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Front cover: A bald uakari, *Cacajao calvus calvus*, from the Brazilian Amazon. Photo by Russell A. Mittermeier.

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Articles

FURTHER NOTES ON THE DISTRIBUTION OF ENDEMIC BOLIVIAN TITI MONKEYS, *CALLICEBUS MODESTUS* AND *CALLICEBUS OLALLAE*

Jesus Martinez[1] and Robert B. Wallace[1, 2]

[1] Wildlife Conservation Society, Greater Madidi Landscape Conservation Program, Casilla 3-35181, San Miguel, La Paz, Bolivia
[2] Wildlife Conservation Society, 185th Street and Southern Boulevard, Bronx, New York, 10460, USA, e-mail:<rwallace@wcs.org>

Abstract

We present information on the distribution of the endemic Bolivian primates *Callicebus olallae* and *C. modestus* based on a series of site visits in the Beni Department. *Callicebus olallae* was registered at four localities and *C. modestus* at 11 localities, and in combination with negative data and localities for other *Callicebus* species in the region we defined the distributional boundaries for both endemics. Mean group size was 2.7 individuals for *C. olallae* and 3 individuals for *C. modestus*. The results highlight the restricted distribution of both species, with *C. olallae* having one of the highest levels of primate endemism in the world and an "occurrence area" of 400 km^2, and considering forest fragmentation in the region, more realistically an "occupancy area" of 50 km^2. Although *C. modestus* is found in slightly larger areas (1,800 km^2 and 450 km^2 respectively) the distribution area is still extremely restricted. The restricted distributions together with ongoing forest fragmentation due to cattle ranching, unregulated ecotourism activities, and principally the scheduled improvement of the "Northern Corridor" road that passes through this region, means that both species should be considered highly endangered.

Key Words: Geographical range, group size, physical characteristics, Southwestern Beni Department, Bolivia

Resumen

Presentamos información acerca de las áreas de distribución de los dos primates endémicos de Bolivia, *Callicebus olallae* y *C. modestus*, mediante la visita de localidades en el departamento del Beni. *Callicebus olallae* fue registrado en 4 localidades y *C. modestus* en 11 localidades, y en combinación con datos negativos y localidades para otras especies de *Callicebus* en la región definimos los límites de distribución para las dos especies endémicas. El promedio del tamaño de grupo para *C. olallae* fue 2.7 individuos y para *C. modestus* 3 individuos. Los resultados resaltan la distribución altamente restringida que ambas especies presentan, siendo *C. olallae* una de las especies con mayor grado de endemismo de Sur América al tener un "área de ocurrencia" de 400 km^2 y, considerando el alto grado de fragmentación del bosque, de forma más realista un "área de ocupación" de 50 km^2. Aunque *C. modestus* ocupa áreas mayores (1,800 km^2 & 450 km^2 respectivamente) muestra también un elevado grado de endemismo. Esta situación, junto con la fragmentación del bosque debido a las actividades de ganadería, además de actividades no reguladas de ecoturismo y, principalmente el proyectado mejoramiento del tramo vial del "Corredor Norte" que atraviesa la zona habitada por estos primates, conlleva a considerar a ambas especies como altamente amenazadas.

Palabras Clave: Rango geográfico, tamaño de grupo, características físicas, suroeste del departamento Beni, Bolivia

Introduction

The titi monkeys (genus *Callicebus*) are considered the most diverse primate genus in the Neotropics, with 29 recognized species (Van Roosmalen *et al.*, 2002; Wallace *et al.*, 2006). Clearly defined distributional patterns, habitat preferences, food habits, and behavior of many of these species are still unknown. Indeed current knowledge of their continental distribution is scant, most dramatically demonstrated by the recent discoveries of new species (Hershkovitz, 1988, 1990; Van Roosmalen *et al.*, 2002; Wallace *et al.*, 2006). A good example of the poor distributional knowledge regarding *Callicebus* is the case of the two Bolivian endemics, *Callicebus modestus* and *Callicebus olallae* (Kinzey, 1981; Hershkovitz, 1988, 1990; Anderson, 1997; Rylands *et al.*, 2000; Van Roosmalen *et al.*,

2002). Collected by the Olalla brothers and described by Lönnberg (1939) based on the examination of just three collected individuals, the specimens have subsequently been considered as full species in taxonomic revisions of *Callicebus* (Hershkovitz, 1990; Kobayashi, 1995). Nevertheless, for almost seventy years no field data were obtained about these apparently range-restricted Bolivian endemic primate species.

In light of this situation, in 2002 the Wildlife Conservation Society began investigating the distribution of both species (Felton *et al.*, 2006). These preliminary studies confirmed the presence of *C. modestus* and *C. olallae*, or at least two distinct phenotypes (Felton *et al.*, 2006), in a zone near the suggested collection sites of the Olalla brothers (Lönnberg, 1939; Anderson, 1997), which comprises non-continuous forest patches interfacing with a natural savannah system (Felton *et al.*, 2006). However, their overall distributional pattern and extent remained unclear.

