

Bearded sakis in south-eastern Amazonia—back from the brink?

Stephen F. Ferrari, Claudio Emidio-Silva, M. Aparecida Lopes and Urbano L. Bobadilla

Abstract The endemic bearded sakis *Chiropotes satanas satanas* and *Chiropotes satanas utahicki* of south-eastern Amazonia are among the most threatened of this region's primates because of a combination of deforestation and hunting, and their apparent intolerance of habitat disturbance. Recent surveys at eight sites confirm that sakis are locally extinct in some areas where intense habitat fragmentation is exacerbated by hunting pressure, but also show that, in the absence of hunting, they can be relatively abundant in isolated forest fragments. Density was unexpectedly low in one protected area, however, which implies that caution is

necessary for the planning of long-term conservation strategies. Well-protected forest fragments of reasonable size (> 5000 ha) appear to have good potential for the protection of bearded saki populations. While many of the region's major landowners may thus make a significant contribution to the management of saki populations, land conflicts are a potentially serious problem for the long-term conservation of not just these primates, but the region's fauna and flora as a whole.

Keywords Bearded saki, *Chiropotes*, deforestation, population density, south-eastern Amazonia.

Introduction

Bearded sakis *Chiropotes* spp. are medium-sized Amazonian primates specialized morphologically for seed predation (Kinzey & Norconk, 1993). Hershkovitz (1985) recognized four taxa, two of which (*Chiropotes albinasus* and *Chiropotes satanas chiropotes*) are widely distributed in northern and central-southern Amazonia, respectively (Fig. 1). The two remaining taxa (*Chiropotes satanas satanas* and *Chiropotes satanas utahicki*) not only have more restricted geographic ranges, in south-eastern Amazonia, but are also endemic to the most densely populated and extensively deforested region of this biome.

Johns & Ayres (1987) proposed that the southern bearded saki *C. s. satanas* was already 'beyond the brink' in eastern Amazonia as a result of a combination of factors. These included its intolerance of habitat disturbance and dependence on key resources, which include tree species valued for their timber, in addition

to deforestation and hunting pressure. The same factors also apply to the closely-related *C. s. utahicki*, although its geographic range is less densely populated, and deforestation is still relatively limited in comparison with that of *C. s. satanas*. For this reason, *C. s. utahicki* has been classified as Vulnerable to extinction, whereas *C. s. satanas* is one of the six Endangered primate taxa found in lowland Amazonia (Rylands *et al.*, 1996).

Research carried out in the region over the past few years provides a slightly less alarmist view of both the current status and future prospects of these unusual monkeys, although it has also revealed unexpected problems. Perhaps surprisingly, one of the findings is that major landowners (*latifundiários*) may have a potentially important role to play in the long-term conservation of bearded sakis—and many other mammals—in south-eastern Amazonia.

Methods

Despite their current taxonomic distinction, the two bearded sakis considered here are similar enough morphologically to have been included in the same subspecies—*C. s. satanas*—prior to Hershkovitz's (1985) systematic revision. Because the few available data indicate that the two forms are also behaviourally and ecologically very similar, they are considered as a single metapopulation here, except where differences between subspecies are relevant.

Bearded saki populations were surveyed at eight sites in south-eastern Amazonia (Fig. 2). Sites 2, 6 and 8 are located within the geographic range of *C. s. utahicki* (the Xingu–Tocantins interfluvium), whereas the remaining sites lie within that of *C. s. satanas*. The latter

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taxon is distributed between the right bank of the Tocantins and the eastern limits of the Amazonian forest in the Brazilian state of Maranhão. Survey localities include isolated forest fragments of varying sizes, in addition to areas of virtually continuous forest (Table 1). Sites also varied considerably in the nature and degree of human activities, such as hunting, logging and habitat fragmentation, from negligible to intense. Human activities were evaluated qualitatively on the basis of both interviews with landowners and local residents, and general observations within each study area (presence of tree stumps, hides, etc.). Hunting pressure was also assessed through records of the number of shotgun shots heard during fieldwork, following Peres (1990).

