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Pitheciines at the behaviour-conservation interface: Using behavioural knowledge in the conservation of southern bearded sakis (*Chiropotes satanas*)

Liza M. Veiga

Department of Experimental Psychology, Federal University of Pará, Belém, Brazil

Many Neotropical Primates live in altered habitats and nearly a third are threatened with extinction. One of today's challenges is how to link the distinct fields of ethology and behavioural ecology with conservation biology, to integrate the knowledge gained through behavioural field studies into conservation strategies. Pitheciines are one of the least know groups of Neotropical Primates and several of their taxa are threatened with extinction. Using the example of pitheciines, specifically the genus *Chiropotes*, this text discusses how an understanding of behavioural characteristics can contribute to the success of conservation initiatives.

Keywords: Behaviour, *Chiropotes*, Conservation, Pitheciinae

Altered habitats and threatened primates today's reality

As primate habitats continue to be destroyed, the number of species requiring conservation measures to ensure their survival is greater than ever. Those who work with primate behaviour have become increasingly interested in the contribution their research might make to conservation goals.

Of the 200 or so recognised Neotropical Primates, close to 30% are classified as threatened or in danger of extinction (Rylands, 2004). Of the Pitheciines, *Chiropotes* is the most threatened genus, with *Chiropotes satanas*[1] (from now on, southern bearded saki) listed by IUCN as endangered (Rylands *et al.,* 2003). To date there are no conservation or management plans relating to this species, and only a few demographic surveys (for example, Johns & Ayres, 1987; Silva Jr., 1991; Lopes, 1993; Ferrari *et al.*, 1999; Ferrari *et al.*, 2001) and a handful of behavioural studies have been undertaken (Ayres, 1981; Port-Carvalho, 2002; Santos, 2002; Silva, 2003; Veiga, in prep.).

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[1] *Chiropotes satanas* (southern bearded saki) was raised to species level following a revision by Silva Jr. and Figueiredo (2002). It was previously recognized as the subspecies *Chiropotes satanas satanas*.

Integrating behaviour and conservation

Despite the benefits that integration of behavioural knowledge into conservation plans could bring. The fields of ethology and behavioural ecology, and conservation biology have remained distinct (Strier, 1997; Caro, 1999; Gosling & Sutherland 2000). Researchers of behaviour and ecology tend to focus on theoretical questions examining how ecological constraints and evolutionary selection pressures influence behaviour. Conservation biologists address more applied problems such as biodiversity loss and species extinction (Soulé, 1985). Behavioural research concentrates at the level of the individual and groups, while conservation action takes place at the population-level, and at the larger scales of ecosystems and landscapes, thus making their integration difficult.

Recently, there has been a flurry of interest in how to reconcile these separate and yet complementary approaches (Curio, 1996; Ulfstrand, 1996; Clemmons & Buchholz 1997; Strier, 1997; Caro 1999; Anthony & Blumstein, 2000; Gosling & Sutherland 2000). A merging of these approaches would increase understanding of how individuals' interactions with their physical and social environments affect the genetic and demographic structures of their populations (Strier, 1997). Thereby giving a higher predictive value in the assessment of population response to disturbance factors.

Primate species such as the southern bearded saki are prioritised for conservation based on an evaluation of their risk of extinction. In conservation studies, population models such as Population and Habitat Viability Analysis PHVAs (See Foose, 1995) are often used to assess risk. These usually involve the development of species-specific computer simulations that require detailed demographic and environmental information. These demographic models are used to project populations into the future and to estimate their risk of extinction in relation to environmental variation.

Behaviour and conservation in Southern bearded sakis

Based on preliminary results from studies undertaken at the UHE (Hydroelectric dam) Tucururí at Eletronorte's Base 4, (right bank Tocantins River, 4º15'S, 49º31'W), this section discusses how behavioural knowledge of the southern bearded saki can contribute to conservation. The species is restricted to an area, between the right margin of the Tocantins River and the eastern limits of the Amazon forest in Maranhão State. This region has suffered from extensive deforestation resulting in significant habitat loss; the survival of the southern bearded saki will depend on conservation intervention to manage its remaining populations, particularly those in forest fragments (Ferrari *et al.*, 1999).

