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SHORT ARTICLES

MALE CARE IN MANTLED HOWLER MONKEYS (*ALOUATTA PALLIATA PALLIATA*)

Eugenia Zandonà

Introduction

Adult male-immature interactions in non-human primates range from aggressive displays – their extreme expression being infanticide (Bartlett et al., 1993) – agonistic buffering (Taub, 1980), tolerance or indifference (Baldwin & Baldwin, 1973) to affiliative and caretaking (Riedman, 1982; Buchan et al., 2003). In some monogamous species such as tamarins and marmosets (reviewed in Riedman, 1982), males participate in parental care almost as frequently as mothers. Indeed in these species, the adult males' reproductive efforts include parental care – (mainly expressed in infant transportation)- and not just mating costs as in polygamous species (Key & Aiello, 2000). Some forms of paternal care, particularly protection from danger, are also seen in polygamous species (e.g. savannah baboons, *Papio cynocephalus*; Buchan et al., 2003).

In the genus *Alouatta*, cases of infanticide by males have been reported following group take-overs (Clarke, 1983;

Agoramorthy & Rudran, 1995; Knopff et al., 2004). Nevertheless, tolerant, playful, and protective behaviors toward infants and juveniles are more common than agonistic activities (Baldwin & Baldwin, 1973; Clarke, 1986). In this paper I report on male care of an immature mantled howler monkey (*Alouatta palliata palliata*) orphan, and discuss whether it can be viewed in terms of paternal care or adoption.

Methods

The observations reported here were recorded during a study of the behavioral ecology of four groups of mantled howler monkeys in the Sector Santa Rosa of the Area de Conservación Guanacaste (ACG) in Costa Rica (Fig. 1). The study area is a tropical dry forest with patches of semi-evergreen forest at various stages of succession, characterized by distinct wet and dry seasons (Janzen, 1986), with an annual rainfall of ~1,500. The study group was observed during a more extensive behavioral research project covering three field periods over a total of 15 months: 1) from September to November 2003, the infant's mother was still in the group; 2) from April to August 2004, interactions occurred between the immature orphan and the immature-adult male and 3) from April to October 2005, when the immature was already independent. Rare behaviors and unusual social interactions, such as those described here, were recorded *ad libitum* and "all occurrences" recording (sensu Martin and Bateson 1993), thus an exact and detailed

