Occurrence and Diet of the Black Bearded Saki (*Chiropotes satanas satanas*) in the Fragmented Landscape of Western Maranhão, Brazil

Márcio Port-Carvalho
Stephen F. Ferrari

Introduction

The bearded sakis, *Chiropotes*, are medium-sized platyrrhine frugivores, morphologically specialised for seed predation (Kinzey and Norconk, 1993; Peetz, 2001). Like most Amazonian primates, relatively few detailed field data are available, especially considering the dimensions of the genus' geographic distribution, which extends from the southeastern extreme of the Hylaea as far north and west as the right bank of the Orinoco (Silva Jr. and Figueiredo, 2002). As is also so often the case, the taxa most threatened with extinction are the least well-known.

The black bearded saki, *Chiropotes satanas satanas*, is the only Amazonian pitheciid found east of the Rio Tocantins (Ferrari and Lopes, 1996) – one of the biome's most densely populated areas – and has been classified as Endangered for some time (IUCN, 1994; Rylands *et. al.*, 1997; MMA, 2003). Johns and Ayres (1987) proposed that the subspecies could be extinct by the end of the twentieth century, although fortunately this prediction proved unfounded. Several recent studies (Carvalho Jr. *et al.*, 1999; Lopes and Ferrari, 2000; Pereira, 2002) have identified a growing number of remnant populations, often in relatively small forest fragments.

While these studies have shown that the black bearded saki is more tolerant of habitat fragmentation than was previously thought, the ecology of the subspecies is still poorly known, and more detailed field data are necessary for the development of effective conservation strategies. With this in mind, five remnants of the original forest cover – including two of less than 100 ha – were surveyed in western Maranhão in order to identify surviving populations of bearded sakis and collect preliminary data on their feeding behaviour. Sakis were found in all fragments, where they were observed feeding mainly on immature seeds. This apparent ability of *C. s. satanas* to survive extremes of habitat fragmentation will be an important asset for its conservation over the long term.

Methods

This study took place on the Celmar plantation complex in the western extreme of the Brazilian state of Maranhão, northwest of the city of Imperatriz. This part of the state is known locally as the Tocantina region, and represents the easternmost extreme of the Amazon forest, or Hylaea. Present-day forest cover consists of a series of fragments that vary in size and degree of habitat disturbance, totalling 40,000 ha, separated by pastures and *Eucalyptus* plantations covering 31,000 ha (Almeida, 2001). Approximately 11,600 ha of primary *terra firma* forest remain, distributed in 12 fragments of different sizes. Bearded sakis were found in all, and data were collected in five fragments, ranging in size from eight to over 2,000 ha (Table 1).

The fragments were visited regularly throughout 2001 (see Carvalho, 2002). In the four larger fragments, in addition to informal observations, standard line-transect surveys were carried out, with a total of between 100 km and 133 km walked per site (Port-Carvalho and Ferrari, 2002; Port-Carvalho and Ferrari, in prep.). Estimates of population density for the three largest fragments were calculated using a Fourier series expansion (Ayres *et al.*, 2000). Whenever sakis were observed feeding during either type of data collection, all relevant details were recorded, including the item (flower, fruit, seed), and the species of plant exploited. Feeding sites were marked, and specimens collected for identification at the EMBRAPA herbarium in Belém. The proportion of secondary forest cover in the larger fragments (Table 1) was estimated by recording the forest type observed at 50-m intervals along the respective trail system (2.5-5.2 km total length, depending on the site).

Complementary behavioural data were collected in the Primavera fragment between December 2001 and February 2002, where a study group with 17 members was monitored using a scan-sampling schedule in which one-minute scans were conducted at intervals of five minutes (see Ferrari and Rylands, 1994). Records were assigned to four principal behaviour categories (Feeding, Locomotion, Rest and Miscellaneous, which includes social interactions and alarm vocalisations and postures).

Results

Bearded sakis were observed in all five fragments (Table 2), including Martirinho, where there was a group of at least four individuals. Given the reduced size of this fragment, it seems likely that the sakis may range into surrounding areas, or even visit neighbouring fragments by crossing open ground – although no evidence of such behaviour was collected, either from direct observation or reports from local residents. Sakis were relatively abundant in all but the largest fragment (Esplanada), especially in comparison with *Chiropotes* populations inhabiting continuous forest (for

Table 1. Characteristics of the forest fragments surveyed.