Populations were surveyed between 1991 and 1997 using standard line transect methods (Brockelman & Ali, 1986). At each site, a system of straight-line trails was cleared in a randomly chosen representative area of *terra firma* forest and marked at 50-m intervals with vinyl flagging. Trails were walked at an average speed of c. 1.5 km/h, primarily between 06.00 and 14.00 hours, with a total transect length of 101–533 km at a given site. Standard records collected at each sighting of bearded sakis included group size and composition (during a maximum of 10 min of monitoring), and perpendicular animal–trail distance, on which estimates of population density were based. Because the number of sightings was relatively small at all sites and perpendicular distances did not vary significantly (Bobadilla, 1998), the Kelker method was used to estimate densities using pooled data, given the problems

associated with small sample size for calculations based on sighting functions (see Burnham *et al.*, 1980). Data were also used to calculate sighting rates (sightings per 10 km of transect), mean group size (individuals per sighting) and the estimated total population at each site (population density \times total area of forest).

Results

Bearded sakis were observed at all sites except the small forest fragment at the Fazenda Monte Verde (Table 2), where interviews with residents confirmed the local extinction of *C. s. satanas*. While hunting pressure is undoubtedly an important variable, habitat fragmentation may have been the decisive factor, given that the much larger-bodied red-handed howler monkey *Alouatta belzebul* is still found there (M. A. Lopes, unpublished data). The spatial requirements of bearded sakis are still poorly known, but the forest fragment at Monte Verde is smaller than the most reliable estimates of home range size for a single social group (Ayres, 1981; van Roosmalen *et al.*, 1981). Monte Verde represents the largest remnant of the original forest cover in the Bragantine Zone, in the north-eastern extreme of the Brazilian state of Pará (see Johns & Ayres, 1987; Vieira *et al.*, 1996), so it seems reasonable to conclude that *C. s. satanas* is now effectively extinct from this region.

The exact influence of habitat fragmentation is unclear from the results from other sites, however (Table 2). In fact, the population density recorded in the next largest fragment, on the Fazenda Arataú (site 2), was

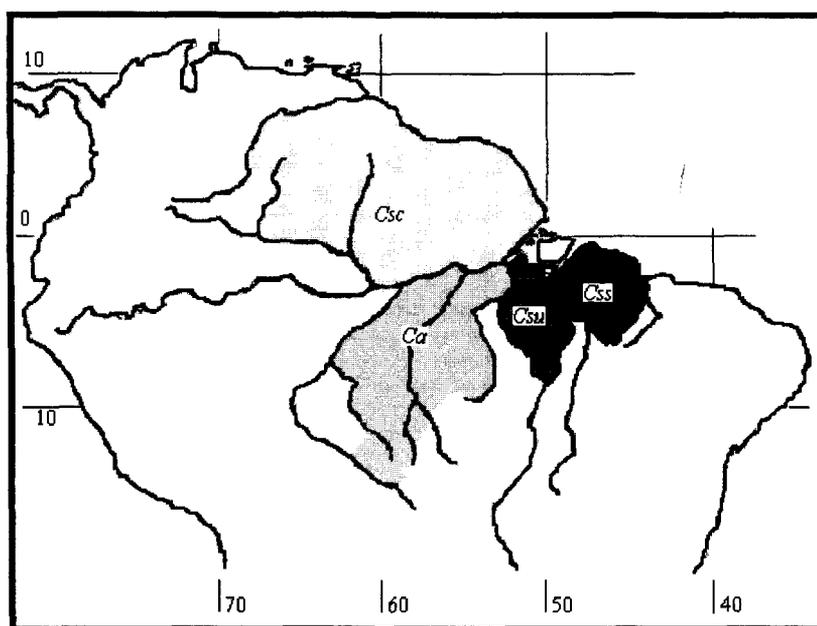


Fig. 1 Known geographic ranges of bearded sakis (cf. Hershkovitz [1985], Ferrari [1995], Norconk *et al.* [1996], Wallace *et al.* [1996] and Ferrari *et al.* [1999]). Ca, *Chiropotes albinasus*; CsS, *Chiropotes satanas satanus*; Csc, *Chiropotes satanas chiropotes*; CsU, *Chiropotes satanas utahicki*.

