

group name for the squirrel monkeys in favour of Saimiriidae Miller, 1912 (1900).

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THE MURIQUI POPULATION OF THE ESTAÇÃO BIOLÓGICA DE CARATINGA, MINAS GERAIS, BRAZIL: UPDATES

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Introduction

The northern murequi, *Brachyteles arachnoides hypoxanthus*, or *B. hypoxanthus*, is considered to be one of the 25 most critically-endangered primate taxa in the world (CI/IPS/PSG, 2002). Fewer than 500 northern murequis are thought to survive today, distributed in small populations in the states of Minas Gerais and Espírito Santo. Although several new populations have been discovered in recent years, the 890 ha forest at the Estação Biológica de Caratinga (EBC), in Minas Gerais is still the largest population known, and the only one that is considered to be viable (Rylands *et al.*, 1998; Strier, 2000). In 2001, the EBC was transformed from a privately-owned forest into a federally-protected reserve, known as the RPPN Feliciano Miguel Abdala (Castro, 2001). Yet, despite the forest's new protected status, continued monitoring of the murequi population there remains an urgent conservation priority. Long-term behavioral, ecological, reproductive, and demographic studies of the largest murequi group at the EBC, known as the Matão group, have been underway since 1982 (Strier, 1999a). During the past 20 years, this group has more than tripled in size, increasing from 22 to 70 members as a result of low mortality among all age-sex classes, high fertility among females, which give birth at 3-year intervals, and a female-biased infant sex ratio. Males in this population remain in their natal groups for life, but females

routinely transfer out of their natal groups at a median age of 73.5 months, prior to the onset of puberty (Printes and Strier, 1999; Strier and Ziegler, 2000).

To date, all but two of the 28 natal females that survived to six years of age have transferred out of the Matão group, and until the late 1990s, the number of female emigrants and immigrants was similar. By the late 1990s, however, female emigrants from the Matão group began to outnumber female immigrants, which came from a second large group, known as the Jaó group, in this forest (Strier, 1999b). During the first systematic census of the EBC primate community, conducted in August 1999, a total of 73 muriquis were sighted in Jaó (Strier *et al.*, 1999). This was substantially more than the 18 individuals previously known to inhabit the Jaó region of the forest, and confirmed prior suspicions that the entire population was expanding at a comparable rate to that of the Matão group. It also emphasized the importance of extending the EBC muriqui project to include the Jaó group, and the value of maintaining long-term demographic records on the survivorship and fertility of all females after they leave their natal groups.

Here, we present an update on the EBC muriqui population. We pool current data from the Matão study, which is now in its 21st year, with data from the forest-wide census conducted in August 1999 and new preliminary demographic data from the Jaó group, which has been monitored since March 2002. Altogether, we estimate there to be at least 171 individuals in the EBC population. We also document the successful immigrations of 13 females, originally from the Matão group, now fully integrated into the Jaó group, and confirm previous estimates on the age of first reproduction in female muriquis that disperse from their natal groups.

Methods

In August 1999, 16 experienced researchers who had conducted long-term studies on the EBC primates joined forces to survey the muriqui population and those of the other three species of sympatric primates, *Callithrix flaviceps*, *Cebus nigrinus*, and *Alouatta guariba*. A brief description of the census can be found in Strier *et al.* (1999), and a more detailed discussion of census methods and results in the Matão region of the forest is currently underway (Mendes and Strier, in prep.). Our priorities in the Jaó region were focused on the muriquis there. Whenever muriquis were heard or sighted, observers remained in the area and searched until they obtained a complete count or the group was lost to view. Age and sex classes were noted, and familiar females, originally born in the Matão group and still recognizable to prior researchers, were identified whenever possible.

Between March-September 2002, 74 members of the Jaó group have been followed systematically. An additional seven individuals have recently been sighted, indicating

that there are at least 81 individuals in Jaó. Like all members of the Matão group, muriquis in the Jaó group can be individually recognized by their natural markings. They have proved to be fairly easy to habituate, undoubtedly due to the prohibition on hunting that has long been respected in this forest, and to the fact that several of the adult females presently in the Jaó group had been previously accustomed to the presence of human observers since their births in the Matão group. Dates of births and emigrations are known for all of the Matão females recently identified in the Jaó group. At least two of these familiar females were seen carrying their first infants in August and September, respectively, and therefore provide the first confirmation of prior estimates of age at first reproduction in dispersing female muriquis.

