

**See you later: roost fidelity of the “Boomerang Bats”,
Artibeus lituratus (Olfers, 1818) (Mammalia, Chiroptera)**

**Até mais tarde: fidelidade de abrigo dos “Morcegos Boomerang”,
Artibeus lituratus (Olfers, 1818) (Mammalia, Chiroptera)**

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Abstract

Animals exhibit sociability behaviors and spatial use patterns that are important for species survival. Bats are animals that exhibit complex patterns of aggregation of individuals, which can vary according to sex and age. Aggregation can be explained by active or passive mechanisms. In this behavioural note, we report a group of female *Artibeus lituratus* in the reproductive stage that exhibits aggregation behavior supporting the active mechanism hypothesis. The females returned to the same roost, for two reproductive season, maintaining the aggregation with the same individuals with which the social bonds were already established.

Keywords: Chiroptera; Female; Aggregation; Roost ecology.

Resumo

Os animais exibem comportamentos de sociabilidade e padrões de uso espacial que são importantes para a sobrevivência das espécies. Os morcegos são animais que apresentam padrões complexos de agregação de indivíduos, que podem variar de acordo com o sexo e a idade. A agregação pode ser explicada por mecanismos ativos ou passivos. Nesta nota comportamental, relatamos um grupo de fêmeas de *Artibeus lituratus* em fase reprodutiva que exibe comportamento de agregação apoiando a hipótese do mecanismo ativo. As fêmeas retornaram ao mesmo poleiro, por duas estações reprodutivas, mantendo a agregação com os mesmos indivíduos com os quais os laços sociais já foram estabelecidos.

Palavras-chave: Chiroptera; Fêmeas; Agregação; Ecologia de poleiro.

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Introduction

Patterns of spatial use and sociability are species behaviors that directly influence the survival and reproduction of individuals.⁽¹⁻²⁾ Understanding such behaviors provides valuable information about population dynamics. However, data on the dynamics of the social life of wild mammals are scarce and bats are among the few animals that form strong bonds.⁽³⁾ Bats live in social systems that are among the most diverse of mammals,⁽⁴⁾ and their ability to fly allows them to disperse over great distances.⁽⁵⁾ These characteristics make bats interesting for research on causes and consequences of sociability. Diurnal roosts, for example, are a fundamental resource for bats, since they spend half of their lives in this environment.⁽⁶⁾ Because of this, the roosting ecology of bats, which aims to understand the processes that drive the aggregation of individuals and the use of space in roosts, is important to help elucidate the taxa evolution, since the use of roosts can be correlated with morphological, ecological and social aspects of individuals of a given species.⁽⁶⁻⁹⁾

Despite having a large home range and moving over long distances,⁽⁵⁾ bats can associate in groups that exhibit roost fidelity.⁽¹⁰⁻¹¹⁾ Two different hypotheses can explain this behavior. The first is passive association, when the grouping of individuals is driven only by landscape resources (food or roosts, for example), regardless of the intra or interspecific individuals that constitute the group.⁽¹²⁾ The second is active association, when there is an effort for individuals to associate with certain members of the same species (for example, when females have already established social relationships with others and choose to maintain this association to form the maternity groups).⁽¹²⁾ The group dynamics of bats are complex and poorly understood. The roost fidelity is usually resource related. For example, when resources are grouped in the landscape, individuals can exhibit greater roost fidelity, thus, non-random patterns could indicate passive aggregation around a given resource.^(10,13) However, the group dynamics in bats are complex

and most studies focus on roosts preference, and do not investigate the processes that drive roost fidelity patterns.^(10,14)

In this short communication, we aim to report a case of roost fidelity of female bats *Artibeus lituratus*. This report can provide support for more detailed studies that corroborate the hypothesis that there are non-random patterns, driven by an active association mechanism, which can explain part of the roost fidelity behavior. Despite the great diversity and complexity of social behaviors in bats, the group is understudied in behavioral ecology when compared to other social mammals (such as primates or rodents, for example).⁽¹⁵⁾ Thus, this case report can serve as a subsidy for understanding the ecology, behavior and evolution of social systems in bats.

