

An assessment of illegal capuchin monkey trade in Bahia State, Brazil

Avaliação do comércio ilegal de macacos-prego na Bahia, Brasil

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Abstract

Wildlife trade is illegal in Brazil. The issues associated with this problem are always difficult to resolve. Based on questionnaires, public and private reports, interviews and personal visits, the quantity and characteristics of captive capuchin monkeys (genus *Sapajus*) in the state of Bahia, northeastern Brazil are described. Questionnaires were sent to public and private institutions throughout the state to assess the captive groups of *Sapajus* spp. and identify possible routes of illegal traffic. Results showed a total of 105 captive capuchins. At least 15 individuals were identified as a byproduct of illegal trade. Six species were identified, three of them native of Bahia. Our study confirms the presence of critical routes for animal trafficking. Major points of illegal sales are the street markets in seven cities. Welfare, biological and sanitary conditions of captive capuchin monkeys need serious revision and improvements throughout the State. A list of management suggestions to captive *Sapajus* groups in Bahia, extensive to captive capuchins in all Brazil, is presented.

Key words: public policy, wildlife traffic, illegal routes, capuchin monkeys.

Resumo

O tráfico de espécies silvestres é uma atividade ilegal no Brasil. Todavia, os diversos aspectos relacionados com essa prática são difíceis de resolver. Neste trabalho, descrevemos o tráfico de primatas na Bahia, com base em entrevistas, relatórios públicos, privados e visitas técnicas. O foco específico deste trabalho é o macaco-prego, gênero *Sapajus*. Foram enviados questionários pelo correio a diversos atores envolvidos na manutenção de indivíduos cativos deste gênero para identificar a origem desses indivíduos e assim traçar as possíveis rotas do tráfico ilegal no Estado. Foram registrados 105 macacos-prego em cativeiro, sendo pelo menos 15 identificados como produto do tráfico ilegal. Seis espécies foram confirmadas, sendo que apenas três estão reportadas para a Bahia. Essa informação confirma o tráfico de espécies através do Estado. A pesquisa mostra locais críticos para o comércio ilegal de primatas, em feiras livres de sete cidades baianas. Sugere-se que as condições sanitárias, biológicas e de bem estar das populações cativas de macacos-prego no Estado sejam revisadas e melhoradas. Apresenta-se uma lista de sugestões para o manejo dos grupos cativos de *Sapajus* na Bahia, extensíveis para outros grupos deste gênero no país.

Palavras-chave: políticas públicas, tráfico ilegal, rotas do tráfico, macaco-prego.

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Introduction

Wildlife trade is a historically complex and difficult issue considering the need of involvement within almost all sectors of society. Several governments and organizations have struggled to reduce or regulate wildlife trade. There is a clear understanding that national laws must be supported by international policies to improve the effectiveness of enforcement and control measures (Traffic North America, 2009). To control this trade, the Convention on International Trade of Endangered Species of Wild Flora and Fauna (CITES) exists since 1976. CITES has currently been ratified by 175 countries or states (Nijman *et al.*, 2011). International wildlife trade is seen as one of the leading threats to biodiversity conservation (Sutherland *et al.*, 2009).

Brazil's primate biodiversity is the second highest in the world (Mittermeier *et al.*, 2009). Wildlife trade is illegal in Brazil, except when originated from licensed breeders (Law 5197/67, Brasil, 1967). The government is responsible for law enforcement through the Brazilian Environmental Agency (IBAMA), as well as through federal organs such as the Forestry Police and the Public Ministry, regional offices (i.e., each State Environmental Office) or even Municipal Environmental Offices (if available). Federal environmental agencies and public zoos are the institutions that receive most animals rescued from wildlife traffic or illegal trade (Vidolin *et al.*, 2004). They represent the final destination of approximately 60% of all wildlife (exotic or native) apprehended in the country (Giovanini, 2006). In the case of native fauna, the main reason to keep animals in captivity is the lack of specific reintroduction programs and release areas for most species (PMA-SP, 2006). Other considerations may be ecological (e.g., introduction of alien species), logistical, financial or sanitary - including the transmission of diseases to wild populations (IUCN, 2000).