Fragment	Location	Area (ha)	Estimated % of secondary forest
Martirinho	05°00'S, 48°08'W	8	100.0
Primavera	05°09'S, 48°17'W	63	61.1
Coração do Brasil	05°00'S, 48°12'W	306	56.3
Santa Rosa	05°05'S, 48°15'W	653	57.5
Esplanada	04°58'S, 48°08'W	>2000	64.9

Table 2. Known (Martirinho and Primavera) or estimated abundance of bearded sakis at the five study sites.

	Martirinho	Primavera	Coração do Brasil	Santa Rosa	Esplanada
Individuals per km²	62.5	27.0	11.4	10.1	2.5
Total population	4	17	35	66	49

example, Ayres, 1981; Van Roosmalen *et al.*, 1988; Ferrari *et al.*, 1999).

The behavioural data for the study group from the Primavera fragment are limited in terms of both sample size and period, but confirm the general pattern recorded for bearded sakis from other sites as active animals (Table 3). The proportion of time spent feeding was reduced in comparison with some previous studies, such as those of Ayres (1981) and Peetz (2001), although it remains unclear to what extent this represents a real difference in behaviour patterns, as opposed to differences in sampling procedures.

Despite the limited number of records, feeding behaviour was typical of *Chiropotes*, characterised by the exploitation of a wide variety of species, a large proportion of immature seeds (Table 4), and the predominance of the Sapotaceae, Lecythidaceae and Leguminosae (Table 5). The total of 48 different species, belonging to 19 families, was recorded in only 75 feeding events – although of course data were collected over a relatively wide area, which may have contributed (at least in part) to increased diversity in comparison with previous studies. However, no fewer than 37 of these species were recorded at Primavera, which suggests that high diversity is a characteristic of the forest in the study area. A majority of the species were exploited for their immature seeds (Table 4), although the sakis also dispersed the seeds of nine families, all of which have relatively small seeds, varying in length between 1-20 mm. With one exception, the species recorded in the diet at more than one site or on more than two occasions were all exploited for their immature seeds, further reinforcing the importance of this item in the sakis' diet. The ingestion of flowers was recorded only once, and no evidence was found of insectivory. However, we emphasize that while data were collected throughout the year, a majority of the records were collected between December and February, which corresponds with the onset of the wet season at the study site. It is thus possible that there may be a certain degree of seasonal bias (see Norconk, 1996).

Discussion

Two aspects of the results of this study of *Chiropotes s. satanas* are especially relevant to the conservation of this endangered primate. The occurrence of a sizeable metapopulation this far east and south is an extremely important finding, and the possibility of the existence of other isolated populations in the region's fragmented landscape surely demands further investigation. In addition, remnant populations were found in all the fragments surveyed, including those smaller than 100 ha, and all disturbed to a greater or lesser degree (Table 1). This is considerably smaller than the original estimates of home range size for bearded sakis in continuous forest (Ayres, 1981; Van Roosmalen *et al.*, 1988), although recent studies (Peetz, 2001; Santos, 2002; Silva, 2003) have also recorded much smaller ranges in fragmented habitat. Even so, it seems unlikely that the group in the Martirinho fragment will be able to survive over the long term without access to neighbouring habitat (Rylands and Keuroghlian, 1988).

In addition to tolerating extremes of habitat fragmentation, the results indicate that the diet and activity regime of *C. s. satanas* in the study area is similar to that of bearded sakis at other sites. In other words, toleration of fragmented habitat appears not to have been dependent on significant changes in behavioural patterns, such as the exploitation of alternative resources, although it must be remembered that the data presented here are preliminary in nature. The characteristics of the process of habitat fragmentation may also be important, however. Many members of the Sapotaceae, Lecythidaceae and Leguminosae are valued hardwoods (Johns and Ayres, 1987), so shifts in feeding patterns might be expected where fragmentation has been accompanied by selective logging. Silva (2003) did find evidence of such a shift in the feeding ecology of *C. s. satanas* in a fragment similar in size to that of Martirinho but, as mentioned above, data from the latter site are far from comprehensive.

Table 3. Activity budget of the *C. s. satanas* study group between December 2001 and February 2002.

Category	Records	% Total
Locomotion	245	58.5
Feeding	83	19.8
Rest	58	13.8
Miscellaneous	33	7.9
N	419	100.0

Table 4. Composition of the diet of *C. s. satanas* according to the different items ingested.

