



## NEST BOX USE AND POLYGYNY IN AN ENDANGERED PRIMATE SPECIES: THE BLACK LION TAMARIN (*Leontopithecus chrysopygus*)

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**Abstract:** The black lion tamarin, *Leontopithecus chrysopygus*, is an endemic and endangered primate species from the Atlantic Forest of the interior of São Paulo State, Brazil. Its mating system is characterized as monogamous and females give birth to two twin infants during each breeding season. They are known to mainly sleep in tree holes, which is considered as a pertinent strategy for increasing their protection from predators during the night. Artificial cavities, like nest boxes, have been installed for other species in areas where tree cavities are depleted, in order to replace them. In this study, we report (i) the use of nest boxes in the wild by a group of black lion tamarins and (ii) the first record of polygyny for this species.

**Keywords:** artificial sleeping site; mating system; trap cameras; wildlife management.

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The black lion tamarin (BLT), *Leontopithecus chrysopygus* Mikan, 1823 (Primates, Callitrichidae), is a species endemic to the Atlantic Forest of the interior of São Paulo State, Brazil (Kierulff *et al.* 2008). In 2000, it was listed as one of the 25 most endangered primate species in the world (Mittermeier *et al.* 1985). Currently, the BLT is classified as “Endangered” in all threatened species lists; state (São Paulo 2014a), national (ICMBio 2018), and global, mainly due to the loss and fragmentation of its habitat (Kierulff *et al.* 2008). Since 2014, the BLT is considered as an Environmental Patrimony of São Paulo State and a symbol of wildlife conservation

in the State (São Paulo 2014b). Its geographical distribution is restricted to the interfluvium of the Tietê-Paranapanema, not overpassing the Paraná river (Mittermeier 2013).

The population of the upper Paranapanema River basin is highly fragmented with small subpopulations occurring in some protected areas: Angatuba Ecological Station (Culot *et al.* 2019), Carlos Botelho State Park (Rodrigues *et al.* 2014), Capão Bonito National Forest (Caldano 2014), and in riparian forest inserted in human-altered landscapes (Lima *et al.* 2003, Rohe *et al.* 2003, Culot *et al.* 2015).

The BLT has been described as a monogamous species in the literature, with the groups being composed of an alpha couple that suppresses the reproductive activity of the other individuals of the group. Usually, the reproductive female of the group gives birth to two twin infants during each breeding season (Kleiman & Mallinson 1998).

They inhabit semi-deciduous forests, and use trees for shelter, food and movement (Coimbra-Filho & Mittermeier 1973). They are known to sleep mainly in tree holes, which can be natural cavities formed in the trunk of a dead or living tree, or abandoned nests dug into trunks (Passos 1992). Tree cavities that are used as sleeping sites are considered to be a pertinent strategy of *Leontopithecus* (Kierulff *et al.* 2002), as these structures can aid, mainly, in the avoidance of predators (Coimbra-Filho 1976, Passos 1992). They also provide comfort, hygiene (Anderson 1998) and shelter from rain (Heymann, 1995). They facilitate social contact (Heymann 1995, Souza-Alves *et al.* 2011), aid in thermoregulation and protect individuals from parasites and diseases (Anderson 2000). Furthermore, these structures influence ranging patterns (Tilson & Tenaza 1982), act in territoriality and resource availability (Anderson & McGrew 1984) and minimize travel distances to early morning and late afternoon foraging sites (Heymann 1995, von Hippel 1998).

However, animal species that are dependent on trees with holes are continually confronted with a shortage of this type of shelter in several parts of the world. This is due to the decline in the abundance of large, old trees since it is specifically in these trees, often older than 100 years, that holes form with greater frequency and if these trees are removed, their substitution will take a long time (Sauders *et al.* 2014, Goldingay *et al.* 2015).

This is precisely what occurs in secondary forests, due to the various types of disruption that they suffer (Brown & Lugo 1990), large and older trees, that are prone to forming holes, are removed or are scarce, resulting in the reduction of this type of shelter for BLTs and consequently pose another threat to an already threatened species.

