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BRIEF REPORT

Births in Wild Black and Gold Howler Monkeys (*Alouatta caraya*) in Northern Argentina

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Previous studies on births in nonhuman primates suggest that births are expected to occur at night to avoid predators. Here, we describe birth-related behaviors in wild black and gold howler monkeys, *Alouatta caraya* and address the various ideas proposed in the literature about the timing of births in group-living nonhuman primates. We collected data on females' birth-related behaviors through continuous focal observations and scan samples. Focal observations on females giving birth were taken for the remainder of the day after noticing a female was in labor. We recorded behaviors and the spatial distribution of the whole group using scan samples taken every 10 min from sunrise to sunset the same day of birth. We recorded five births at the continuous forest (CF) over a 25 months period (January 2004–December 2004 and September 2005–September 2006) and two births in the fragmented forest (FF) over a 13 months period (September 2005–September 2006). From these, four births were during daylight (two at CF and two at FF) and three during the night at CF. Our descriptions of *A. caraya* births contribute to a growing data set on the timing of parturition in wild nonhuman primates and suggest that a clear pattern of nocturnal births is not universal across nonhuman primate species. Am. J. Primatol. 71:261–265, 2009.

Key words: *Alouatta caraya*; black and gold howler monkey; parturition behavior; wild birth; Argentina

INTRODUCTION

Previous studies on births in diurnal nonhuman primates suggest that births are expected to occur at night [Jolly, 1972]. Natural selection may favor mechanisms that couple the time of birth to the most appropriate phase of the daily activity cycle (resting or sleeping time) to avoid potential interference of hostile congeners or predators [Honnebier & Nathanielsz, 1994]. Births occurring at night time may give the mother certain advantages including the avoidance of excessive attention that social group members give to the newborns or the possibility of avoiding potential group displacements during or immediately after parturition [Bowden et al., 1967; Jolly, 1972; Nowell et al., 1978]. Because most reported births in free-ranging primates occur during the night and high in the forest trees (arboreal primates), descriptive behaviors before, during, and immediately after parturition are still limited or scarce [Dias, 2005].

Although nocturnal births are proposed to be the general pattern across nonhuman primate species, daytime births have been reported in several primate species such as *Erythrocebus patas* [Chism et al., 1983], *Papio cynocephalus* [Condit & Smith, 1994], *Saguinus imperator* [Windfelder, 2000], and *Lemur catta* [Takahata et al., 2001]. In *Alouatta*, records of births in wild populations are only available for *Alouatta seniculus* [Sekulic, 1982], *A. palliata* [Dias, 2005; Moreno et al., 1991; Nisbett & Glander, 1996], and *A. belzebul* [Camargo & Ferrari, 2007].

We report four cases of births that occurred at daylight and three births that occurred during the night in four groups of wild *A. caraya*. *A. caraya* is a species of leaf and fruit eating New World primate, sexually dimorphic, and sexually dichromatic [Cabrera, 1939; Crockett & Eisenberg, 1987; Milton, 1998] and it reaches the southernmost distribution of New World primates in Argentina [Wolfheim, 1983].

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METHODS

Study Site

The births were observed during a long-term study on the behavior and ecology of several groups of black and gold howlers in two different sites in northern Argentina. One of the sites is ''Isla Brasilera'' (192 ha) located near the confluence of the rivers Paraná and Paraguay (27° 18′ S, 58° 38′ W). This island does not have permanent human settlement and is covered by a continuous flooded forest (CF). The primate's ecological density is 3.25 individual/ha [Kowalewski & Zunino, 2004] and the groups usually overlap their home ranges up to 60–70% of their areas [Kowalewski, 2007]. The other site is ''San Cayetano'' (306 ha). This site presents a fragmented forest (FF) under continuous deforestation on the basin of the Río Riachuelo (27 30′ S, 58° 41′ W). The FF area has 24 identified fragments, with an average area = 9.24 ha, SD = 7.62 ($N = 24$ fragments), the fragments range from 1.44–29.31 ha, and the average distance between fragments is 1763.15 m, SD = 538.7 ($N = 11$ fragments) [Oklander, 2007]. The ecological density at this site is 1.04 individual/ha and in general, there is one howler group per fragment [Zunino et al., 2007]. The sites are located 20 km from each other and both have a subtropical climate with an average annual temperature of 21.6°C and an annual average of rainfall of 1200 mm [Rumiz et al., 1986]. For a more complete description of these sites see Kowalewski and Zunino [2004] and Zunino et al. [2007].

