MANAGEMENT OF MURIQUIS (*BRACHYTELES*, PRIMATES) IN CAPTIVITY

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Abstract

Muriquis are the largest of the Neotropical primates. Two forms are recognized today — *Brachyteles arachnoides* (É. Geoffroy, 1806), the southern muriqui with a black face, and *Brachyteles hypoxanthus* (Kuhl, 1820), the northern muriqui with face and genitalia mottled pink and black. They occur in eastern Brazil from the south of the state of Bahia to northern Paraná. The destruction, degradation and fragmentation of the Atlantic forest, along with hunting, are the reasons for their severely threatened status today. In this article, I briefly describe the history of conservation efforts and research on muriquis. Captive breeding, although still incipient as an effective conservation measure, has been successful at the Rio de Janeiro Primate Center (CPRJ/FEEMA) and the Curitiba Zoological Park, Paraná. I discuss particularly aspects of breeding success, cage design, colony formation, feeding and nutrition, diseases and the prevention and treatment of illnesses.

Key Words – primates, muriqui, *Brachyteles*, Atelidae, captive breeding, Atlantic forest

Introduction

Muriquis are the largest of the Neotropical primates. They occur in southeastern Brazil, with recent discoveries of a population in the state of Paraná in the south (Koehler *et al.*, 2002, 2005), and reports of their existence in the state of Bahia, to the far north. Their name comes from the word "Myraqui," of the Tupi language. Its approximate meaning is "people that swing as they come and go" and it refers particularly to the large, pale brown monkeys that inhabit forests along Brazil's Atlantic coast, initially assigned the scientific name of *Ateles hypoxanthus* by Wied-Neuwied (1958).

Two forms are recognized today — *Brachyteles arachnoides* (É. Geoffroy, 1806), the southern muriqui with a black face, and *Brachyteles hypoxanthus* (Kuhl, 1820), the northern muriqui with face and genitalia mottled pink and black. The first author to consider the two forms distinct was Vieira (1944), although he subsequently referred to *Brachyteles* as a single species (Vieira, 1955). More recent studies by Lemos de Sá and Glander (1993) confirmed Vieira's initial suggestion, which had also been considered by Torres de Assumpção (1983) and Coimbra-Filho (1990, 1992a, 1992b).

Coimbra-Filho and Magnanini (1968) and Coimbra-Filho (1972) noted the increasing scarcity of muriquis. However, only in 1982 was there international recognition of the plight of *Brachyteles*, during a symposium on the conservation of primates in tropical forests held in Houston, Texas, USA (Mittermeier *et al.*, 1983). The most detailed evaluation of the population and habitat status of *Brachyteles* was conducted by Aguirre (1971), but studies on this taxon resumed only in the 1980s, with work by Fonseca *et al*. (1983), Mittermeier *et al.* (1987), Nishimura *et al*. (1988), Oliver and Santos (1991) and Strier (1992), whose long-term research, begun in 1983, focused on the northern form of *Brachyteles*, at the Fazenda Montes Claros, Caratinga, in Minas Gerais. Torres de Assumpção (1983) and Milton (1984) carried out some early studies of the southern muriqui at the Fazenda Barreiro Rico, São Paulo, but a long-term field research program was established (in the Carlos Botelho State Park) only in the mid 1990s (Talebi and Soares, 2005).

In the early 1980s, Russell A. Mittermeier, Chair of the IUCN/Species Survival Commission (SSC) Primate Specialist Group (PSG), and then Director of Primate Programs at the World Wildlife Fund–US, began working in close collaboration with researchers at the Rio de Janeiro Primate Center (*Centro de Primatologia do Rio de Janeiro – CPRJ/FEEMA*), the Zoology Department of the Federal University of Minas Gerais (UFMG), the Brazilian Forestry Institute (*Instituto Brasileiro de Desenvolvimento Florestal – IBDF*), and a non-governmental organization (NGO), the Brazilian Foundation for Nature Conservation (*Fundação Brasileira para Conservação da Natureza – FBCN*) in Rio de Janeiro, to identify the most important federal and state reserves protecting remnants of the Atlantic forest and its rich endemic fauna (Mittermeier *et al.*, 1982). The WWF–US project included three areas of investigation. One concerned the nonhuman primates and

other large mammals, another the avifauna, and the third the vegetation and flora.