A critical issue in the study of these species is their rather similar morphological features (Lönnberg, 1939; Hershkovitz, 1990) that together with variable lighting conditions during field observations make accurate identification a challenge. This situation calls into question the original taxonomic distinctions made by Lönnberg (1939) and subsequently supported by others (Hershkovitz, 1990; Kobayashi, 1995), especially when considering the small sample size and the restricted and apparently overlapping distribution area determined for both species. The original specimens for both species were collected within 65 km of each other (Felton *et al.*, 2006), although it is important to note that some sources have questioned the collection locations for other primate species reported by the Olalla brothers in other areas of South America (Aquino and Encarnación, 1996).

Establishing the taxonomic and conservation status of these endemic, range-restricted species is of urgent concern, particularly considering imminent plans to improve the road system in the immediate region. This improvement includes the paving of a major road and is likely to have a deleterious effect on forest cover in the immediate vicinity due to the colonization effect (Reid and Landivar, 1997; Forman and Deblinger, 2000; Trombulack and Frissell, 2000). In this way, conservation research efforts for *C. modestus* and *C. olallae* need to prioritize establishing the range of these Bolivian endemics, estimating population size, as well studying titi monkey genetics in order to confirm their taxonomy in a phylogenetic framework. Here we present the results of research conducted between March 2004 and December 2006 regarding the distributional limits of *C. olallae* and *C. modestus* in the Beni Department of Bolivia. Additionally we report on preliminary data regarding their biology.

Methods

Study area

The area evaluated (Fig. 1) stretched from the Beni River to the east of the Mamoré River (eastern and western limits of survey), and from the Rurrenabaque – Yucumo road to Riberalta (southern and northern limits of survey). We visited 43 sites across the region, placing more effort in the area of the Yacuma River and in drier forest patches between the Beni and Mamoré rivers. Site selection was facilitated using satellite images, and corresponded to the locations of the original collection sites, the initial field observations of Felton *et al.* (2006), new observations obtained during this study, and reports from other researchers and local people. However, it is important to remark that in general local people only recognize titi monkeys at the genus level.

Determining the distributional limits

At each locality, we conducted preliminary non-structured interviews with local people using photographic material and vocalization recordings to determine the presence of *Callicebus* and to identify specific potential locations for further observation. We then actively searched for *Callicebus* groups at a series of locations using vocalization 'playbacks' at regular intervals in an attempt to elicit vocal responses. Searches lasted between 06:00–10:00 h because these periods correspond to their highest vocal activity; complementary searches were made between 16:00–18:00 h. Whenever we located a group, we recorded the time and method of detection (response to playback, direct visual observation, or spontaneous vocalizations). We observed groups with Zeiss 10 × 40 binoculars and filmed them with a Sony Digital 8 Video Camera TRV 361. Vocalizations were recorded with a Sony TCM-5000-EV tape recorder equipped with a unidirectional Sennheiser ME 67 microphone. Upon first sighting, we noted group size, composition, position, and height in the forest canopy, as well as the geographic location obtained with a GPS (Garmin 12 XL III Plus and V). We also noted general habitat characteristics for each observation locality.

Data analysis

Considering our initial lack of knowledge regarding the morphological features of these monkeys in the field, species identifications were made using available visual information and comparing these data with descriptions made by Lönnberg (1939), Hershkovitz (1990), and also with Felton *et al.* (2006), who had obtained video footage of reported groups. To improve our identifications we also compared images with photographs of specimens at the Royal Natural History Museum of Stockholm, Sweden (A612105 *C. modestus* and A632187 *C. olallae*). In order to assist in the interpretation of distributional patterns, we developed a map of all known localities, including the original collection sites (Lönnberg, 1939; Anderson, 1997), the observations by Felton *et al.* (2006) and our ongoing observations. The map also included sites where we did not register *Callicebus*, although we differentiated between sites

where local people reported *Callicebus* and those where titi monkeys were completely unknown.

Results

Species identification

During this study, we encountered 66 groups of *Callicebus* at 20 localities. Of these, 14 groups were *Callicebus olallae*, 31 were *Callicebus modestus*, 16 were *Callicebus donacophilus*, and for five groups we were unable to assign a species identification. These new records have dramatically increased the number of observations for the endemic species (Table 1).

For each species, we have identified diagnostic morphological characteristics helpful to distinguish the species

Figure 1. Geographic location of sightings of *Callicebus* during the field survey. For current knowledge status of *Callicebus* in Bolivia, we are including in this figure the locations reported for *C. aureipalatii* and *C. donacophilus* from Anderson (1997), Wallace *et al.* (2006) and Felton *et al.* (2006) and unpublished WCS observations.

Table 1. Number of documented *Callicebus modestus* and *Callicebus olallae* groups.

Species	Lönnberg (1939)	Felton *et al.* (2005)	This study	Total groups
C. olallae	1	3	14	18
C. modestus	1	2	31	34
C. cf. *modestus**	0	1	0	1

* Supposed hybrid groups between endemic species (Felton *et al.* 2006).

in field. These features relate mainly to pelage coloration patterns. *Callicebus olallae* has rather long, brown reddish body pelage. Under good light conditions, a wide orange band along each hair is visible, with the tip of the hair appearing brown. The tail is more grayish but the color does not contrast strongly with the coloration of the body fur; the base of the tail is lighter both dorsally and ventrally. White ear tufts are very conspicuous. Narrow rims of black hair that reach the ears are distinguishable around the faces of some individuals. Hands and feet are black with some white hairs visible. Another important feature is the vertically elongated form of the head with a clearly prominent and oval-shaped mouth especially noticeable in adult males (Fig. 2). Body fur color appears more intensely red when individuals are in direct sunlight.

