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## BEHAVIOR OF SQUIRREL MONKEYS (*SAIMIRI SCIUREUS*) - 16 YEARS ON AN ISLAND IN FRENCH GUIANA

*Benoît de Thoisy, Olivier Louguet  
Françoise Bayart, Hugues Contamin*

### Introduction

Squirrel monkeys (*Saimiri* spp.) are small frugivore-insectivores widely distributed in the Amazon basin and through the Guiana Shield. They occur in a number of different habitats: primary and secondary forests, mangroves, and remnant forests (Baldwin and Baldwin, 1981). The main features of their ecology are similar throughout their range, although Boinski (1999) correlated some differences in key aspects of the social organization with biogeographic variations in fruit availability.

Since the late seventies, the Pasteur Institute of French Guiana has used the squirrel monkey as an experimental model for the study of human malaria. In addition to the captive colony, the Institute manages an island where 150 wild squirrel monkeys originating from French Guiana and Suriname were introduced in 1981. There were several reasons for the establishment of this free-ranging population: (i) as a supply of animals for experimental needs which could be easily trapped; (ii) to accommodate older and post-experimental animals; (iii) since a part of the area can be visited, this site is an opportunity to educate people about primates and medical

research; and (iv) the population is isolated from major infectious risks, allowing for a rapid re-establishment of the captive colony in the case of an epidemic (de Thoisy and Contamin, 1998).

Field work was conducted on the island in 1997 in order to assess the status of the population 16 years after the first release. Our goal was firstly to assess the potential of the island in fulfilling the objectives outlined above, but also to study the main eco-ethological patterns of these insularized monkeys. A report on their feeding behavior will be provided in a second paper.

### Methods

The “Ilet-La-Mère” is a 56-ha, island offshore from Cayenne (4°54'N, 52°12'W), French Guiana (de Thoisy and Contamin, 1998). The island is covered by dense secondary forest with numerous lianas and epiphytes, and the tree community is dominated by *Spondias mombin* (Anacardiaceae), *Schefflera morototoni* (Araliaceae), *Cecropia obtusa* (Cecropiaceae), *Ficus* spp. (Moraceae), and such introduced species as *Mangifera indica* (Anacardiaceae) and *Carica papaya* (Caricaceae).

The study was carried out during the rainy season, from April to July 1997. Two free-ranging populations live on the island: wild monkeys (throughout), and food-provisioned monkeys in a 2-ha area around the camp. The wild population was censused through *ad libitum* observations and subsequently through direct observations of one focal troop (T1) and by radio-tracking two other troops (T2 and T3). One adult female of each group was trapped and radio-collared (Telonics®, model 1A), and located three times a day by triangulation (Harris *et al.*, 1990). The fourth troop (T4) was located and censused just once. The provisioned population is about 90 monkeys, all in a single troop, but the composition was not determined.

Troop T1 was studied for 101 hours spread equally during the day, using the scan-sampling method (Altmann, 1974). The locations of the individuals, both in terms of the height in the forest and where they were in the home range, and their behavior (foraging and feeding, locomotion, resting, and social behavior (including agonistic and affiliative interactions) were recorded every 10 minutes. Vertical use of space and the different behaviors were correlated using a Factors Correspondence Analysis. Home range use was determined using the 50 x 50 m grid-cell method. Daily travel distances were calculated by measuring the distance between the centers of successive grid-cells crossed. The home ranges of T2 and T3 were determined using the convex polygon technique (White and Garrott, 1990).

### Results

The spatial distribution of the squirrel monkey population is shown in Figure 1. The home range sizes of T1, T2 and T3

were 12.3, 17.5, and 20 ha, respectively. T1 was comprised of two adult males, two subadult males, eight adult females, five juveniles and six infants. T2 was comprised of 12 adults and subadults, and five infants; T3 of 27 adults and subadults, and three infants; T4 of 15 adults and subadults, and five infants. The total population was 90, equivalent to a density of 164 individuals/km<sup>2</sup>.