The Endemic Primates of the Atlantic Forest

The status of the primate species in the region was studied in great detail, with the aim of assessing their populations and habitats. In the first phase, emphasis was given to the most threatened — the muriquis (*Brachyteles*), and the lion tamarins (*Leontopithecus rosalia*, *L. chrysomelas*, and *L. chrysopygus*) (*L. caissara* was only discovered in 1990). Hunting and the widespread destruction and degradation of their forests are the principal causes of threat.

Twenty-four species and subspecies of nonhuman primates occur in the Atlantic forest. Twenty of them are endemic, and 17 are found in the southeast — the states of São Paulo, Rio de Janeiro, Espírito Santo, the eastern portion of Minas Gerais and the southern part of the state of Bahia, below the Rio de Contas. We consider this area critical because it is where most of the remaining forests still exist, and because it is where the Pleistocene forest refugia are thought to have been concentrated (Kinzey, 1982; Rylands *et al*., 1996). Of the 17 species and subspecies of nonhuman primates in southeastern Brasil, 14 are endemic and only encountered in this region. As indicated by the field investigations conducted by the Primate Program organized by WWF–US/CPRJ-FEEMA, at least 13 of these forms are seriously endangered and two are vulnerable. Some of the endangered primates were even considered on the verge of extinction.

Muriquis (*Brachyteles*) are one of the most endangered nonhuman primates in southeastern Brazil, and are also considered to be amongst the most threatened primates in the world (Strier *et al*., 2006). Altogether, the total population of *B. hypoxanthus* is estimated at 864 individuals, and for *B. arachnoides* the estimate is 1300 individuals (Melo and Dias, 2005) which, for both species, live precariously in few remaining forests, mostly degraded and isolated.

The original habitat of *B. arachnoides* and *B. hypoxanthus* is primary forest, or late successional and mature forest to be more precise. Few forests remain that provide adequate habitat for the muriquis. They are always a target for hunters that further reduces their populations, even in state and federal protected areas. Improving the management and policing of these reserves and parks, would be a very positive measure for their long-term protection.

Unlike the three species of *Leontopithecus* that benefit from highly organized and effective captive breeding programs, there are very few muriquis in captivity. There are small colonies in the Centro de Primatologia do Rio de Janeiro (CPRJ/FEEMA) and the Parque Zoológico de Curitiba, where they have been bred successfully.

The Captive Breeding Program

The existence of a Primate Center in the region where *Brachyteles* occurs made it possible to establish an *ex situ* breeding project to support an integration of field and captive management, following the example established and functioning for *Leontopithecus.* Despite the critical status of the two species, only a few individuals were maintained in public or private institutions in the past, and without any pretensions to a structured breeding program. It fell to the Centro de Primatologia the historic task of reproducing this rare species in captivity (Coimbra-Filho *et al*., 1993). Animals kept by a Swiss Animal dealer, Marco Schwarz, were transferred to the Parque Zoológico de Curitiba, which has also had success with their reproduction. The Fundação Parque Zoológico de São Paulo, Orquidário de Santos, Parque Zoológico Quinzinho Barros, Museu de Biologia Mello Leitão (Ruschi, 1964) have all maintained this primate, but without establishing a breeding nucleus. Perhaps, as Crandall (1964) and Aguirre (1971) thought, and even today for many others, the maintenance and reproduction of these primates *ex situ* represents a difficult and uncertain challenge.

Conditions in captivity

Captive management is one of the alternatives for the preservation of species threatened with extinction. In these man-made environments, it is necessary to utilize specific knowledge to develop plans for the areas and people, as well as the animals involved. These plans must take into consideration the principals of functionality, hygiene, and security. Enclosures must be sufficiently large, and contain high quality space suitable for the species. Other specific considerations that must be taken into account in the construction of enclosures include:

- Protection against predators
- Exposure to the sun's rays, preferably in the morning
- Avoidance of large fluctuations in temperature and humidity
- Access to shade
- Minimization of contact with feces, urine, and food remains
- Sheltered areas, as necessary.