Callicebus modestus has a non-uniform orange-brownish fur color caused by the presence of alternate bands of orange and dark brown hair, known as agouti pelage. The tail does not have the conspicuous lighter basal zone, and the grayish color of the tail is very noticeable and highly contrasting with the rest of the body fur. Conspicuous white ear tufts are present as in *C. olallae*. Hands and feet are also black with light hairs visible, though not as light as in *C. olallae*. However, this last trait is not easily distinguishable. Contrasting with *C. olallae*, the head of adult male *C. modestus* is wider laterally with a not too prominent pentagon shaped mouth area apparently due to a more prominent nasal area not observed in *C. olallae* (Fig. 3). The tail appears black if exposed directly to sunlight, and appears lighter if backlit.

Determining the distributional limits

According to our observations, *C. olallae* is largely restricted to riverine habitats on the Yacuma River, although one group occurred 5 km east of the Maniqui River but in similar habitat. A partial preference for drier forest patches is noticeable for *C. modestus*, which occurred on the eastern and western sides of the Yacuma River. One *C. modestus* group occurred just 100 meters east of the Maniqui River, but this area was a higher and drier forest area. Overall, these data give preliminary support to the hypothesis that *C. olallae* is found in relatively humid and riverine forest

Figure 2. Adult male *Callicebus olallae* at Estancia La Asunta (Yacuma River). Photo by M. Spanowicz.

Figure 3. Adult male *Callicebus modestus* from Aguaizal (Northeast of Santa Rosa). Photo by M. Spanowicz.

in this patchily forested landscape; whereas *C. modestus* is found in relatively drier forest patches (Fig. 1).

We determined the Beni River as the distributional western barrier for both Bolivian endemics. During 2005, WCS researchers recovered a titi monkey skin from a hunted individual from forest immediately adjacent to the Beni River on the western side. This specimen represents *Callicebus aureipalatii*, the new species recently described from the Madidi protected area and registered only on the western side of the Beni River (Wallace *et al.*, 2006). In June 2005, we observed *C. modestus* groups in forest immediately adjacent and on the eastern side of the Beni River. However, it is important to note that the *C. modestus* location around the San Marcos community was in a noticeably drier belt of forest than the majority of the relatively humid forest found immediately adjacent to the Beni River. Indeed, on several previous visits to the community we failed to register *Callicebus* in the more humid sectors of this forest.

The southern and southwestern limits for the two endemics occur in two broad 10 km swaths on either side of the Yucumo – Rurrenabaque road, an area characterized by lack of primary forest and low densities of wildlife related to several human settlements. Colonists who settled in these areas almost ten years ago do not report titi monkeys. In addition, no confirmed records exist for *Callicebus* in the Pilón Lajas Biosphere Reserve and Indigenous Territory, and indigenous people indicate that titi monkeys are not present within the reserve. These negative reports together with areas of humid forest located to the south (as observed in satellite images) suggest that these larger blocks of more humid forest represent a southern limit for the distribution of both endemic species.

We extended the known distributional limits (Hershkovitz, 1990; Anderson, 1997) for both *C. olallae* and *C. modestus*. We found groups of *C. modestus* between Yacuma and Maniqui Rivers, and groups of both species in the riverine forests of the Maniqui River. Subsequently we investigated reports of the presence of *C. modestus* to the east of the Mamoré River (M. Herrera, pers. comm. to R. Wallace), but instead were able to verify the presence of *Callicebus donacophilus* at this location. Additional observations of *C. donacophilus* east of the Maniqui and Mamoré Rivers suggest that neither *C. modestus* nor *C. olallae* occur further east of the Maniqui River. Indeed, the San Borja region is the current known eastern distributional limit for both species. To determine the northern limit, we extended our surveys to the relatively tall and humid Amazonian forests located south of Riberalta (see Fig. 1). Here we observed *Callicebus* groups that resembled species within the *C. cupreus* species group (van Roosmalen *et al.*, 2002). Unfortunately, due to observation conditions, we were unable to assign species-level identification to these groups. Nevertheless, we are certain that these observations do not represent either of the endemic species. We suggest that the southern limit of this more humid forest probably represents a northern boundary for *C. modestus* and perhaps *C. olallae* although further field confirmation is recommended.

In the highly fragmented forests between Santa Rosa del Yacuma and San Borja and northeast of Trinidad on the eastern side of the Mamoré River we failed to register *Callicebus*, and people here report not to have ever seen or heard these monkeys. Forest vegetation in these areas was very scarce and highly patchy, with relatively small and rather scattered stands of forest. In addition, forests did not have abundant canopy vines — a feature that characterized *Callicebus* localities in the broader southwestern Beni region.

