

DOI: <https://doi.org/10.62015/np.2024.v30.829>

A CASE OF MATERNAL INFANTICIDE IN THE BLACK TUFTED-EAR MARMOSET *CALLITHRIX PENICILLATA* (PRIMATES: CALLITRICHIDAE)

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Abstract

This brief report provides a detailed description of maternal infanticide in an introduced group of black tufted-ear marmosets (*Callithrix penicillata*), living in an urban park of Florianópolis, Santa Catarina, Brazil. In November 2017, the dominant female of the group (mother of twins) ate facial parts and the whole skull of an infant that was approximately five days old. This case of infanticide seems to mostly fit the hypothesis of parental manipulation and nutritional resources, but its ultimate cause remains unknown.

Keywords: cannibalism, nutritional resource, parental manipulation, sexual selection, social pathology

Resumo

Esta nota científica apresenta a descrição detalhada de um infanticídio maternal em um grupo introduzido de sagüí-de-tufos-pretos (*Callithrix penicillata*). Este grupo vive em um parque urbano em Florianópolis, Santa Catarina, Brasil. Em novembro de 2017, a fêmea dominante do grupo (mãe de gêmeos no momento) comeu partes da face e o crânio todo de um infante com cerca de cinco dias de idade. Este caso de infanticídio parece se adequar à hipótese de manipulação parental e de recursos nutricionais, mas sua causa final permanece desconhecida.

Palavras-chave: canibalismo, manipulação parental, patologia social, recurso nutricional, seleção sexual

Introduction

Infanticide, or killing of intraspecific offspring, has been documented in several species of mammals including primates, rodents, cetaceans, bats, and carnivores (Hrdy, 1974; Labov, 1980; Hoogland, 1985; Lunn and Stenhouse, 1985; Patterson et al., 1998; Van Schaik, 2000; Dunn et al., 2002; Lukas and Huchard, 2019). Infanticide can be an adaptive behavioral strategy, to increase the perpetrator's fitness (Wilson, 1975; Hrdy, 1979; Hausfater and Hrdy, 1984). There are five general hypotheses that explain the infanticide: exploitation, resource competition, parental manipulation, sexual selection, and social pathology (Hrdy, 1979). On the one hand, the evolutionary causes of infanticide by males are relatively straightforward, typically linked to potential reproductive benefits (Hrdy, 1979; Digby, 2000). In contrast, infanticide by females is less well understood, and its evolutionary drivers are

more complex (Lukas and Huchard, 2019). Recently, it has been observed that the primary cause of infanticide committed by females is resource competition – more specifically, for reproductive space, access to milk, allomaternal care, and social status (Lukas and Huchard, 2019).

Infanticide has been widely reported in non-human primates, across all major groups: lemurs, platyrrhines, and catarrhines (Goodall, 1996; Sussman, 2000; Nievergelt et al., 2002; Ebensperger, 2007; Ramírez-Llorens et al., 2008; Lukas and Huchard, 2019), and has been recorded in all families of platyrrhine primates, in at least 15 genera (Herrera et al., 2000; Bezerra et al., 2007; Cäsar et al., 2008; Culot et al., 2011; Lukas and Huchard, 2019). In Callitrichidae the females are dominant and usually give birth to twins. There is strong allomaternal care provided mostly by adult males or subadult group members, often referred to as helpers (Sussman and Garber, 1987; Dunbar, 1995a, b; Garber, 1997). High birth rates and rapid infant growth, combined with the presence of helpers, appear to increase the likelihood of infanticide committed by females (Culot et al., 2011; Lukas and Huchard, 2019). Notably, reports of infanticide committed by the mother herself are rare among non-human primates (Hrdy, 1999; Culot et al., 2011). In this paper we present a detailed description of maternal infanticide and cannibalism in an introduced group of black tufted-ear marmosets (*Callithrix penicillata*) in an urban park of Florianópolis, Santa Catarina state, Brazil.

Methods

Our observations took place in Córrego Grande Ecological Park, a fragment of approximately 21.5 ha of Atlantic Forest in the second stage of regeneration, located in the municipality of Florianópolis (27°35'51.8"S, 48°30'41.7"W), in Santa Catarina state, Brazil. This park contained at least four groups of marmosets, ranging from 5 to 16 individuals per group, and totaling between 30 and 40 individuals overall (Zago, 2012; Zago et al., 2013; González-Carvajal, 2019). Data collection was non-invasive and satisfied the legal requirements of the Brazilian Environment Institute (IBAMA).

We performed behavioral monitoring on two introduced groups of *Callithrix penicillata* that have been non-continuously studied since 2008 (continuous monthly monitoring was in 2008-2011, 2014-2015, and 2017-2018) by our primatology group (Zago et al., 2013, 2014; da Rosa, 2016; González-Carvajal, 2019). These marmosets were habituated to the presence of researchers and could be identified by distinctive marks like body size, coloration, scars, and genital spots.