The core area of T1 was 3 ha, that is 24.5% of its home range with 60% of recorded locations (Fig. 1). Feeding and foraging took up 63% of their daily activity, while 20.5% was given over to locomotion, 12.5% to resting and 4% to social behaviors. The daily travel distance was 4.5 km. They spent most time in the lower levels of the forest, with 41.7% of records during scans in the undergrowth,

31.5% in the low canopy, and only 26.8% in the upper levels (chi-square = 7.04, df = 2,  $p < 0.05$ ). They traveled more in the lower canopy and fed more in the upper levels. Resting and social behaviors were more frequent in the undergrowth (Fig. 2,  $\phi = 0.28$ , horizontal axis contribution = 79%, vertical axis contribution = 21%). In troop T1, males tended to be peripheral. Fifteen agonistic behaviors were recorded, nine involving a male and a female, one involving two males, and five involving females. Once, a coalition of females was observed pursuing a male. Twenty-six affiliative coalitions were observed, 16 involving adult females. Five infants were born at the end of the rainy season, and one later at the beginning of the dry season. Male fattening and sexual behavior were not seen

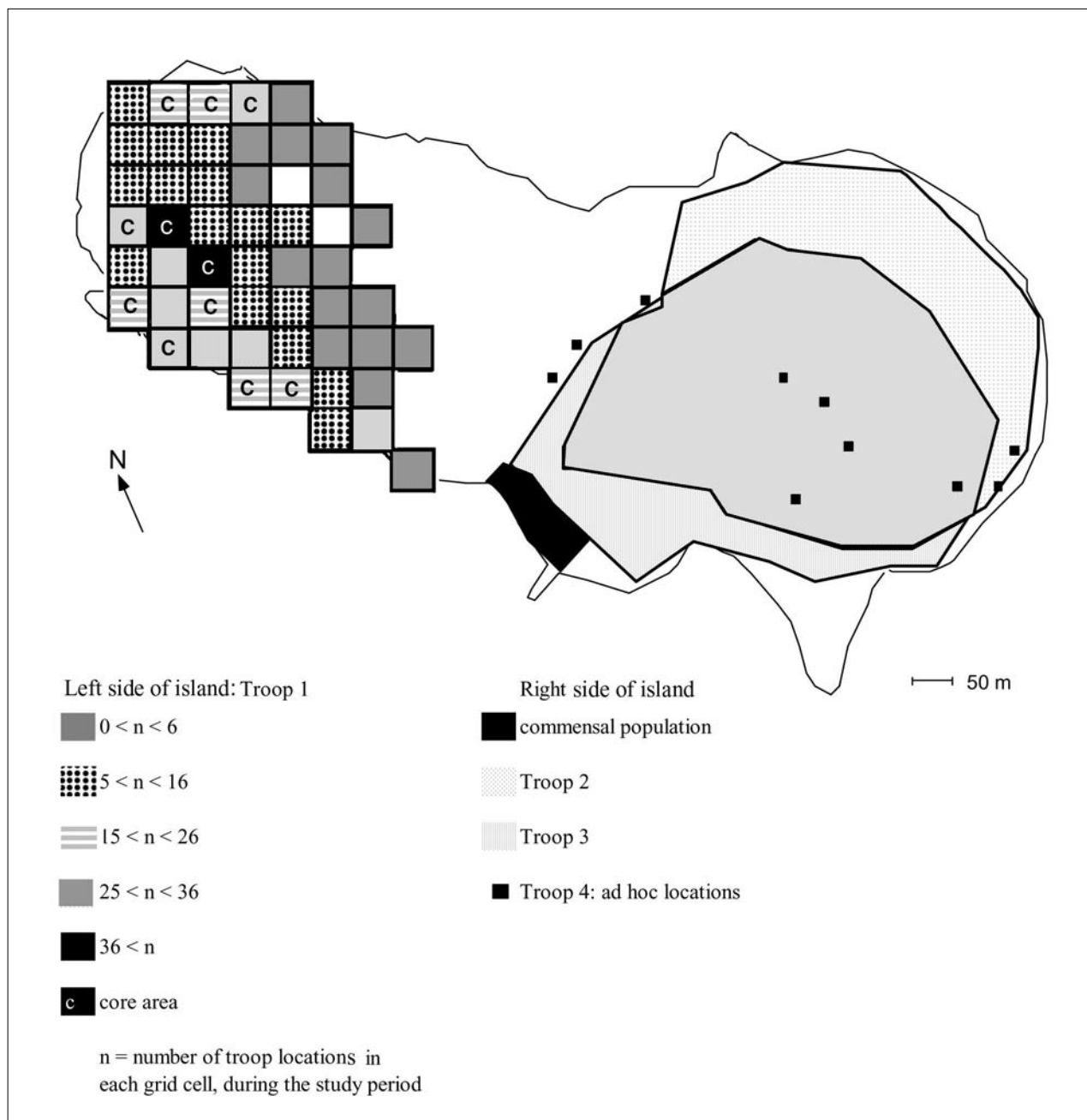
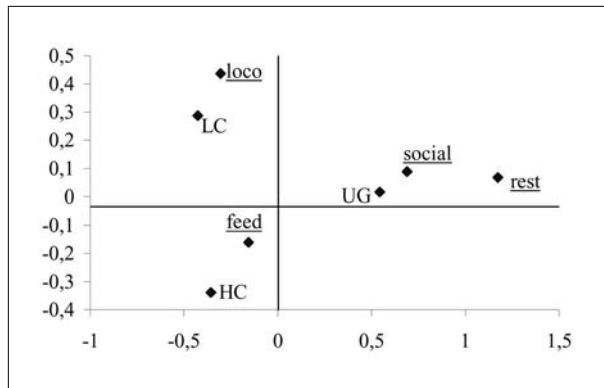