Biological data

Group sizes ranged from 1 to 5 members in *C. olallae* and 1 to 6 in *C. modestus*. Solitary individuals were observed on one occasion for each species. Average group sizes were similar with 2.7 and 3.0 individuals for *C. olallae* and *C. modestus*, respectively ($t = -0{,}936$; $df = 43$; $n_1 = 31$; $n_2 = 14$; $p = 0.354$; see Table 2). Group composition data showed similar proportions of adult and juvenile members for both species although observations for each species occurred in different seasons, thereby limiting comparisons.

Despite the riverine and non-riverine division of the observations for *C. olallae* and *C. modestus*, respectively, both species occurred in a similar habitat known locally as "chaparrales" and characterized by a relatively low forest canopy with dense lianas and the notable presence of motacú palms (*Attalea phalerata*) and/or garabatá terrestrial

Table 2. Group size and composition of *C. olallae* and *C. modestus.*

Species	*C. olallae*	%	*C. modestus*	%
Group size	**14**		**31**	
Maximum	5		6	
Minimum	1		1	
Mean	2.7		3.0	
Population structure (no. of individuals)	**38**		**94**	
Adults	28	73.7	62	66.0
Subadults	1	2.6	3	3.2
Juveniles	7	18.4	16	17.0
Infants	2	5.3	13	13.8

bromeliads (*Pseudoananas sagenarius*). We observed a slight tendency for more motacú at *C. olallae* sites, and more garabatá at *C. modestus* sites. Local people reported that *Callicebus* feed on motacú palms, and we found seeds similar to garabatá in *C. olallae* feces. The average height of *Callicebus* observations did not differ between the two species ($t = -1{,}175$; $df = 43$; $n_1 = 31$; $n_2 = 14$; $p = 0.094$; Table 3). For both *Callicebus* species, adult males typically appeared alert in the presence of researchers and often approached observers, while other group members usually remained still and stayed in relatively high branches. Usually, upon achieving direct visual contact, monkeys changed from a territorial call to an alarm call directed at the observers and the rest of the primate group. These calls are short harmonics that cover a wide frequency range. On other occasions, groups stayed in dense vegetation without vocalizing.

Other primate species observed in the forest patches where *C. olallae* and *C. modestus* occurred included *Saimiri boliviensis*, *Cebus libidinosus*, and *Alouatta sara*. At the Yacuma River, we observed *Alouatta caraya*. We registered *Ateles chamek* in the riverine forest along the Beni River.

Identified local threats to Callicebus

Local communities reported some hunting of both *Callicebus* species, but their small size does not make *Callicebus* a preferred game animal compared with other primates and ungulates. Hunting pressure appears to be greatest along the Maniqui River. The administrative policies of the private cattle farms, numerous in the region, usually prohibit hunting on their properties. We obtained occasional reports of *Callicebus* hunting near cattle farms to use the skin for making ropes and fur to make thread, although these uses are not unique to these species. Unfortunately, hunting is more of a threat during logging activities where workers obtain most of their food from hunted wildlife, including *Callicebus*. This activity is only relevant in the Beni riverine forest on the western side of the endemics' distribution.

In the Amazonian forests in the northern reaches of the survey area, interviews and anecdotal observations suggested high levels of primate hunting, including *Callicebus*, especially during an intensive but short annual period of Brazil nut harvesting that represents the major income source for a large proportion of the local population. Indeed, for some people hunting remains an important subsistence and opportunistically commercial activity throughout the year as many people wait for the next Brazil nut harvest. As suggested in informal interviews with local people, intensive hunting pressure is probably responsible for the dramatic change toward more evasive behavior in *Callicebus* in this region.

Discussion

This study represents a significant contribution towards the biological knowledge of these poorly known endemic and range-restricted species. Direct and prolonged observations allowed us to determine critical diagnostic phenotypic traits for both *C. olallae* and *C. modestus* under a variety of lighting and weather conditions. Pelage coloration is the clearest characteristic that allows species identification in the field. For *C. olallae* for at least some animals we confirmed the black ring around the face originally described by Lönnberg (1939), contrasting with observations of the same species by Felton *et al.* (2006). The contrast between the color of the tail and body pelage is another important difference, with the basal zone conspicuously lighter in *C. olallae*. The longer and shaggier pelage of *C. olallae* was another recognizable trait. Differences in the density of white hair on the ear tufts were not considered diagnostic because observations suggested variability across phenotypes in the same groups, although this may be related to observation conditions that did not allow for the distinction of subtle features. We also noticed some distinctions in the head shape of adult males that concur with cranial measurements reported by Kobayashi (1995).

Video recording was a useful methodology for identifying these species, although we did find some inconsistencies between video records and direct observations, with more orange colorations registered by video instead of the more grayish color observed directly. We noted that some lighting conditions affected the digital sensors of the video camera. This problem is solvable by recording individuals as they move through distinct light conditions. These results show the great importance of making detailed phenotypic descriptions, as well as video recordings under different light conditions. Even though the morphological features cited above allow us to make some clear phenotypic distinctions between these two primates, the final taxonomic status remains unclear considering the potential formation of hybrid groups reported by Felton *et al.* (2006). Thus,

Table 3. Observation height and canopy height details for *Callicebus modestus* and *Callicebus olallae.*

Species	Average height obs. (m)	SD	Max. values	Min. values
C. olallae	6.8	3.5	15	3
C. modestus	8.8	3.8	20*	3
	Average canopy height (m)			
C. olallae	8.9	3.0	15	5
C. modestus	10.2	2.8	15	5

*Observed in emergent tree

genetic analyses are required to confirm their taxonomic status, clearly fundamental from a conservation viewpoint.