Primates are amongst the most commonly commercialized wild mammals in the world (Fitzgerald, 1989; Redmond, 2005; Mittermeier *et al.*, 2009). They can be found as pets, used in traditional medicine and for biomedical research (RENTAS, 2001). The active traffic of primates mainly involves live individuals, but can also include body parts or meat (Mittermeier *et al.*, 2009). In recent years, primate trade included as many as 40,000 animals/year (Giovanini, 2006). The main source of these animals is Asia and Africa, but they are also obtained from Latin America, particularly from Peru, Colombia and Brazil (Fitzgerald, 1989; Maldonado *et al.*, 2009). In nations such as Great Britain, monkeys most commonly kept as pets are New World Primates: *Saimiri* sp., *Callithrix* sp., *Saguinus* sp. and *Cebus* sp. (Redmond, 2005). The slow but continuous growth of the number of robust capuchin monkeys (*Sapajus* sp.) in captivity is a result of apprehensions of illegally traded animals and donations of former pets (Kierulff *et al.*, 2005).

Few years ago, capuchin monkeys were the most common medium-sized primate found in captivity in Brazil (Ellis and Ellis, 1988), and this situation has not changed (Kierulff *et al.*, 2005). As of 2007, 28.1% of the captive primates in CETAS all over Brazil belonged to several species of *Sapajus* (Levacov *et al.*, 2007). Until recently, all capuchins belonged to one genus (*Cebus* Erxleben 1777). After Lynch-Alfaro *et al.* (2012) there has been a widespread acceptance of the division of capuchins in two genera, with the tufted capuchins, popularly known as robust capuchins, belonging to the genus *Sapajus* Kerr 1792.

Our study aims to gather information on the captive groups of *Sapajus* in the state of Bahia, northeastern Brazil. To attain this goal, we have used a multidisciplinary approach, using different types of research methodologies, some more typical of the social sciences (interviews, documental

research) and some more traditional, such as personal visits to assess taxonomical traits of the captive capuchin monkeys. This information will serve to assess the origin of these specimens and identify possible traffic routes. These considerations are relevant because three of the most threatened primates in the northeastern Atlantic Forest are found in Bahia or along its boundaries: the yellow-breasted capuchin monkey *Sapajus xanthosternus* (Wied-Neuwied, 1826), the crested capuchin *Sapajus robustus* (Kuhl, 1820) and the Marcgrave's capuchin *Sapajus flavius* (Schreber, 1774) (Rylands *et al.*, 2005). We aim not only to support conservation actions that will benefit these and other primates but also to suggest preventive measures to be used against wildlife traffic in Bahia and in other Brazilian states.

Material and methods

The current and historic capuchin monkey traffic within Bahia was assessed by using different sources: bibliographic and documental information, online searches, questionnaires and personal inspections. Documents (hearings, statements and final reports) from the Congressional Investigative Commission (CPITRAFI, 2003), formed to investigate illegal wildlife traffic in Brazil; the Brazilian Environmental Institute (IBAMA); and the National Network for Combat of Wild Animal Traffic (RENTAS) were used to obtain basic information for comparison with present conditions. Additional information on capuchin monkeys with emphasis on their management and traffic was gathered through bibliographic and online resources. The main search engines (such as PubMed, Scielo, Google Academic, Scopus and others) were accessed by using the keywords "Wildlife traffic and Brazil." This information was then filtered to extract any available data on *Cebus* species; data was analyzed qualitatively, focusing on mentions of capuchin traffic in

Bahia and all possible information of primate trade in Brazil. The information presented in the Results section regarding animal movement, housing, conditions, taxonomic assessment, illegal movement, commerce and apprehensions, and the maps that were constructed are all product of this data gathering and analyses.

Questionnaires and interviews were used throughout the State at institutions where individuals of *Sapajus* spp. could potentially be sheltered after being apprehended or donated. All institutions were either contacted by phone and/or visited. During the interviews, requests were made for further information about any other institutions that could receive and/or maintain these primates. Institutions were classified as private or public, regular (acknowledged by the IBAMA as official housing institutions) or irregular (not meeting IBAMA's standards, but nevertheless housing medium-sized primates). The visits also included gathering information on individual registration for each animal, as well as housing and management procedures. Other primate species housed at the centers were registered, but not evaluated or analyzed in any other way. Personal visits were made to the Zoobotanic Gardens of Salvador and Itapetinga, Wildlife Screening Centers (CETAS) of Vitoria da Conquista and Salvador, and the Biological Station of the Environmental Group of Bahia (GAMBA), located in the city of Elísio Medrado.

