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ADOPTION OF AN ORPHAN INFANT IN WILD BLACK AND GOLD HOWLER MONKEYS (*Alouatta caraya*)

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ABSTRACT: This study reports the first case of adoption in a wild group of black and gold howler monkeys (*Alouatta caraya*). After the death of one adult female with a dependent infant, her daughter with a dependent infant adopted the orphan of similar age of her own infant. We recorded the activity and proximity between the adopter and both infants during two following days. The adoptive female appeared to provide equal treatment toward both infants and the orphan seemed to recognize the female as his mother. This report suggests that adult females of *A. caraya* can rear two infants at once.

RESUMEN: Adopción de un infante huérfano en monos aulladores negros y dorados (*Alouatta caraya*). En este estudio se cita el primer caso de adopción en un grupo silvestre de monos aulladores negros y dorados (*Alouatta caraya*). Luego de la muerte de una hembra adulta, su hija adoptó al infante huérfano de similar edad que su propio infante. Durante dos días seguidos registramos la actividad y proximidad de la hembra adoptiva y los dos infantes. La hembra adoptiva expresó igual trato hacia ambos infantes y el infante huérfano parecía reconocer a la hembra como su propia madre. Este estudio sugiere que hembras adultas de *A. caraya* pueden criar dos infantes a la vez.

Key words. Adoption. Alloparental care. *Alouatta caraya*. Kin selection. Orphans.

Palabras clave. Adopción. *Alouatta caraya*. Cuidado aloparental. Huérfano. Selección por parentesco.

Infant adoption is a permanent association between a lactating female and a nutritionally dependent infant other than her offspring (Maestripieri, 2001). Several factors influence both the likelihood and the permanence of adoption, including age, sex, kinship, ecological conditions, and in the case of adoptive females, reproductive status (Thierry and Anderson, 1986). Adoption may be interpreted as a cooperative behavior explained by kin-selection if relatives adopt the infant (West-Eberhard, 1975) or reciprocal altruism if the adoptee provides future social support for the adoptive female (Trivers, 1971; West Eberhard, 1975). However adoption can be interpreted as a selfish behavior of the adoptive mother if she uses this opportunity either to practice maternal skills (Lancaster, 1971) or to reduce the fitness of rival females (Silk, 1980).

Adoption of infants has been reported in several mammalian species including non-human primates (Riedman, 1982; Thierry and Anderson, 1986). In the genus *Alouatta*, adop-

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tion has been documented in *A. palliata* (Clarke and Glander, 1981), *A. pigra* (Schneider et al., 1999), and *A. seniculus* (Figueroa, 1989; Izawa, 1989; Agoramoorthy and Rudran, 1992). In this study we document the first case of adoption reported for wild black and gold howler monkeys (*Alouatta caraya*). *A. caraya*, like other species of howler monkeys, is a folivore-frugivore arboreal and diurnal primate characterized by bisexual dispersal (Crockett and Eisenberg, 1987; Di Fiore and Campbell, 2007). In the case of *A. caraya* the adults are sexually dichromatic and sexually dimorphic (Di Fiore and Campbell, 2007).

The study site is Isla Brasilera (27° 18' S; 58° 38' W) in Northern Argentina characterized by a continuous flooded forest and located near the confluence of the rivers Paraná and Paraguay (Kowalewski and Zunino, 2004). A more complete description of the site is provided in Kowalewski and Zunino (2004). The case of adoption was observed on September 12, 2008. Prior to the adoption in August, 2008, the study group had 12 individuals (one adult male, three adult females, two subadult females, one juvenile female, three juvenile males, and two infants). This group was continuously studied since 2001 (Kowalewski and Zunino, 2004; Kowalewski, 2007; Oklander, 2007; Peker et al., 2008) and individuals were identified by body size, pelage colors, and natural and artificial marks. The maternal kinship of the infants and juveniles was known (Kowalewski, 2007; Oklander, 2007; Pavé pers. obs.). Two out of three resident adult females (Josefa and Gorda) were mother and daughter respectively. Gorda was a juvenile of less than two years old when behavioral data collection began on this group and there was a strong affiliative association (maternal care, time in contact, and grooming interactions) among them in comparison to other female-female dyads (Ana and Gorda) (Kowalewski, 2007; Oklander, 2007). The two infants belonging to Josefa and Gorda were born in July, 2008. The infant of Josefa was born approximately 10 days before the infant of Gorda. Behavioral observations began the day after finding the remains of Josefa. Focal and instantaneous point samples techniques were employed during two following days. Continuous focal observations on the adoptive female and both infants simultaneously were taken from sunrise to sunset to record the activity and proximity between the three individuals (Altmann, 1974). Instantaneous point samples were taken every five min during the focal sample. We obtained 22.45 h of focal samples and 258 instantaneous point samples.