Felton *et al.* (2006) reported a group of *C. olallae* (November 2002) with more than two adults and during this study local people reported the same for *C. donacophilus* (February–March 2005). However, all of our observations consist of groups with up to four or five individuals with only two adults, always a male-female pair. *Callicebus* species are monogamous (Kinzey, 1981; Rylands *et al.,* 2000; Van Roosmalen *et al.,* 2002), and therefore larger groups containing several adults might be the result of temporary or seasonal aggregations, offspring remaining in their natal group after sexual maturation (Eckhard W. Heymann, pers. comm. 2007), and/or temporal variations in group size due to reduced dispersal opportunities in forest patches (Bicca-Marques *et al*., 2002).

The key result for both *C. olallae* and *C. modestus* is the extension of the eastern limit from the previously known distributional area in the Beni and Yacuma Rivers (Anderson, 1997; Felton *et al*., 2006). Our results also offer a preliminary northern distributional limit for both species although further work is required to establish how this limit varies for each species. Our results show that *C. olallae* is restricted to riverine forests along the Yacuma and Manique Rivers, whereas *C. modestus* seems to occupy patches of forest in a larger area between the Beni and Maniqui Rivers. We therefore suggest that *C. olallae* has an extremely restricted distribution with groups almost entirely concentrated on the Yacuma River, and so far just one group registered along the Maniqui River. Nevertheless, the habitat preferences of both species need further study, particularly given that both species are absent from smaller forest patches in the region.

Distribution points for these endemic species and their congeners in the broader region (Fig. 1), suggest IUCN "extent of occurrence" distributional areas of ca. 1,800 km^2 for *C. modestus* and ca. 400 km^2 for *C. olallae*. Nevertheless, because of the fragmented nature of the forest landscape in the region, the IUCN "area of occupancy" standard measure of distributional area seems more pertinent. Under this measure *C. modestus* should be provisionally considered Endangered (*c.*450 km^2) and *C. olallae* should be provisionally considered Critically Endangered (*c.*50 km^2). To date no abundance estimates for these species exist, however, given that they are not superabundant in the forest patches we have visited, in terms of populations we recommend that both species be considered endangered. The most important threat to both endemics is the forthcoming improvement and paving of the "Corredor del Norte" road. This road crosses the distributional area of both species (Fig. 1) and although the use of heavy machinery, noise, and pollution are concerns, there is a high probability for increasing human settlements and forest loss along the road. Given the suspected low population numbers for both species, significant forest loss and fragmentation would lead to a very fragile conservation situation and a potential extinction risk, principally for *C. olallae*. Information collected to date has been provided to the official environmental evaluation team for the proposed Corredor del Norte road construction project; this team was previously unaware of the presence of these endemics and are now proposing to make specific considerations within their recommendations. Subsistence and commercial hunting is also a major threat in areas undergoing forestry and Brazil nut activities. Even though current eco-tourism activities on the Yacuma River are not an obvious threat to *Callicebus*, the presence of *C. olallae* in the tourism area indicates the need to monitor the impact of this activity in the future.

The information gathered to date has been provided to municipal authorities, and these meetings and presentations have drawn the attention of local decision-makers to the presence of these endemic titi monkeys. Now the creation of municipal protected areas is being promoted in the region. Municipal authorities are motivated by the status of the Yacuma River region as a major tourism attraction; over 75% of the 20,000 tourists that visit Rurrenabaque every year visit the Yacuma River region. Indeed, the two endemic titi monkeys could well become important flagship species for this initiative and we are working to ensure they are included in the design and management of the proposed municipal reserves. Finally, both *C. modestus* and *C. olallae* have restricted distributional ranges. The situation of *C. olallae* is particularly alarming, and given the imminent threat of major road improvements in the region, the race is on to establish the conservation status of these endemics. Knowledge of the precise northern distributional limits is urgently required for both species, as well as population estimates for both species in a series of strategically targeted forest patches. Finally, determination of their taxonomic status through genetic analyses is also an urgent priority.

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RESOURCE USE AND SEED DISPERSAL BY RED HOWLER MONKEYS (*ALOUATTA SENICULUS*) IN A COLOMBIAN ANDEAN FOREST

Paula Giraldo[1, 2], Carolina Gómez-Posada[1], Jesús Martínez[1, 2] and Gustavo Kattan[1]

[1] Fundación EcoAndina/Wildlife Conservation Society Colombia Program, Apartado Aéreo 25527, Cali, Colombia, e-mail: <palgira@yahoo.com>, <cgomez@wcs.org>, <jesusmartinezgz@gmail.com>, <gkattan@wcs.org>
[2] Departamento de Biología, Universidad del Valle, Cali, Colombia

