



A record of diurnal birth and placentophagia in an urban-dwelling female black and gold howler monkey (*Alouatta caraya*, Primates: Atelidae) in the City of Pilar, south-west Paraguay

Rachel V. Taylor¹ , Mikel Redin Hurtado¹ , Matthew T. Owen¹ , Rebecca L. Smith^{1*} 

1 Fundación Para La Tierra, Centro IDEAL, Pilar, Ñeembucú, Paraguay.

* Correspondence: Rebecca L. Smith. Fundación Para La Tierra, Centro IDEAL, Pilar, Ñeembucú, Paraguay. +595981219957 rebecca@paralatierra.org

Abstract

Placentophagia, the postpartum consumption of the afterbirth by a mother, is widespread among eutherian mammals and linked to both endocrinological and ecological advantages. However, its occurrence in urban-dwelling arboreal primates, including the genus *Alouatta*, is not well represented in the literature. This is the first recorded instance of diurnal birth and placentophagia in an urban environment by a female black-and-gold howler monkey (*Alouatta caraya*) in Pilar, Paraguay. The mother exhibited self and allogrooming of the infant, and consumption of the placenta and umbilical cord, which aligns with known *Alouatta* post-parturition behaviors, despite the novel urban setting. This event indicates the species' behavioral flexibility and suggests potential adaptation to urban habitats, that are absent of natural predators but present novel anthropogenic stressors. Understanding a species' adaptability is vital for development of conservation strategies of primates in urban landscapes.

Key words: Behavioral flexibility, diurnal birth, urban environment.

Resumen

La placentofagia, el consumo posparto de la placenta por parte de la madre, está muy extendida entre los mamíferos euterios y está relacionada con ventajas tanto endocrinológicas como ecológicas. Sin embargo, su aparición en primates arbóreos urbanos, incluido el género *Alouatta*, no está bien representada en la literatura. Este es el primer caso registrado de parto diurno y placentofagia en un ambiente urbano por parte de una hembra de mono aullador negro y dorado (*Alouatta caraya*) en Pilar, Paraguay. La madre exhibió auto-acicalamiento del bebé y consumo de la placenta y el cordón umbilical, lo que se alinea con los comportamientos posparto conocidos de *Alouatta*, a pesar del novedoso entorno urbano. Este evento indica la flexibilidad de comportamiento de la especie y sugiere una posible adaptación a hábitats urbanos, que están ausentes de depredadores naturales pero presentan nuevos factores estresantes antropogénicos. Comprender la adaptabilidad de una especie es vital para el desarrollo de estrategias de conservación de primates en paisajes urbanos.

Palabras clave: Flexibilidad comportamental, parto diurno, ambiente urbano.

Placentophagia, defined as the postpartum maternal consumption of any or all of the afterbirth components, is a near-ubiquitous behaviour among eutherian mammals (>4000 species) (Sharon et al., 2010; Kristal et al., 2012; Mota-Rojas et al., 2020). The practice of placentophagy has been studied for its adaptive significance, leading to several proposed endocrinological post-partum (Kristal et al. 2012; Mota-Rojas et al. 2020) and ecological benefits (Thompson et al., 1991; Keverne et al., 1997; Turner et al. 2010; Young et al. 2010). However, the motivation for placental consumption varies between taxonomic groups (Kristal et al. 1980; Mota-Rojas et al. 2020). Placentophagy has been widely reported in howler monkeys (*Alouatta*) (Peker et al., 2009; Martins et al., 2015). However, to date, no instances of placentophagy in *Alouatta caraya* have been documented in urban habitats (Table 1).

The presence of primates in urban environments is becoming increasingly common due to urbanization and anthropogenic development (Berry 2008). The behavioral flexibility of howler monkeys enables their survival in degraded or urbanised environments (Alesci et al. 2022). Due to the increasing presence of black-and-gold howler monkeys in urban habitats, it is relevant to investigate the yet unclear potential impacts on their reproductive behaviour (Cárdenas-Navarrete & Van Belle 2023). Here we report on the first account of a diurnal birth and placentophagia in an urban-dwelling black and gold howler monkey (*Alouatta caraya*) female in Paraguay.

The observation was recorded in the City of Pilar, Ñeembucú department, south-west Paraguay (26°52'04" S 58°17'46" W) on the 13th July 2023. Pilar is the capital of the political department Ñeembucú and has a population of around 33,000 people (www.dgeec.gov.py/). Its climate is humid, with a mean annual temperature of 22 °C. In summer, temperatures can reach as high as 45 °C, dropping to 1 °C in winter. The urban area of Pilar is home to around 17 groups of black-and gold howler monkeys (~100 individuals), eight of which have been studied by researchers from Fundación Para La Tierra (a Paraguayan conservation NGO 8008644-2) since 2017. This observation was recorded during the data collection for an ongoing study of black-and gold howler monkeys infant care behaviours as part of the long-term Fundación Para La Tierra Urban Howler Project. The focal female belongs to an urban-dwelling, well-habituated group (the "Church" group). Church group live in a 16677 m urban forest patch (26° 51 '28"S, 58° 17' 43"W) two blocks from the city's main road (fig. 1). The group's home range is surrounded by residential buildings and roads, hence they are subject to frequent disturbance by anthropogenic activities. At the time of observations, the group comprised three adult males, four adult females (including the focal female), two juvenile females, and one infant.