From November 6th to 8th, 2017, one researcher conducted three day-long follows of a group called "Porteira", at the study site. This group was composed of seven

individuals: one adult female, two adult males, one sub-adult (undetermined sex), two juveniles (undetermined sex), and twin infants, following Yamamoto's (1993) age composition proposal. The group was observed throughout its daily activity period (from 6:20 to 19:00 approximately), using scan sampling methodology (Altmann, 1974), at five minute intervals. Occasional or rare events were recorded "ad libitum" (Altmann, 1974), thoroughly describing each behavior, in a traditional field notebook. Photo records were taken on a Canon Powershot Sx50 Hs camera. The corpse was not collected for postmortem analysis.

Results

On November 6th, 2017, we observed that a female in this *Callithrix penicillata* group had given birth to twins; the newborns were being carried on the back of the group's adult male (helper), who was individually identified by a spot in its genitals. When he was first observed carrying the newborns, the group was heading to a tree to search for refuge to sleep at the end of the day. The next day, this group started activities after 6:15 a.m. At 6:20 the adult male (possibly the father) kept carrying the twins on his back while traveling with the group. During the next 3 hours and 30 minutes, based on scan sampling, the most common activities in the group were locomotion and foraging. At 9:50 the entire group took refuge in a tangled tree, to wait out the rain, which lasted approximately 25 minutes. At 10:22 the group moved toward another tree, and it was observed that the adult female and the adult male were each carrying one of the twins. At 11:00, the adult male tried to take away the twin infant from the adult female's back two times, but the female did not allow this. At 11:16 the entire group was together on a tree branch; the dominant female nursed the twin that was on her back (Fig. 1a), while the adult male carried the other twin on his back. Once the adult female finished nursing the twin at 11:21, she continued carrying the twin on her back, until reaching another tree branch that was at least 3 m away from any other member of the group. After 3 minutes, the infant began to vocalize, and it was observed that the female held the infant in her arms with its head in her mouth. After this, the female began biting the infant's face. At 11:28 the female continued biting the twin infant's face. The infant vocalized constantly, and other group members walked toward the female and infant. At 11:31 it was noted that the adult female's mouth was full of blood, and she had eaten part of the twin's skull (Fig. 1b, 1c, and 1d). The adult female continued feeding on the soft tissues of the infant's head for approximately 3 min, during which she dropped the corpse twice on the ground, but she searched for it again to keep eating the soft tissues of the head. At 11:34 the adult female dropped the corpse to the ground for the third time, and this time she did not pick it up. Instead, the adult male who was carrying the other twin on his back, approached and ate

the remains of the dead twin's skull (Fig. 1e), while the dominant female watched.

At 11:36, after eating the remains of the dead twin's skull, the male adult dropped the corpse on the ground and moved forward with the dominant female and the rest of the group. At 11:39 the dead twin's body remained on the ground, without most of the face and head, although the other body parts were intact (Fig. 1f). The surviving twin continued to be carried by the adult male and remained alive for at least two more months, when the primate monitoring ended.

Discussion

Although male-inflicted infanticide is more common among primates (and mammals in general), in Callitrichidae, infanticide committed by females appears to be more frequent, with no cases of male-inflicted infanticide reported (Digby and Saltzman, 2009; Culot et al., 2011). This study may be the first case of maternal infanticide reported for *Callithrix*, but not for Callitrichidae (Tirado-Herrera et al., 2000; Culot et al., 2011).

In the present study, the mother committed infanticide, and it was observed that she ate parts of the twin's face and head, leaving the rest of the body untouched and intact. We considered the possibility of cannibalism as a "nutritional resource" derived from the consumed parts of deceased offspring (Lazaro-Perea et al., 2000; Melo et al., 2003). However, it remains unclear why in most reported cases including this one, only the victim's head was consumed (e.g., Melo et al., 2003). Hilário and Ferrari (2010) suggest that the mother first bites the victim's head to subdue it, using the same behavior exhibited when chasing prey, possibly ingesting parts of the skull and face instinctively.

The "Parental Manipulation" hypothesis proposes that infanticide by mothers serves to regulate the sex ratio within the group by selectively eliminating some or all offspring (Agrell et al., 1998). This hypothesis does not necessarily involve the elimination of non-viable offspring alone but may also extend to those born during ecologically unfavorable periods when additional caregiving could require excessive energy expenditure (Culot et al., 2011). According to Volland and Stephan (2000), maternal infanticide may be considered adaptive under conditions where offspring have low reproductive potential, are highly dependent on maternal care beyond normal levels, or when the act increases the mother's overall adaptive value.