Abstract

As part of a study of responses by red howler monkeys (*Alouatta seniculus*) to forest fragmentation, we studied red howlers in an extensive forest including a habitat mosaic of old-growth forest, secondary forest of different ages, and non-commercial monospecific plantations of exotic Chinese ash (*Fraxinus chinensis*) and pines, to produce baseline information on resource use and their role as seed dispersers. We followed three troops for six months, encompassing a dry and a wet season; in total, they fed on 48 species of trees, including fruits, leaves and flowers, but each group relied on a limited set of species available within its home range, particularly in the Moraceae and Cecropiaceae. This contrasts with lowland forest, where howlers feed on a larger variety of species. We observed no season of generalized fruit scarcity, as is the case in the lowlands. However, localized fruit scarcities in howler home ranges occurred. Howlers fed on relatively small quantities of leaves when fruit was available, and became primarily folivorous when fruit was unavailable. Howlers transported a mean of 2.3 species of seeds per fecal sample, to a mean distance of 116 m from the parent tree. More importantly, howlers are transporting seeds to ash and pine plantations, helping to enrich these habitats.

Key words: Andes, Colombia, red howler monkey, frugivory, folivory, montane forest, cloud forest, seed dispersal, habitat restoration

Resumen

Como parte de un estudio sobre la respuesta del mono aullador rojo a la fragmentación de bosques, estudiamos una población en un bosque extenso que incluía un mosaico de hábitats de bosques maduros, bosques de regeneración de distintas edades, y plantaciones monoespecíficas de urapán o fresno de la China (*Fraxinus chinensis*) y pinos, para producir información de base sobre patrones de uso de recursos y su papel como dispersores de semillas. Seguimos tres grupos de aulladores durante seis meses, que incluyen una estación seca y una húmeda. Los tres grupos se alimentaron de 48 especies de árboles, incluyendo frutos, hojas y en menor medida flores, pero cada grupo dependió de unas pocas especies de acuerdo a la disponibilidad de aquellas en su área de actividad, particularmente en el Moraceae y Cecropiaceae. Esto contrasta con los bosques de tierras bajas, donde esta especie se alimenta de una variedad de especies mucho mayor. No observamos una época de escasez generalizada de frutos, como sí ocurre en tierras bajas, sin embargo, sí observamos escasez localizada en las áreas de actividad de los grupos estudiados. Los aulladores siempre consumieron pequeñas cantidades de hojas cuando había frutos disponibles, y fueron principalmente folívoros cuando los frutos fueron escasos. Los aulladores dispersaron un promedio de 2.3 especies de semillas en sus heces, a una distancia promedio de 116 m del árbol parental. Lo más importante, sin embargo, es que están transportando semillas a las plantaciones de urapán y pino, ayudando a enriquecer estos hábitats.

Palabras clave: Andes, Colombia, mico aullador rojo, frugivoría folivoría, bosque montano, bosque nublado, dispersión de semillas, restauración de hábitat

Introduction

The red howler monkey, *Alouatta seniculus*, is widely distributed in northern South America. It is found in the northern and western Amazon basin and east to the Guyanas, and in the Andes from Colombia to Bolivia. Red howler monkeys occupy a variety of forest habitats, from lowland rain forest in the Amazon, to gallery forest and relatively open woodland in savannas, tropical dry forest, and cloud forest (Hernández-Camacho and Cooper, 1976). They can also use secondary forest and survive in isolated patches (Rylands and Keuroghlian, 1988; Schwarzkopf and Rylands, 1989). In Colombia the red howler is distributed from sea level to 2,400 m a.s.l. and occassionally up to 3,200 m a.s.l. (Hernández-Camacho and Cooper, 1976; Defler, 2003). Howler monkeys (*Alouatta* spp.) have a folivorous-frugivorous diet, although they do not possess a highly specialized digestive tract to deal with leaves, nor

do they exhibit particularly low metabolic rates (Milton, 1998). As frugivores, howlers are recognized as important seed dispersers in tropical forest, because they have long intestinal retention times and they move seeds away from the parent trees (Julliot, 1996a; Yumoto *et al.*, 1999). Secondary dispersers may then scatter these seeds and contribute to their germination (Andresen, 1999, 2002).

The ecology of red howlers has been well studied in a variety of lowland forest types. However, there is only one detailed study available for Andean populations (Gaulin and Gaulin, 1982). This one-year study examined food habits of one group of howlers at a cloud forest in the Central range of the Colombian Andes, and reported consumption of fruits and leaves of 34 plant species. There are reasons to believe that aspects of the behavioral ecology of howlers may differ between lowland and montane forest. First, plant diversity decreases with elevation and species composition changes (Gentry, 1992; Cavelier *et al.*, 2001), so montane populations may have a different and more restricted choice of food species. Second, primary productivy decreases with elevation in correlation with a decrease in temperature. These factors may affect activity patterns and space and resource requirements of howlers.