Questionnaires were used to assess the number and characteristics of captive *Sapajus* spp. in Bahia. Questions included the history of capuchin monkeys housing in the institution, known origins of current animals and possible routes of illegal traffic. The questionnaires were also completed through personal interviews and evaluations at the major institutions. These evaluations included assessment of housing conditions, such as shelter, water, vertical strata within the enclosure, number of animals per enclosure, con-

tact with other species, natural light and substrate of the enclosure, noise, and any other characteristic of the housing that could indicate improvement or diminishing of capuchin's welfare.

When capuchins were located, points were marked with a GPS. A map showing the institutions housing capuchins was built by using the information collected from July 2008 through February 2009. ArcGIS 9.2 software was used to make the map. The data were georeferenced using the coordinate system "Córrego Alegre UTM Zone 24S". Information on *Sapajus* was filtered from general data on captive

primates. Information on traffic routes was compiled through interviews, questionnaires and bibliographic revision, specifically of RENTAS (2001), CPITRAFI (2003) and CPIBIOPI (2006). This information, along with a map of the original geographic distribution of the capuchin species found captive in Bahia, was used to identify potential traffic routes.

Results

Sixteen institutions in fifteen counties within Bahia were identified as housing *Sapajus* spp. (Figure 1). Salvador, the capital of the state, has two institutions:

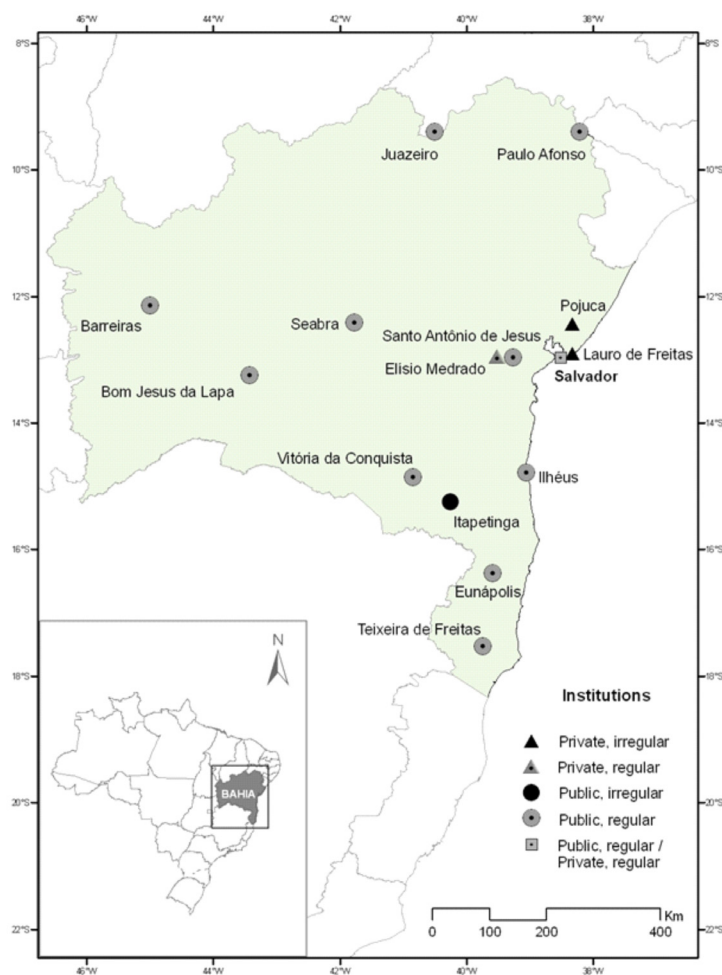


Figure 1. Institutions housing capuchin monkeys in the state of Bahia.