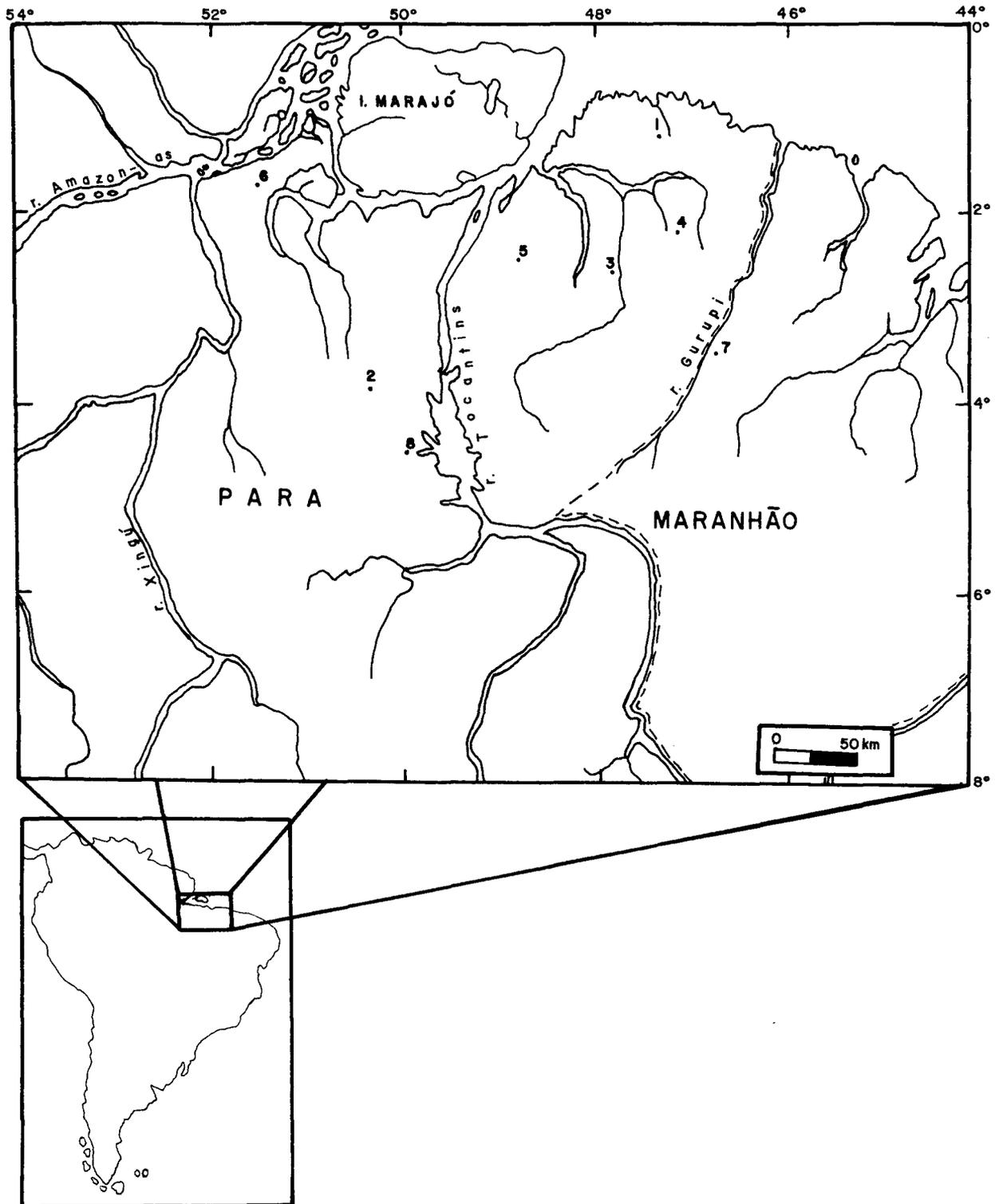


Fig. 2 Survey sites in south-eastern Brazilian Amazonia (see Table 1).