Montane populations of red howler monkeys in Colombia are threatened by habitat destruction and fragmentation. Recent estimates indicate that over 70 percent of Andean forests have been transformed, and most of what remains is in isolated patches, particularly within the howlers' range in the inter-Andean valleys (Kattan and Alvarez-López, 1996; Cavelier *et al.*, 2001). Across Latin America, howler monkeys have not escaped the negative consequences of human-caused disturbances of natural habitats. Some populations of mantled howlers (*Alouatta palliata*) have gone locally extinct, and many populations of *Alouatta* spp. barely persist in isolated fragments, under conditions that put them at risk (Estrada and Coates-Estrada, 1988, 1996; Gómez-Posada, unpublished data). However, some studies suggest that howlers can persist in isolated forest patches, relying on a limited subset of plant food species in the families Moraceae and Cecropiaceae (Estrada and Coates-Estrada, 1986; Rylands and Keuroghlian, 1988; Schwartzkopf and Rylands, 1989; Estrada *et al.*, 1999).

Understanding the ecology of red howler monkeys and their role as seed dispersers in montane forest fragments is critical to the conservation of both the monkeys and their habitat. Here we present results of a six-month study of red howler monkey at Otún-Quimbaya Flora and Fauna Sanctuary, a cloud forest site in the Central Cordillera of the Colombian Andes. The study site is a restored forest, formed by a mosaic of remnant patches of old-growth forest, second-growth forest and non-commercial monospecific tree plantations that were established as part of a revegetation program. Our study area (489 ha) is part of a larger forested area (several thousand hectares) and is the largest remnant in the howlers' range on the western slope of the Central Cordillera of the Colombian Andes. This study provides baseline data for a larger study, currently in progress, documenting patterns of habitat and resource use, and space requirements of red howler monkeys in forest fragments in the Colombian Andes (Gómez-Posada, unpublished).

Study Area and Methods

The study was conducted at the Santuario de Fauna y Flora Otún-Quimbaya (04°43'N, 75°28'W), located on the western slope of the Central Cordillera of the Andes of Colombia, east of the city of Pereira. This reserve protects a mosaic of Andean forests of different regeneration ages, including patches of old-growth forest, and patches of different sizes of native Andean oak (*Quercus humboldtii*), exotic Chinese ash (*Fraxinus chinensis*) and conifers. These monospecific tree stands were planted in the 1960s as part of a revegetation and soil stabilization program initiated by the local utility authority to protect the Otún river drainage (Londoño, 1994). Tree plantations were abandoned to natural regeneration and presently have a high plant diversity, particularly in the understory (Durán and Kattan, 2005), although the canopy is dominated by the planted species. The Sanctuary encompasses 489 ha at elevations between 1,800 and 2,100 m a.s.l., but is contiguous with Ucumarí Regional Park, which protects 3,980 ha of forest between elevations of 1,750 and 2,600 m a.s.l. Precipitation in the region is bimodal, with peaks of rain in April and October and an annual mean of 2,712 mm (Estación Metereológica El Cedral, CENICAFE, 1995–2001), and the mean annual temperature is 15°C (Aguilar and Rangel, 1994). A mild dry season occurs in December-January and a stronger one in July–August, when monthly precipitation may be under 100 mm.

The study was carried out during July–December 2001, including a dry and a wet season. We identified 11 monkey troops (mean group size ± SD = 7.3 ± 2.5 individuals) in an area of 113 ha, and selected three groups (labeled C, D, and E; Table 1) for intensive observations (Giraldo, 2003; Martínez, 2003). Each group used a home range of 10.2 ± 3.3 ha during the six-month study period (Gómez-Posada *et al.*, 2004). The home range of troop C (8 ha) was completely contained in mature forest. Troop D's home range (14 ha) was next to the river, in an area of secondary forest (old enough to have a developed canopy with interlocking tree crowns), Andean oak, ash and pine plantations. Troop E (8.7 ha) used mostly an ash plantation and a small area of secondary forest. We tried to follow each group for three to four consecutive days each month, making observations between 06:30 and 17:00. We obtained 6–9 observation hours per day, depending on weather; monkeys remained inactive during cold days. The harsh topography also made following troops difficult. We recorded diet every 15 min using a slow scan method (Altmann, 1974, adapted by Robinson, 1986); in each sample, we scanned the group for ten minutes, and for each monkey, we noted the first item

consumed. In each scan we noted the type of food eaten (leaves, mature or immature fruits, flowers), the troop's location, and the habitat type. The proportions of use of different food items were compared with a G contingency test (Zar, 1996). Voucher samples of plants were collected and identified at several national herbaria (see Rios *et al.*, 2004).

To estimate availability of resources used by howlers, we measured fruit and new leaf production in three 400 x 4 m transects (total area sampled = 4,800 m^2) distributed in an area of about 100 ha where the study troops occurred. No previous studies have evaluated resource availability for montane populations of red howler monkeys so there were no criteria for deciding transect size. We chose to use fixed-width transects (Stevenson *et al.*, 1998; Hemingway and Overdoff, 1999) and the size of the transects was decided by taking into account the lower diversity and smaller spatial scale of montane forests, compared with lowland forests (Gentry, 1992; Cavelier *et al.*, 2001; Silverstone-Sopkin, pers. comm.). We included all trees over 15 m tall. We monitored these transects once per month to estimate new-leaf production (estimated as the proportion of the tree's canopy with young leaves) and number of ripe fruits in canopy trees. Fruits were directly counted in one tree branch and multiplied by the number of branches to extrapolate to the whole tree. We explored the correlation of monthly fruit and leaf availability with intensity of use (for each group) using Spearman's rank correlation coefficient (Zar, 1996).