Notes: *Regular Institution:* institution covering all legal standards for captive animals, according to the IBAMA, and/or linked to it. *Irregular institution:* Institution not recognized by the IBAMA or under formal recognition still in process. Questionnaires were not sent to institutions where no person could be contacted.

a Federal screening center and a Zoo, owned by the city council. If we consider each institution as mainly receiving animals from its county and neighboring districts, their area of influence covered only 3.16% of the state's territory. Most of them are overlapped (have the same area of influence) and are located within the coast. Only one could not be contacted. Two others stated that they had never received a capuchin monkey and did not answer the questionnaire. Thirteen forms were sent, with a 53.85% (N = 7) return rate.

Information collected by the questionnaires indicates that 105 specimens of *Sapajus* spp. were kept in captivity in Bahia (Table 1). The institutions reported a slow but steady flow of *Sapajus* specimens within the state, which reached three or more entries per year (not including official exchanges between zoos). Once in captivity, most capuchins remained at the same institution for more than two years. However, exact information on the length of captivity for each animal was difficult to assess because individual registration forms are not a common management practice in Bahia. Only some animals were individually recognized, usually by their handlers, and identified within their institution

as "*Cebus* (= *Sapajus*) *apella*" or "*Cebus* (= *Sapajus*) sp.". Primatologists from the Chico Mendes National Institute of Biodiversity (ICMBio) identified all monkeys at the CETAS-VCT and took samples for further genetic studies. Other than that, no taxonomical aid for species identification has been received in any other institution. During interviews, most managers seemed confused about capuchin taxonomy and systematics. Most of them believed that all individuals they housed at the time belonged to the same species, *Cebus* (= *Sapajus*) *apella*, probably with different subspecies, being unable to define clearly what that meant.

Nineteen of the 105 capuchin monkeys kept in captivity in Bahia were potential hybrids, because they were born in institutions where more than one *Sapajus* species was kept within the same enclosure and the parenthood was not clearly established. The extent of this problem is difficult to define because individual registration forms seldom exist, as formerly mentioned. The phenotypes of these potential hybrids did not match any of those described for the genus. We could not gather information on the potential hybrid status of four other individuals that could not be phenotypically

identified. However, they were not born in captivity so chances of being hybrids are small but not ruled out (remembering that there are actual contact zones between *Sapajus* species within the state, and that animals do not have known origin). Apart from these 23 individuals, the remaining 82 animals had clearly recognizable phenotypes (following Silva, 2001) and were identified as *Sapajus xanthosternus* (N=45), *Sapajus robustus* (N=19), *Sapajus flavius* (N=3), *Sapajus libidinosus* (N=11), *Sapajus nigritus* (N=3) and *Sapajus apella* (N=5).

There were 23 individuals lacking accurate information on their origin. We are therefore forced to underestimate the extent of animal movements before captivity. Moreover, these animals could not be used to obtain information on illegal traffic routes. In all, 31 (54.38%) of the remaining 59 *Sapajus* spp. were born in captivity. The Zoobotanic Garden of the capital, Salvador, housed 14 of these captive-born individuals. Another 17 were housed at the Zoobotanic Garden of Itapetinga.

It was more difficult than we expected to count apprehended individuals. Eight localities reported the presence of apprehended capuchin monkeys but were unable to specify the exact number. Only 15 confiscated animals

Table 1. Origin of captive capuchin monkeys in Bahia state, according to the questionnaires.

Current institution	Source	Municipality where animals became captive	Number of incoming individuals
CETAS – Salvador	CB	--	9
	O	Conquista	NI
	Ap	Eunápolis, Ilhéus, Conquista, Caririnha, Tremedal	NI
CETAS – Vitória da Conquista	CR	Conquista, Ilhéus, Livramento, Caculé,	4
	Do	Ilororó, Conquista Jequié, Salvador Maranhão state	2
Environmental Group of Bahia (Elísio Medrado)	Ap	Valença, Castro Alves, Cruz das Almas, Ituberá	5
IBAMA – Barreiras	Do	Conquista	3
IBAMA – Eunápolis	Ap	Itabela, Canavieiras, Porto Seguro, Ilhéus, Prado	5
	O	Eunápolis	1
	Do	Itapetinga, Ilororó	3
Zoobotanic Garden of Itapetinga	CB	--	17
	O	Salvador	1
Zoobotanic Garden of Salvador	CB	--	14
	O	Lauro de Freitas	2

Notes: Ap: Apprehension; CR: Capture or rescue; Do: Donation; CB: Captive born; O: Donation from other institutions; NI: Not informed.

were conclusively identified. However, 90% of the institutions stated that they currently received apprehended capuchin monkeys or had done so in the past.