Study Subjects and Methods

We recorded five births at the continuous forest (CF) over a 25 months period (January 2004–December 2004 and September 2005–September 2006) and two births in the FF over a 13 months period (September 2005–September 2006). From these, four births were during daylight (two at CF and two at FF) and three during the night at CF. The first one (Continuous forest daylight birth (CFD1)) occurred in a group of four individuals (one adult male, two adult females, and one juvenile male) and the mother was multiparous (Table I). CFD1's female was approximately 5 m away from the observers. The second birth (CFD2) occurred in a group of 11 individuals (two adult males, four adult females, two subadult males, one subadult female, one juvenile female, and one infant). Mother's age and parity is not available (Table I). CFD2 occurred approximately 14 m away from the observers. Two daylight births occurred at FF (Fragmented forest daylight birth (FFD1) and FFD2) in the same group and involved the same multiparous female. The group changed composition through time. During the first birth, the group was composed of three individuals (one adult male, one adult female, and one juvenile male); and during the second birth, of four individuals (one adult male, one adult female, and two juvenile males). The FF female was approximately 12 m away from the observers during FFD1 and 5 m during FFD2.

We recorded behaviors and spatial distributions of the whole group through scan sampling [Altmann, 1974] every 10 min from sunrise to sunset the same day of birth (except for the CFD2 birth, when observations commenced 11 min before birth occur) and the day after births (except for CFD2 and FFD2 births). Scan sampling allowed knowing the spatial distribution of group members during the births. Continuous focal observations [Altmann, 1974] on females giving birth were taken for the remainder of the day after noticing a female was in labor. Behavioral categories used in birth description were based on those used for others *Alouatta* wild births [Dias, 2005; Sekulic, 1982]. For each birth, we recorded height above ground, and then we assigned each height to a particular forest stratum. We

TABLE I. Summary of Observed Day and Night Births in *Alouatta caraya* in this Study.

Female	Mother parity	Site	Group composition	Date	Time	Height	TSF	DBS
CFD1	Multiparous	IB	1 AM, 2 AF, 1 JM	27 July 2006	5:45 pm	4 m	23 min	15 m
CFD2	Multiparous	IB	2 AM, 4 AF, 2 SAM, 1 SAF, 1 JF, 1 I	20 September 2007	4:46 pm	13 m	20.7 min	50 m
FFD1	Multiparous	SC	1 AM, 1 AF, 1 JM	23 September 2006	6:52 pm	9 m	10.4 min	120 m
FFD2	Multiparous	SC	1 AM, 1 AF, 2 JM	24 September 2007	11:59 am	4 m	36.1 min	20 m
CFN1	Nulliparaous	IB	3 AM, 3 AF, 1 SAF, 1 IM, 1 IF	Night of 24 September/ 25 September 2004	NIA	NIA	NIA	NIA
CFN2	Multiparous	IB	1 AM, 3 AF, 1 JM, 1 JF, 1 IF	Night of 11 May/ 12 May 2006	NIA	NIA	NIA	NIA
CFN3	Multiparous	IB	2 AM, 3 AF, 1 JM, 1 JF, 2 IF	Night of 20 September/ 21 September 2006	NIA	NIA	NIA	NIA

References. Female: CFD (Continuous forest daylight birth), CFN (Continuous forest night birth), FFD (Fragmented forest daylight birth). Site: IB (''Isla Brasilera'', 27° 18′ S, 58° 38′ W); SC (''San Cayetano'' 30′ S, 58° 41′ W). Group composition: AM (adult male/s), AF (adult female/s), SAM (subadult males), SAF (subadult female), JM (juvenile male/s), JF (juvenile female), I (infant), IM (infant male), IF (infant female/s). TSF: Time started foraging after birth (minutes). DBS: Distance birth site-resting site (meters). NIA: No information available.

defined forest stratum considering vegetation studies at both sites [Kowalewski, 2007, Peker unpublished data] as follows: Low stratum: 0–6 m, Middle stratum: 6–9 m, and High stratum: 9–16 m.

The three other births took place during the night at CF in the same group. This group also changed composition through time. During Continuous forest night birth (CFN1), the group was composed of nine individuals (three adult males, three adult females, one subadult female, one infant male, and one infant female); during CFN2 of seven individuals (one adult male, three adult females, one juvenile male, one juvenile female, and one infant female), and finally during CFN3, nine individuals (two adult males, three adult females, one juvenile male, one juvenile female, and two infant females) (Table I). CFN1 and CFN3 are from the same mother (she was nulliparous when CFN1 occurred). CFN2 is from a multiparous mother (Table I). We recorded behaviors of the whole group through scan sampling every 10 min from sunrise to sunset the day before and the day after births occurred. Focal observations on the new mothers' behaviors were taken the day after birth. Data on the exact time of birth is not available. The study complies with the current laws of the country in which it was conducted (IACUC protocol ♯01071).