One approach that has been used in other species of arboreal mammals to mitigate the problem of the lack of tree cavities is to install artificial cavities in the form of nest boxes (Goldingay *et al.* 2015). In this study, we report (i)

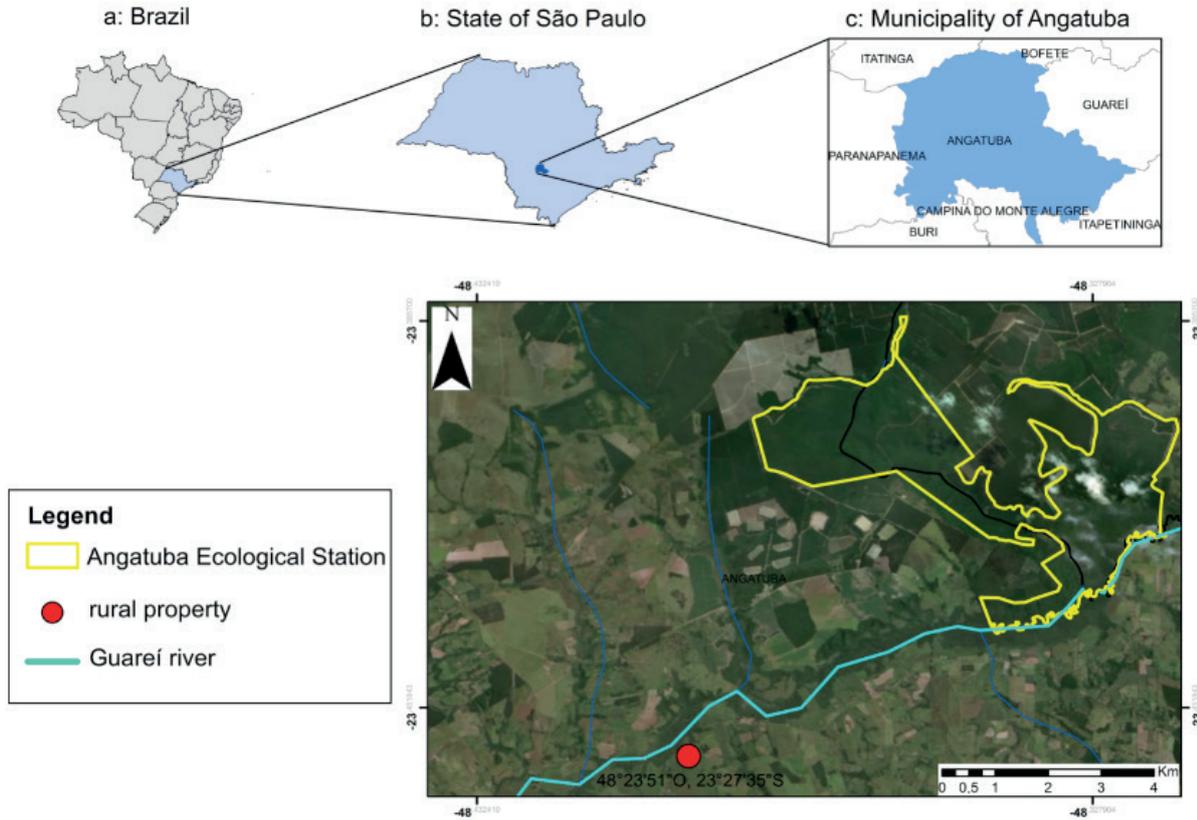
the use of nest boxes in the wild by a group of black lion tamarins and (ii) the first record of polygyny for this species.

The observations took place in a rural property named Recanto Sagrada Família of 1.500 m<sup>2</sup> (23° 27' 35" S; 48° 23' 51" W *datum* SAD69) in the municipality of Angatuba, in the State of São Paulo, Brazil. This property is located on the banks of the Guareí River, in the basin of the upper Paranapanema River, and is approximately 6 kilometers away from the protected area, denominated Angatuba Ecological Station (AES) (Figure 1).

The rural property preserves the riparian forest of the Atlantic Forest characterized as secondary forest. This riparian forest connects small remaining fragments of the Atlantic Forest with the AES, where BLTs were registered for the first time in 2001 (Medici *et al.* 2003). Nowadays, this area has one population, estimated at 46 individuals and it is considered as a source area for other BLT populations in the region (Culot *et al.* 2019).

Two nest boxes were installed by the owner of the rural property in the study area. He reported that a group of BLTs appeared on his property since 2013, often in the late afternoon and that at dusk they left the area, which made him think that the group had no shelter in which to sleep. Then, in July 2016 he installed the first nest box (NB1). It was 0.35 m wide, 0.47 m tall, 0.28 m deep and had a hollow of 0.13 m x 0.13 m. This nest box was made of wood, nails and a metal sheet was fixed to the front of the nest box to avoid the infiltration of rainwater (Figure 2).