In all visits, we found enclosures significantly smaller than the law requires for capuchin monkeys. However, in both zoos (Salvador and Itapetinga) some animals were kept in suitable exhibits, with wooden shelters, open air, environmental enrichment and natural vegetation. At the Salvador Screening Center and the GAMBA Biological Station, different species were caged together. Our observations about enclosures, medical support, nutritional guidance, management practices and staff qualification indicated that Salvador Zoo is the only appropriate institution for housing monkeys in the state. An additional problem at Itapetinga Zoo and Vitória da Conquista Screening Center is that free-ranging capuchin monkeys interact actively with caged animals. Sometimes the free-ranging animals even open the cages and release capuchins belonging to their own species or to other species as was seen during our visit to the Vitória da Conquista Screening Center in 2008.

The main traffic routes for *Sapajus* spp. (Table 2) indicated Bahia as its starting point. Our results confirm that capuchin monkeys are trafficked through the same main routes for wildlife traffic in Bahia proposed by RENTAS (2001) and CPITRAFI (2003). Main locations of irregularly occurring confiscations are also confirmed by our study. These locations are primarily in the north-northwest of the Bahia: Cocos, Ibotirama, Morro do Chapéu, Itaberaba, Uauá, Canudos, Jeremoabo, Euclides da Cunha, Tucano, Ribeira do Pombal, Amargosa and São João do Paraíso (district of Mascote). These localities are considered key points for the control of wildlife traffic. However, it must be mentioned that capuchin traffic does not start exclusively in Bahia, since species that do not occur in the State

have been apprehended in these cities. Therefore, our evaluation of illegal capuchin monkey trade is preliminary and must be completed with information from other states.

The major sites of illegal sales identified by the questionnaires are the street markets at Curaçá, Feira de Santana, Jequié, Milagres and Itatim. The cities of Vitória da Conquista and Jequié are mentioned as traffic points, but no specific locations within these cities are cited. Our data cite confiscations or donations of *Sapajus* spp. in previously unreported cities, such as Cruz das Almas, Ilhéus, Canavieiras, Ituberá and Castro Alves (Figure 2).

Discussion

Bahia is the largest state in north-eastern Brazil and one of the largest in the country. Nevertheless, it has only 16 institutions capable to house medium-sized primates like capuchin monkeys. Moreover, these institutions cover only 3.16% of the state's counties. These facts are consistent with national information from RENTAS (2001) and CPITRAFI (2003). These sources have indicated that the number of suitable institutions for apprehended animals in Brazil is insufficient. However, the situation is worsened by the fact that only four institutions (the Itapetinga and Salvador Zoos and