Results

Muriqui Census, August 1999

At the time of the census, the Matão group was known to contain 64 members. An additional seven adult males, originally from Jaó, have been frequently sighted in the Matão part of the forest and account for about 10-12% of copulations involving Matão females (Strier *et al.*, 1993; Strier, 1997). A smaller group, thought to be a subset of the Jaó group and known as "Matão II" since the early 1990's (Strier *et al.*, 1993) was also known to use a small area of the Matão forest. During the Matão census, a total of 13 individuals in the Matão II group were sighted. In addition, the seven males from Jaó are now thought to associate primarily with the Matão II group. Together with the 64-member Matão group and the seven Jaó/Matão II males, there were at least 84 muriquis known in the Matão forest.

Muriquis were also sighted on the daily censuses in the Jaó region. The total of 73 muriquis in Jaó was based on the largest number of each age-sex class sighted on any occa-

Table 1. Natal Matão females identified in the Jaó group during the 1999 census and the 2002 study period.

Female	1999 Jaó Census	2002 Jaó Study Period
Brh	Present	Present, 1 st birth 08/02
Cat	Present, with infant	Present
Den	Present	Present, 1 st birth 09/02
Fa	Present	Present, with infant 09/02
Hel	Present	Present, with infant 09/02
Ma	Present	Present, with infant
Nd	Present, with infant	Present
Pri	Present	Present
Rs	Present	Present
Nn	Not sighted*	Present
Bri	Not sighted**	Present, with infant
Fl	Emigrated 10/0t0	Present
Kk	Emigrated 04/02	Present

*Not sighted during the 1999 census, but was seen with the Jaó group after she emigrated from the Matão group in November 1989 (Strier *et al.*, 1993).

**Not sighted during the 1999 census, but was seen with the Jaó group after her emigration in November 1995 (Printes and Strier, 1999).

sion. Altogether, 20 different adult males, 28 adult females, 1 subadult female, 10 juveniles, and 14 infants were counted. Combining the Jaó census results with those from the Matão side of the forest, we estimated the total EBC miqui population to be at least 157 individuals at that time. Comparisons of the composition of the Matão and Jaó group indicated a higher proportion of adults in the Jaó group and of immatures in the Matão group, but the adult sex ratios in the two groups were similar (Fig. 1).

During the Jaó census, nine females were observed which were known to have been born in the Matão group and to have subsequently emigrated (Table 1). Two of them (Cat and Nd) were carrying dependent infants. Both of these females, as well as others that were not associated with infants, were known to have emigrated from the Matão group prior to the onset of puberty (Strier and Ziegler, 2000).

The Jaó Project

By September 2002, 74 members of the Jaó group could be recognized by trained observers. By this time, the Matão group had increased to 70 members, and the age structures of the two groups appear to have converged (Fig. 1). At least seven additional miquis have been sighted in Jaó, but cannot yet be identified. All nine of the female immigrants from the Matão group identified during the census were still present, and an additional four natal Matão females have been identified with the Jaó group (Table 1). Two of these females (Nn and Bri) were known to have immigrated previously (Strier *et al.*, 1993; Printes and Strier, 1999), but were not sighted during the census. Two additional females from the Matão group that emigrated after the census, in October 2000 (Fl) and March 2002 (Kk), were also confirmed in Jaó.

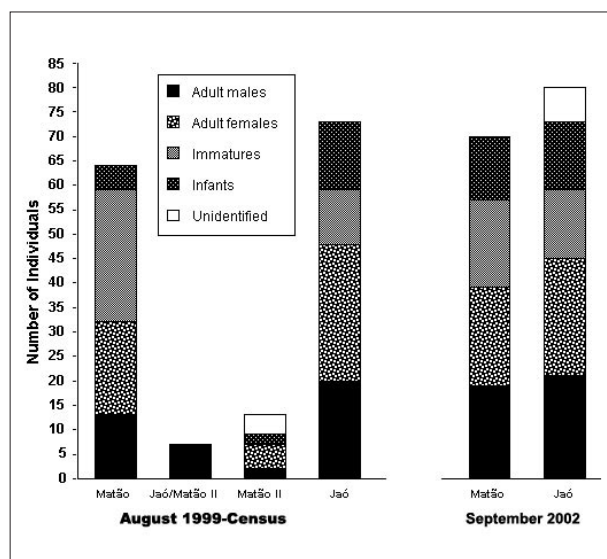


Figure 1. Age-sex composition of the EBC miqui population. Matão and Jaó groups shown during the August 1999 census and during ongoing studies as of September 2002. Note that the Jaó/Matão II males and the Matão II group are still present as of 9/02.

