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**First record of albinism in *Artibeus obscurus*
(Chiroptera: Phyllostomidae) in an Atlantic Forest area**

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ABSTRACT

Albinism is a congenital disorder that provokes the total loss of body pigmentation. Until this study, 149 cases of albinism distributed in 11 families and 61 species have been recorded in the order Chiroptera throughout the world. Herein, we report the first case of albinism for the dark fruit-eating bat, *Artibeus obscurus* (Schinz, 1821), a Neotropical frugivorous species. The individual, an adult male reproductively active, was captured in a mist-net in an Atlantic Forest coastal fragment at the Espírito Santo state, southeast Brazil. We also review cases of albinism in bats.

Key words: albinism, Atlantic forest, bats, Brazil, Phyllostomidae.

RESUMO - Primeiro registro de albinismo em *Artibeus obscurus* (Chiroptera: Phyllostomidae) em uma área de Mata Atlântica

O albinismo é uma desordem congênita que provoca a perda total de melanina no corpo. Até o presente estudo, haviam 149 registros de albinismo, distribuídos em 11 famílias e 61 espécies, para a Ordem Chiroptera no mundo. Aqui, nós reportamos o primeiro caso de albinismo para a espécie de morcego frugívoro neotropical *Artibeus obscurus* (Schinz, 1821). O indivíduo, um macho adulto reprodutivamente ativo, foi capturado por meio de uma rede de neblina em um fragmento costeiro de Mata Atlântica, no estado do Espírito Santo, sudeste do Brasil. Nós também revisamos os casos de albinismo em morcegos.

Palavras-chave: albinismo, Brasil, Mata Atlântica, morcegos, Phyllostomidae.

The great diversity of color patterns displayed by mammals is determined by the presence and distribution of pigmentation in their skin, hair and eyes, and is especially related to melanin (Lucati & López-Baucells 2017). Concealment, communication, and physiological aspects are the main evolutionary pressures over skin and pelage coloration in mammals (Caro 2013). A few rare mutations can produce a lack or

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excess of pigmentation, generating chromatic disorders that have been classified in many ways: albinism, leucism, piebaldism, hypomelanism, melanism, among others (Lucati & López-Baucells 2017). Albinism is an inherited condition characterized by the total absence of melanin. Albino individuals lack the tyrosinase enzyme, an essential component in the synthesis of melanin. As such, these individuals do not have any pigmentation on their skin, hair and eyes, which are usually red (Van Grouw 2006; Acevedo et al. 2009). Albino individuals have been recorded in many mammal species, such as marsupials, gorillas, squirrels, shrews, and sloths (Martínez-Arias et al. 2000; Uieda 2000; Tsuboi et al. 2009; Xavier et al. 2010; Ferron & Laplante 2013; Dalapicolla et al. 2020). They are considered rare events in wild populations, because they are more susceptible to predation, in addition to a number of pathologies that can arise in association with albinism, such as visual or immunological defects (Abreu et al. 2013). However, this might not apply to nocturnal species, where coloration has a minor role, and predators are more oriented by olfactory and auditory cues (Buys et al. 2002).

Bats are primarily nocturnal mammals, and generally select dark roosts for shelters, including caves, rock crevices, tree hollows and buildings (Garbino 2016), making predation a less likely event. Some species occasionally venture outside the shelter during the day, mainly for foraging and drinking (Bõlla et al. 2017), when they are more vulnerable to predation (Esbérard & Vrcibradic 2007; Barros et al. 2015).

There are 149 records of albinism in bats globally, representing 61 species in 11 families (see Supplementary Material S1). Of these, five belong to the Neotropical genus *Artibeus*, representing three species: *A. jamaicensis* Leach, 1821 (Moreno et al. 2020), *A. lituratus* (Olfers, 1818) (Pozo & Escobedo-Cabrera 1998), and *A. planirostris* (Spix, 1823) (Uieda 2000).

Here we report the first record of albinism in *Artibeus obscurus* (Schinz, 1821) from southeastern Brazil. In addition, this record represents the third confirmed case of an albino bat in an open shelter (Uieda 2000; Charles-Dominique et al. 2001; Zortéa & Silva 2018).