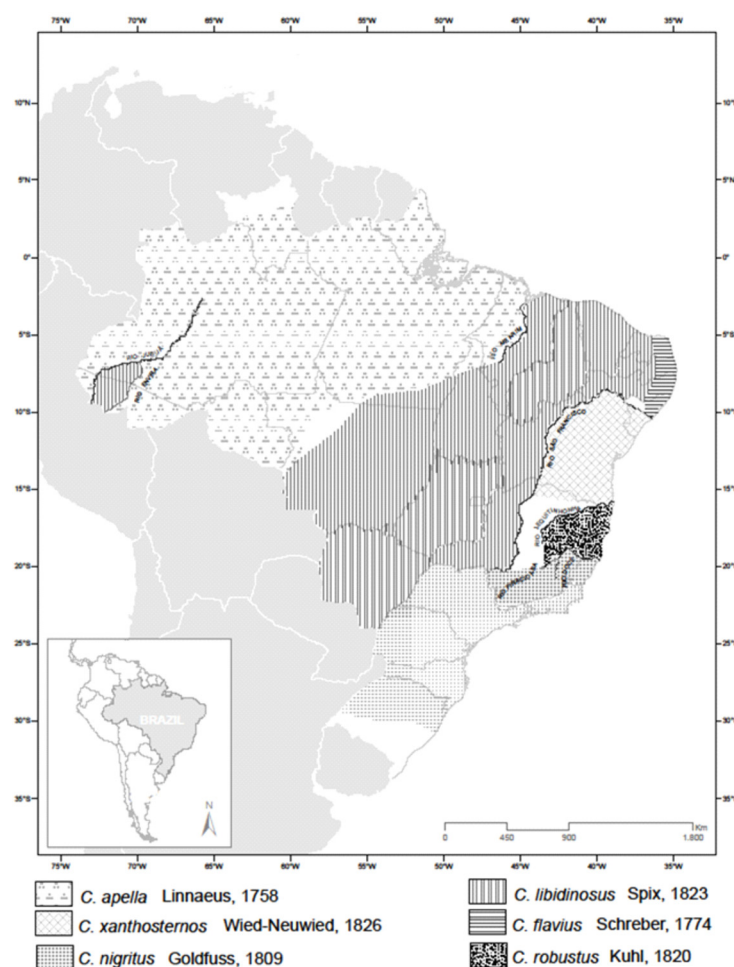


Figure 2. Overview of the geographical distribution of *Sapajus* (=Cebus) species registered in captivity during this study (compiled and adapted from Oliver and Santos, 1991; Coimbra-Filho *et al.*, 1992; Groves, 2001; Silva Jr., 2001; Fragaszy *et al.*, 2004; Kierulff *et al.*, 2005; Martins, 2005; Rylands *et al.*, 2005).

Table 2. Traffic routes for capuchin monkeys, compiled from information on the questionnaires, RENCTAS (2001) and CPITRAFI (2003).

Initial point of traffic route in Bahia State	Traffic route	Final destiny
Barra do Tarrachil	Highway BR-116 through Feira de Santana (BA)	Belo Horizonte (MG) São Paulo (SP) Serra (ES)
Feira de Santana	Highway BR-101 through Itabuna (BA)	Rio de Janeiro (RJ)
Feira de Santana	Highway BR-290 through Santana do Livramento and Uruguai (RS)	Argentina
Barreiras	Highway BR-020	Brasília (DF)
Barreiras	Highway BR-040	Belo Horizonte (MG)
Cândido Sales	BR-116/251 through Montes Claros (MG)	São Paulo (SP) Rio de Janeiro (RJ)

the Salvador and Vitória da Conquista Screening Centers) house more than 90% of all apprehended or donated primates and are usually overcrowded. Moreover, they have low budgets and small staffs and lack training opportunities. Due to overcrowding, captive capuchin monkeys are threatened by disease and hybridization. These facts were only superficially assessed during our study and are in great need of thorough investigation. Bahia is an easy destination for illegal primate trade because of its strategic location linking several ecosystems, its touristic appeal and its weak legal control.

Our data point capuchin monkeys as the primates having the most significant presence in captivity throughout the state. During our visits we also found howler monkeys (*Alouatta* sp.) captive in three institutions, marmosets (*Callithrix* sp.) and golden-headed lion tamarins (*Leontopithecus chrysomelas*) in two institutions and spider monkeys (*Ateles* sp.) only at the Salvador zoo, along with squirrel monkeys (*Saimiri* sp.) and sakis (*Pithecia* sp.) (unpublished data). Our documentary research confirmed that there is a large absolute number of captive *Callithrix* individuals, with more than 200 registered in the 2009 CETAS inventory for Bahia. These marmosets are housed in only two institutions. We affirm that capuchins are more represented along Bahia because all four CETAS

maintain steady groups of several species of *Sapajus*. According to Levacov *et al.* (2007), the abundance of capuchin monkeys in captivity is true for the whole country. We have found three threatened species in captivity, and a semi-captive group with at least three different species interbreeding freely in the forest remnant adjoining the CETAS of Vitória da Conquista, one of our visited institutions. In spite of this alarming information, proper planning and control are absent from all institutions that withhold capuchins within the state. In the light of these considerations, measures are urgently needed to furnish adequate captive conditions for *Sapajus* to ensure the potential inclusion of the most threatened species (*S. xanthosternos*, *S. robustus* and *S. flavius*) in international *ex situ* conservation programs. Our findings regarding the enclosures demonstrate an urgent need for the improvement of management in all institutions but the Salvador Zoo. Stray capuchins pose a problem because they are extremely adaptable to human presence and take advantage of human empathy towards monkeys to obtain food and shelter in urban areas (Ceballos-Mago *et al.*, 2010). Semi-captive capuchins in a public park in Vitória da Conquista are known for their invasions of the Screening Center and human settlements. They also cause up to 10 accidents (bites, scratches, etc.) to humans per year (Dos Santos, 2011).