On September 12, 2008 (15:43) we found the head of an adult female (Josefa) within the home range of the study group. The other female with a dependent offspring (Gorda) was carrying her own infant (i1) and the infant of Josefa (i2). Josefa was a multiparous adult female when she was studied for the first time in 2001 (Oklander, 2007), and we assume that she was at least 13 years old when she died for unknown causes. On September 13, 2008 (06:45) we began to record the behavior in this group. Because both infants were males of similar age (approximately two months old) and size, it was not possible to distinguish them most of the time.

Gorda was observed during 59.7 % (N=154) of the instantaneous point samples in contact with both infants when she was resting, feeding, moving, and grooming the infants. In the remaining 40.3% (N=104) of the time the infants were feeding, moving, exploring, playing together, and interacting with other group members. During feeding, Gorda carried both infants (in dorsal, ventral, and lateral position) or the infants were feeding, exploring, and playing between 0 and 1 m distance from her. During moving, Gorda carried both infants (in dorsal, ventral, and lateral position) and just on two occasions, she carried one infant while the other one followed her (**Fig. 1**). In addition, Gorda spent 18.6% (N=48) of the instantaneous point samples (or 3.3hs of observation) nursing the infants and on 18 occasions during the focal, she simultaneously nursed both infants. On seven occasions during the focal the infants fought (screamed and tried to move the other away from the nipple) when they attempted to suckle on the same nipple.

Fig. 1. The adopter female moving with both infants in dorsal position (Photo by R. Pavé).

On one occasion during the focal in which i2 was suckling, Gorda pushed her own infant (i1) away when it attempted to suckling.

One or both infants interacted with the other group members and this accounted for 4.65% (N=12) of the instantaneous point samples. The interactions included: dorsal carrying, grooming the infants, playing with infants, and touching and biting the infants. Dorsal carrying was observed just on one occasion when the subadult female Ema (non-relative to Gorda) carried one infant that stayed behind when Gorda moved away to feed. The individuals who groomed the infants were juvenile and subadult females. On four occasions during the focal, Gorda behave as a restrictive mother either by placing her body between the infant and her three year old daughter Charlie or subadult Ema or by retrieving the infant from them.

Spontaneous adoptions in non-human primates both in wild and captive groups suggest that neonates are most likely to be adopted by adult females who had recently lost their infants or lactating females that adopt an additional infant and rear "twins" (i.e. Thierry and Anderson, 1986; Izawa, 1989; Gould, 2000; Casar and Young, 2008). Thierry and Anderson (1986) suggested that hormonal conditions associated with late pregnancy and lactation appear to potentiate adoptive tendencies in adult females. Moreover, several studies reported that infants less than three months old had been adopted or kidnapped by adult individuals (Agoramoorthy and Rudran, 1992; Agoramoorthy, 1998; Biedzicki de Marques and Ades, 2000; Gould, 2000).

In this study, the adoptive female expressed the general adoptive behavioral patterns suggested by Thierry and Anderson (1986): nursing, carrying and cuddling, and protecting. Because she had an infant of her own, she simultaneously carried and nursed both infants. Agoramoorthy (1998) reports a case of a female of *A. seniculus* simultaneously carrying her own twins as well as an alien infant. The adopter appeared to provide equal treatment toward both infants and she protected both when other individuals attempted to take the infants away from her. Similarly, the adoptee seemed to recognize the adult female as his mother. This observation coincides with such cited in Thierry and Anderson (1986).

This adoption cannot be attributed to gaining parental experience (Lancaster, 1971) or reducing the fitness of rival females (Silk, 1980) because the adoptive female (Gorda) was multiparous and the biological mother of the infant (Josefa) died. We suggest that this adoption event may be explained by kin selection (West-Eberhard, 1975). Adoption is possibly a costly behavior because it causes the adoptive female to concurrently invest in an extra infant; however a female adopting her young brother may increase her inclusive fitness if both infants survive. In this regard we suggest that the benefits obtained through the adoption of a relative outweigh the costs of investing in rearing an extra infant. Examples of adoption of relatives, although rare, have been reported for different species of non-human primates such as *Alouatta seniculus* (Izawa, 1989; Agoramoorthy and Rudran, 1992), *Lemur catta* (Gould, 2000), *Presbytis entellus* (Dolhinow and DeMay, 1982), and *Saimiri sciureus* (Scollay, 1978).

This study shows that adult females of *A. caraya* like other *Alouatta* species can adopt infants and rear more than one infant at once. The adopted infant in our study was in June 2009 eleven months old and both adopter and

adoptee seem to behave as biological mother and offspring. Finally, we ignore if the reproductive cost of raising two young infants is high to affect the interbirth interval (IBI) of the female. Agoramoorthy and Rudran (1992) reported an increase of five months in the IBI of a female who adopted an extra infant. In this regard, we suggest that the cost of raising two infants may be overridden by the benefits that this investment produces.

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