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AGGRESSION BETWEEN *ALOUATTA CARAYA* MALES IN FOREST PATCHES IN NORTHERN ARGENTINA

The aggressive interactions between primates that live in social groups varies in form and intensity according to the species, social organization, and habitat type. Aggressive behavior can involve fights over food, water, and sites for resting and feeding (Calegaro-Marques and Bicca-Marques, 1994). Howler monkeys are considered to be a peaceful species in terms of group interactions as a result of their adaptation to a folivorous diet, where the presence of anti-herbivorous defenses impose selective forces that constrain the use of aggressive behavior (Jones, 1980; Calegaro-Marques and Bicca-Marques, 1994).

In *Alouatta*, both sexes obtain benefits through intrasexual aggressive competence, maintaining as such the possibility of entering and remaining in a stable group. This is a prerequisite for reproductive success in this genus (Crockett and Pope, 1988; Calegaro-Marques and Bicca-Marques, 1994). Solitary individuals, males or females that leave their natal groups, are found in *A. caraya* as for other species. The howlers may leave a group because of intense intrasexual competition which can limit group size. Non-stable groups promote dispersal (Neville *et al.*, 1988). Solitary individuals are subadults or young adults that are forced to occupy marginal zones of the habitat, with low availability of resources. They may join an established group or form a new one with other solitary animals, and compete as such for sites with adequate availability of food sources (Zunino *et al.*, 1985).

The arrival of immigrant males in established groups is interpreted as an invasion with fights between males. The encounters can result in: coexistence with the residents, the replacement of the dominant male, or the withdrawal of the invader (Rumiz, 1990). The replacement of the dominant male has been associated with infanticide and the disappearance of infants in several howler species (Clarke, 1983; Zunino *et al.*, 1985; Rumiz, 1990; Galetti, 1994). Howling occurs in a variety of contexts, and is believed to act as a mechanism of communication, spacing, and territory defense (Baldwin and Baldwin, 1976; Jones, 1980; Sekulic, 1982).

Behavioral observations on *A. caraya* were made during of a study of seed dispersal in forest patches in the Province of Corrientes in northeastern Argentina (27° 30' S - 58° 41' W), during August 1994 (Figure 1). One forest fragment (10 ha) was occupied by a group of nine howlers comprised of: one adult male (male A), two subadult males, three adult females, one juvenile female, and two infants. When an adult male (B) strange to the troop appeared, we began to observe aggressive interactions. During the first three days, the strange male B remained 20-30 m from the troop. Subsequently, he began moving closer to the group, and the male A, followed by the other males, chased the male B for about 250 m into low forest. The females did not participate, and remained where they were until the chase finished, about 1-2 hours later, after which they rejoined the males.

When the resident males returned, the male B began to follow the group at a distance of 23-30 m. Each time the male B approached, it resulted in a series of vocalizations, involving all of the group members. On the fourth day, the male B was observed to descend to the ground, and ran for about 25 m, followed by the male A. On day 6 there was a fight between males A and B when the male B again approached the group, coming to within about 1 m of an adult female (about 1 m) and an infant (about 0.5 m). This resulted in vocalizations and chasing, but this time the male B did not retreat, and attacked male A. They hung from

Figure 1. Study site.

their tails and the fight resulted in injuries to both. When male B, smaller than male A, freed himself, he jumped to the ground and was chased for about 50 m. During the following days, male B disappeared, along with a subordinate adult female, but we were unable to discover if they were together.

Another forest patch of 12 ha was inhabited by a group of *A. caraya*, also comprised of nine individuals: one adult male, two subadult males, three adult females, one juvenile female, and two infants. When an adult male and an adult female appeared in a strip of forest about 90 m from the group, it began a series of vocalizations towards the pair. On the following day, the group came to the ground and went to the forest strip through the grassland. Although the infants were already independent, they were carried dorsally by the adult females. The group remained in the forest strip for four days.