In addition to the preparation of areas for the temporary isolation of individuals when needed, there must also be:

- Storage areas for both non-perishable and perishable foods (controlled refrigeration)
- Storage areas for equipment and materials used in the colony
- Storage for any hazardous materials and food wastes
- Medical-veterinary supplies and storage
- An area to maintain and store data
- A hygienic area for the workers and other people involved in the management of the colony

- An area for washing and disinfecting equipment, cages, etc.

Colony formation

Ex situ reproduction should begin with a founding population that is of high quality in every aspect. This unfortunately was not the case with the colony at the CPRJ-FEEMA, as shown by Coimbra-Filho *et al.* (1993), and in Table 1. Nonetheless, we have had notable breeding success in a period of only five years. Ideally, captive breeding initiatives would have a colony of healthy animals of the appropriate sexes and ages, and the behavior of which has not been influenced by humans and, most especially, negative social experiences. These factors, along with dietary management and sanitary medicine, could result in successful reproduction. However, the Centro de Primatologia has received confiscated animals many of which were in terrible condition on their arrival (Coimbra-Filho *et al.*, 1993). Some even died soon after arriving (Table 1), while others presented health risks to the rest of the colony. Some of the individuals that developed an aversion to the food they were presented ultimately recovered over time (CP 891, CP 924, CP 2049, CP 2097). Others died quickly (CP 2047 e CP 2050) (Table 1), despite every effort and care.

Feeding and nutrition

Special care in the choice of food and in the preparation of the diets for these monkeys is necessary. Knowing the fondness that muriquis have for Garapa (*Apuleia leiocarpa*) and for Jacarandá-branco (*Platypodium elegans*) leaves, we

Table 1. Breeding and Management of captive muriquis, *Brachyteles*, at the Centro de Primatologia do Rio de Janeiro (CPRJ-FEEMA).

Species	Sex	Origin	Local number	Date of arrival (A) or birth (B)	Locale	Father	Mother	Date of death	Tatoo	Experience	Cause of death
B. hypoxanthus	F	W	850	A 11 Sep 87	CPRJ	WB	WB	25 Jun 90	A 1	NOX	Multiple lesions; peritonitis associated with *Strongyloides*
B. hypoxanthus	F	W	891	A 12 Jan 88	CPRJ	WB	WB	11 Oct 96	A 2	IE 2(2) B 2(2)	Serious internal hemorrhage
B. hypoxanthus	F	W	924	A 18 Jul 88	CPRJ	WB	WB	25 Jul 97	A 3	IE 2(2) B 3(3)	Enteritis and anorexia
B. arachnoides	M	W	1012	A 24 May 89	CPRJ	WB	WB	Transfer to Rio Zoo (12 Mar 99)	A 4	IE 4(4) B 1(1)	Hepatitis B
B. arachnoides	M	W	1091	A 5 Jan 90	CPRJ	WB	WB		A 5	B 4(4)	
Hybrid	F	C	1245	B 10 Sep 91	CPRJ	1091 MS	924 FS	12 Sep 91	-	NOX	Birth difficulties; ruptured lung vessel
Hybrid	F	C	1286	B 30 Oct 91	CPRJ	1091 MS	891 FS		Chip 2558	IE 1(1)	
Hybrid	F	C	1335	B 3 Jun 92	CPRJ	1091 MS	924 FS	4 Jun 98	-	IE 2(2)	Festering abscess of abdominal wall; peritonitis
B. arachnoides	M	W	1407	A 21 May 93	CPRJ	WB	WB	4 Dec 96	-	NOX	Hepatitis B
Hybrid	-	C	1430	B 12 Oct 93	CPRJ	1091 MS	924 FS	12 Oct 93	-	NOX	Dead at birth
Hybrid	M	C	1475	B 25 Apr 94	CPRJ	1091 MS	891 FS		CHIP 9539	IE 3(3)	
Hybrid	M	C	1488	B 24 Jun 94	CPRJ	1091 MS	924 FS	Transfer to Rio Zoo (12 Mar 99)	1488	IE 2(2)	Hemorrhagic enteritis
B. arachnoides	F	W	1528	A 20 Dec 94	CPRJ	WB	WB	13 Jul 95	-	NOX	Anorexia, general infection
Hybrid	M	C	1671	B 8 Jun 96	CPRJ	1012 MS	924 FS	11 Oct 98		IE 1(1)	Enteritis
Hybrid	M	C	1689	B 7 Sep 96	CPRJ	1012 MS	891 FS	25 Sep 96		NOX	Exhaustion due to mother's illness
B. hypoxanthus	F	W	2047	A 22 Jan 02	CPRJ	WB	WB	21 Jun 02		NOX	Anorexia, enteritis
B. arachnoides	F	W	2049	A 6 Feb.02	CPRJ	WB	WB	-		NOX	
B. arachnoides	M	W	2050	A 14 Mar 02	CPRJ	WB	WB	22 Mar 02		NOX	Serious intestinal lesions and *Strongyloides*
B. hypoxanthus	F	W	2097	A 13 Nov 02	CPRJ	WB	WB			NOX	

