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Short Communication

Unusual behaviour in grey woolly monkeys (*Lagothrix cana*): Females breastfeeding adult males

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ABSTRACT

Weaning varies between primate species, usually occurring long before adulthood. Here we report adult female woolly monkeys, *Lagothrix cana*, breastfeeding adult males. From March to June 2013, a study was conducted on a group of 18 grey woolly monkeys, *L. cana*, living in an *ex situ* conservation area. During the observation period, five breastfeeding events between adults were observed. The events involved two adult females and two adult males. Although our findings generally correlate with current literature on allonursing, the nurse far exceeded the expected age. Thus, we propose three hypotheses that may explain the occurrence of this adult nursing behaviour: (1) extended maternal care, (2) opportunistic foraging and (3) forming of alliances. The most likely explanation for our observations is that the female woolly monkeys use breastfeeding to move up or maintain the hierarchy, through alliances with top-ranking males. This study adds to our understanding of a little-studied, endangered primate, as well as the costs and benefits of breastfeeding behaviour.

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Lactation is generally considered the most energetically expensive aspect of reproduction in female mammals (Gittleman and Thompson 1988). It should be expected that lactating females would avoid providing milk to offspring other than their own (Roulin 2002; Baldovino and Di Bitetti 2008). Nevertheless, allonursing behaviour has been reported in several primate taxa, including humans, gorillas, macaques, howler, spider, squirrel and capuchin monkeys (Baldovino and Di Bitetti 2008; Hrdy 2010; Ren et al. 2012).

The weaning period varies between primate species, but usually occurs long before adulthood (Lee 1997). Continuing to nurse until a late age would enhance the chances of the offspring's survival (Kennedy 2005). In non-human primates, weaning can occur at about seven years in orangutans, five years in chimpanzees, over one year for rhesus macaques, eight months in Japanese macaques

and six months for the common squirrel monkey, marmosets and lemurs (Buss 1971; Kennedy 2005 for a review). In addition to providing highly digestible nutrients required for the growth and development of the young (McClellan et al., 2008), breastfeeding also supports bonding between mother and child, endowing the newborn with a well-developed set of emotional responses (Stone and Bakwin 1948; McKenna 1979; Ren et al. 2012).

Breastfeeding between adult individuals has been reported in humans in the context of erotic lactation (e.g. Barlett 2005) and there is evidence of some whales suckling sporadically for as long as 13 years (Klinowska 1991). Here we provide observations of breastfeeding between adults in a group of grey woolly monkeys, *Lagothrix cana*. Female grey woolly monkeys usually give birth to one baby and nurse for the first two years (Ramirez 1988). After birth, the dominant male of the group assumes a protective role for the mother and infant until the baby is two months old (Ramirez 1988). Grey woolly monkeys establish a dominance hierarchy based on sex and age; adult and subadult males rank higher than other members of the group, with the alpha male being the largest and strongest (Ramirez 1988). In non-human primates, food resources seem to rule female competitive strategies, with resource acquisition maximized when relatives behave in a cooperative manner (Wrangham 1980; Bergstrom and Fedigan 2010).

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In grey woolly monkeys, adult females are dominant over subadult females and the young of both sexes, having priority access to food and space (Ramirez 1988). Grey woolly monkeys are mainly frugivorous, completing their diet with leaves during adulthood (Peres 1994). Grey woolly monkeys are highly susceptible to habitat disturbances such as fragmentation and hunting (Iwagana and Ferrari, 2002). The species is considered Endangered by the IUCN and populations exist in Bolivia, Peru and Brazil (Iwagana and Ferrari, 2002; Boubli et al. 2008).

In this paper, we describe our observations of breastfeeding between adult grey woolly monkeys. Further, we propose three hypotheses to explain the occurrence of this behaviour based on allonursing (Roulin 2002; Baldovino and Di Bitetti 2008; Hrdy 2010; Leung et al. 2010), weaning (Lee and Moss 1986; Lee 1997; Hennessy et al. 2002; Stanley and Shultz, 2012), foraging (Charnov 1976; McKenna 1979; Heiduck 1997) and hierarchy (Wrangham 1980; Bergstrom and Fedigan 2010), i.e. “extended maternal care”, “opportunistic foraging” and “forming of alliances”.

This study was carried out in a 1700 ha area of Amazonian forest (2°59'42.00" S, 60°7'16.40" W), located above the Amazon – Solimões River, Brazil. The area has belonged to the Living Rainforest Foundation (LRF) since 1991 and is an *ex situ* conservation area for woolly monkeys that have been illegally exploited. From March to June 2013 (9 days/month), we investigated 18 grey woolly monkeys. Observations were made from 08h00 to 11h00 and from 13h00 to 16h00 with 288 cumulative hours of fieldwork. Over the course of the study, animals were being systematically observed through scan sampling method, with five minute intervals between scans (Altmann 1974). Focal animal sampling (Altmann 1974) was also used, with three focal sessions of 3 min/day for each individual, with at least 30 min between sessions. However, rare behaviours such as the breastfeeding events reported here were recorded *ad libitum*. This group was provisioned twice a day by LRF staff, once at 11h00 and again at 16h00; nevertheless, they could leave the provisioning area *ad libitum*. Also, since there was no barrier between the LRF area and the neighbouring forest, the group lived freely in the wild. Individuals were divided into four different sex–age classes, based on size and sexual maturity (Moro-Rios et al. 2009). The group consisted of seven adults, three subadults, five juveniles and three infants. From our observations (and with the help of the LRF staff), we were able to determinate the hierarchy and age of the group's individuals (Table 1). We determined dominance (Table 1) based on the order provisioned food was accessed. Whenever a higher-ranking individual arrived at the provisioning site, subordinates were consistently pushed aside or left the location.