Two of the immigrant females (Ma and Bri) from Matão were confirmed to be carrying dependent infants during the Jaó study period (Table 1). Two additional females were visibly nulliparous when they were sighted during early months of the Jaó study (Brh and Den), and gave birth to what we know to be their first infants in late August and early September 2002. Based on their birth records from the Matão group, we know they were 108 and 111 months of age at their first parturitions. These ages are remarkably similar to the 106.3 months estimated for Jaó females that were assumed to have immigrated into the Matão group at the same median age (73.5 months) at which Matão females have emigrated (Strier and Ziegler, 2000).

Two additional female immigrants from Matão (Fa and Hel) were observed with new infants in mid-late September 2002, when they were 123 and 131 months of age. If these are their first infants, they raise the median age at first reproduction for immigrants into Jaó to 117 months ($n = 4$), which is nearly a year older than that estimated for immigrants into Matão. However, neither of these females had been confidently classified as nulliparous prior to their September parturitions, and it is therefore possible that their September 2002 infants were not the first; possibly their previous infants had died.

Discussion

Our preliminary findings demonstrate the importance of expanding the demographic monitoring of the EBC miquis to include the entire population, which we now estimate to include at least 171 individuals. These findings also provide insights into demographic processes that affect the different groups. For example, four natal Jaó females have immigrated into the Matão group since the census, while a fifth Jaó female that temporarily associated with the Matão group has since been sighted carrying a new infant in the Matão II group.

Nine Matão females have disappeared from their natal group since the August 1999 census. Of these, two were identified in the Jaó group, and four were ≤ 3 years of age when they were last sighted. This is much younger than the median age of 73.5 months (6.12 years) at which confirmed emigrations have occurred (Strier and Ziegler, 2000), and we assume that the disappearances of these females coincided with their deaths. Previous analyses of mortality patterns in the Matão group indicated a peak in mortality at approximately 3 years of age, which is also when mothers are pregnant with or carrying their next offspring (See appendix in Strier, 1993/1994). Although the only two suspected predations involved 13-month old infants (Printes *et al.*, 1996), the period during which mothers shift their reproductive efforts to future offspring appears to represent a particularly vulnerable time for young miquis.

The remaining three Matão females that are presently unaccounted for were last sighted with the Matão group when they were about 5.5-6.65 years of age. It is possible that

they joined the Matão II group, or that they are present in Jaó, but have not yet been identified. Ongoing efforts in Jaó, and new efforts to periodically census the Matão II group (e.g., Possamai and Strier, in prep.) may ultimately provide confirmation of their whereabouts.

Monitoring the survivorship and subsequent fertility of dispersing females from both the Matão and Jaó groups is clearly important for evaluating the long-term viability of this population, and is therefore one of the primary objectives of the expanded, long-term murrequi project at this site. Although it has been possible to confirm female emigrations from the Matão group by tracking them into Jaó (e.g., Strier *et al.*, 1993; Printes and Strier, 1999), we have previously lacked systematic data on the number of natal females that leave the Jaó group, but fail to immigrate into the Matão group. As long-term demographic data on the Jaó group accumulate, we will be able to more accurately assess the mortality rates of dispersing females in this population.

The ages at first reproduction that could be confidently determined for the two females from the Matão group that immigrated into the Jaó group are similar to those previously estimated for females that immigrated into the Matão group from Jaó (Strier and Ziegler, 2000). However, if the other two infants born to Matão emigrants in September also represented first parturitions, the median age at first reproduction of females dispersing into Jaó would be older than that of females dispersing into Matão. It is possible that Jaó females are older than natal Matão females when they emigrate, or that ecological or demographic conditions in the two groups are responsible for differences in the ages at which immigrants first reproduce. Long-term monitoring will be necessary to confirm the ages at which female infants born in the Jaó group emigrate, and to determine whether there are differences in the ages at which female immigrants in the two groups reproduce.