Item	Number of species (% of total)	Number of events (% of total)
Immature seeds	28 (58.3)	47 (62.7)
Mesocarp or aril (seeds spat out)	10 (20.8)	14 (18.7)
Mesocarp (seeds ingested)	9 (18.8)	13 (17.3)
Flowers	1 (2.1)	1 (1.3)
Total	48 (100.0)	75 (100.0)

Table 5. Food sources exploited by bearded sakis in western Maranhão.

Family	Species	Habitus	Item	Events	Site
Annonaceae	*Xylopia* sp.	Tree – 25 m	Immature seed	1	PRI
Apocynaceae	*Apisdosperma multiflorum*	Tree – 20 m	Mesocarp	1	PRI
	Not identified	Liana	Mesocarp	2	ESP
Arecaceae	*Euterpe oleracea*	Tree – 15 m	Mesocarp	1	MAR
Boraginaceae	*Cordia scrabifolia*	Tree – 15 m	Mesocarp	2	PRI
Burseraceae	*Protium apiculatum*	Tree – 25 m	Mesocarp	1	PRI
	Protium puncticulatum	Tree – 20 m	Mesocarp	2	MAR
	Tetragastris altissima	Tree – 15 m	Mesocarp	3	PRI/MAR
	Tetragastris paraensis	Tree – 30 m	Mesocarp	1	PRI
Caesalpinaceae	*Dialium guianense*	Tree – 25 m	Immature seed	1	CBR
Cecropiaceae	*Cecropia* sp.	Tree – 15 m	Mesocarp	1	PRI
Chrysobalanaceae	*Licania kunthiana*	Tree – 20 m	Mesocarp	2	PRI
Clusiaceae	*Caraipa* sp.	Tree – 25 m	Seed	1	MAR
Combretaceae	*Buchenavia* sp.	Tree – 20 m	Mesocarp	1	PRI
Dilleniaceae	*Tetracera wildnoviana*	Tree – 25 m	Mesocarp	1	CBR
Flacourtiaceae	*Laetia procera*	Tree – 30 m	Mesocarp	1	MAR
	Laetia suaveolonus	Tree – 15 m	Mesocarp	1	PRI
Hippocrateaceae	*Cheiloclinium coguateae*	Liana	Mesocarp	2	PRI
Lecythidaceae	*Cariniana* sp.	Tree – 25 m	Seed	1	MAR
	Eschweilera coriaceae	Tree – 25 m	Immature seed	3	PRI/CBR
	Eschweilera ovata	Tree – 25 m	Immature seed	1	PRI
	Eschweilera pedicillata	Tree – 20 m	Immature seed	1	CBR
	Eschweilera sp.	Tree – 20 m	Immature seed	2	PRI
	Lecythis lurida	Tree – 25 m	Immature seed	2	PRI
Leguminosae	*Hymenaea parvifolia*	Tree – 20 m	Immature seed	1	PRI
	Inga alba	Tree – 25 m	Mesocarp	2	PRI
	Inga nobilis	Tree – 10 m	Mesocarp	1	PRI
	Peltogyne venosa	Tree – 20 m	Immature seed	2	PRI
	Pterocarpus rohrii	Tree – 15 m	Immature seed	1	PRI
Moraceae	*Brosimum guianense*	Tree – 05 m	Immature seed	1	PRI
	Brosimum parinarioides	Tree – 35 m	Immature seed	1	MAR
	Ficus pertusa	Hemiepiphyte	Mesocarp	1	PRI
	Pseudolmedia laevigata	Tree – 15 m	Mesocarp	1	PRI
Myrtaceae	*Eugenia patrisii*	Tree – 15 m	Immature seed	7	PRI
	Eugenia sp.	Tree – 15 m	Flower	1	PRI
Quinaceae	*Lacunaria crenata*	Tree – 15 m	Immature seed	1	PRI
	Lacunaria oppositifolia	Tree – 15 m	Immature seed	1	SRO
Sapotaceae	*Franchetella anibifolia*	Tree – 15 m	Immature seed	1	PRI
	Manilkara amazonica	Tree – 15 m	Immature seed	1	PRI
	Micropholis egensis	Tree – 20 m	Immature seed	1	PRI
	Micropholis guyanensis	Tree – 20 m	Immature seed	1	PRI
	Neoxythece sp.	Tree – 20 m	Immature seed	1	PRI
	Panchonella guianensis	Tree – 20 m	Immature seed	1	PRI
	Pouteria caimito	Tree – 20 m	Immature seed	2	SRO
	Pouteria lasiocarpa	Tree – 25 m	Immature seed	5	PRI
	Pouteria hispida	Tree – 10 m	Immature seed	1	PRI
	Priurella prieuri	Tree – 20 m	Immature seed	1	PRI
Vochysiaceae	*Qualea dinizii*	Tree – 30 m	Immature seed	2	PRI
	Qualea gridonia	Tree – 20 m	Immature seed	3	PRI/CBR