The experiences and circumstances of older individuals prior to entering the LRF rehabilitation centre are unknown. However, the subadult male “Tchutchanco” (~6 years old, Table 1) was born within the LRF area and raised under natural conditions by his biological mother. Nevertheless, provisioning by LRF staff meant continued contact with humans. This allowed for observation of behaviours that would not otherwise be seen in fully natural conditions (Hosey, 2005).

Five breastfeeding events between adults were reported in detail over the course of four months (Table 2; Fig. 1). The duration of the breastfeeding events ranged from 10 to 90 s (mean: 46 s ± 40.9SD).

In all situations the males were the initiators of the breastfeeding. The females involved were relaxed and did not resist male approaches (Fig. 1). Other group members continued in their regular activities i.e. foraging, moving, playing and resting. These breastfeeding events involved more than one female and male in the study group and were observed five times in four months of fieldwork, suggesting that this behaviour is not rare in the species. Nevertheless, the background of the alpha male (~8 years old) is

Table 1

Hierarchy of the grey woolly monkeys present in the Living Rainforest Foundation at the time the study was made. A: Adult, S: Subadult, J: Juvenile, I: Infant, F: female, M: male.

Ranking	Individuals	Age and sex class	Estimated age in years ^a
1st	Tony	AM	8
2nd	Tchutchanco	SM	6
3rd	Carlinha	AF	9
4th	Aninha	AF	15
5th	Lilica ^b	AF	10
6th	Bruninha ^b	AF	9
7th	Eduarda	AF	9
8th	Nacy ^b	AF	7
9th	Joncleia	SF	3
10th	Lua	SF	3
11th	Eduardo	JM	2
12th	Trento	JM	2
13th	Artémio	JM	2
14th	Inoman	JM	2
15th	Gordita	JF	2
16th	Luci	IF	<1
17th	Mariano	IM	<1
18th	Mara	IF	<1

^a The age of the individuals is based on LRF records (i.e. estimated according to the body size and time the monkeys arrived in the area).

^b Females with infants.

unknown. For woolly monkeys, reaching captivity as infants usually means the mother was poached for bush meat (Peres, 1991). Traumatic experience in infant primates may lead to behavioural deficiencies in adulthood and even pathologies (e.g. Laudenslager et al., 1982; Coe et al. 1989; Jovanic and Maestripieri, 2010; Feng et al. 2012). Thus, the possibility that the suckling behaviour of the alpha male is a behavioural abnormality cannot be ruled out. Breastfeeding only occurred with the males as the initiators. Also, the males only tried suckling from lactating females.

There are cases of extended maternal care for the males of several species. For elephants, mothers can nurse infant males for longer periods than infant females, possibly enhancing their future mating success (Lee and Moss 1986). Preferential maternal care of the male offspring, even after weaning, is relatively common in polygynous red deer groups (Clutton-Brock et al. 1984; Stanley and Shultz, 2012). In guinea pigs, biological or adoptive mothers can reduce infant stress levels by breastfeeding, even after they become adults (i.e. >50 days old) (Hennessy et al. 2002). Although this “extended maternal care” hypothesis may apply to many mammal species, it may not apply to the studied grey woolly monkeys, where the females were too young to be a possible mother of either



Fig. 1. Female breastfeeding the alpha male, while her infant climbs on the male's back.

Table 2
Breastfeeding events between adult grey woolly monkeys present at the Living Rainforest Foundation, during March–June 2013.

Date	6th March	14th March	1st May	24th May	20th June
Female	Bruninha	Bruninha	Bruninha	Lilica	Lilica
Female age (yr)	9	9	9	10	10
Offspring age (mo)	2	2	3	2	3
Male	Tony	Tchutchanco	Tony	Tony	Tony
Male age (yr)	8	6	8	8	8
Duration of the event (s)	90	10	30	10	90
Female response	Relaxed	Relaxed	Relaxed	Relaxed	Relaxed
Offspring response	Climbed to male's back	Moving close-by	Moving close-by	Moving close-by	Moving close-by

of the males (Table 1). Also, the alpha male was breastfed by two different females.

“Opportunistic foraging” behaviour by males is an alternative hypothesis to be explored. Optimal foraging theory assumes energy intake as the most important principle for food choice (e.g. Charnov 1976) and previous studies suggested that opportunism plays an important role in evolution (McKenna 1979; Heiduck 1997). Nevertheless, the small amount of breastfeeding time (90 s, at most) and its apparent low frequency seem to downplay this hypothesis, which deserves a more complete approach and further testing.

Adult females may receive social benefits (e.g. improved social bonds, increased social status or reduced harassment) by providing allomaternal care to infants of other females (review at Baldovino and Di Bitetti 2008). Alternatively, our study's females may be using breastfeeding to move up the hierarchy, through alliances with the higher-ranked males. If this hypothesis holds true, one should expect “adult male breastfeeding” to be more directed towards top-ranking males as also observed in *Lagothrix lagothricha*, common woolly monkey, in Colombia (Nishimura 1994). None of the study male juveniles (i.e. lower ranking males – Table 1) were seen being breastfed by females other than their mothers. However, it should be noted that females might not resist breastfeeding males simply because of their higher rank. Mating rate seems to be positively related to dominance in male *L. lagothricha* (Nishimura 1994). Finally, breastfeeding behaviour was only seen in the study subadult male once, which could imply imitation/copying behaviour. Imitation has been reported in both Old and New World primates and may be a fundamental form of social learning (e.g. Kumashiro et al. 2003; Perry 2011). Further systematic and long-term observations of this and other populations of woolly monkeys would help to bring additional insights about the evolution of breastfeeding behaviour between adult non-human primates.

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