THERYA NOTES 2021, Vol. 2 : 140-142 DOI: 10.12933/therya_notes-21-50

Early observations on the use of termite nests by bats

Primeras observaciones sobre el uso de nidos de termitas por murciélagos

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The remarkable discovery of Neotropical round-eared bats (Phyllostomidae, *Lophostoma*) actively hollowing out cavities in termite nests for roosting sites has enabled researchers to explore several aspects of their previously unknown behavior. We now know that round-eared bats excavate cavities in *Nasutitermes* nests that are actively used by the termites and the bats roost only in these cavities, as well as a number of other aspects of the bats' behavior. In the early 1800s, a British naturalist, Charles Waterton, observed and published that bats "clear out" and roost in termite nests, and how he was able to ascertain if a termite nest was being used by bats. Waterton's descriptions of this behavior have long been overlooked and now provide us with additional insights on the distribution and ecology of these poorly known bats.

Key words: *Lophostoma*; *Nasutitermes*; Neotropics; Phyllostomidae; roosting behavior; round-eared bats.

El notable descubrimiento de murciélagos de orejas redondeadas neotropicales (Phyllostomidae, *Lophostoma*) que habitan las cavidades en los nidos de termitas como sitios de anidamiento, ha permitido a los investigadores explorar varios aspectos desconocidos de su comportamiento. Ahora sabemos que los murciélagos de orejas redondeadas excavan cavidades en los nidos de *Nasutitermes* que son utilizados activamente por las termitas y que los murciélagos anidan exclusivamente en esas cavidades, entre otros aspectos de su comportamiento de los quirópteros. A principios de la década de 1800, un naturalista británico, Charles Waterton, publicó la observación de que los murciélagos hacen agujeros y se posan en nidos de termitas y cómo fue capaz de comprobar si un nido de termitas estaba siendo utilizado por murciélagos. La descripción por parte de Waterton de este comportamiento se ha obviado durante mucho tiempo y ahora nos proporciona información adicional sobre la distribución y la ecología de estos quirópteros poco conocidos.

Palabras clave: Anidamiento; *Lophostoma*; *Nasutitermes*; Neotrópicos; Phyllostomidae; murciélagos de orejas redondeadas.

One of the remarkable discoveries on roosting behavior in bats is that the Neotropical round-eared bats of the genus *Lophostoma* (Chiroptera: Phyllostomidae) hollow out the nests of the termite genus *Nasutitermes* (Isoptera: Termitidae) for roosting sites. *Nasutitermes* termitaria are large, often 0.5 m or more in length and width, and often 2 or more meters off the ground on the trunks of trees. These nests provide both the termites and bats with a waterproof and warm refuge with a stable temperature regime, as well as providing the bats with a well-camouflaged daytime roost and maternity site. It is currently believed that at least three species of round-eared bats (*Lophostoma brasiliense*, *L. carrikeri*, and *L. silvicola*) roost exclusively in these arboreal termite nest cavities they have excavated. Recent authors have documented that round-eared bats roost only in active *Nasutitermes* termitaria that they regularly modify. Males excavate the cavities, cavity use is tied to social organization, associations stay together year-round, and perhaps the chemical defenses used by the termites contribute to reduced parasite load in the bats (Dechmann *et al.* 2004, 2005; Kalko *et al.* 2006; Dechmann *et al.* 2007; Timm and McClearn 2007; Dechmann and Kerth 2008; York *et al.* 2008).

Round-eared bats historically had been considered uncommon or rare and little was known about their behavior or ecology. Although it was reported that round-eared bats were occasionally found in termite nests, it was believed that they were roosting in cavities excavated by birds. In the first modern study of these bats, Kalko *et al.* (1999:349) wrote, "Possibly, the bats use termite nests opened by nesting birds such as trogons (*Trogon* sp.) or orange-chinned parakeets (*Brotogeris* sp.)". The discovery in the early 2000s that round-eared bats hollow out arboreal termite nests for roosting sites was a breakthrough in unraveling the behavioral ecology of these species because they could be observed at the roost site and captured unharmed (Dechmann *et al.* 2004, 2005).

This roosting behavior and that round-eared bats actually modify the termite nests however, was first observed in the early 1800s and recent researchers seemingly were unaware of these observations. Charles Waterton (born 1785, died 1865), British aristocrat, explorer, and naturalist, described his observations of bats roosting in termitaria: "Independent of the hollow trees, the Vampires have another hiding-place. They clear out the inside of the large ants' nests, and then take possession of the shell .

. . we stopped under an ants' nest; and, by the dirt below, conjectured that it had got new tenants . . . an Indian boy ascended the tree; but, before he reached the nest, out flew above a dozen Vampires" (Waterton 1879:319–320).