It was installed at a height of 4 m in a tree of the species *Luehea grandiflora* (Malvales, Malvaceae) which had a height of 8m and a diameter at breast height of 1.65 m. The second nest box (NB2) was installed in March 2018. It was bigger than the first one, measuring 0.49 m wide, 0.53 m tall, 0.30 m deep with a hollow of 0.13 m per 0.13 m. This nest box was made of wood and nails and it was installed at a height of 3.90 m in a tree of the species *Cedrela fissilis* (Sapindales, Meliaceae), with a diameter at breast height of 0.83 m. The observations of nest box use and the presence of the infants in the group were made by the owner through direct random observations during a period of 29 months (July 2016 to December 2018). This



**Figure 1.** Study area map: Rural property and Angatuba Ecological Station connected by the Guareí River where field work was performed. Geographic Coordinate System – Datum: D\_WGS\_1984.

information was verified by the authors through direct observations with a frequency of one day per month between July 2017 and December 2018 and by using one trap camera, model Powerextra high quality full HD, in the video mode, 1080p video resolution, which was installed in October and November 2017 - 2018 during 20 consecutive days. Videos lasted 30 seconds with a 5 second interval.

The targeted group used the NB1 for the first time in April 2017, nine months after its installation. At the time, the group was composed of seven individuals. There are records of NB1 use over consecutive days and it was used at least once per week between April and October 2018 (Figure 3). During this period the surprising occurrence of four infants in the same group was recorded.

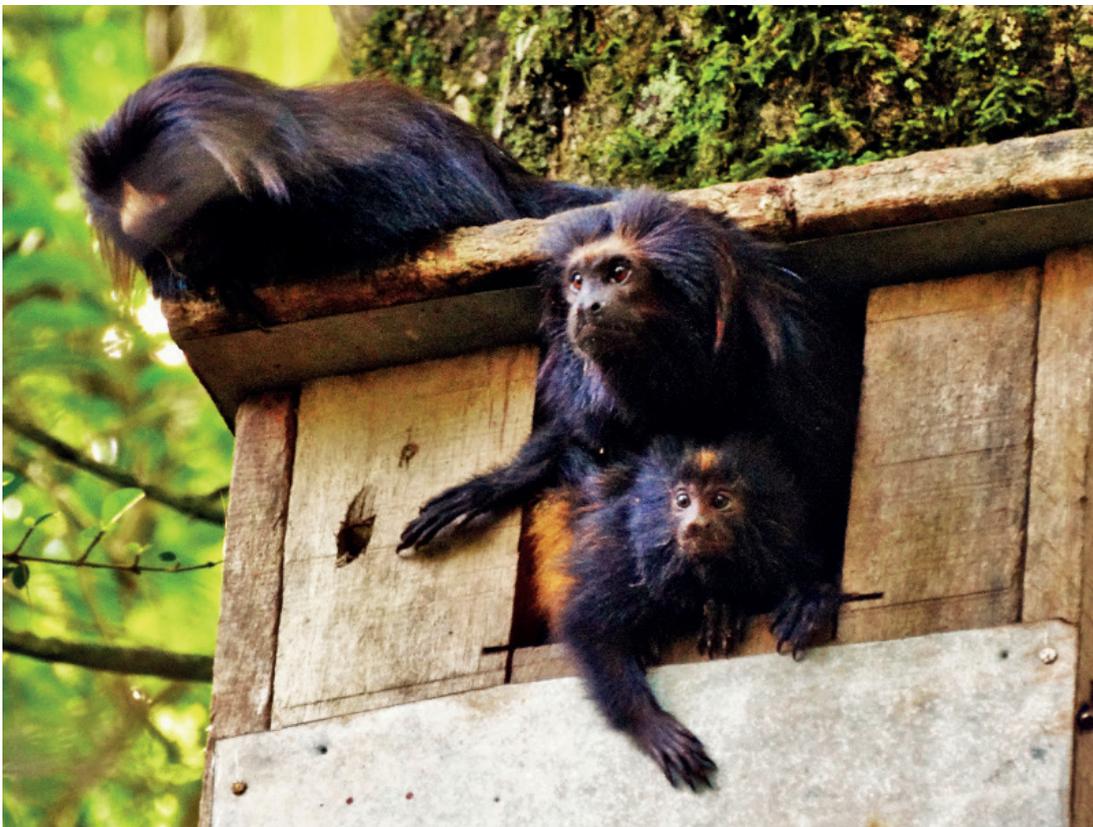
The group continued with 11 individuals until March 2018, when one juvenile was killed by the neighborhood’s dog when the juvenile went down to cross a dirt road. The group continued with 10 individuals until the next breeding season, when two infants in July 2018 and two more infants in October 2018 were observed. In October 2018, the