Our preliminary documentation of age at first reproduction represents an important confirmation of a basic life history variable, and provides further support for the idea that female dispersal and delayed reproduction are associated in this species (Strier and Ziegler, 2000). However, larger sample sizes are still necessary to determine whether Jaó females leave their natal groups at the same ages as Matão females, and whether variation in age at first reproduction differs more between groups or within groups. Continued monitoring of the Jaó group will permit us to evaluate the ages at which other nulliparous females that join the Jaó group give birth to their first infants. It will also provide comparative perspectives on the life histories of Jaó females that remain and reproduce in their natal groups, as occasionally occurs among natal Matão females (Martins and Strier, submitted).

Like all long-term field studies, the demographic data on the EBC murrequis will continue to increase in value over time. It will be particularly important to monitor their

demographic transitions and life history changes as the growth that has characterized this population over the past 20 years begins to slow, and to accompany the effects of the EBC's new protected status on the number of murrequis that this forest can support.

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- ing primate populations and habitat fragmentation patterns over the entire Rio Doce basin in Minas Gerais (Hirsch, in prep.). The farm is in the Rio Suaçuí Grande valley, 26 km from the town of Peçanha. The first author, accompanied by personnel of the Minas Gerais State Forestry Institute (IEF/MG), flew over the area in a helicopter the previous day to estimate the extent of deforestation in this and a number of protected areas in the region. During the overflight we were able to identify an area of relatively well-preserved forest occupying one of the hilltops on the farm.
- Using information obtained from local inhabitants, Aguirre (1971) concluded that *B. a. hypoxanthus* had been extinct in the region of the headwaters of the Rio Suaçuí Pequeno since 1945/47. Kinzey (1982), following Aguirre (1971), stated that *B. a. hypoxanthus* was formerly present in the region of Peçanha. However, in July 1981, 40 years on, Russell A. Mittermeier, Andrew Young and Carlos Alberto Machado Pinto found a population of eight individuals at the Fazenda Córrego de Areia (Mittermeier *et al.*, 1987). Rosa Lemos de Sá (pers. comm. in Strier, 1992) attempted to locate this group again in 1990, but without success.
- In our two-days of fieldwork in 2001, we performed five playback points (playing recordings of miquis vocalizations, spending 10 minutes at each: 5 minutes playing the tape recording with a 5-minute pause). We also made a detailed assessment of habitat structure at six further points. However, due to technical problems, we were unable carry out a full primate census of the Fazenda, and this is planned for our next field trip.
- We obtained a positive response of miquis calls on the third playback point. At this time, we were in a deep and humid mountain gorge surrounded by some trees estimated as being 30 m in height. The group we located was composed of four adult males, one sub-adult male, one juvenile male, two adult females each with a juvenile, one adult female with an infant, and one juvenile female. We stayed with the group for about 30 minutes till they moved away. During this period, some of the individuals vocalized frequently, several evidencing a certain degree of stress, probably related to our presence, possibly exacerbated by hunting pressure in the area. In the same gorge during the fifth playback session, we also detected a group of *Cebus robustus* of at least four individuals.

REDISCOVERY OF *BRACHYTELES ARACHNOIDES HYPOXANTHUS* AT THE FAZENDA CÓRREGO DE AREIA, MINAS GERAIS, BRAZIL

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On 1 December, 2001, we encountered a group of 13 *Brachyteles arachnoides hypoxanthus* in a forest in the Fazenda Córrego de Areia (18°26'S, 42°25'W, altitude 388-805 m, 60 ha), municipality of Peçanha, in the state of Minas Gerais (Fig. 1). The forest was surveyed as part of a project examin-

The forest in the Fazenda Córrego de Areia covers only 60 ha, but during the helicopter overflight we were able to obtain coordinates using a Garmin GPS III Plus, and with a Landsat 5 TM satellite image and an Arc View GIS 8.1 geographic information system (ESRI, 2001), we were able to estimate that it extends over 449 ha surrounding the hilltop. For the habitat structure assessment, we used the technique of Sample Points along a Transect. A circle of 6 m in radius (113.2 m²) was demarcated at each of six points at 300 m intervals along the transect (see Hirsch *et al.*, 1994; Hirsch, 1995, in prep.), the first placed 200 m inside the forest to avoid "edge effects". In general terms, the forest of Fazenda Córrego de Areia can be considered