We used scan sampling with 1-minute intervals to record the behaviours of the mother, infant, and surrounding group members for 165 minutes. Behaviours recorded fulfilled the descriptions of a pre-defined ethogram, with the exception of some birth-related behaviours for which descriptive observations were taken and later categorised. The observation period began at the final moments of parturition, and continued until dusk, which time the group reached a sleeping site and showed reduced activity.

All Fundación Para La Tierra research is approved by the Ministerio de Ambiente y Desarrollo Sostenible (MADeS) and complied with all local laws. The Fundación Para La Tierra Urban Howler Monkey Project is non-invasive and followed the American Society of Primatology Code of Best Practices for Field Primatology (2014).



FIGURE 1: Satellite view of the Church Group home range in Pilar, Paraguay.

At 14:35 on 13th July 2023, the focal female was seen to be in the final stages of parturition (fig. 2). Pre-parturition and early stages of the delivery were not observed. She then engaged in self-grooming, cleaning her genital area and the neonate's tail. From 14:36 to 14:42, she held and cleaned the newborn while it rested on her hind leg, before initiating ventro-ventral contact, occasionally licking her hands, tail and pubic region, potentially consuming residual amniotic fluid. The infant remained on the female's ventral side for the remainder of the observation period.

At 14:42 she began consuming the delivered placenta (fig. 1A), pulling the umbilical cord to aid in delivery, and continued for 12 minutes. The umbilical cord remained attached to the infant. Following consumption of the placenta, she approached an inactive male before returning to her original position, and began consuming the umbilical cord, and did so until 15:34. Her position varied from a crouch to standing as she self-groomed, with observer-directed behaviour noted at 15:16. Self-grooming resumed at 15:35, and soon after, she leaned back to scratch against a branch, revealing the neonate. After additional observers arrived at 15:41, the mother ceased grooming, vocalised a warning, and moved higher into the tree. Intermittent grooming continued from 15:42, and she fed for the first time postpartum at 15:59. From 16:03–17:02 the female interchanged between feeding, resting and self-grooming (fig. 2C), and on two occasions was observed grooming the infant. The mother then commenced the first bout of long-distance movement at 17:03, following the path taken by the other group members shortly after delivery of the infant, carrying the infant ventrally and scanning the environment. Following three minutes of feeding, at 17:14, the focal female stopped briefly vocalised and stared at the observer, the continued

travel. She settled at a height of 12 metres and began resting at 17:22, not in close proximity to other group members. There, she remained solitary and stationary until observation ended at 17:35 due to low light.



FIGURE 2A. Black and gold howler monkey female removing the placenta and cleaning herself following parturition ($26^{\circ} 51' 28"S, 58^{\circ} 17' 43"W$) in Pilar, Ñeembucú, Paraguay. **2B** Black and gold howler monkey female with her newborn infant consuming the placenta and umbilical cord ($26^{\circ} 51' 28"S, 58^{\circ} 17' 43"W$) in Pilar, Ñeembucú, Paraguay. **2C** Black and gold howler monkey female resting with her newborn infant while consuming the umbilical cord ($26^{\circ} 51' 28"S, 58^{\circ} 17' 43"W$) in Pilar, Ñeembucú, Paraguay.

During parturition, two adult males, two adult females and one juvenile shared the tree with the focal female. During this time, only a single close-proximity interaction of the focal female was observed with a juvenile female and an adult male. No other group members were located within close proximity to the new mother, with no attempts to interact with her or the newborn post-partum. No other observable behavioural changes in other group members occurred during the observation period.

This report contributes to the existing data of placentophagia not only in non-human primates but specifically in the genus *Alouatta* (A. belzebul: Camargo & Ferrari, 2007; A. caraya: Peker et al., 2009; A. guariba: Martins et al., 2015; A. palliata: Nisbett & Glander, 1996; Dias, 2005; A. seniculus: Sekulic 1982). The reported examples in *Alouatta* suggest some heterogeneity in the birth-related behaviours, including birth time, placentophagia, duration between birth and placentophagia, the order of consumption of placental material, and social and infant-oriented behaviours.