Figure 1. Spatial organization of the squirrel monkey population (*Saimiri sciureus*) on the Ilet-la-Mère, French Guiana.



**Figure 2.** Vertical use of space by squirrel monkeys (*Saimiri sciureus*) on the Ilet-la-Mère, French Guiana. UG = undergrowth; LC = lower canopy level; HC = higher canopy level.

during the study period. No interactions between troops were recorded.

## Discussion

Over the years, approximately 300 monkeys have been released on the island, and the free-ranging population today is close to 100 individuals. Newborns are numerous, suggesting that fertility is certainly not a limiting factor. There are no predators, and carrying capacity of the island should therefore be the limiting factor to population size, although infectious diseases and the survival rate of newly-released animals are also important in controlling population increase. Consequently, the initial objectives of Ilet-la-Mère of both the capture of naive animals for experimentation and the release of old animals as “retirement”, probably need to be reevaluated.

The habitat preferences, locomotory behavior, foraging techniques and food preferences, are similar to those observed for *Saimiri oerstedii* (Costa Rica), *S. boliviensis* (Peru), and *S. sciureus* (Suriname) (Janson and Boinski, 1992; Boinski, 1999). The population density of 164 individuals/km<sup>2</sup> in our study area is close to those observed in other secondary forests in Peru (Neville *et al.*, 1976), Panama (Balwin and Baldwin, 1972) and Colombia (Thorington, 1968). The small size of the troops can be explained by the size of the island and the secondary forest (Baldwin and Baldwin, 1971). Small home ranges have been reported in other secondary forest areas (Thorington, 1968). The sleeping sites of the four troops were on the southern coast of the island, which provided protection against rain and wind. Activity patterns and the vertical use of space observed in our study troop are comparable to those of *S. oerstedii* in secondary forests (Boinski, 1987 and 1999). Group compositions are also similar to those reported from other study areas (Baldwin and Baldwin, 1981); social behavior traits, characterized by female coalitions and female aggression, and males being peripheral to troops of adult female troops, are typical also of *S. boliviensis* in Peru (Mitchell *et al.*, 1991). Interspecific differences in the social behavior of squirrel monkeys, especially in female

bonding patterns, can be correlated with the abundance and distribution of fruit resources, and essentially to food competition (Boinski, 1999). In the Peruvian study area (*S. boliviensis*) fruit patches harvested were typically large and moderately dense, differing from the Surinamese study site of *S. sciureus*, where smaller and more dispersed patches were exploited (Boinski, 1999). On the Ilet-la-Mère, fruit patches are also large and dense. Our preliminary results suggest that, despite genetically-based variations of social organization in squirrel monkeys (Boinski, 1999), habitat constraints can also modify social organization, indicating considerable plasticity (Johns and Skorupa, 1987). *Saimiri* has rarely been studied in isolated habitats (Johns and Skorupa, 1987), and this island population is of great interest for furthering our understanding of their behavior, ecology and demographics in these circumstances.

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**Benoît de Thoisy**, Association Kwata, BP 672, 97335 Cayenne cedex, French Guiana, France, e-mail: <thoisy@kwata.org>, **Olivier Louguet**, Laboratoire d'Ecologie Générale, MNHN/CNRS-UMR 8571, 4 avenue du Petit Château, 91800 Brunoy, France, **Françoise Bayart**, Laboratoire d'Ecologie Générale, MNHN/CNRS-UMR 8571, 4 avenue du Petit Château, 91800 Brunoy, France, and **Hugues Contamin**, Centre de Primatologie, Institut Pasteur de Guyane, BP 6010, 97306 Cayenne cedex, French Guiana, France.

