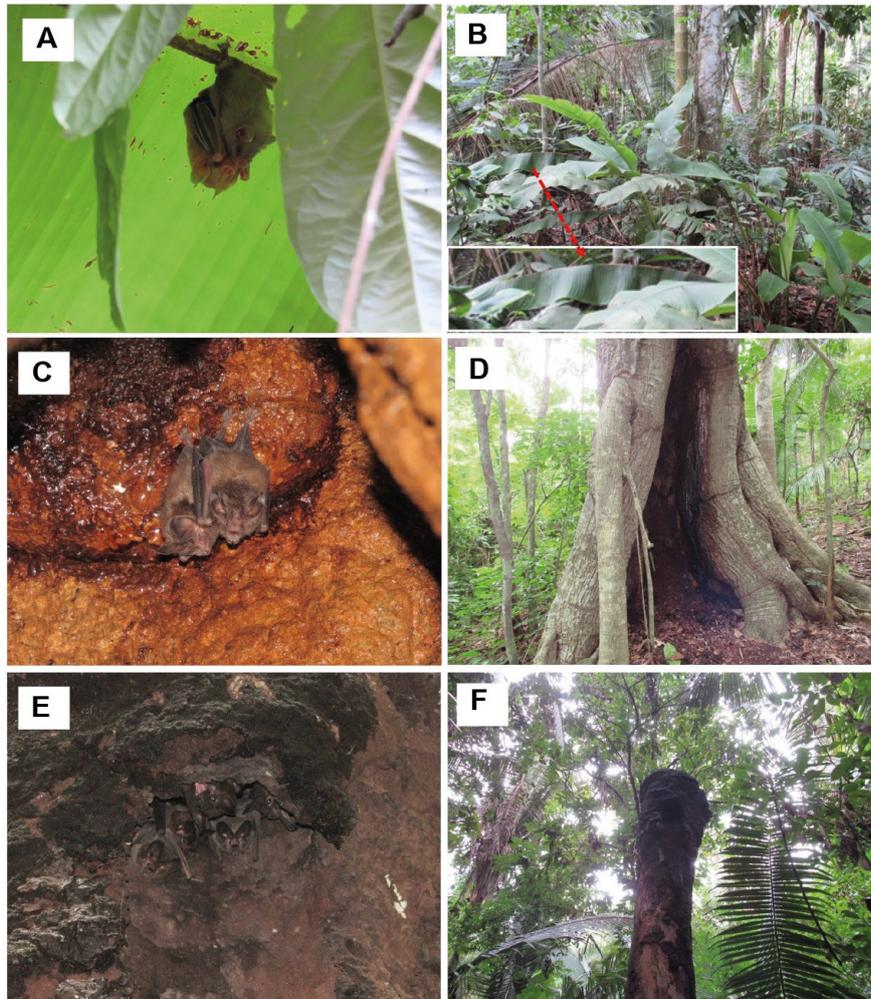
observations help fill the knowledge gap about roosting by four phyllostomid bats in southwestern Amazonia.

Species and roost records were collected between February 2022 and May 2023 in forest fragments between Ji-Paraná/Machado and Jaru rivers, Rondônia, Amazon, Brazil (Fig. 1). The region is in the Rondônia center of endemism, an important area of the Amazon, and in the largest deforestation frontier in the world, called the arc of deforestation. This region is characterized by several fragments of the Open Amazon Rainforest formation (Perigolo et al. 2017), with varying sizes and degrees of isolation (Goebel et al. 2025a, 2025b). The climate is Tropical Rainforest (Am), with ~2,000 mm annual rainfall and distinct dry (May–Oct) and rainy (Nov–Apr) seasons (Alvares et al. 2013).