While the similarities with previous studies of bearded sakis have been emphasised here, an alternative interpretation of the results may be relevant to an understanding of the ecology of the genus. Early ecological studies of bearded sakis (Ayres, 1981; Van Roosmalen *et al.*, 1988; Frazão, 1992) were conducted at sites located well within the main body of the genus' distribution, and supported what came to be a "standard" dogma, that these primates were intolerant of habitat disturbance and dependent on large areas of continuous forest (for example, Johns and Ayres, 1987). All recent studies, however, have contradicted this idea (Bobadilla and Ferrari, 1999; Lopes and Ferrari, 2002; Peetz, 2001; Pereira, 2002; Santos, 2002; Silva, 2003; present study). A common aspect of these studies is that they were conducted at relatively marginal sites, close to the transition of the continuous forest with the Venezuelan Llanos to the northwest (Peetz, 2001) and the Brazilian Cerrado to the southeast (all other studies).

This suggests that these sakis may be naturally more tolerant of habitat disturbance than those found at more central sites, although it remains unclear whether this reflects phylogenetic differences, or variation at the local population level. More detailed data will obviously be required before such conclusions can be evaluated definitively. In the meantime, whatever the factors involved, the results presented here, together with those of other recent studies, indicate that *C. s. satanas* is able to survive in the fragmented landscape of eastern Amazonia, although the long-term conservation of this primate will depend on adequate metapopulation management.

Acknowledgments: This study was supported by Celmar S. A. – Companhia de Celulose e Papel, the Brazilian Higher Education Authority (CAPES), the World Wide Fund for Nature (WWF) – Brasil (CSR 187-2000) – USAID, the Brazil Science Council (CNPq) and the Kapok Foundation. Botanical specimens were identified by Manoel Cordeiro at EMBRAPA – Amazônia Oriental, Belém, Pará. We also thank Paulo Lobo for logistical support, and Fábio Rohe and Mayson Peterson for field assistance.

Marcio Port-Carvalho[1,2] and **Stephen F. Ferrari**[1,3], [1]Departamento de Psicologia Experimental, Universidade Federal do Pará, Belém 66075-110, Pará, Brazil, [2]Instituto Florestal do Estado de São Paulo, Rua do Horto 931, Horto Florestal, São Paulo 02377-000, São Paulo, Brazil, e-mail: <portcarvalho@mail.com> and [3]Departamento de Genética, Universidade Federal do Pará, Belém 66075-110, Pará, Brazil.

References

Almeida, A. 2001. Diversidade, abundância e conservação de aves em habitats secundários da Pré-Amazônia maranhense, Brasil. Master's thesis, Escola Superior de Agricultura "Luiz de Queiroz" (ESALQ) / Universidade de São Paulo (USP), São Paulo.

Ayres, J. M. 1981. Observações sobre a ecologia e o comportamento dos cuxiús (*Chiropotes albinasus* e *Chiropotes satanas* Cebidae, Primates). Master's thesis, Instituto Nacional de Pesquisas da Amazônia (INPA), Fundação Universidade do Amazonas (FUA), Manaus.

Ayres, J. M. 1989. Comparative feeding ecology of the uakari and bearded saki, *Cacajao* and *Chiropotes*. *J. Hum. Evol.* 18: 697-716.

Ayres, J. M. and Nessimian, J. I. 1982. Evidence of insectivory in *Chiropotes satanas. Primates* 23: 458-459.

Bobadilla, U. L. and Ferrari, S. F. 1999. Habitat use by *Chiropotes satanas utahicki* and syntopic platyrrhines in Eastern Amazonia. *Am. J. Primatol.* 50: 215-224.

Carvalho, M. P. 2002. Dieta, comportamento e densidade populacional do cuxiú-preto, *Chiropotes satanas satanas* (Primates: Pitheciinae) na paisagem fragmentada do oeste do Maranhão. Master's thesis, Universidade Federal do Pará (UFPA), Belém.