To Waterton, all bats were called vampires. He did know what true vampires (= *Desmodus rotundus*) were because he tried in vain to get them to feed on him (they frequently feed upon other members of his traveling party, especially younger people, but were disinclined to choose him). In the explanatory notes later in the book, "the large ant's nest" he discusses were correctly attributed to termite termitaria; today we know this is the genus *Nasutitermes*.

Wateron traveled extensively throughout Guiana in 1812, 1816, 1820, and 1824 as well as in Brazil. His description of bats roosting in termite nests was presented as part of a chapter on his travels in 1824 although he seems to be summarizing observations from his earlier travels also. Now, two centuries later, we can more fully appreciate the observations of this early naturalist and note that he should be attributed with the discovery that *Nasutitermes* termitaria are actively modified and are an effective roost site for Neotropical round-eared bats.

The nearly two centuries between Waterton's observations and the recent "rediscovery" of round-eared bats actively modified *Nasutitermes* nests highlights how cryptic the roost sites can be. When investigators develop a search image and with diligent searching of *Nasutitermes* nests, the cavities created by round-eared bats are visible. There is only a single opening of the cavity and it is always ventrally directed (Figure 1; Figure 2A, B). Not all cavities observed are occupied by a colony or singleton bat but bats are only found in active termite nests. Much remains to be learned about the roosting ecology, social behavior, and relationships among individuals that are found within a cavity; but

Figure 1. An adult female pygmy round-eared bat, *Lophostoma brasiliense*, that was observed as part of the roosting colony in the *Nasutitermes* nest illustrated in Figure 2.

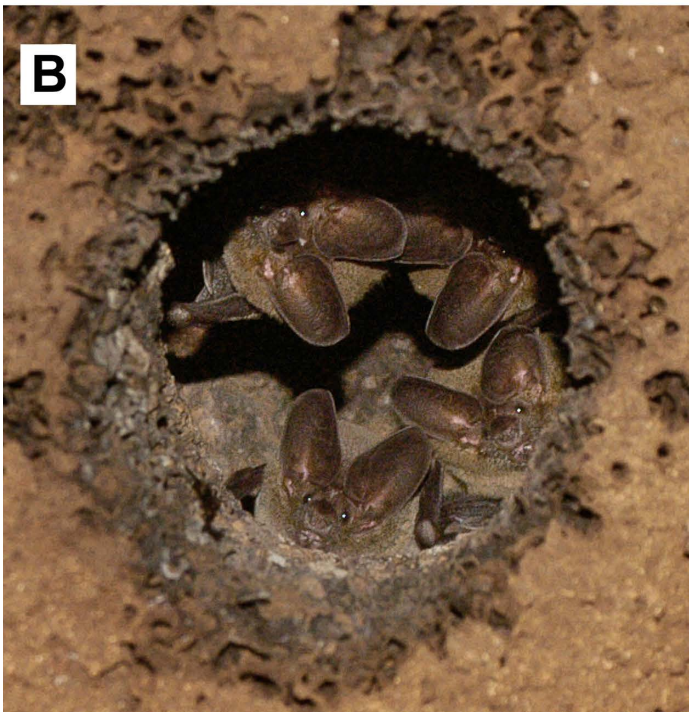

Figure 2. A) Nest of *Nasutitermes* in the melastome *Loreya mespiloides*, at the Bijagual Ecological Reserve in the Caribbean lowlands of northeastern Costa Rica, containing a roosting colony of pygmy round-eared bats (*Lophostoma brasiliense*). Note the roost cavity opening on the underside of the nest. Foliage from a living epiphyte is incorporated into the termite nest. B) Four round-eared bats hanging in the roost cavity are visible from below. Fresh chewing on the termite nest is visible as the dark rough areas. See York *et al*. (2008) for additional details. All photographs courtesy of H. A. York.

Charles Waterton and more recent investigators provide us a route to explore this fascinating behavior.

Acknowledgements

I thank H. A. York for providing the images used as Figures 1 and 2 here that contribute significantly to our understanding of the roosting behavior in these bats. P. F. Foster's efforts in providing outstanding logistic support for researchers and educational classes at Reserva Ecológica Bijagual de Sarapiquí, Heredia, Costa Rica is greatly appreciated. A. Romero provided the Spanish translation for the Resumen. Comments from D. McClearn and two anonymous reviewers improved earlier versions of this manuscript.

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Associated editor: Consuelo Lorenzo
Submitted: August 6, 2021; Reviewed: September 7, 2021.
Accepted: October 5, 2021; Published on line: October 18, 2021.