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- et al.*, 1995). Destaca-se como uma forma de coleta de dados que não provoca distúrbio aos animais, e que pode ser utilizada com espécies de difícil visualização (Palomares *et al.*, 1991; Soldateli e Blacher, 1996). Apesar dos primatas serem considerados animais de fácil visualização, pelo hábito diurno da grande maioria das espécies, certas espécies são mais difíceis de serem encontradas devido ao seu comportamento. Esse é o caso de *Alouatta*, pois apesar do ronco que facilita a localização do grupo, são animais difíceis de serem localizados devido a existência de períodos prolongados de inatividade diária, comportamento típico desse gênero de primatas (Mendes, 1985; Marques, 1989; Fortes, 1999).

No Parque Estadual de Itapuã, o monitoramento, através da contagem de bolos fecais é facilitado por esta ser a única espécie de primata não-humano presente na área e devido a geomorfologia de Itapuã, em geral, e do Morro do Campista, em particular, que apresenta grande número de afloramentos graníticos no interior da mata, facilitando a localização visual dos mesmos. Além disso, o aspecto e o odor característico do bolo fecal do bugio-ruivo são bastante peculiares, o que facilita sua identificação e localização.

O objetivo desse trabalho é verificar a eficácia da contagem de bolos fecais para monitoramento das populações de bugio-ruivo, *Alouatta guariba clamitans* Cabrera, 1940 no Parque Estadual de Itapuã, Viamão, Rio Grande do Sul, bem como, trazer informações relativas ao uso do hábitat. Este trabalho é parte integrante do “Programa Macacos Urbanos para Pesquisa e Conservação do Bugio-ruivo (*A. g. clamitans*) no Rio Grande do Sul”.

## Métodos

### Área de Estudo

O Morro do Campista (30°23'S, 51°02'W), também conhecido como Ponta de Itapuã, localiza-se no Parque Estadual de Itapuã, Viamão, Rio Grande do Sul (Fig. 1). O “Campista” caracteriza-se como um complexo orogênico, granítico, cujo cume principal possui 182 m de altura, e apresenta uma área aproximada de 300 ha. Estão presentes afloramentos rochosos no topo, enquanto suas encostas encontram-se praticamente todas cobertas por mata. O clima local se classifica como Cfa pelo sistema de Köppen, descrito como subtropical úmido, com média do mês mais quente superior a 22°C (janeiro), média do mês mais frio entre -3 e 18°C (julho), sendo a temperatura média anual de 17,5°C. A precipitação média anual situa-se em torno de 1.300 mm (Brasil, Rio Grande do Sul, 1997).

A classificação fisionômica da vegetação das unidades amostrais foi realizada utilizando-se a classificação proposta por Brack *et al.* (1998), sendo a que segue:

(A) Mata higrófila - formação florestal que ocorre nos fundos dos vales e encosta sul dos morros, constituindo-se algumas vezes em comunidades relictuais com forte influência da Floresta Pluvial Tropical Atlântica (Floresta

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## ESTUDO PRELIMINAR DO MONITORAMENTO DO BUGIO RUIVO, *ALOUATTA GUARIBA CLAMITANS*, ATRAVÉS DA CONTAGEM DE BOLOS FECALIS NO PARQUE ESTADUAL DE ITAPUÃ, RIO GRANDE DO SUL, BRASIL

Gerson Buss  
Helena P. Romanowski

### Introdução

Existe uma necessidade imediata de incremento nos estudos ecológicos e comportamentais de campo, em busca de dados que nos forneçam uma base concreta para um melhor conhecimento e que permita o manejo e a conservação de nossos primatas (Cullen Jr. e Valladares-Pádua, 1997). O bugio-ruivo, *Alouatta guariba*, distribui-se pela mata Atlântica, estendendo-se do sul da Bahia até a porção mais ao sul desse bioma, atingindo Missiones, no norte da Argentina (Fonseca *et al.*, 1994, Printes *et al.*, 2001). Trata-se de uma espécie ameaçada (Brasil, IBAMA, 1989) e a principal causa de seu desaparecimento tem sido a destruição do hábitat (Neville *et al.*, 1988).

A presença de vestígios pode ser utilizada em estudos de animais silvestres como indicador de sua ocorrência (Romanowski *et al.*, 1998) e uso de hábitat (Welch *et al.*, 1990). No caso das fezes, também fornece importantes informações sobre o estado de saúde do animal e dieta (Prates *et al.*, 1990; Stuart *et al.*, 1998; Santos e Hartz, 2000). Adicionalmente, a detecção de mudança no número de bolos fecais pode ser satisfatória para fins de manejo (Davis e Winstead, 1987; Mitchell *et al.*, 1985; McIntosh