Legend: WB = Wild born, W = Wild, C = Captivity, NOX = None, IE = Infant experience, B = Breeder

planted them nearby. This was enormously beneficial for the recovery of these animals when brought to us in poor health (Coimbra-Filho *et al.*, 1993). Those that were rescued were generally reluctant to accept artificial food, or even wild foods that were not part of their accustomed diet. New foods must be introduced carefully, with variety, to break the monotony of the diet and to stimulate their digestive tracts. Milton (1984), Strier (1991), and Moraes (1992) made important observations on the diet of *Brachyteles* in the wild that indicate appropriate recipes in captivity.

In general, primates with strongly folivorous diets are more difficult to maintain in captivity, mainly because of the difficulty of obtaining a diversity of appropriate foods to offer them. Owing to the enviable location of the CPRJ-FEEMA, we were able to overcome these difficulties, a factor certainly contributing to our success in breeding them. Animals that had been kept as pets had, in general, been accustomed to very bizarre diets (the case of the individuals CP 1528 and CP 2047, for example), which made the process of adapting them to a diet more typical of their natural needs more difficult. To illustrate the complications of adjusting their feeding regime, we relate the story of one individual (CP 1528) that had been maintained on entirely inadequate foods.

To stimulate this individual to eat a new diet, she was housed in an enclosure that was adjacent to that of the resident muriqui group. There, she could observe, vocalize and interact with the other muriquis, and become familiar with their diets. Over time, with little or nothing to eat, we decided to release her with the others, where she was well-received. Under these conditions, she ate few of the new food items, and in very small quantities, which probably lowered her physical resistance. She contracted a respiratory illness, and later had gastrointestinal problems. Although experiencing a long period of improvement, during which she received various medications, she eventually died.

The acceptance of food can be improved by adopting an appropriate feeding strategy. The muriquis fight over vegetation if we offer it to them in small quantities, but when offered as a large branch with numerous leaves, the muriquis feed together peacefully, as has been observed in the wild. They remain peaceful while feeding and vocalizing, as if they were satisfied with the food. Offering natural vegetation instead of supermarket foods is a more adequate diet for these primates in captivity.

Breeding—evolution of the colony

The breeding colony at the Centro de Primatologia do Rio de Janeiro originated with two females (CP 891 and CP 924), both *B. hypoxanthus*, and two males (CP 1012 and CP 1091), both *B. arachnoides*. The two males arrived very young, but were in better condition than the females. The contributions of male CP 1091 and of female CP 924 were greater than those of male CP 1012 and female CP 891. Births were problematic in 50% of the cases, as shown in Table 2, emphasizing the precarious history of these females as "pets," which had resulted in developmental problems with their pelvic bones and subsequent complications during parturition (Table 2). Under these conditions, there are always concerns with the female and the offspring. The possibility of success is uncertain.

Table 2. Contribution of males (*Brachyteles arachnoides*) and females (*Brachyteles hypoxanthus*) in the reproduction of muriquis in captivity at the CPRJ/FEEMA.

Males *B. arachnoides*	Females *B. hypoxanthus*	Offspring	Sex	Birth conditions
1091 ×	924	1245	F	D
		1335	F	T
		1430	?	D
		1488	M	D
	891	1286	F	T
		1475	M	T
1012 ×	924	1671	M	T
	891	1689	M	D

Legend: D = Difficult birth; surgery necessary, T = Full-term (normal)

Prevention and treatment of illnesses

Various studies provide detailed coverage of pathologies associated with primates, with those by Ruch (1959), Appleby *et al.* (1963), Fiennes (1967, 1972), Martin (1986), and Brack (1987) being of particular relevance. Preventive medicine is fundamental for the good health of the colony. It is also necessary to protect researchers from illness and death due to direct or indirect contact with pathogens transmitted by primates (Whitney Jr., 1976; Brack, 1987; Dalgard, 1991; Adams *et al.*, 1995; Butler *et al.*, 1995).