Research was conducted at Estação Biologia Marinha Augusto Ruschi (latitude -19.97; longitude -40.14), an Atlantic Forest fragment located in Aracruz municipality, Espírito Santo state, Brazil (Figure 1). It is a coastal private property, inserted at the limits of two other protected areas, Refúgio de Vida Silvestre de Santa Cruz and Área de Proteção Ambiental Costa das Algas. Both areas are administered by Instituto Chico Mendes de Conservação da Biodiversidade (ICMBio). The albino individual was captured in an area of “Floresta inundável de Restinga”, a forest formation under strong influence of the water table that leads to a susceptibility to flooding, characterized by soil with high humidity, and containing abundant plant material (Pereira 2003).

Inventory works were conducted from November 2018 to June 2019, involving one night in each of the first two months (November – December 2018), and two nights in each of the following six months (January – June 2019), totaling 14 nights of capture. Each night, three to six mist-nets, varying between six and twelve meters in length,



were opened on ground level by sunset, and closed six hours later. Sampling effort was 7.659 m²/h (Straube & Bianconi 2002). Forearms (FA) of captured individuals were measured with a caliper to the nearest 0.1 mm, and their weight (W) recorded, ossification of the phalanges following Kunz & Anthony (1982) was used for age determination. Individuals were identified using the keys of Reis et al. (2017) and Díaz et al. (2016). The study was conducted under license 62555-2 of the Sistema de Autorização e Informação em Biodiversidade – SISBIO.

We reviewed records of albinism in bats from the literature, using keywords such as “albinism”, “chromatic disorder”, “anomalous coloration”, “Chiroptera”, “bats”, among others. We analyzed bat species, sex and reproductive status, type of roost, and geographical locality for each of the records found.

On November 2018, the reserve administrator communicated that an albino individual was seen sheltering alone during the day on a palm leaf, and we decided to position a mist-net near its location. On the night of December 1, around 23:30 h, an adult male *Artibeus obscurus* with scrotal testes, was captured in a mist-net. It had a forearm length of 62 mm for right and left forelimbs, weighting 44 g, appearing healthy, without injury marks, and pelage bright and dense. The individual got our attention immediately in the nest due to its coloration, with completely white hairs, ears and noseleaf with a pink hue, translucent patagia, and red eyes (Figure 2), unmistakably characterizing an albino (Lamoreux et al. 2010). After being removed from the mist-net, the individual was kept in a cotton bag where it remained until inspection, when we obtained morphometric data, age, sex and reproductive status. The individual was identified by the following characters: inner upper incisors distinctly bilobed; forearm length from 50 to 77 mm; interfemoral membrane and legs slightly hairy, seeming naked; the horseshoe noseleaf is free from the upper lip; and the presence of 3–4 warts on each side of the chin (Díaz et al. 2016; Reis et al. 2017). The individual was photographed, marked with nail polish for capture/recapture purposes, and released near the capture location. This was the sole albino individual registered among 116 other *A. obscurus* captured during the study. The individual was not collected as a voucher specimen due to license restrictions in a nature reserve area (i.e., Estação Biologia Marinha Augusto Ruschi).

The impact of albinism in bats has long been debated. Some authors mention that pigmentation loss leads to overexposure, higher predation risk, and intraspecific conflicts, reducing species fitness and overall survivability (Marin-Vasquez et al. 2010; Zortéa & Silva 2018). Others (e.g., Buys et al. 2002), that the impact of albinism and other pigmentation disorders is negligible due to the nocturnal activity and diurnal sheltering of bats.

The individual reported here was, in all characteristics, completely normal. Its measurements (W= 44 g, FA= 62 mm) were similar to other adult male *A. obscurus* that we captured (W= 39.2 ± 3.5 g; FA= 61.2 ± 1.4 mm; n= 20). The pelage was bright and dense, and notably lacked any type of injury marks, indicating that it did not seem to have had any recent intraspecific conflict as a result of rejection due to its unusual coloration. The individual was observed alone under the (apparently unmodified)