by far the highest ever recorded for *Chiropotes*, whereas densities recorded in large tracts of continuous forest (sites 6, 7 and 8) are largely indistinguishable from

those of isolated fragments, with the exception of the Fazenda Badajós (site 3), where sakis were observed only once during 200 km of survey. While similar in

size to Arataú, the forest fragment at Badajós is subject to considerably greater pressures in terms of both hunting and logging.

The abundance of sakis at the Fazenda Arataú is especially intriguing when compared with the much lower—but more 'normal'—density recorded at site 8 (Table 2), 50 km to the south-east (Fig. 2). The fragment at the former site has been isolated for more than 20 years, which contradicts the idea that the unusually high density of sakis might be due to a short-term concentration of fauna, especially as other primate species (including *Saguinus midas*, which usually benefits from habitat disturbance) were less abundant at Arataú than at most other sites. Bobadilla (1998) concluded that the high density of *C. s. utahicki* at this site was related to the use of alternative resources such as the mesocarp fruits of the babaçu palm *Orbignya martiana*, which is abundant there. Unfortunately, it is unclear whether the current high density reflects pre-existing levels and/or is related to habitat disturbance. Whatever the case, the evidence indicates that bearded sakis may be more tolerant of habitat disturbance than was previously assumed (Johns & Ayres, 1987), although this tolerance may depend on specific local factors such as 'key' resources and, of course, hunting pressure.

By contrast, the second lowest sighting rate and density of bearded sakis were recorded at the ECFPn, an integral part of what is probably the most extensive, best-preserved and botanically diverse tract of continuous forest remaining in eastern Amazonia (Almeida *et al.*, 1993; Lisboa, 1997). Population density would have been even lower but for the fact that relatively large groups of sakis were encountered at this site (Table 2). Once again, the factors determining these exceptional values are obscure (Bobadilla, 1998), but what is clear is that the adequacy of a protected area for the conservation of a given species is not necessarily guaranteed by its size or lack of disturbance. Clearly, then, the potential of any given site for the conservation of bearded sakis must be evaluated carefully within the context of overall management strategies.

Isolated fragments of forest on private land can obviously support only limited populations, but many of the region's *latifundiários* are at least conscious of the value of conservation measures and, in contrast with the government agencies responsible for public reserves, are not only strongly motivated, but also have the means to protect their properties from encroachment. In addition, human population densities on cattle ranches are normally lower than those of equivalent areas colonized by smallholders, who also tend to rely

Table 1 Study sites in south-eastern Amazon

| Site | Area (ha) | Characteristics | Logging | Hunting pressure |
|--|-----------|---|----------|------------------|
| 1. Fazenda Monte Verde | 200 | Isolated | Moderate | High |
| 2. Fazenda Arataú | 7500 | Isolated | Moderate | Low |
| 3. Fazenda Badajós | 8000 | Semi-isolated | Intense | High |
| 4. Fazenda São Marcos | 10,000 | Isolated | Moderate | Moderate |
| 5. Real Agropecuária S.A. | 17,485 | Semi-isolated | None | High |
| 6. Ferreira Penna Scientific Station (ECFPn) | 33,000 | Part of 330,000-ha Caxiuanã National Forest | None | None |
| 7. Gurupi Biological Reserve | 341,000 | Part of a reserve complex of 1,000,000 ha | Low | Low/moderate |
| 8. Parakanã Territory | 351,697 | Contiguous with surrounding forest | None | None* |

* Bearded sakis are not hunted by the Parakanã, although most other medium- and large-bodied mammals suffer intense hunting pressure.