Observations/Results

First observation and intervention: on January 23, 2019, we received a request to remove a group of nine individuals of *A. lituratus* (seven pregnant females – detected visually and by palpation of the abdome – and two males) from a residential condominium (Condomínio Bélgica) in the urban area of Londrina, North of Paraná, Brazil (23°20'58.20"S; 51°9'0.69"W) (Figure 1a) (Chiroptera Capture Authorization No. 38253/6, Sisbio). The individuals were captured using a butterfly net. After capture, individuals were marked with aluminium arms band individually differentiated by numbers, taken and released on the campus of Universidade Estadual de Londrina (UEL) (23°19'19"S; 51°12'04"W), eight kilometers away from the capture site (Figure 2).

Second intervention: approximately four months later, on May 15, 2019, we were again required to remove 12 female individuals of *A. lituratus* from the same roost as the first capture in the residential condominium. Of the 12 individuals of *A. lituratus* that made up the group, all pregnant females, six (50%) represented recaptures from the previously removed group, on January 23, 2019 (Figure 1b). We used arm bands to mark the

individuals that were not marked, and we released the entire group at Parque Estadual Mata dos Godoy (PEMG) (23°26'53"S; 51°15'21"W), at 18 km away from Condomínio Bélgica (Figure 2).

On July 31, 2019 (two and a half months after the last intervention), we received a new notification that bats were roosting again in the same site in the residential condominium. However, this time the residents chose not to remove the animals and we were not authorized to go to the site to capture and check the markings on the individuals. However, through pictures sent to us by local residents, it was possible to quantify thirteen individuals of *A. lituratus*, of which five it was possible to verify the presence of arm bands, stating that they were part of the group since the other two previous interventions (Figure 1c).

Group and release sites of bats

The bat roost is located in the leisure area of the condominium, using the cover of an open kiosk. The site remains with natural lighting, movement of people and noise throughout the day. The structure of the kiosk is made of wooden beams, used as roost by individuals of *A. lituratus*. In front of this leisure area, on the sidewalk of the condominium, there are trees of *Syagrus* sp. In addition, less than 200 meters away, there is a green area of approximately 30 ha of secondary forest, with several fruit trees that can serve as a food resource for *A. lituratus*, such as *Ficus* sp., *Mangifera* sp. and *Terminalia* sp.

The UEL campus, the first release site, has approximately 220 ha, with 10 ha of native forest remnants of secondary vegetation in a late stage of succession⁽¹⁶⁾ in addition to human constructions such as classroom blocks, laboratories, library, canteens, parking lots, church and kiosks with wooden beams.

The PEMG is one of the last remnants of the Semideciduous Seasonal Forest of Paraná. Although it covers approximately 650 ha,⁽¹⁷⁾ it connects to other fragments covering 2,800 ha of semideciduous seasonal forest.⁽¹⁸⁾ The surroundings of

the native area are made up of soy, wheat and corn plantations, promoting extensive areas without vegetation cover, which change their appearance between one crop and another (eg soil exposed during planting).

In both release areas (UEL and PEMG), there is a great diversity of bats and an abundance of plants with zoocoric fruits such as Piperaceae, Moraceae, Urticaceae, Solanaceae and Arecaceae, which are often consumed by frugivorous animals, such as *A. lituratus* that already was recorded in both areas.⁽¹⁹⁾

Discussion

Both UEL and PEMG offer a diversity of resources in abundance for *A. lituratus*.⁽¹⁹⁾ Despite this, we found that during the period covered by the study, it is likely that the females observed here may have gone through two reproductive cycles, corroborating the bimodal polyestrous pattern for *A. lituratus*,⁽²⁰⁾ and that some of them returned to the same roost (even with the disturbance we caused to the individuals twice, and the distance from the roost where the individuals were originally captured to the release sites). These observations may indicate and support the hypothesis that there are active mechanisms that drive association patterns in bats and explain roosting fidelity, evidencing an effort for individuals to associate with certain members of the same species and on roosts that were chosen by them. Perhaps these associated female individuals are from the same family, since the female philopatry pattern is a predominant behavior in mammals and is also present in bats.⁽²¹⁾ This behavior contributed to stable groups formed by related individuals.⁽¹⁵⁾ Males are usually expelled from these groups, disperse and change roosts more than females. It is difficult to explain why this happens, but avoiding competition with females and endogamy are hypotheses that need to be tested.⁽²²⁻²³⁾

Group dynamics in bats are complex and can vary even according to gender and reproductive age, with females tending to have high fidelity

