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IMMIGRATION OF A FEMALE *ALOUATTA GUARIBA CLAMITANS* INTO A GROUP INHABITING A RESTINGA FOREST IN SOUTHERN BRAZIL

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Introduction

Among primates, dispersal may result from aggressive interactions (competition for reproductive positions, social status or food resources) or from a result of events such as changes of social hierarchy, infanticide avoidance, fission of a group or habitat destruction (Pusey and Packer, 1987). Although there are benefits attributed to primate dispersal (increased genetic variability, reduced inbreeding and possibly diminished competition for reproductive opportunities), predation risk increases and the chances of finding food and familiarity with the environment decrease when an individual disperses (Chepko-Sade *et al.*, 1987; Pusey and Packer, 1987; Shields, 1987; Jones, 2005). Additionally, arboreal primates face high costs for traveling in open anthropic areas to reach other forest fragments (e.g., predation, morbidity associated with automobile, illegal trade) (Rodriguez-Toledo *et al.*, 2003; Mandujano *et al.*, 2004). The relations between intrinsic factors (social, demographic and genetic) and habitat factors (deforestation, hunting and others) that influence the decision of an individual to stay or leave its natal group are complex and may vary among species and sexes (Mandujano *et al.*, 2004; Jones, 2005).

Female philopatry is common among primates (Pusey and Packer, 1987) but Neotropical primates polygamist species tend to a female-biased dispersal (e.g. *Brachyteles hypoxanthus* and *Ateles chamek*) or bisexual dispersal (e.g. *Cebus olivaceus, Leontopithecus rosalia* and *Saguinus fuscicollis*) (Campbell *et al.*, 2007; Strier, 2008). For howler monkeys, the dispersal of both males and females has been observed in *Alouatta palliatta* (Glander 1992; Jones 1980, 1999; Mandujano *et al.* 2004, Clarke and Glander, 2008), *Alouatta seniculus* (Rudran, 1979; Crockett, 1984; Crockett and Pope, 1993; Agoramoorthy and Rudran, 1993; Palacios, 2000; Pope 2000), *Alouatta caraya* (Rumiz, 1990; Calegaro-Marques and Bicca-Marques, 1996; Giudice, 1997), and *Alouatta pigra* (Brockett *et al.*, 2000). For *Alouatta guariba clamitans* some cases cited in the ecological studies report the dispersal of howlers, mostly adult and sub-adults males (Mendes, 1989; Katz and Otta, 1991; Strier *et al.*, 2001; Jardim, 2005; Miranda *et al.* 2006; Podgaiski and Jardim, 2009).

Methods

Ten groups of howler groups (*Alouatta guariba clamitans*) (Cabrera, 1940) were monitored as part of a study of population ecology (Jardim, 2005) in three forest fragments around the cities of Porto Alegre and Viamão in state of Rio Grande do Sul: Lami (300 15' S; 510 03 W); Morro da Extrema (30012' S; 510 04 W) and Parque Estadual de Itapuã (30o 23' S, 51o 30' W). The determination of the group composition was conducted according to the age–sex classification used for *A. g. clamitans*, in Caratinga, Minas Gerais (Mendes, 1989). Howlers were individualized mainly by body size, pelage color and scars. After the initial definition of the social composition (from June to November 1999), the howler groups were followed every second month from December 1999 to December 2001.

Thirteen surveys were carried out and the following information was registered: date, time, location, and social composition of each group. Every change in group composition due to births, deaths, and dispersal was documented as the group was encountered. The groups were observed by the method *ad libitum* (Altmann, 1974) for at least two hours at each encounter. The average interval between the surveys was 50.2 days, with a total of 149 days on-site (586 hours of direct observation) and 214 encounters with groups of howler monkeys.

Results

On February 16, 2000, we recorded the immigration of an adult female into a resident group in a Restinga forest fragment in Lami, a private property in Porto Alegre. This group originally contained eight individuals (two adult females, one adult male, four juveniles, and one infant). This same composition was observed in three surveys previous to immigration. When the group was first seen with the new female, we made the following observations: the immigrant female, while vocalizing, moved towards one of the resident adult females, which moved away, apparently showing submission. The second female was carrying an infant on her back and was about 50 meters from the rest of the group. The male was seemingly indifferent to the females' behavior. In the following months, no aggressive behaviors or displays of domination–submission among the females were observed. Similarly, aggressive behavior was not observed among females in the same group in other groups observed. Agonistic interactions were always observed between females of different groups in the context of intergroup conflicts. In July 2001, approximately 18 months after her arrival, the immigrant female gave birth. Throughout the survey, there was no other alteration of the social composition of this group, except for four births. In the other groups,

sixteen disappearances cases (emigrations and/or deaths) were observed including adult and sub-adult males, an adult female, and juveniles. Although the fates of these animals are unknown, these data are consistent with a tendency of dispersal for both sexes, with a predominance of adult males and juveniles.

Discussion

In the genus *Alouatta*, female emigration seems to be a consequence of aggressive interactions among adult females, and the competitive behavior among females is well documented (Crockett, 1984; Pope, 2000). Aggression followed by emigration has been observed for *A. seniculus* in Venezuela (Pope, 2000), *A. pigra* in Belize (Brockett *et al.*, 2000), and *A. caraya* in southern Brazil (Calegaro-Marques and Bicca-Marques, 1996) and Argentina (Giudice, 1997). The opportunities for females to enter groups that are already established may be uncommon (Rudran, 1979; Crockett, 1984; Brockett *et al.*; 2000; Palacios, 2000; Pope, 2000). For this reason, the most frequent situation is for females to join other individuals to establish new groups (Calegaro-Marques and Bicca-Marques, 1996; Palacios, 2000; Pope, 2000; Miranda *et al*. 2006).

Some authors have suggested that there may be a maximum number of howler females per group as a result of competition for reproductive positions (Crockett, 1984; Crockett and Pope, 1993). For *A. seniculus* and *A. caraya*, it is thought that four females are the limit (Pope, 1966; Thorington *et al.,* 1984; Rumiz, 1990; Palacios, 2000). For *A. g. clamitans,* records of 4 adult females per group are uncommon and the limit reproductive females may be lower (Mendes, 1989; Steinmetz, 2001; Jardim, 2005; Miranda *et al*., 2006; Fortes, 2008). On the other hand, groups containing a smaller number of females may be likely to receive female immigrants. Calegaro-Marques and Bicca-Marques (1996) observed in *A. caraya* the recruitment of a female by a group that previously lost a female as a result of emigration. Crockett (1984) observed the immigration of two females of *A. seniculus.* In both cases, the females joined groups after the death of one of the adult females. Palacios (2000) described the female immigration of *A. seniculus* to a howler group with two adult females, both rearing infants. Our observation of the arrival of an adult female is consistent with this hypothesis, as this group had only two resident adult females. Moreover, one of them was carrying a newborn and the other was pregnant.

The year and a half interval between the first record of immigrant female and her giving birth described in this study, is similar to the average delay for the first litter of immigrant females of *A. palliata* (19.7 months, Zucker et al. 2001). The reproduction of the immigrant female and her interactions with the other individuals of the group indicate that the immigration was successful.

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A FAILED IMMIGRATION ATTEMPT BY A MOUSTACHED TAMARIN, *SAGUINUS MYSTAX*

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Introduction

Dispersal, i.e. leaving the natal group or home range and immigrating into a different group or new area, is a critical stage in the life of organisms and often associated with high risks of mortality (Pusey and Packer, 1987; Weisser, 2001). Successful dispersal and immigration into a new group do not only depend on the survival in the transitional phase