RESULTS

Description of Observed Births

Birth 1, CFD1, 27 July 2006, daylight: prepartum behaviors included squatting position and anogenital self-examination. During the birth, the female was approximately 17 m from the rest of her group on a *Cecropia pachystachya* branch, 4 m above ground (low stratum). The mother took a squatting posture during parturition and assisted the delivery with her left hand taking out the infant toward her ventrum. The infant was born at 5:45 pm, 5.4 min after first appearing at the vulva. The mother started eating the placenta 5.2 min after the birth (including licking the blood off her fingers), and it was completely ingested 47 min after parturition. The female started foraging *Ocotea diospyrifolia* leaves (not phenophase information available) 23 min after parturition, and the infant nursed for the first time 67 min after being born. During birth the rest of the group were resting 18 m away from the female giving birth. The mother entered into the night sleeping tree 38 min after parturition. This birth occurred relatively near (approximately 15 m) the sleeping night site and in sight of the other members of the group. The mother accepted the inspection of her infant by the other adult female of the group the day after parturition.

Birth 2, CFD2, 20 September 2007, daylight: Prepartum phase started before we began to register behaviors. Prepartum behaviors included squatting position and touching of the vulva (before and during birth). The female was situated 40 m from the rest of the group on a *Banara arguta* branch 13 m above ground (high stratum). The mother assisted the delivery with her right hand (her left hand was clinging to the branch). The infant was born at 4:46 pm, 7 min after first appearing at the vulva. The mother started eating the placenta 5.3 min after the birth and it was completely ingested 8.8 min after parturition. She cleaned herself licking the blood off her fingers, arms, and legs. The female started foraging on new leaves of *B. arguta,* 20.7 min after parturition, and the mother placed the newborn in nurse position 11.5 min after birth. During birth the rest of the group were moving 40 m away from the female giving birth. The mother entered the sleeping tree 146.7 min after parturition. The birth took place approximately 50 m from the group night sleeping site. On the day of birth, other members of the group did not inspect the infant. Our observations stopped at night and we have no record of what happened the following day.

Birth 3, FFD1, 23 September 2006, daylight: prepartum behaviors included squatting position (before and during birth), touching of the vulva, and smelling and licking of hands. During the birth the female was situated on a *Ficus luschnathiana* branch 9 m above ground (medium stratum). The nearest neighbor during birth was the adult male (6 m). The mother assisted the delivery with her right hand. The infant was born at 6:52 pm, 4 min after first appearing at the vulva. She started eating the placenta 13.7 min after the birth and completely ingested it 23.8 min after parturition. She started cleaning (licking) her arm, hand, and vulva 15.8 min after giving birth. The mother resumed foraging behavior (*F. luschnathiana* new leaves) 10.4 min after parturition. The mother placed the newborn in nurse position 2.3 min after birth. During birth the rest of the group were moving (AM 8 m and JM 10 m away from the female giving birth). Following the birth, the rest of the group started moving to the resting site. The mother entered into the night sleeping tree 33.6 min after parturition. The birth site was located approximately 120 m from the sleeping tree. Inspection of the infant by other members of the group (juvenile male tried to touch the infant) took place the day after parturition. The FF female did not have a permissive behavior.

Birth 4, FFD2, 24 September 2007, daylight: prepartum behaviors included squatting position and touching of the vulva. During birth, the female was situated approximately 12 m from the rest of her group and 5 m from her 1–year-old son, on a *Nectandra falcifolia* branch, 4 m above ground (low stratum). This female urinated repeatedly before giving birth. She took a squatting position and assisted the delivery at first with her right hand and then with both hands. The infant was born at

11:59 am 5.6 min after first appearing at the vulva. The mother started eating the placenta 7.3 min after the birth (also licking the blood off her hands and arms), and it was completely ingested 1 min after parturition. Then she ate the umbilical cord. She resumed foraging behavior (vine new leaves) within 36.1 min after parturition. The infant nursed for the first time 2.6 min after being born. She started licking the newborn 0.6 min after birth, and exploring the infant 6.2 min after birth. During birth a juvenile male (1–year-old) was moving 5 m away from the female, the rest of the group were resting 12 m away from the female. The mother entered into the night sleeping tree 440.7 min after parturition. The birth occurred 20 m from the sleeping site. There was no inspection of the infant by other members of the group. Our observations stopped at night and we have no record of what happened the following day.