The presence of injuries is connected with the intrasexual competition and the acquisition and maintenance of status in the group. Aggression between males and females is rare and has been observed in infant defense from immigrant males (Crockett and Pope, 1988). Infanticide in mammals may be interpreted in a variety of ways, including, for example, sexual selection. This hypothesis predicts that the infanticidal male may be an invader or a member of the family group that has risen in the hierarchy. Killing infants would reduce the reproductive success of competitors, as well increasing the infanticidal male's success as the females involved become receptive in a shorter time. Another hypothesis tries to explain this behavior through competition for food resources, where the death of non-related individuals would result in an increase of resource availability to the infanticidal individuals and their offspring (Hrdy, 1979; Rudran, 1979). If infanticide occurs frequently it will represent as such an important source of mortality. During 1984 in our study area, infanticide and infant disappearance represented 25% of mortality for the population (Zunino *et al.*, 1985). When populations reach a low density, male replacement and the infanticide become less frequent, along with a return to population growth (Hrdy, 1979; Rudran, 1979). In *A. caraya*, infanticide and dominant male replacement are correlated with an increase in density through the increase of the number of solitary males (Zunino *et al.*, 1985; Galetti, 1994). The elimination of non-related infants would have a double effect, on the one hand, the females become fertile in less time, and on the other, this reduces the number of potential competitors for its descendants. Male replacement may also contribute to reduce the inbreeding, increasing the genetic variability in the groups (Zunino *et al.*, 1985).

We observed agonistic interactions caused principally by the expression of intrasexual competition, but also for the most profitable feeding sites. We believe that competition in our study site may increase due to progressive deforestation, which is resulting in an alarming reduction of the habitat available for *A. caraya*, and predicting a future reduction in the ecological density (Zunino *et al.*, 1994; Amaya Santi *et al.*, 1994). If habitat reduction acts as a stressor, the rate of aggression may increase, along with the number of dispersing individuals (Jones, 1980), but this has to be confirmed. We are presently looking for a relation between habitat destruction and aggression.

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CHROMOSOMAL VARIATION IN *ALOUATTA FUSCA*

The genus *Alouatta* (Primates, Atelidae) includes six different species, with a wide distribution in South and Central America (James *et al.*, 1993). Of these, the brown howling monkey (*Alouatta fusca*) is endemic to the Atlantic Coastal Forest being found from Bahia, Espírito Santo and Minas Gerais (Brazil) south to Missiones (Argentina), and comprises two subspecies: *A. fusca fusca* and *A. fusca clamitans*.

Koiffmann (1977) reported a variation in the diploid number of *A. fusca* from 48 to 50. The diploid number of 48 chromosomes was found in a single male from Registro (southern part of the state of São Paulo), heterozygotic for two Robertsonian rearrangements. The same author reported males with 2n = 49, due to a y-autosome translocation, and males and females with 2n = 50.

Methods

Blood samples of ten specimens of *Alouatta fusca*, eight males and two females from different localities (Table 1), were collected using heparinized plastic syringes. Lymphocytes were cultivated for 72 hours in RPMI medium, enriched with fetal calf serum at 20% and Phytohemagglutinin at 2%. The chromosome analyses were performed by G-C-NOR banding procedures (Seabright, 1971; Sumner, 1972; Howel and Black, 1980).

Results and Discussion

The chromosome complement of *Alouatta fusca* showed a wide variation in the diploid number, with 2n = 45, 46, 49 and 52. This variation may be associated with the geographic origin of each individual (Table 1).
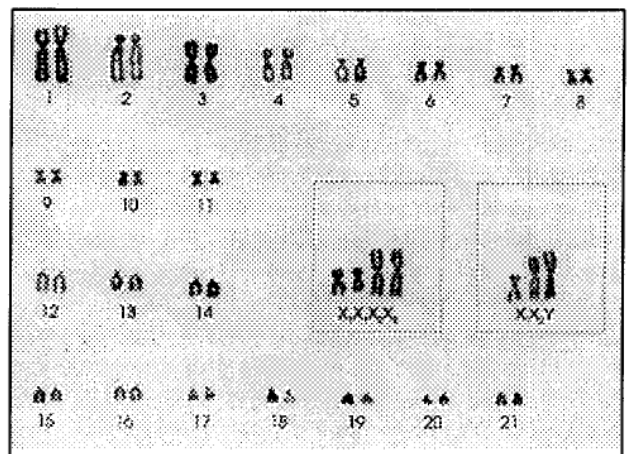

Figure 1. Karyotype of *Alouatta fusca* from southern Brazil.