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NATURAL HISTORY NOTE

Albinism in *Carollia perspicillata* (Chiroptera; Phyllostomidae) in Southeastern Brazil: a long-term observational study in the field

Rafael de Souza Laurindo[1*], Andrea Cecília Sicotti Maas[2], Adriana Ruckert da Rosa[3], Irineu Norberto Cunha[4], João Paulo de Souza da Rosa[5], Luzia Helena Queiroz[6], Marilene Fernandes de Almeida[3]

[1] Instituto Sul Mineiro de Estudos e Conservação da Natureza. Monte Belo/MG, Brasil

[2] Laboratório de Mastozoologia, Instituto de Biologia, Universidade Federal Rural do Rio de Janeiro, Brasil

[3] Divisão de Vigilância em Zoonoses-DVZ, Coordenação de Vigilância em Saúde, Prefeitura da Cidade de São Paulo, Brasil

[4] Alto Tietê Ambiental, Mogi das Cruzes, SP, Brasil

[5] Universidade Cruzeiro do Sul, Ciências Biológicas, Polo Mogi das Cruzes, SP, Brasil

[6] Universidade Estadual Paulista - Faculdade de Medicina Veterinária de Araçatuba, SP, Brasil

*Corresponding author: rafaelslaurindo@gmail.com

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ABSTRACT

Complete albinism is a phenomenon that rarely occurs in bats. True albinism has been reported in 152 individuals from sixty-seven bat species in 40 countries. The purpose of this paper was to report two cases of true albinism in bats of the species *Carollia perspicillata* and the observation of one of these specimens in the field for thirteen months in an artificial shelter in Minas Gerais state, Southeastern Brazil. The animals were apparently well-integrated into the group, healthy, and had a normal size for the species and compared to other individuals in the colony.

INTRODUCTION

Anomalous colourations are rare in wild animal populations (Abreu et al. 2013), but the number of records have been growing worldwide, which demonstrates an increasing interest of researchers in this topic during the last years (Zapala et al. 2016). Yet, there are still big problems in the terminology used to differentiate between different types of anomalous colourations, which can make it difficult to correctly report and count new records (Lucati & López-Baucells 2017). Lucati & López-Baucells (2017) proposed a pattern in the terminology and classification of chromatic disorders that distinguish between albinism, leucism, piebaldism, hypomelanism, melanism, and partial melanism.

Albinism is an inherited genetic condition where animal cells are unable to produce melanin, a dark pigment that results in the colouration of skin, scales, eyes, feathers, or hair. Thus, albinos usually have pale skin white hair or feathers, and red eyes (Hofreiter & Schöneberg 2010). Previous studies have demonstrated that pigmentation anomalies, such as albinism, can have a negative effect in vertebrate fitness (Møller & Mousseau 2001, Krecsák 2008, Caro 2005). While the extension of these effects can vary between taxa, some authors believe that chromatic disorders might not affect bat survival and reproduction, as bats select dark shelters and are active during the night time (Lucati & López-Baucells 2017). Many articles report the survival of bats with hypopigmentation for several years (Brack & Johnson 1990, Sánchez-Hernández et al. 2010) as well as the capture of pregnant or lactating albino females (Sánchez-Hernández et al. 2010).

A recent review has compiled the information about records of chromatic disorders, such as albinism, leucism, piebaldism, hypomelanism, partial melanism, and melanism, in bats worldwide, with 609 reported occurrences in 115 species from 10 families, from which there were 152 reported cases of albinism (Lucati & López-Baucells 2017). In Brazil, cases of albinism have been reported for 10 bat species (Oliveira & Aguiar 2008, Zórtea & Silva 2018, Bernardi et al. 2019, Ventorin et al. 2021). Six species belong to the family Phyllostomidae (*Artibeus cinereus*, *Artibeus planirostris, Artibeus obscurus, Carollia perspicillata, Desmodus rotundus,* and *Gardnerycteris crenulatum*), two to the Molossidae (*Eumops glaucinus* and *Molossus molossus*), one to the Vespertilionidae (*Myotis levis*), and one to the Emballonuridae (*Peropteryx kappleri*).