The temporal and spatial flexibility that has been previously observed in members of the genus *Alouatta* is suggested to be attributed to their energetically conservative ecology, as they are known to engage in prolonged diurnal resting periods (Sekulic, 1982; Nisbett & Glader, 1996; Dias, 2005; Carmago & Ferrari, 2007; Peker et al., 2009; Martins et al., 2015; Cárdenas-Navarrete & Van Belle, 2023). Potentially minimising the pressure for nocturnal

births, allowing day-time parturitions to occur. Additionally, the observed absence of wild predators in urbanised settings (Fundación Para La Tierra, unpublished data) offers an alternative plausible rationale for diurnal parturitions in areas altered by human activity, suggesting an anti-predation strategy. Although the stressors associated with such habitats are comparatively novel to those in their natural setting (e.g., risks posed by human activity, domestic animals, infrastructure and cars), *Alouatta* have consistently shown a high adaptive capacity to different environments (Richard-Hansen et al. 2000; Bicca-Marques et al., 2003; Asensio et al., 2007; Estrada, 2015).

The observed behaviours during the post-parturition phase of diurnal births in previous studies in *Alouatta* conformed with the reported events (Sekulic, 1982; Nisbett & Glander, 1996; Dias, 2005; Camarago & Ferrari, 2007; Peker et al. 2009; Martins et al. 2015; Cárdenas-Navarrete & Van Belle, 2023). These include cleaning of the neonate and self, delivery and consumption of the placenta, ingestion of the umbilical cord, and minimal interactions with other group members. Of the reported examples in *Alouatta*, there is heterogeneity in the birth-related behaviours, in terms of the order of events (consumption of the umbilical cord and placenta), proximity to other group members, duration between birth and placentophagia, and infant-oriented behaviours (Table 1). The order of reported events in the present study (feeding on the placenta first, and then proceeded by chewing on the umbilical cord) varies from other reports of placentophagia in howler monkeys. In contrast to studies reporting the ingestion of umbilical cord to occur first then termination of the post-parturition phase with consumption of the placenta (Dias, 2005), the described order of events is consistent to that reported in *A. palliata* parturition events (Moreno et al. 1991; Nesbitt & Glander 1996), and four *A. caraya* births (Peker et al. 2009). In addition, the female began to ingest the placenta six minutes after birth, consistent with the average latency time between birth and placentophagia recorded by Peker et al. (2009) across four diurnal *A. caraya* births (Table 1).

Table 1. Placentophagia accounts following diurnal births in the genus *Alouatta*.

| Species | Habitat | Time of parturition | Observed placentophagia (Y/N) | Infant survival? (Y/N) | Reference |
|-----------------------------|------------|-------------------------|---|---|-------------------------------------|
| <i>A. belzebul</i> | Natural | 1- 14:01 2- ~15:42 | 1- N 2- Y (~17 minutes after birth) | N | Camargo & Ferrari 2007 |
| <i>A. caraya</i> | Natural | 1- 17:45 | 1- Y (5.2 minutes after birth) | 6 out of 7 infants survived and developed normally (last recorded information: March 2008). | Peker et al. 2009 |
| | | 2- 16:46 | 2- Y (5.3 minutes after birth) | | |
| | | 3 - 18:52 | 3- Y (13.7 minutes after birth) | | |
| | | 4 - 11:59 | 4- Y (7.3 minutes after birth) | | |
| <i>A. guariba clamitans</i> | Semi-urban | -14:33 | Y- 15 minutes after birth | N - Serious injury as a result of an attack by the group's adult and subadult males. | Martins et al. 2015 |
| <i>A. palliata</i> | Natural | 14:14 | Y- 14 minutes after birth | Y | Dias 2005 |
| <i>A. pigra</i> | Urban | 17:47 | N - female was not seen to consume the placenta, but it was not found | Not disclosed. | Cárdenas-Navarrete & Van Belle 2023 |
| <i>A. palliata</i> | Natural | 15:08 | Y | Y (only reported survival on following day, further survival not disclosed) | Nisbett & Glander 1996 |
| <i>A. seniculus</i> | Natural | 1 - ~15:40 2 - 18:05 | Y- 10 minutes after birth Y - 8 minutes after birth | 1 - N: the day after birth the infant was killed by infanticide. 2 - Y | Sekulic 1982 |

The observations of placentophagia presented here provide further insights into the behaviours of black-and-gold howler monkey in novel environments. With primates increasingly inhabiting urban spaces, it is essential to understand the potential for behavioural shifts, or lack thereof, that contribute to their survival and reproductive success. Normal development of the infant (119 days old as of 9th November 2023), and the two subsequent births within the group suggest that, despite the challenges posed by anthropogenic factors, howler monkeys display adaptability. Comparative studies of birthing events and associated behaviours, like placentophagia, in both natural and urban-impacted habitats deepen our understanding of how urban environments influence primate behaviour, which is crucial for effective conservation strategies and human-wildlife coexistence.

ACKNOWLEDGMENT

We would like to thank all the staff, interns, and volunteers of Fundación Para La Tierra for all of their support. RLS is grateful to the PRONII program of CONACYT Paraguay. Para La Tierra is grateful to the estate of Don Julio Contreras for their continuing support. As always, we are grateful to our community of Pilar (Ñeembucú) and all the people of Paraguay for the welcome and making Paraguay home.

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Editor: Diego J. Lizcano
Received 2023-11-09
Reviewed 2023-11-25
Accepted 2023-14-04
Published 2023-14-04