Table 2 Sightings of bearded sakis and population densities at the different study sites

| Site | Survey length (km) | Sightings | Sighting rate per 10 km | Mean group size (individuals) | Population density (individuals/sq km) | Estimated total population |
|------|--------------------|-----------|-------------------------|-------------------------------|--|----------------------------|
| 1 | 202 | 0 | 0 | 0 | 0 | 0 |
| 2 | 101 | 21 | 2.07 | 6.57 | 23.78 | 1784 |
| 3 | 205 | 1 | 0.05 | 6.00 | 0.90 | 72 |
| 4 | 408 | 14 | 0.34 | 7.00 | 6.44 | 644 |
| 5 | 216 | 6 | 0.28 | 4.50 | 3.24 | 567 |
| 6 | 533 | 6 | 0.11 | 9.16 | 2.88 | 951 |
| 7 | 480 | 18 | 0.37 | 7.94 | 6.75 | 23,018 |
| 8 | 178 | 6 | 0.34 | 6.20 | 5.81 | 20,434 |

heavily on forests for subsistence resources, including game.

Nevertheless, land conflicts are a chronic problem in south-eastern Amazonia, and tensions have increased considerably in recent years, especially following the 1996 massacre of squatters by military police at Eldorado dos Carajás, located just south of site 8. In addition to increasing pressure on remaining forests, either potentially or in practice, such conflicts also tend to have a negative influence, from a conservation viewpoint, on the attitudes of *latifundiários*. While supportive of conservation efforts, the owner of one of the ranches surveyed here, for example, plans to take what he sees as unavoidable measures to guarantee the integrity of his property, which will include logging part of the forest reserve. The manager of a second ranch became noticeably less co-operative with researchers immediately after the Carajás incident.

Conservation perspectives

In purely numerical terms, then, the existing metapopulations of *C. s. satanas* and *C. s. utahicki* appear to be relatively healthy, although habitat fragmentation and the consequent isolation of relatively small local populations is clearly a major long-term threat to both subspecies (Lande & Barrowclough, 1987; Turner & Corlett, 1996). A second positive aspect of the surveys was the finding that bearded sakis are apparently more tolerant of habitat disturbance than was assumed previously, contributing to the potential of habitat fragments for the eventual management of metapopulations.

Forest fragments of between 5000 and 20,000 ha, which are typical of the region's present-day landscape (outside the Bragantine Zone), thus seem able to sustain apparently healthy populations of more than 500 individuals, although the long-term viability of populations of this size is still debatable (Lande & Barrowclough, 1987; Soulé, 1987; Thomas, 1990). Judging viability, and developing effective management strategies will nevertheless require far more detailed data than are currently available on relevant aspects of bearded saki biology, such as genetic variability, population dynamics and even feeding ecology. The evolution of the present-day landscape is also unpredictable, given that continuing fragmentation appears to be the norm, despite recent changes in federal legislation, which severely restrict clear-cutting of forest on Amazonian properties.

The answer to the initial question would thus seem to be that bearded sakis, in common with most other elements of the fauna and flora of eastern Amazonia, are on the brink of a potentially definitive decline fuelled primarily by widespread deforestation and habitat fragmentation. However, the situation is as yet

far less critical than that of Brazil's Atlantic Forest, for example (Lopes & Ferrari, 1993), although there is an urgent need for the development of adequate conservation policies. While private initiatives, rather than public entities, may play a key role in their implementation, the effectiveness of such policies will depend, ultimately, on the resolution of wider social problems such as the distribution of land and wealth.

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Biographical sketches

Steve Ferrari's principal research interests are the ecology and conservation of Amazonian primates. He has supervised a number of local postgraduates, including the masters' dissertations of the three co-authors.

Claudio Emidio-Silva is continuing his research on the effects of hunting and the development of wildlife management strategies in the Parakanã reservation, which will form the basis of his doctoral thesis.

Cida Lopes is a doctoral student at the University of Miami, and is currently investigating the effects of the local extinction of southern bearded sakis on seed dispersal patterns and the population dynamics of lecythid tree species.

Urbano Bobadilla has recently taken up a lecturing position at the Brazilian Lutheran University in his hometown of Porto Alegre, but plans to continue research on primate ecology, in particular population viability studies, in the near future.