Birth 5, CFN1: the night of 24 September/25 September 2004. At 11:29 am (25 September 2004), the mother was holding the female infant with one hand (apparently, the infant could not cling to the mother). The infant slipped out and fell 8 m to the ground (9:05 am). The mother came to the ground, picked up the infant, and returned to the tree. After 36 min the infant fell again, the mother picked her up again, and immediately the infant fell to the ground. The mother picked up the infant and climbed 6 m into a nearby tree. Although she was resting, the mother sniffed and touched the infant. At 12:44 am, the infant fell again but this time the mother didn't pick her up. The infant did not survive.

Birth 6, CFN2: the night of 11 May/12 May 2006.

Birth 7, CFN3: the night of 20 September/21 September 2006.

Six infants out of seven reported in this study survived and developed normally (last census information was obtained in March 2008). The infant described in Birth 5, CFN1, died on the same day it was born.

DISCUSSION

We reported seven births in two groups of wild *A. caraya* inhabiting two different kinds of forests located 20 km from each other. Our observations show that from seven registered births four occurred during daytime. These results resemble accounts presented in the literature for other *Alouatta* species: *A. belzebul* [Camargo & Ferrari, 2007], *A. palliata* [Dias, 2005; Moreno et al., 1991; Nisbett & Glander, 1996]. The four diurnal birth observations are insufficient to speculate on a species or population particular pattern of daytime parturition. However, we suggest some potential advantages of given birth during daylight. Although there are potential advantages of nocturnal births such as avoiding the potential risk of straying from other group members, and escaping harassment by other members or predators toward the newborn infant [Bowden et al., 1967; Honnebier & Nathanielsz, 1994] several diurnal births have been reported for *Alouatta* [Camargo & Ferrari, 2007; Dias, 2005; Moreno et al., 1991; Nisbett & Glander, 1996; Sekulic, 1982].

Predation pressure may influence the timing of births in different species [Honnebier & Nathanielsz, 1994]. In this regard, we have registered both diurnal and nocturnal potential predators at both sites. These predators include carnivores: domestic dogs (*Canis domesticus*), yaguaroundi (*Herpailurus yagouaroundi*), and Pampa's fox (*Pseudolapex gymnocercus*); and raptors: savanna hawk (*Heterospizias meridionalis*), turkey vulture (*Cathartes aura ruficollis*), bay-winged hawk (*Parabuteo unicinctus unicinctus*), and peregrine falcon (*Falco peregrinus*). However, we never detected a predation event on any of the groups we have studied (possibly related to the presence of researchers). Miranda et al. [2006] described antipredatory behaviors in *A. guariba clamitans*. These behaviors included individual moving to the lower strata of the forest to evade aerial predators. In our study, the height position of the mother during daylight births did not show a clear pattern (CFD1 and FFD2: low stratum, CFD2: high stratum, and FFD1: medium stratum, see Table I). In this regard, we cannot suggest any relationship with aerial predator avoidance. In total one birth occurred at noon, one during the afternoon, two in the late afternoon shortly before dusk, and three during the night (Table I). Although the data set is limited, we suggest that the timing of births may not be clearly related to predator avoidance.

Another evolutionary pressure for nighttime births is escaping harassment toward the newborn from other group members. In contrast with this idea, in all the births reported here other group members did not react aggressively with the infant. Additionally, on the day of birth, other group members did not inspect the infant. This lack of interest of other members of the group to the newborn was also described for *A. palliata* [Moreno et al., 1991] and *A. belzebul* [Camargo & Ferrari, 2007]. These results are consistent with those reported for *Alouatta* [Camargo & Ferrari, 2007; Dias, 2005; Moreno et al., 1991; Nisbett & Glander, 1996; Sekulic, 1982], where no aggressive reaction of other group members were reported the day of birth.

Other proposed factor acting upon the timing of births is the energy invested in such event. Nagy & Milton [1979] suggested that howlers would show behaviors associated with energy conservation to cope with problems of a leaf-eating diet (i.e. long periods of inactivity and the avoidance of sudden movements or rapid travel). Additionally, Sekulic [1982] suggested that howler monkeys are less constrained by selection against giving birth during

the day, because of their energetically conservative feeding ecology, which allows recent mothers to continue to be in contact with the group and nurse their newborns without interruption of group travel. All mothers in this study resumed foraging behavior soon after giving birth (Table I). In this regard, we propose that diurnal births also allow recent mothers to feed immediately after giving birth as a possible recovery of energy. However, it is not clear what mothers do after giving birth during the night. Our results show that both night and day births occurred in these populations and there is not a clear pattern of birth timing.

Most of birth reports in the literature describe nocturnal births [Jolly, 1972]. However new studies, including this work, have shown that this pattern is not clear across nonhuman primate species. More information on wild births is needed to provide a better understanding of primate delivery behavior. Our observations and description of *A. caraya* wild births increase the available data set and indicate that both daily and nightly births occur in this species.

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