According to our results, capuchins in captivity in Bahia were mostly captured to be sold as pets rather than for biomedical or subsistence purposes. This finding is supported by the fact that more than 90% of the captive (but not captive-born) capuchins were “donated” to the institutions by their former owners or confiscated from traders who intended to sell those as pets. Donations are not considered illegal under Brazilian laws, but they result from illegal extraction of wildlife from its original source and therefore furnish further evidence of illegal traffic. This information demonstrates the expansion of the range of influence of the illegal traffic in wildlife. The growth of pet trade in primates appears to be a worldwide trend in recent years (Ahmed, 2001; Ceballos-Mago *et al.*, 2010). In contrast, during the 70s and 80s most of the world’s primate traffic was for biomedical purposes (Maldonado *et al.*, 2009). However, the available data on subsistence hunting of capuchin monkeys in Bahia are sparse (Dos Santos, 2011; Kierulff *et al.*, 2005). One study mentions a “monkey’s head” used as a religious item at Una, southern Bahia, within the geographic range of *S. xanthosternos* (Rezende and Schiavetti, 2010). Three of the *Sapajus* species reported as captive in Bahia occur within the state (*Sapajus xanthosternos*, *S. robustus* and *S. libidinosus*). However, three other species reported as captive and confirmed by personal identification

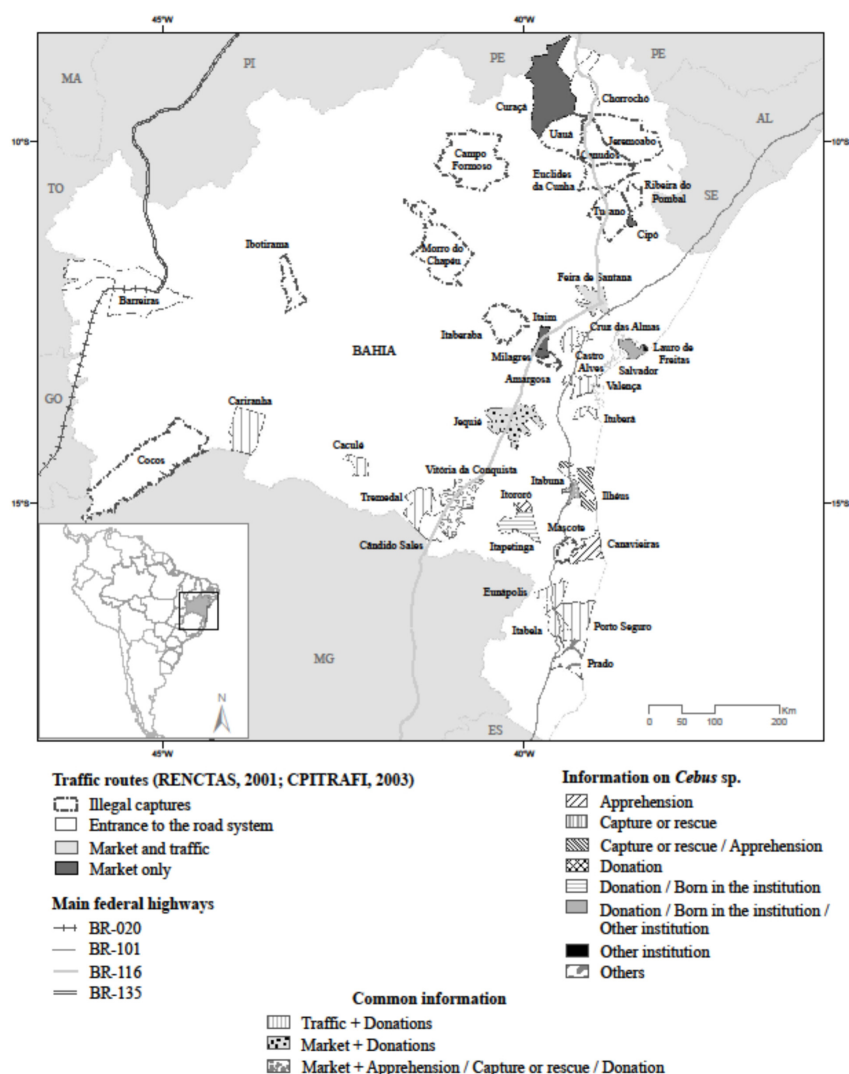


Figure 3. Traffic routes in Bahia and origin of the capuchin monkeys kept in captivity.