The neotropical bat genus Carollia (Gray 1838) includes eight species, of which three occur in Brazil (Wilson & Mittermeier 2019, Garbino et al. 2020). *Carollia perspicillata* is a common species throughout much of its distribution,

which makes its ecology relatively well known in relation to its diet, reproduction, and behaviour (Mello et al. 2004, York & Billings 2009, Fasel et al. 2016, Wilson & Mittermeier 2019). *C. perspicillata* is a frugivorous bat, which is considered to be an important seed disperser, especially from pioneer plants, that has an essential role in the network of fruit-bat dispersal (Laurindo et al. 2019).

The purpose of this paper is to report two cases of complete albinism in *C. perspicillata* and the observation of one of these specimens in the field for 13 months in an artificial shelter in the city Além Paraiba, Minas Gerais state, Southeastern Brazil.

MATERIALS AND METHODS

We conducted seven fieldwork campaigns to capture bats between 2018 and 2020 as part of two monitoring programs to study the environmental impacts of a hydroelectric power plant built on the Paraiba do Sul River. Surveys were carried out in locations that might be used as shelters by bats in four municipalities in Southeastern Brazil: Sapucaia and Três Rios in the Rio de Janeiro state; and Chiador and Além Paraiba in Minas Gerais state. Permit number 1004/2018/IBAMA.

Two albino individuals were observed in an abandoned building (21°54'59.1''S, 42°49'33.4''W) in the municipality of Além Paraíba, Minas Gerais state. The vegetation around the abandoned building contained numerous plants from the family Piperaceae, which are the main food source for this species (Mikich et al. 2003), as well as plants from the genera *Cecropia, Ficus, Solanum*, and *Vismia*, that can provide continuous food resources for *C. perspicillata* throughout the year (Laurindo et al. 2019).

We used hand nets and mist nets to capture bats, which were weighted and had their forearm length measured. We also took notes of the sex and classified the bats according to two age categories (juvenile and adult) based on the level of epiphysis ossification of arm metacarpals and phalanxes, according to Anthony (1988). In addition, we followed Wilson & Mittermeier (2019) for bat species identification and nomenclature.

RESULTS

The first observation of albinism in our study was recorded in May 2019 in a building used as a shelter at Além Paraíba, Minas Gerais state. A small bat colony composed of four specimens of *C. perspicillata* (one albino) and six specimens of the *Anoura caudifer* (nectarivorous bat) were observed hanging on the roof (Fig. 1A). We captured three individuals of *C. perspicillata* and two individuals of *A. caudifer*, which were released in the same site where they have been captured after their morphology was measured (Table 1).

The second observation was made in July 2019 in the same site. However, in this case we found a colony containing 200 to 250 individuals of *C. perspicillata* and ten individuals of *A. caudifer*, which were all normally pigmented, except for one albino individual. In September 2019, the same colony of *C. perspicillata* was still there and, at this time, two complete albino individuals were captured (Fig. 1B) and received the identification ring numbers ECO299 and ECO300 (Table 2). Within the shelter, bats were distributed in two groups, each group with one albino individual. In addition to these two albino individuals, 22 individuals of *C. perspicillata* were captured and released at their capture site after they had their morphological measurements taken. The morphological data showed that the albino bats had a normal size for the species as well as in comparison to other individuals in the colony.

In November 2019, the same shelter was visited again, and only one of the albino bats was sighted in a colony of 40-45 specimens of *C. perspicillata* and less than ten *A. caudifer.*

In March 2020, the abandoned building was visited, and one of the albino bats was still there in a colony of 20 *C. perspicillata* (although no other bat species was detected). In June 2020, one of the albino bats *C. perspicillata* was sighted again in the same shelter in a colony with 40 to 50 bats.

In the November, March, and June in our surveys we did not capture any bat specimen, and therefore, it was not possible to identify which albino bat remained in the colony.