Carvalho Jr., O., Pinto, A. C. B. and Galetti, M. 1999. New observations on *Cebus kaapori* Queiroz, 1992, in eastern Brazilian Amazonia. *Neotrop. Primates* 7: 41-43.

Ferrari, S. F. and Rylands, A. B. 1994. Activity budgets and differential visibility in field studies of three marmosets (*Callithrix* spp.). *Folia Primatol.* 63: 78-83.

Ferrari, S. F. and Lopes, M. A. 1996. Primate populations in eastern Amazonia. In: *Adaptive Radiations of Neotropical Primates*, M. A. Norconk, A. L. Rosenberger and P. A. Garber (eds.), pp.3-19. Plenum Press, New York.

Ferrari, S. F., Emídio-Silva, C., Lopes, M. A. and Bobadilla, U. L. 1999. Bearded sakis in south-eastern Amazonia – back from the brink? *Oryx* 33: 346-351.

Frazão, E. R. 1991. Insectivory in free ranging bearded saki (*Chiropotes satanas chiropotes*). *Primates* 32: 243-245.

Frazão, E. R. 1992. Dieta e estratégia de forragear de *Chiropotes satanas chiropotes* (Cebidae: Primates) na Amazônia central brasileira. Master's thesis, Instituto Nacional de Pesquisas da Amazônia (INPA), Fundação Universidade do Amazonas (FUA), Manaus.

Instituto de Pesquisas e Estudos da Vida Silvestre. 1999. Diagnóstico, monitoramento e conservação ambiental do Empreendimento Florestal da Celmar – Indústria de Celulose e Papel do Maranhão. Sub-projeto 3A e 5A, Levantamento Florístico e Fitossociológico das Reservas da Celmar. Unpublished report to Celmar S.A., Piracicaba, SP.

IUCN. 1994. *IUCN Red List Categories*. IUCN – The World Conservation Union, Gland, Switzerland.

Johns, A. D. and Ayres, J. M. 1987. Southern bearded sakis beyond the brink? *Oryx* 21: 164-167.

Kinzey, W. G. and Norconk, M. A. 1993. Physical and chemical properties of fruit and seeds eaten by *Pithecia* and *Chiropotes* in Surinam and Venezuela. *Int. J. Primatol.* 14: 207-227.

Lopes, M. A. and Ferrari, S. F. 2000. Effects of human colonization on the abundance and diversity of mammals in eastern Brazilian Amazonia. *Conserv. Biol.* 14: 1658-1665.

Ministério do Meio Ambiente. 2003. *Lista Nacional das Espécies da Fauna Brasileira Ameaçadas de Extinção*. Website: <http://www.mma.gov.br/port/sbf/fauna>.

Norconk, M. A. 1996. Seasonal variation in the diets of white-faced and bearded saki (*Pithecia pithecia* and *Chiropotes satanas*) in Guri Lake, Venezuela. In: *Adaptive Radiations of Neotropical Primates*, M. A. Norconk, A. L. Rosenberger and P. A. Garber (eds.), pp. 403-425. Plenum Press, New York.

Norconk, M. A., Grafton, B. D. and Conklin-Brittain, N. L. 1998. Seed dispersal by Neotropical seed predators. *Am. J. Primatol.* 45: 103-126.

Oren, D. C. 1988. Uma Reserva Biológica para o Maranhão. *Ciência Hoje* 8: 36-45.

Peetz, A. 2001. Ecology and social organization of the bearded saki *Chiropotes satanas chiropotes* (Primates: Pitheciinae) in Venezuela. *Ecotrop. Monog.* 1: 1-170.

Pereira, A. P. C. P. 2002. Ecologia alimentar do cuxiú-preto (*Chiropotes satanas satanas*) na Fazenda Amanda, Pará. Master's thesis, Universidade Federal do Pará (UFPA), Belém.

Port-Carvalho, M. and Ferrari, S. F. 2002. Estimativas da abundância de cuxiú-preto (*Chiropotes satanas satanas*) e outros mamíferos não-voadores em fragmentos antrópicos de floresta na região Tocantina, Amazônia Oriental. *Resumos do XXIV Congresso Brasileiro de Zoologia,* Itajaí, SC, pp.531-532.

Rylands, A. B. and Keuroghlian, A. 1988. Primate populations in continuous forest fragments in central Amazonia. *Acta Amazonica* 18: 291-307.