During survey expeditions for non-volant mammals (Goebel et al. 2025b), we searched for opportunistic records of bats along line-transects. Sampling was conducted primarily in *terra firme* forests (non-flooded) and, to a lesser extent, in floodplain forests (igapó). We searched for bats roosting under foliage and tents, in exposed trunks, in tree cavities, and on liana surfaces, according to Appel et al. (2021). Upon finding a roost, individuals and their respective roosts were photographed, and we documented information such as group size, roost type, and tent architecture, following Kunz et al. (2003) and Rodríguez-Herrera et al. (2007). Bats were identified to the lowest taxonomic level possible, based on identification keys and field guides, such as Solari et al. (2019) and Díaz et al. (2021). *Mesophylla macconnelli* was identified based on the yellowish ears and noseleaf, dark chiropatagia, and light grayish-brown pelage

(Solari et al. 2019). The two individuals of *Microncyteris* sp. were identified as such based on the relatively large ears, light brown pelage, and more delicate face than the similar *Lophostoma brasiliense* (York et al. 2019). *Phyllostomus hastatus* was identified based on the relatively small ears, dark brown pelage, and relatively large size, when contrasted with the neighboring individuals (Díaz et al. 2021). *Lophostoma silvicola* was identified based on the ventral pelage similar to the dorsum, relatively large size, based on the neighboring *P. hastatus*, and the fact that this species roosts in termite nests (Williams & Genoways 2008).

We found three roosts occupied by four species of the Phyllostomidae family: *Mesophylla macconnelli*, *Microncyteris* sp., *Lophostoma silvicola*, and *Phyllostomus hastatus* (Fig. 2). On October 1st, 2022, at 14:12h, during the dry season, two individuals of *Mesophylla macconnelli* (an adult and a juvenile of unidentified sex) were observed roosting on modified leaves of *Heliconia* sp. (Heliconiaceae; Fig. 2), with architecture classified as “Inverted Boat” (Rodríguez-Herrera et al. 2007). The species occupied the same roost on the following two days (October 2nd and 3rd). The record was made in a 22-hectare forest fragment, located in the municipality of Vale do Paraíso, Rondônia, Brazil (-10.5153 S, -62.0775 W). *Mesophylla macconnelli* is known to use modified leaves of Araceae, Arecaceae, and Cyclanthaceae to form apical, paradox, and bifid tents (Koepcke 1984, Simmons & Voss 1998, Rodríguez-Herrera et al. 2007, Voss et al. 2016, Garbino & Tavares 2018, Appel et al. 2021). This is the first report of the species using modified *Heliconia* leaves and the “inverted boat” architecture. In this architecture, bats cut along the midrib of elongated



**Fig. 2** - Daytime roost used by phyllostomid bats in the forest fragments, Rondônia (Brazil). (A) Two individuals of *Mesophylla macconnelli* in a tent formed by a leaf of *Heliconia* sp., demonstrated in (B); Two individuals of *Micronycteris* sp. (C) in a cavity in a living tree (probably *Ficus* sp.), shown in (D); (E) Two individuals of *Lophostoma silvicola*, and three *Phyllostomus hastatus*, and (F) their respective roost, in an ant or termite nest over a dead tree trunk.

leaves, causing the blades to bend downward and form an inverted roost that offers protection from weather and other environmental factors (Timm 1987, Kunz et al. 1994). In Central America, *Heliconia* “inverted boat” tents are commonly made by *Ectophylla alba* (Rodríguez-Herrera et al. 2007), with additional records for *Uroderma bilobatum*, *Artibeus anderseni*, and *A. cinereus* (Kunz et al. 1994). In the Atlantic Forest of Brazil, *Vampyressa pusilla* and *Rhinophylla pumilio* have also been reported using *Heliconia* tents (Charles-Dominique 1993, Zortéa 1995, Zortéa & Brito 2000).

The presence of a suckling juvenile supports previous reports that births begin in September, following pregnancies from April to August (Arroyo-Cabrales 2008). The observed group size was typical (4–8 individuals; Koepcke 1984, Simmons & Voss 1998, Rodríguez-Herrera et al. 2007), although our record of two individuals represents the first such observation. Small group sizes may be influenced by the structural limitations of the leaf roost. The finding of this roost within a 22-hectare forest fragment further highlights the conservation value of small, isolated patches that continue to provide critical roosting substrates like *Heliconia* leaves (Kunz et al. 2003).