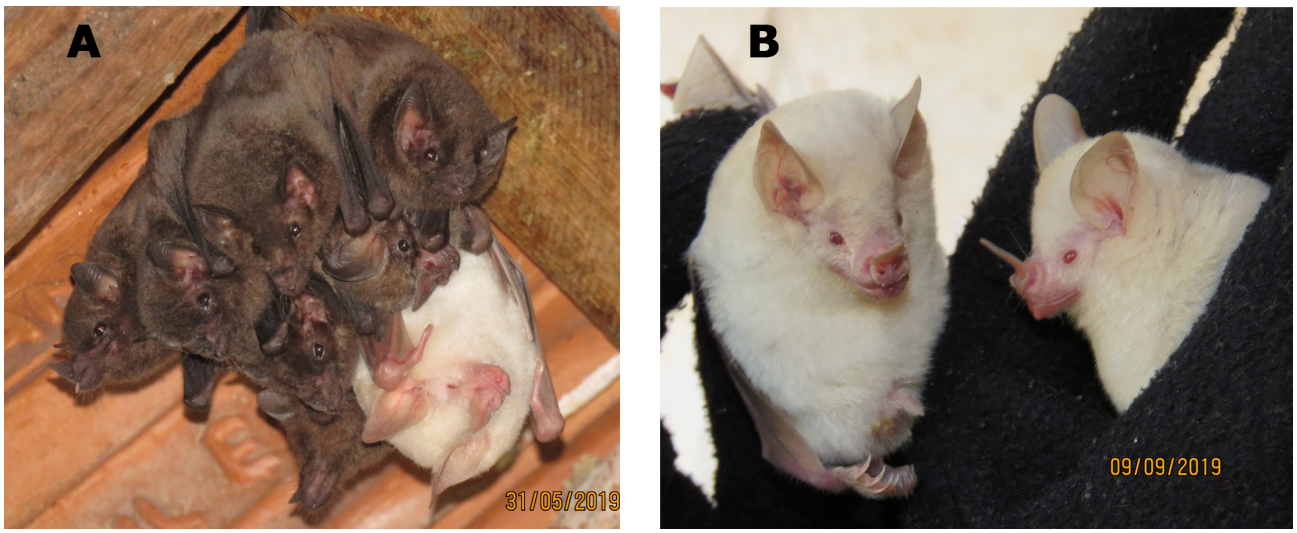

Fig. 1 - A: An albino *C. perspicillata* in a bat colony; B: Two captured albino individuals of *C. perspicillata*. Photos were taken in an abandoned building in Southeastern Brazil.

Table 1 - Morphological data of bats captured in May 2019 in a building used as a shelter at Além Paraíba, Minas Gerais state, Brazil. * Average value of two individuals. Value in parentheses = Standard deviation

Species	Age	Sex	Forearm (mm)	Weight (g)	Reproductive status
Carollia perspicillata albino	Adult	Male	39.74	17	Active
Carollia perspicillata *	Adult	Male	39.88 (0.5)	18 (0)	Active
Anoura caudifer	Adult	Female	37.18	15	Pregnant
Anoura caudifer	Adult	Male	37.36	12	Active

Table 2 - Morphological data taken from bats that were using a building as shelter in September 2019 at Além Paraíba, Minas Gerais state, Brazil. * Average value of 17 individuals. ** Average value of five individuals. Value in parentheses = Standard deviation

Species	Age	Sex	Forearm (mm)	Weight (g)	Reproductive status
Carollia perspicillata albino	Adult	male	39	16	Inactive
Carollia perspicillata albino	Young	male	39	15	Inactive
Carollia perspicillata *	Adult	Female	40 (1.2)	13.60 (1.3)	Not Pregnant
Carollia perspicillata **	Adult	Male	40.6 (0.8)	13.8 (0.8)	Inactive

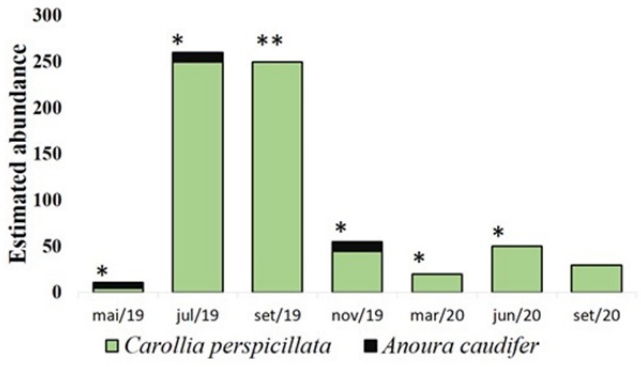

Fig. 2 - Estimated number of *C. perspicillata* and *A. caudifer* individuals during each survey in an artificial shelter in Southeastern Brazil. * one albino individual sighted; ** two albino individuals sighted.