Many illnesses can attack primates in the wild and in captivity, the latter exacerbated through direct contact with humans. When different species are put together, there is also the possibility that one will pass serious diseases to the others. For example, *Herpesvirus tamarinus* is latent in *Saimiri*, but fatal in *Aotus* and *Saguinus* (Holmes *et al.*, 1964; Melendez *et al.*, 1966; Hunt *et al.*, 1973) as well as in other species. Conversely, *Herpesvirus hominis* is latent in humans, but fatal for *Aotus* and *Hylobates* (Smith *et al.*, 1969).

Very little has been written about the pathologies of muriquis. Works by Artigas (1935), Travassos (1943), Stuart *et al.* (1993), and Pissinatti *et al.* (1997) remain the best sources on their parasites. There has been a prevalence of intestinal problems associated with the deaths of muriquis in captivity, where the presence of *Strongyloides* sp. is marked, despite the sanitary medical controls employed (Pissinatti *et al.*, 1997). *Strongyloides* has been the cause of deaths among the individuals received and maintained at the Center (Table 1).

The conservation status of the muriqui continues to be critical, despite the many studies conducted to date. It was only 18 years after the first intensive field studies on muriquis that the first "Population and Habitat Viability Assessment Workshop for the Endangered Muriqui. *Brachyteles arachnoides*" was held, and where some recommendations for the conservation of the species were established (Rylands *et al.*, 1998). From this meeting until present, ongoing studies have continued at Caratinga and surrounding areas, as well as in the state of São Paulo, and at the Centro de Primatologia, where efforts to extend the captive breeding project have resulted in the approval of three enclosures (similar to the one already built) as part of the compensatory measures resulting from the *Programa de Despoluição da Baia de Guanabara* (PDBG). Construction of two more enclosures has been approved as part of the project of the surrounding the Paraíso State Ecological Station. All of the approved resources for these enclosures are embargoed, however, due to unrelated administrative and political issues.

Recently, the Brazilian Institute for the Environment (*Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis – IBAMA*) and the research group working at the Serra dos Órgãos National Park initiated a census of the muriqui population. Two workshops were organized by this "Programa Muriqui", through a partnership of IBAMA/TEREVIVA. They culminated in the creation of the International Committee for the Conservation and Management of the Muriqui/Woolly Spider Monkey (*B. arachnoides* and *B. hypoxanthus*) (Edict 1.369/02 of 10 October 2002 – IBAMA) — an international committee of the government specifically to discuss the two species and provide advice and coordinated direction for research, conservation and captive management measures on their behalf (Oliveira *et al.*, 2005). We believe that the best and most important actions on behalf of this extraordinary primate can be executed now that all of the necessary legal instruments for implementing them exist.

Acknowledgments

The Wildlife Preservation Trust International (WPTI) provided funding for the construction of the enclosure for muriquis. The Zoological Society of Philadelphia, Conservation International (CI), the Jersey Wildlife Preservation Trust (JWPT), the American Zoological and Aquarium Association (AZA), the Greater Los Angeles Zoo Association, IBAMA-DF and IBAMA-BH, Zoology Department of the Federal University of Minas Gerais (UFMG), Parque Ecológico Turístico Alto Ribeira (PETAR), Orquidário de Santos, Federal University of Viçosa, the Rio de Janeiro State Research Support Foundation (*Fundação de Amparo à Pesquisa do Estado do Rio de Janeiro – FAPERJ*) (Proc. E-26/171.573/00), and the *Ministério Público Federal* provided fundamental help during the muriqui project. We appreciate the support of Braz Cosenza, Lucio Leoni, Rosa Lemos de Sá, Milton Thiago de Mello, Russell A. Mittermeier, Andy Baker, Anthony B. Rylands, Adelmar F. Coimbra-Filho and Sonia Maria Eduardo de França. Our thanks to Karen B. Strier for her kindness in translating this paper.

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