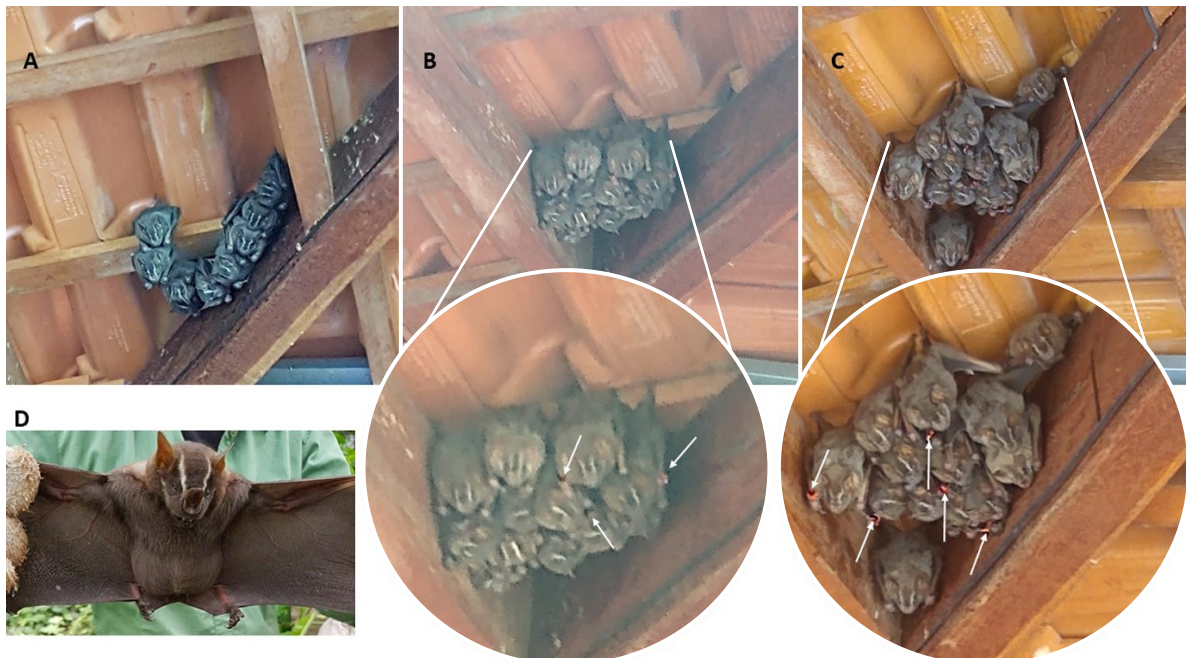
to the same maternity roost over several years.⁽²⁴⁻²⁵⁾ Bat species of the genus *Artibeus*, exhibit a preference for roosting in foliage,^(10,14) are generally not very faithful to the roost and live in small groups.⁽²⁶⁾ However, human constructions can be more stable over time than natural roosts, such as foliage, which can ensure greater safety and permanence of pregnant females in these sites.⁽⁶⁾ In addition, for pregnant or lactating females, it seems to be impractical, in terms of energy cost, to move in search of another resting site to form the maternity group. Seeking new places means, in addition to spending energy on displacement, also having to find and establish new relationships with other individuals.⁽²⁷⁾ Female bats nurse their young until around two months of age.⁽²⁸⁾ This length of lactation, highly costly in terms of energy⁽²⁹⁾ makes roosting fidelity and sociability beneficial⁽¹⁵⁾ Creating nurseries facilitates thermal regulation, cooperation in baby bats care, and security from predators.^(6,30-33)

If only roost characteristics were important to explain roosting fidelity, the resources found in

the two release sites would be sufficient for a passive aggregation of female *A. lituratus* individuals. Therefore, we would not find evidence of an active effort for these females to maintain association with certain members of the same species. It is important for the reproductive success of the species and the development of the offspring, that females remain in colonies already established over a certain period of time.⁽³⁴⁻³⁵⁾ Thus, this may be one of the reasons that influence the displacements of females of *A. lituratus* and the active mechanism that drives roosting fidelity.