However we know it was one of them as it was still possible to observe the ring.

Figure 2 summarizes the estimated number of normally pigmaented bats and the presence of albino bats during each visit to the shelter in our study period.

DISCUSSION & CONCLUSIONS

Until now, there were only three reports of complete albinism in *C. perspicillata* worldwide, one in French Guiana (Charles-Dominique et al. 2001) and two in Brazil (Falcão 2014, da Rosa et al. 2017). Falcão (2014) reported an adult female collected with a mist net in the municipality of Igaporã, Bahia state, in Northeastern Brazil. da Rosa et al. (2017) reported a young male captured in an anthropogenic area in the district of Caiçara, in the municipality of Porto Velho, Rondônia state, in Northern Brazil. In both cases, morphological data for the albino specimens were within what has been recorded for other individuals in the wild. This is the fourth record for this species in the world and the third for Brazil, as well as the first record for Southeastern Brazil.

It is important to note that there has been an increasing interest in the effect of chromatic disorders in bats during the last years, but many knowledge gaps still exist, which is because most of the information available is limited to species recorded with disorders in pigmentation (Lucati & López-Baucells 2017). Few studies have followed bats with abnormal colouration in their natural roosts for long periods of time (Brack & Johnson 1990, Sánchez-Hernández et al. 2010). Our results reinforce the hypothesis that pigmentation anomalies might not negatively affect the survival of these species.

During the seven sightings, the bat appeared to be healthy and well-integrated into the group. It was not isolated when we observed it at the shelter, and it was not rejected when returning to the colony after being captured to take its biological measurements. Morphological data were taken during three opportunities, and the albino bats had a normal size for the species as well as compared to other individuals in the colony.

In the review from Lucati & López-Baucells (2017), they shown that the majority of albino bats had been found in enclosed roosts, such as caves, mines, galleries, buildings, with only 15% of the 354 records compiled from the literature made of bats captured while in flight. Uieda (2000) proposed that these shelters may be important for the survival of albino bats because they offer protection against sunlight, water loss, and predation. However, other factors might be playing an important role in these results, such as a greater possibility to detect abnormal bat colourations in caves and urban shelters, such as buildings, and also that roosts in urban centers and caves are more intensively monitored, which can subestimate the number of bats with abnormal colourations in nature (Lucati & López-Baucells 2017).

Based on the reviews about albinism by da Rosa et al. (2017) and Uieda (2000), 18 bats (40%) were classified as adults among the 45 albino bats for which the age was reported. One of the two *C. perspicillata* albino bats, classified as an adult during the first sighting, was seen six additional times during the following thirteen months after

its first capture, which corroborates the long survival time.

Considering the nocturnal habit of bats and the dark shelters where they live, albinism might not negatively affect predation and social behaviour (Buys et al. 2002), which is corroborated by the captured adult albino individuals in our study. For seven years, Bartonička & Buřič (2007) observed one albino individual of *Rhinolophus hipposideros*. Sánchez-Hernández et al. (2010) captured an albino female of *D. rotundus* during its lactation period, which could indicate that pigmentation changes do not represent a negative effect on reproductive success in some bat species. Actually, in some cases, bats could even be potentially benefited from the lack of melanin due to an increased camouflage in their roosts (Oliveira 2021).

Albinism in mammals results from inheriting mutated genes from each parent, which interferes with melanin production (Richards & Hawley 2011). Although both individuals were apparently healthy and well integrated in the colony, more long-term studies are necessary in order to understand the real effect of chromatic disorders in the survival and behaviour of these individuals. The same is recommended in relation to kinship and the occurrence of more than one albino individual in the colony, in which we suggest that future studies evaluate the genetic basis related with pigmentation disorders.

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