Rylands, A. B., Mittermeier, R. A. and Rodríguez-Luna, E. 1996. A species list for the New World primates (Platyrrhini): Distribution by country, endemism, and conservation status according to the Mace-Lande system. *Neotrop. Primates* 3: 113-160.

Santos, R. R. 2002. Ecologia de cuxiús (*Chiropotes satanas*) na Amazônia oriental: Perspectivas para a conservação de populações fragmentadas. Master's thesis, Museu Paraense Emílio Goeldi (MPEG) / Universidade Federal do Pará (UFPA), Belém.

da Silva, S. S. B. 2003. Comportamento alimentar de cuxiú-preto (*Chiropotes satanas*) na área de influência do reservatório da usina hidrelétrica de Tucuruí-PA. Master's thesis, Museu Paraense Emílio Goeldi (MPEG) / Universidade Federal do Pará (UFPA), Belém.

Silva Jr., J. S. and Figueiredo, W. M. B. 2002. Revisão sistemática dos cuxiús, gênero *Chiropotes* Lesson, 1840 (Primates, Pitheciidae). *Livro de Resumos do X Congresso Brasileiro de Primatologia*, Belém, Pará, p.21.

Van Roosmalen, M. G. M., Mittermeier, R. A. and Milton, K. 1981. The bearded sakis, genus *Chiropotes*. In: *Ecology and Behavior of Neotropical Primates*, Vol. 1, A. F. Coimbra-Filho and R. A. Mittermeier (eds.), pp.419-441. Academia Brasileira de Ciências, Rio de Janeiro.

Van Roosmalen, M. G. M., Mittermeier, R. A. and Fleagle, J. G. 1988. Diet of the northern bearded saki (*Chiropotes satanas chiropotes*): A Neotropical seed predator. *Am. J. Primatol.* 14: 11-35.

Infección por Larvas de *Alouattamyia baeri* (Diptera: Cuterebridae) en Monos Aulladores, *Alouatta palliata* (Primates: Cebidae) de la Costa Caribe de Costa Rica

Olger Calderón-Arguedas, Adriana Troyo
Mayra E. Solano, Ronald Sánchez
Misael Chinchilla, Gustavo A. Gutiérrez-Espeleta

Introducción

Alouattamyia baeri es una especie de cuterébrido cuya larva se asocia con el parasitismo en primates del Nuevo Mundo (Catts, 1982). La descripción de la morfología fue realizada por Shannon y Greene (1926) con ejemplares procedentes de la Guayana Inglesa y de la Región del Darién en Panamá. Zeledón y colaboradores (1957) describieron el caso de una miasis furuncular en un mono aullador procedente de La Hacienda Lombardía en Tilarán (Guanacaste, Costa Rica) en la que el agente etiológico identificado correspondió a *Cuterebra* (=*Alouattamyia*) *baeri*. Este fue el primer informe acerca de la presencia de este díptero en el territorio nacional.

A pesar de que el parasitismo por esta mosca se ha informado en primates como *Aotus trivirgatus* (Guimarães, 1971) y el ser humano (Guimarães y Coimbra, 1982; Fraiha *et al.*, 1984), se ha observado que las relaciones parasitarias más frecuentes se establecen con monos del género *Alouatta* (*A. palliata* y *A. belzebul*) (Catts, 1982), por lo que podrían constituir un importante agente patogénico para estas especies.

En el presente trabajo se analizaron las características de la infestación que presenta este díptero en una muestra de monos aulladores procedentes de la Costa Caribe de Costa Rica.

Métodos

Se estudió la presencia de *A. baeri* en monos aulladores procedentes de la Costa Caribe de Costa Rica. El manejo de los mismos se hizo de acuerdo con los protocolos descritos por Troyo y colaboradores (2002). Brevemente, los animales fueron anestesiados con dardos que contenían los sedantes Telazol o una mezcla de ketamina y xylosin (aproximadamente 0.2 mg/kg). El primate fue capturado en una red y una vez en el suelo, se realizó su inspección física, ubicando la presencia o ausencia de lesiones miásicas. Esta evaluación se realizó en el marco de una investigación multidisciplinaria en la cual se estudian diferentes aspectos de las poblaciones de primates de Costa Rica.

El diagnóstico del agente etiológico fue realizado mediante análisis de las larvas que fueron extraídas mecánicamente de las lesiones. Estas fueron colocadas en alcohol al 70% para su fijación y transporte al laboratorio. Dichas larvas fueron observadas macroscópicamente y posteriormente se aclararon en lactofenol por un período de 20 días, luego del cual