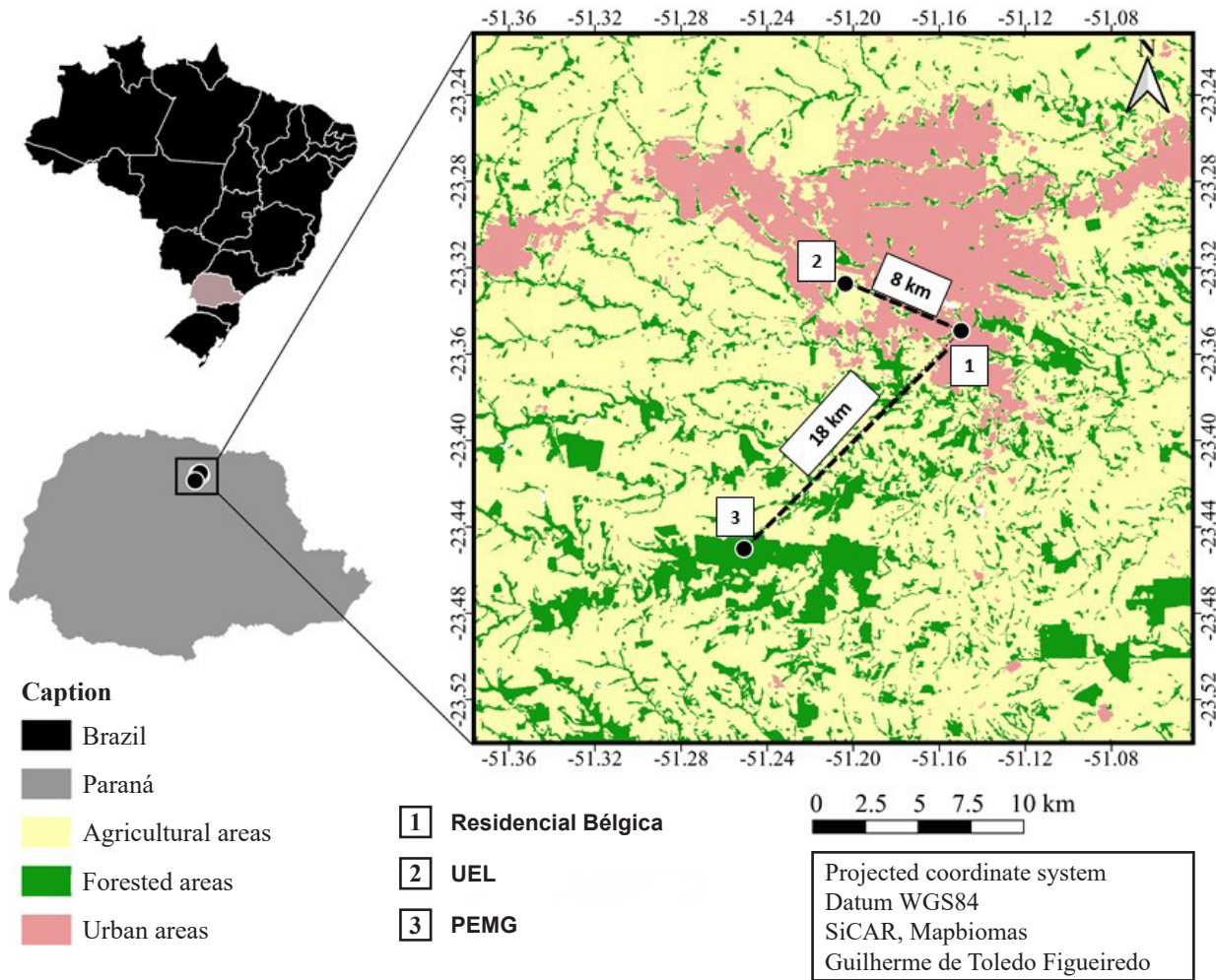
Our observations demonstrate that groups of female bats that form groups exhibit complex patterns of aggregation behavior on roosts. It seems that maintaining established social relationships is more important for *A. lituratus* females in the reproductive state, since they chose to fly from eight to 18 km to return to the roost where they had already formed the group, instead of using the buildings humans from release sites (or other environmental resources) as a new site maternity/nursery roost.

Figure 1 - Group of *Artibeus lituratus* observed in the Condomínio Bélgica (Londrina, Paraná, Brazil): (a) Recorded on January 23, 2019; (b) Recorded on May 15, 2019; (c) Recorded on July 31, 2019. (d) Pregnant female removed from the group on January 23, 2019. Arrows indicate arm bands used for marking the individuals.



Source: author's own work.

Figure 2 - Location of Roost (1) in the urban perimeter of Londrina, Paraná, Brazil and the release sites of marked individuals.



Source: author’s own work.

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