On February 20, 2023, at 13:55h, during the rainy season, we observed two individuals of *Micronycteris* sp. using cavities in a *Ficus* sp. tree trunk (Fig. 2C and 2D). The record was made in a 42.7-hectare Amazon forest fragment located in the municipality of Jaru, Rondônia, Brazil (-10.3951 S, -62.3815 W). Bats of the genus *Micronycteris* are described as roosting in fallen or standing trees, animal burrows, termite and ant nests, small underground roosts, and anthropogenic structures (Voss et al. 2016). Although it was not possible to identify the species of *Micronycteris* observed, we revealed the use of cavities in *Ficus* trunks. Standing trees with rotted-out central cavities are abundant in Neotropical rainforests—about a third of large trees in central Amazonia have hollow cores (Apolinário & Martius 2004)—and are frequently used as roosts by bats (Voss et al. 2016). On April 24, 2023, at 15:20h, during the rainy season, we observed individuals of *Lophostoma silvicola* and *Phyllostomus hastatus* cohabiting the same roost, a cavity in an active termite nest at the top of a dead tree trunk (Fig. 2F). The roost was shared on the following two days (April 25th and 26th) in a 13.4-hectare forest fragment in the municipality of Jaru, Rondônia (-10.4351 S, -62.2550 W). *Lophostoma silvicola* usually builds its roosts by excavating active termite nests (Dechmann et al. 2009). These cavities

are excavated by single males who use them to attract females (Dechmann et al. 2005), the number of which is limited by the size of the hollow. An active termite mound guarantees higher temperatures (approximately > 2°C) and thermal stability compared to the external environment, and bats tend to abandon it as soon as the termite colony dies (Dechmann et al. 2004).

*Phyllostomus hastatus* also forms harems as a mating system; however, there are no records of these harems in termite nest holes, nor their construction by this species. Interestingly, there are records in the literature of *P. hastatus* (one or two individuals) sharing termite nest hollows with *L. silvicola* (Kalko et al. 1999, 2006, Voss et al. 2016). For example, Voss et al. (2016) and Velazco et al. (2021) report a single termite nest, out of four, co-occupied by both species. Still, literature specific to cohabitation between these species is limited to anecdotal cases.

In caves with large colonies of *P. hastatus*, where space is not a limitation, harems (with over 100 females), bachelor males, and solitary individuals are common (McCracken & Bradbury 1981, Santos et al. 2003). In smaller roosts, such as tree hollows, only fit males able to attract females and maintain harems remain, while older, younger, or physically inferior males live as bachelors (Page & Dechmann 2022). Thus, one hypothesis to be tested is whether, in degraded forest environments where there are no caves (such as those studied here) and the availability of roosts is limited (e.g., tree hollows), bachelor individuals of *P. hastatus* use the *L. silvicola* roosts. Are they unwanted guests, or is there a mutually beneficial relationship for both species? Previous studies have shown that *Phyllostomus hastatus* also cohabits with species such as *Desmodus rotundus*, *Molossus rufus*, *M. molossus*, *Myotis nigricans*, and *Pteropteryx macrotis*, and may become more frequent in fragmented environments where resources such as roosts are limited (Santos et al. 2003, Costa et al. 2010).

Bat roosting ecology remains poorly understood, with gaps in biodiversity knowledge (Garbino & Tavares 2018). While Amazonian bat roost data were recently compiled (Voss et al. 2016), our study represents a first step in mapping roost use in Rondônia state, thereby expanding knowledge in the Rondônia center of endemism and the arc of deforestation. Specifically, our results contribute to the understanding of the structures used as roosts by four species of Phyllostomidae, which depend on a wide variety of natural roosts, including foliage and cavities. Our findings, from small-scale sampling in an area under intense human pressure, emphasize the need to preserve both large and small forest remnants. Despite lower diversity, small fragments act as vital corridors for wildlife, preventing local extinctions (Wintle et al. 2019). Considering the important ecosystem services provided by bats, further research on roost use patterns is needed, particularly regarding seasonality and the impact of altered landscapes on roost availability.

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## CONFLICT OF INTEREST

The authors declare no conflict of interest.

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