We think that the "Nutritional Resource" and "Parental Manipulation" hypotheses are the most plausible explanations for the observed episode of infanticide, based on the following considerations. First, the female committed

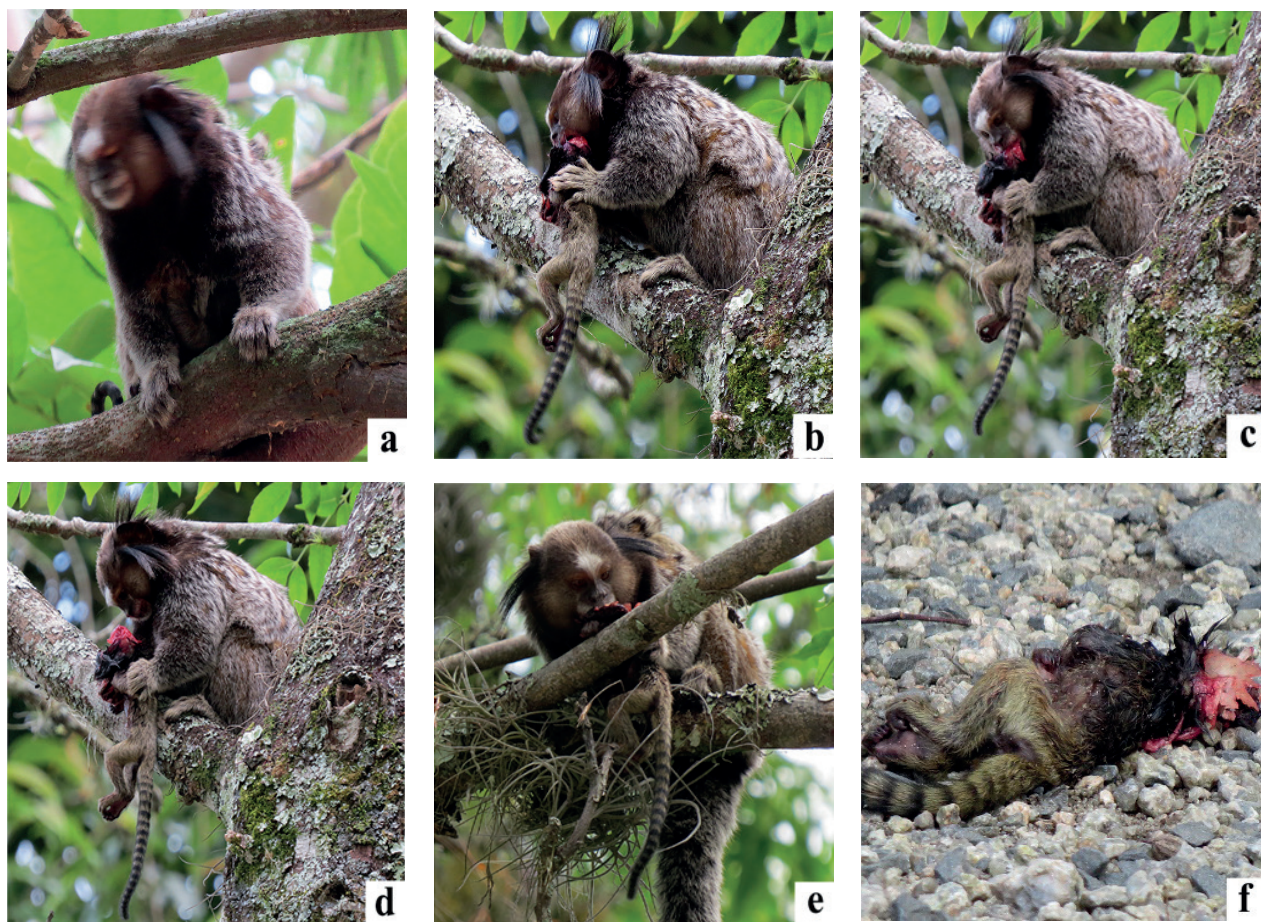


Figure 1. Pictures before, during, and after infanticide. a) Mother nursing the infant. b), c), and d) Sequence of the mother eating parts of the head. e) Adult male carrying the other infant eating parts of the skull. f) Face and skull parts eaten, while rest of the body intact.

infanticide and selectively ingested parts of her offspring's head and face, possibly to meet heightened nutritional demands associated with consecutive twin pregnancies and births. Cannibalism of specific body parts, particularly the brain and facial tissues, may provide a concentrated source of nutrients required during these physiologically demanding periods (Lazaro-Perea et al., 2000; Melo et al., 2003). However, as we did not examine the infant post-mortem, this hypothesis remains untested.

Acknowledgments

This study was financed in part by the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior – Brasil (CAPES) – Finance Code 001. We thank the administration and the technical staff of the Córrego Grande Ecological Park, for allowing us to develop this research project there. We also thank the UNICENTRO University, the OAS, and the CAPES for promoting spaces that allow for the expansion of academic, scientific and intellectual knowledge, through awarding of research scholarships. We are grateful to Zonia Elizabeth Caro Carvajal who commented on the manuscript and revised the English language.

Author Contributions

Juliett M. González-Carvajal conducted the survey, wrote the text, and took the photographs. João M. D. Miranda reviewed and edited the manuscript. Both authors read and approved the final manuscript.

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