leaf of a palm tree. Members of this species were observed forming large groups in a Colombian cave (Sampedro & Mendoza 2009), yet this does not imply that our individual was rejected by its group, as roosts with far fewer individuals were also encountered, containing even a solitary adult male in French Guiana (Haynes & Lee 2004). Lack of injuries in albino bats were also mentioned for species such as *Carollia perspicillata* (Rosa et al. 2017), *Gardnerycteris crenulatum* (Zortéa & Silva 2018), and *Desmodus rotundus* (Sánchez-Hernández et al. 2010). Noteworthy, the individual was a reproductively active adult male, indicated by its scrotal testes. As far as we know, this is the second record of a sexually reproductive male albino bat. Though descended testes are not a sure signal of reproductive success, we found records of pregnant or at least lactating albino females of some species, including *Artibeus lituratus* (Pozo & Escobedo-Cabrera 1998), *Desmodus rotundus* (Sánchez-Hernández et al. 2010), and *Myotis lucifugus* (Lucati & López-Baucells 2017). This suggests that, for bats, albinism would not be that detrimental to intraspecific interactions in the wild. However, there are records of an albino female being socially and apparently sexually discriminated by males in a captive colony, while normally colored females got pregnant, the albino female did not (Uieda 2001). Moreover, it is important to point out that there are naturally white bat species, such as *Ectophylla alba* and *Diclidurus albus*, and they do not seem more prone to overexposure than other bats (Zortéa & Silva 2018). Furthermore, the white color can be advantageous. While white seems ill-adapted for a forest dwelling nocturnal mammal, white pelage reflects the color of immediate surroundings, so that white bats look green in the roost,, thereby reducing the contrast against leaves, as observed with *Ectophylla alba* in Costa Rica (Brooke 1990).

Currently, Chiroptera includes 21 families in which most of them have at least one record of albinism. The best represented families are Vespertilionidae (51 records), Phyllostomidae (39), Rhinolophidae (21), and Molossidae (20). These groups, Vespertilionidae particularly, have a wide geographic distribution, high species richness, and are frequently observed in the wild (Uieda 2000). Ten families have no record of albinism. Except for Natalidae with 12 species, all have less than 10 species currently known, and are among the most elusive bats such as the Craseonycteridae, Furipteridae, Mystacinidae, and Myzopodidae (see Supplementary Material S1). Approximately 31% of the 149 records we found provided age estimations of the albino individuals, either directly or indirectly (for example, pregnant females can only be adult). Of those, 29 were classified as adults, and 17 as subadults. Despite the remaining being unclassified, we presume that the majority consist of adult individuals. Capture or at least observation of albino adults is somewhat more common than that of juveniles. In our sample, we recorded 105 adults of *A. obscurus*, nearly 90% of the total within the colony. An occurrence of an adult and reproductive individual, such as our record, suggests that albino bats can reach adult life stages, and have normal intraspecific relations (Rosa et al. 2017). Males and females seem equally affected, with 43 records of albinism each.

Information on roosting sites of albino bats account for 60% of all records known