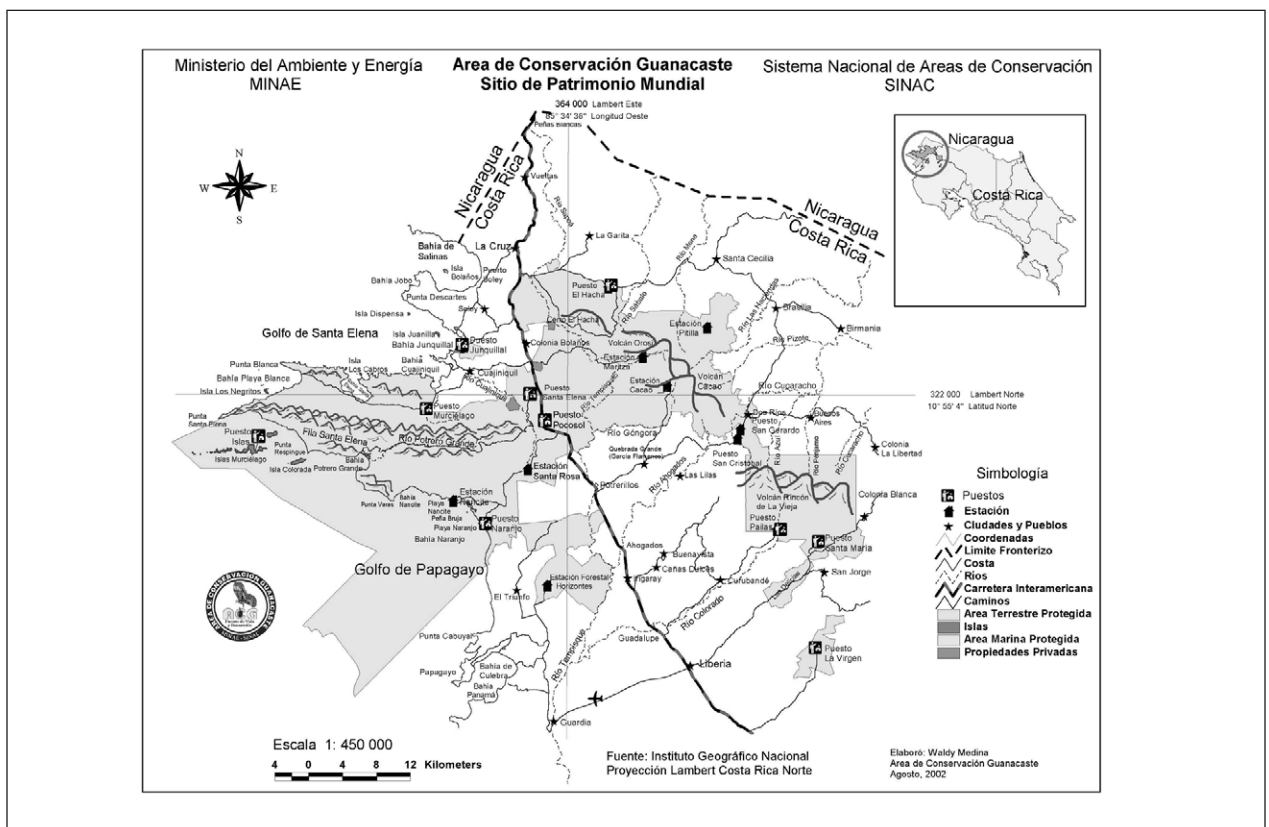


Figure 1. Map of the study site, the Area de Conservación Guanacaste (ACG) in Costa Rica. (Map credit Wally Medina, ACG).

account of the behavior was recorded. Group composition and details of the sampling and recording methods for data collection during the three field periods are presented in Table 1. It was possible to identify all group individuals via unique physical features such as light spots underneath their feet, scars, or clitoris shape.

At the beginning of the study, the group comprised 2 adult males, 4 adult females and 3 immature, however the two key individuals in this study were an adult male, CH, and a female infant, EV. CH was probably the elder of the two adult males, he had numerous facial wrinkles. EV's birth is estimated to have taken place in March or April 2003; so at the start of the study she was approximately 5–6 months old. When group observations resumed in 2004, EV was an orphan and her mother had disappeared from the group. Here I report on interactions between EV and CH during 2004. As the group was not the main focus of the overall research project during this year, it was followed for a shorter period (4 and 7 hours per day over 13 days) when compared to 2003 and 2005. Data reported here were collected *ad libitum* and recorded continuously (Altmann, 1974).

Results

During 2003, EV was still nursing and spending a large amount of time in proximity or in body-contact with her mother. In particular, while resting and sleeping, they were frequently in the mother-offspring resting (MOR) position, typical for an infant of EV's age. MOR is when the mother sits on her haunches on a support and the immature maintains ventral contact. In 2003, no interactions were recorded between CH and EV. By April 2004, EV was approximately 12–13 months old and an orphan, at this time she was observed interacting habitually with CH. During each of the 13 observation days, EV and CH were frequently seen resting in close proximity. On 17 occasions EV and CH were observed assuming the MOR posture, six times at sunrise, three at sunset and seven times during the day and once during a heavy rainfall event.

In the majority of cases, EV solicited that CH assume the MOR position, vocalizing, approaching him and crawling on to his body. In general, CH was passive during these interactions, simply allowing EV to attain body contact. However, on two occasions CH actively invited EV to assume the MOR posture, reaching out and pulling her gently towards him. The first event (30 Jun 2004) occurred when it was raining heavily, EV approached CH and started to emit distress calls; CH offered her protection, enabling her to position herself in ventral contact with him. The second time (23 Aug 2004), CH and EV were already in the MOR position, but after a few minutes CH removed EV, after which the infant started to produce distress calls and moved closer to CH, who then gently lifted her towards him, allowing her to return to the MOR posture. On several occasions, EV was observed following CH during travel, and feeding in close proximity to him. Play sessions were also recorded between these two individuals. No other adult was observed giving EV maternal/paternal care.

When the group was observed again in 2005, EV was 24–31 months old, she was completely independent and appeared to be healthy. She was never seen assuming the MOR posture with CH, however, affiliative interactions between the two individuals continued, mainly expressed through play (three records). EV was also seen playing with other juveniles and adult females. During the three years of observations (634 hours), EV was never observed interacting with the other adult male member of the group.

Discussion

Adult male howler monkeys are generally tolerant of infants and immatures, and have been recorded playing with them and allowing them to crawl on their bodies (Bolin 1981; Clarke, 1986). Males also occasionally baby-sit immatures when the mother moves away for short periods of time and they may also protect them in situations of potential danger (Clarke et al., 1998). Bolin

Table 1. Description of the sampling methods, group and orphan characteristics during the three years of observations for the study group. Sampling methods refer to all data collection for the study group during the larger behavioral project. EV: orphan; CH: adult male; M: adult male; F: adult female; I: immature; Fs: subadult female; MOR: mother-offspring resting posture.

Year	Sampling methods	Observation time	Group composition	EV's estimated age (months)	EV's condition	Interactions between EV and CH
2003	All occurrences, focal animal and <i>ad libitum</i>	33 days, 5–10 hr/d (Total=290 hrs)	2 M, 4 F, 3 I (Total=9)	~5–8	EV was still nursing and dependent on her mother	No interactions recorded
2004	All occurrences, <i>ad libitum</i>	13 days, 4–7 hr/d (Total=70 hrs)	2 M, 3–4 F, 3 I (Total=8–9)	~12–17	EV was an orphan	Numerous affiliative interactions were recorded, including MOR
2005	All occurrences, scan and <i>ad libitum</i>	30 days, 8–10 hr/d (Total=274 hrs)	2 M, 5 F, 2 Fs, 4 I (Total=13)	~24–31	EV was healthy and completely independent	Observed playing on 3 separate occasions