have no natural populations within the state (*Sapajus flavius*, *S. nigritus* and *S. apella*). These animals constitute evidence of capture and illegal trade involving primates. Their presence supports previous studies indicating that the Brazilian cities viewed as strategic points for illegal animal trade are primarily concentrated in the North, Northeast and Midwest regions of the country (RENTAS, 2001; CPITRAFI, 2003; Levacov *et al.*, 2007). The results of our questionnaires and interviews confirm that the traffic routes denounced in the reports of RENTAS (2001) and CPITRAFI (2003) still ex-

ist with minor variations. The situation remains serious. Although the traffic routes are well known, the inefficiency of existing inspection procedures act against the interruption of this illegal activity. This assertion is supported by the fact that although a congressional report on illegal wildlife traffic was issued in 2003 and a second congressional investigation was conducted in 2006 (CPIBIOP, 2006), our study has identified the same key points for illegal traffic that these earlier investigations had highlighted. Our interviews also highlight that coordination among institutions is scarce. Public organs

intended to combat wildlife traffic (IBAMA, Federal Police, State Police) seldom work together and rarely coordinate their activities with other institutions protecting threatened species (Brazilian Biodiversity Conservation Institute – ICMBio, various NGOs). No joint actions have been taken on behalf of such threatened primates as *S. xanthosternos* or *S. flavius*. Rediscovered in 2006 (Oliveira and Langguth, 2006), the latter stands out as the capuchin species most urgently in need of action to produce basic knowledge and facilitate conservation. This species also appears in the statistics on wild animal traffic and on voluntary donations to institutions in Bahia.

The current removal of capuchin monkeys from their natural environment is demonstrated by the fact that the geographical areas in which the monkeys naturally occur include localities where apprehension or voluntary donations have been registered. We can infer the existence of a traffic network based on local demand because captive animals generally show a phenotype that matches the particular characteristics of color and coat pattern exhibited by the wild individuals inhabiting that region. For example, Kierulff *et al.* (2005) have reported the occurrence of yellow-breasted capuchin monkeys (*Sapajus xanthosternos*) in the municipalities of Canavieiras and Ituberá. The only apprehension report that we have verified from these localities involve this particular species. Taken together, these two facts support the idea that the animals were captured locally, even though there is no current way of knowing exactly which animals are those, since there is no individual identification in the institutions within the state.

Final considerations

Our task presented three main challenges: (a) scarce and non-homogeneous data, (b) lack of interest shown by the managers/decision makers who did not answer our questionnaire, and

(c) impossibility of assigning differential weights to key localities, even though we knew from previous sources how crucial these localities might be for wildlife traffic. We tried to address these drawbacks by using the following strategies: (a) We assumed that there were no significant institutions for wildlife housing or for traffic enforcement other than those that our research had identified. Thus, even though data are scarce, they are the only data available. The scarcity of available data demonstrates the need for more thorough data production by stakeholders or law enforcers. These sources commonly include information on wildlife traffic in enormous general reports on crime. As a result, the specific information needed becomes almost inaccessible. (b) To address the lack of interest by decision makers, we visited the state's wildlife centers. We made thorough evaluations of these institutions and offered suggestions for improving the living conditions of their captive primates. We attempted to draw attention to *Sapajus* and its situation in captivity, which we view as a critical issue. (c) Our third challenge has proved quite difficult to overcome with our current tools. We hope to clarify this point in the future, through quantitative and qualitative analyses in order to find a way of assigning relative weights to each captive institution according to its functional role in *ex situ* conservation (e.g. rank its activities in captive care, conservation breeding, education, research, etc).

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