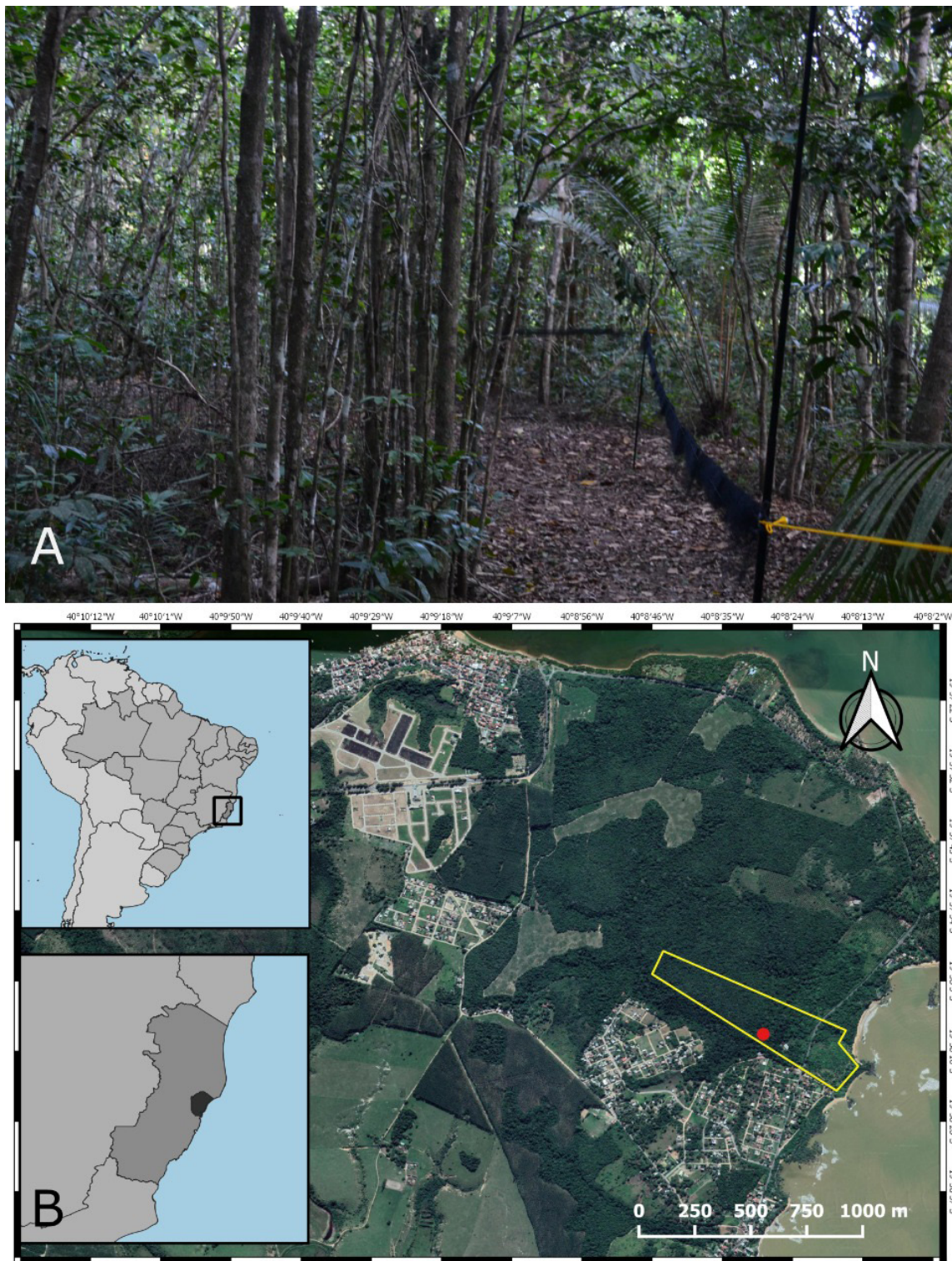


Figure 1. A) Capture locality of the albino *Artibeus obscurus*, at Estação Biologia Marinha Augusto Ruschi (EBMAR). B) Map depicting the new occurrence. Yellow shows the EBMAR perimeter, and the red dot marks the capture locality. Top detail shows the continental scale, bottom the regional scale, with Espírito Santo state and Aracruz municipality highlighted. Image created using QGIS 3.02.2 and GIMP 2.10.18.

so far. The majority of those records (76%) consisted of closed shelters, including natural caves, mines, and buildings in use or abandoned. The remaining were caught in open spaces, with only two records observed in an open shelter: *Artibeus planirostris* (Uieda 2000), and *Rhinophylla pumilio* (Lucati & López-Baucells 2017). The former was captured while resting on a tree branch, while the latter was from a “palm”, most likely in a tent, formed by modified leaves as they are known to do (Rinehart & Kunz 2006). Therefore, our record is the third known case of an albino bat in an open roost. Other species with cases of albinism known to shelter in those spaces are *Dermanura cinerea* (Oliveira & Aguiar 2008) and *Artibeus lituratus* (Pozo & Escobedo-Cabrera 1998).

In conclusion, we report the first record of albinism for *Artibeus obscurus*, and the third known albino bat in an open roost. The individual was an adult, reproductively active male, appearing healthy and with size and weight similar to its conspecifics collected during the study, indicating that its social and foraging habits were not affected by its anomalous coloration.



Figure 2. Albino adult male *Artibeus obscurus* showing white pelage, translucent patagia, and red eyes.

Supplementary Material: Review of the literature, containing 150 records of albinism (including our new record). When available, records have the Institution and number of the vouchers, sex, age group, reproductive status, type of roost, country, state and locality, geographic coordinates, the source and page.

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