owner found one dead infant inside the nest box. On the previous day, he had observed that the group approached the nest box in the late afternoon and that one individual put its head inside the nest box quickly and then the group left the area continuing through the forest. The camera trap recorded, that days before this incidence observed by the owner, one adult was expelled from the nest box and stayed outside for the entirety of the night. After that, the group never used the NB1 again and it started using the NB2, seven months after its installation. The frequency of the use of the NB2 was the same as the NB1, at least once per week. The BLT group continued to be observed with 13 individuals until December 2018 when the data collection ceased.

In August 2017 and February 2018, NB1 was invaded by honeybees, *Apis mellifera* (Hymenoptera: Apidae) however, they spontaneously left the nest after a few days on both occasions. The owner also observed in September 2017 that a white-eared opossum, *Didelphis albiventris* (Didelphimorphia, Didelphidae), was using the NB1 at night for consecutive days and



**Figure 2.** First nest box installed (NB1). Author: Francini Garcia



**Figure 3.** Black Lion Tamarins using nest box number one (NB1): an adult outside and an adult and an infant inside the nest box. Author: Bárbara Prado.

during that time the BLT group did not appear in the area. The animal was removed by the owner of the property and it was released in the same area. After some days, he observed that the group returned to use the NBI. The camera trap recorded that one species of squirrel, *Guerlinguetus brasiliensis* (Rodentia, Sciuridae), visited the NBI many times during the day throughout the monitoring period in 2017, but it did not interfere in the use of the NBI by the BLT group.

It is known that captive tamarins of the genus *Leontopithecus* use nest boxes as sleeping sites (Caine *et al.* 1992), but this has never been observed in the wild. Our observations suggest that nest boxes can also replace tree cavities in areas that lack this resource, working as secure sleeping sites in terms of predators and even providing protection from weather conditions due to the physical characteristics of the NBI, such as wood thickness, material and form of assembly, that can potentially prevent the entry of rain water and strong winds (Anderson 1998, Hankerson *et al.* 2007).

The observation of the nest box use by the group over consecutive days may be related to their comfort or preference for the nest box design tested (Carvalho & Carvalho 1989) or may be associated with resource scarcity in the area. Although the use of the sleeping sites over consecutive days is unusual for BLTs (Kierulff *et al.* 2002), this has been previously observed with natural shelters (Carvalho & Carvalho 1989, Passos 1992).

The record of the four infants simultaneously in the same group over two consecutive years, can be considered as cases of polygyny. Polygyny was observed by Dietz & Baker (1993) in golden lion tamarins in approximately 10 % of group samples in *Poço das Antas* Reserve. In these cases, polygyny usually did not last longer than two years, and in our study, it was confirmed for at least two reproductive periods, when the data collection ceased.

There are two possible explanations for polygyny in lion tamarins. Dietz & Baker (1993) suggested, in their study, that the isolated and saturated nature of the area are factors that could reduce the success of dispersal, stimulating the occurrence of polygyny, as reproduction outside the natal group becomes limited under these ecological conditions. Roda & Pontes (1998)

associated the polygyny observed in common marmosets, *Callithrix jacchus* (Primates, Callitrichidae), with the saturated nature of the area due to the fragmentation of the Atlantic forest. Another explanation is habitat quality, as it is considered that secondary and edge forests promote a richer habitat for callitrichids, compared to mature forests, since food resources are more abundant and their distribution patterns are more favorable (Rylands & De Faria 1993), which can induce the departure from a monogamous mating system. In our study, the explanation for habitat quality seems to be the most likely, as the area is not isolated and is characterized as secondary forest and forest edge.

The group composition of 13 individuals is greater than previously registered in the literature for BLTs (Passos 1992, Valladares-Padua 1993, Paranhos 2006, Caldano 2014, Culot *et al.* 2019). The nest box infestation with feral honeybees did not seem to be a problem for the BLT group, as recorded for other species (Goldingay *et al.* 2015).

Our records suggest that nest boxes can be considered as a new management tool for the conservation success of the black lion tamarin in modified landscapes, where tree cavities are scarce. The polygyny documented in this study may be useful to direct further research regarding mating system models in lion tamarins.

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