The implementation of a successful conservation strategy will require behavioural and ecological knowledge. The identification of factors that limit population growth call for an understanding of the relationship between social organisation, reproductive strategies, ranging behaviour and population density, with the abundance, distribution, and quality in time and space of the specie's key resources.

Bearded sakis (*Chiropotes* spp.), as specialised seed predators are considered sensitive to habitat disturbance and thought to depend on large areas of undisturbed forest for their survival (Ayres, 1981; Johns & Ayres, 1987; Ferrari *et al.*, 1999). Recent studies undertaken in Tucuruí, however, show that they are relatively abundant on small-forested islands and in the remaining forest surrounding the reservoir (Ferrari *et al.*, 2004). A survey undertaken at Base 4 found southern bearded sakis present on 28.6 % of the surveyed islands (Ferrari *et al.*, 2004). In addition, groups are surviving and reproducing in areas much smaller than previously thought possible. A continuous *terra firme* forest group with a home range of 80 ha, increased from 27 to 39 members over a period of 3 years (Santos, 2002; Silva, 2003; Veiga, in prep) and a group on a small island (18 ha) increased from 7 to 8 members over 2 years (Veiga, in prep.). Prior home range estimates for the genus ranged from 250 to 500 ha (Ayres, 1981). This demonstrates a greater tolerance of habitat disturbance (in the absence of hunting) than previously thought and a degree of behavioural flexibility in the face of change.

Two groups occupying small islands, Su Island (16 ha) and Hiram Island (18 ha) have demonstrated both signs of nutritional stress (Silva, 2003) and a degree of dietary flexibility respectively (Veiga, in prep.). The group on Su Island showed a high dependence on flowers (55,61 % of feeding records) and reduced activity levels, and in contrast to Hiram Island, no reproduction was recorded (Silva, 2003). During moments of reduced resource availability the group on Hiram Island used a series of alternative resources such as pith and shoots, flowers were also important for this group (Veiga, in prep.)

Obviously isolated populations living on small islands with little opportunity for dispersal are probably not viable in the long-term (Schaffer, 1978). Population growth is determined by intrinsic reproductive factors and offspring survival, which in turn are linked to the availability and quality of food and other resources, and there are already some indications of nutritional stress on small islands. While there is evidence for movement of individuals between islands (Veiga, in prep.), this probably only occurs between islands which form interlinking land bridges when the reservoir is at the dry season low water level. These limited dispersal opportunities are probably insufficient to guarantee adequate genetic variability and population growth (see Schaffer, 1987). Studies are necessary therefore, to establish the genetic diversity of existing populations, these could contribute to the development of an effective management plan for the entire remaining population. A translocation program could be implemented to ensure that the genetic diversity of the species is maintained. One option is the translocation of animals from small islands to large uninhabited islands, with suitable habitat characteristics (Ferrari *et al.*, 2004).

Dispersal mechanisms for southern bearded sakis are unknown, data for a *terra firme* mainland group show a higher than expected degree of social interaction between males (Veiga & Silva, in prep). During monitoring, lone females have been observed at a distance from their group. These findings would seem to suggest a system of female dispersal, more data is needed to confirm this but if correct, this knowledge could help in translocation decisions.

Conclusion

Undoubtedly behavioural insights are essential elements in successful wildlife conservation management and this is especially true for primates that demonstrate behavioural flexibility in the face of ecological pressures. To be able to identify the factors that limit southern bearded saki population growth we need knowledge of the specie's ecological needs, its degree of diet flexibility and behavioural adaptability in the face of change. We will also need to be able to 'translate' this behavioural knowledge into the spatial and demographic consequences needed for incorporation into conservation plans.

The protected area, in the region of the UHE-Tucururí appears to have excellent potential both for conservation of southern bearded sakis and for systematic evaluation of the factors that may limit their long-term survival. A great deal of complementary research is needed to provide data on specie's characteristics and extrinsic influences. This combined with knowledge of behaviour will assist in development of a wise and informed conservation and management plan for this threatened species.

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