(1981) reported an increase in adult male-infant interactions with increased age of the infant in *Alouatta palliata pigra*, documenting that older infants (12 months or more, moderately independent of their mother) followed males during travel and foraged next to them. In 2004, EV and CH were observed both foraging and traveling in close proximity and playing together. However, the interactions between EV and CH were not limited to these contexts, CH undertook a role as paternal caregiver over longer periods. At night, and even during the day, they repeatedly assumed the MOR posture, which is normally restricted to the mother and infant. As infants mature (approximately 2 years in *Alouatta p. palliata*), this type of physical contact with the mother occurs less frequently, only during nighttime sleeping or heavy rainfall (pers. obs.). During these moments, older infants are still dependent on their mother for thermoregulation and protection from predators (Bicca-Marques & Calegare-Marques, 1998). EV was orphaned at around 8–12 months, an age when she probably still needed the protection of an adult and required parental care, especially at night. Without the care of another individual of the group, she may have died. CH provided exclusive care to EV and probably contributed to her survival.

In *Alouatta palliata*, likely fathers show different forms of paternal care, such as carrying, cuddling, watching, and sitting in proximity, and have never been observed showing aggressive behavior towards their probable offspring, but they can be violent towards non-related infants (Clarke 1986; Clarke et al., 1998). During the observation period (2003–2005), CH and another individual were the only two adult males in the group. In stark contrast to the close relationship shared by EV and CH, no interactions were ever observed between EV and the other male. Although the genetic relatedness of EV and CH was never tested, it is possible that CH was EV's father.

It has been demonstrated that in some non-human primate species males can recognize their offspring and provide them with paternal care (e.g. *Papio cynocephalus*; Buchan et al., 2003). CH may have recognized EV as his daughter and taken care of her when she became an orphan, thereby substituting her mother and providing her with atypical paternal care for the species. Guaranteeing the survival of EV would thereby optimize CV's reproductive effort and increase his fitness. Infant adoption is often dependent upon the persistence of the immature in soliciting adult care, the tenacity of the infant can affect its chances of survival (Clarke & Glander, 1981; Dolhinow & Taff, 1993; Gould, 2000). In the case reported here, the female infant was often observed closely following the adult male, and more importantly, actively soliciting body contact and adoption by the male of the MOR posture. EV's insistence appeared to have paid off and she was able to secure the parental care she needed.

Biedzicki de Marquez and Ades (2000) described the only known case of male adoption in the genus *Alouatta*, where infant persistence seems also to have played a considerable role in the positive outcome of the adoption. Nevertheless, the adoption they described followed the kidnapping of the infant from another group and was undertaken by an adult female and adult male (the only two mature individuals of the group). This is somewhat different to the case described here. The orphan's survival was probably due largely to the care and protection given by the adult male, promoted by the orphan's persistence and the possible paternity of the adult male, thus this can be viewed as a case of paternal care rather than adoption.

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A PRELIMINARY STUDY OF THE GENETIC DIVERSITY OF PYGMY MARMOSET *CALLITHRIX PYGMAEA* (PRIMATES: CEBIDAE: CALLITHRICHINAE) USING SHORT SEQUENCE REPEATS (SSR)

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Introduction

Genetic diversity is a major concern in conservation biology, the loss of genetic diversity is often associated with a reduction in reproductive fitness and a population decrease. Genetic diversity is required for populations to evolve and adapt to environmental changes that in present times are more frequent and more rapid due to anthropogenic factors (Frankham et al. 2003).

Primates play a fundamental role in the dynamics of tropical ecosystems. The pygmy marmoset *Callithrix pygmaea* is the smallest primate species in Ecuador and shows a high degree of specialization in habitat and diet (de la Torre et al. 2009). This specialization combined with the increase of human activities in tropical rainforests could drive pygmy marmoset populations to genetic bottle necks with the subsequent loss of genetic diversity. Almost nothing, however, is known about the genetic diversity of this species so we began a pilot study to evaluate the genetic diversity of 3 wild groups of pygmy marmosets in one population located on the margins of the Aguari-co River, in northeastern Ecuador. We developed a non-invasive protocol to obtain DNA samples from feces to characterize the genetic diversity of the groups as a first and necessary step in the implementation of a program to evaluate human impact on the genetic diversity of pygmy marmosets and other Ecuadorian primate species.

Study area and subjects

The San Pablo population is located at the margins of the Aguari-co river (0°16'27"S, 76°25'29"W) (Fig 1). This area has varzea forest and is seasonally flooded by white-waters rivers. Three groups (P1, P2, P4), in this population have been monitored since the year 2000 and were the study subjects (de la Torre et al. 2009). Group size varied from 5 to 7 individuals during the sampling period. Groups P1 (5 individuals) and P2 (6 individuals) had the most distant home ranges, separated by open areas, houses and several plantations (closest linear distance between P1 and P2 home ranges: 250 m). Groups P1 and P4 (7 individuals) had a disturbed, secondary forest connecting their home range areas (closest linear distance between P1 and P4 home ranges: 165 m). Finally, between the home range areas of groups P2 and P4 there are open areas with some trees but no houses (closest linear distance between P2 and P4 home ranges: 200 m).