To complement feeding observations and document seed dispersal, we collected feces from the forest floor and understory vegetation, as soon as monkeys defecated. Defecation in howlers was a group activity; usually the alpha male initiated a defecation bout and all members of the group followed. Samples were washed, dried and filtered to separate fiber and seeds, and we counted manually all seeds >5 mm and estimated numbers of seeds <5 mm by weighing samples of 100 seeds. To estimate dispersal distances from parent trees, we made *ad libitum* observations (Altmann, 1974) while following a troop for at least two continuous days; we recorded the time and place of consumption of fruits at a particular tree, and the site where seeds were defecated afterwards (making sure monkeys had not fed on another tree of the same species). Points were located on a map of the study area and dispersal distances measured as a straight line. We included data only on defecations that occurred after 20 h of beginning observations of a troop feeding on a particular tree, to make sure that seeds originated from this particular tree. Twenty hours is the mean retention time estimated for red howlers by Julliot (1996a), Andresen (1999) and Yumoto *et al.* (1999).

Results

Availability of resources

In the three transects we recorded a total of 74 species of trees and a mean (± SD) of 83.3 ± 30 individual trees per transect, representing about one third of the species of canopy trees in the study area (Rios *et al.*, 2004). Availability of new leaves was low during the six months of the study, but some species like *Ficus* spp., *Cecropia telealba* and some Clusiaceae produced new leaves all the time. In general, trees in this cloud forest were nondeciduous and at any particular moment had a low proportion of the crown (~ 5 %) covered in new leaves. The only deciduous species were Andean oak and Chinese ash (leaves not consumed by howlers in this study). In July and August availability was high because of synchronized leafing in Andean oak (Fig. 1).

Both the total fruit availability and the number of species in fruit peaked in August and November (Fig. 1). The August peak was due to fruiting of *Garcinia* sp. and *Wettinia kalbreyeri*. In November the peak was produced by *Heliocarpus americanus* (which has a dry fruit not consumed by howler monkeys) and the palm *W. kalbreyeri*. In general, fruit production in the forest showed little synchronization, both intra- and interspecifically, and reflected fructification events of individual trees. This was the case of one individual tree of *Ficus killipii*, and one *Garcinia* sp., which produced fruit during two non-consecutive months; this particular *Ficus* tree was an important food item for troop E during this study (Appendix and see below).

Diet composition and food preferences

Although our aim was to follow each group for 3 – 4 days per month, the rough topography of the study area made it difficult to always locate and follow groups, in spite of intensive search efforts. Groups C and D were followed during five months and group E during four non-consecutive months. We obtained a total of 1,643 feeding records of fruits, leaves and flowers, in 388.3 hours of observation

Table 1. Size, composition and sampling effort (hours and days of observation) of three red howler monkey troops studied during six months in the Central Cordillera of the Colombian Andes (M = male, F = female).

Group	Adult		Subadult		Juvenile		Infant	Total	No. hours / No. days
	M	F	M	F	M	F			
C	1	2				1	1	5	119.4 / 18
D	1	3	1	1	1	1	2	10	136.4 / 19
E	1	2	1	1	1		2	8	132.0 / 15
Total	**3**	7	**2**	**2**	**2**	**2**	**5**	**23**	**388.3 / 52**

for the three howler groups in the six months of study. They fed on 48 species of plants, in some cases including fruits and leaves or fruits and flowers of the same species (Appendix). In addition, we once observed the adult male of group C feeding on tree bark, and a juvenile twice sucked and then dropped mouthfuls of moss obtained from a cypress tree.

The diet was mostly folivorous (49.2% of feeding records) and frugivorous (45.1%); flowers had a low representation in the diet (5.7%; Table 2). It was difficult to distinguish young and mature leaves through binoculars, particularly for species such as *Paullinia* sp., *Ficus* spp. and *Macrolobium colombianum*, so we pooled all leaf-feeding records in one category. The most important plant families, with both fruits and leaves consumed, were the Moraceae (17 species with 45.7 percent of the total of 1,643 feeding records, including several species of *Ficus* representing 42.2 percent of feeding records) and Cecropiaceae (one species, *C. telealba*, representing 17.2 percent of feeding records). The leaves of two other species, *Paullinia* sp. (Sapindaceae) and *Macrolobium colombianum* (Leguminosae) also made up an important proportion of feeding records (Appendix). During their daily travel routes (553.9 ± 247.9 m; Gómez-Posada *et al*., submitted), howlers always found at least one fruiting tree within their home range each month. Particularly important in this regard were *C. telealba* and *Ficus* spp., which usually had one or more trees in fruit within the study area. However, on any particular day howlers fed on a combination of fruits, leaves, and occasionally flowers, of several species. Monthly rates of consumption of the different food items varied widely (Fig. 2). This reflects intense and opportunistic feeding in particular trees when resources were available, as was the case with individual *F. killipii* and *Garcinia* sp. trees that produced fruit abundantly in non-consecutive months. There were significant differences among troops in diet composition (G = 328.7, P < 0.01; Table 2).

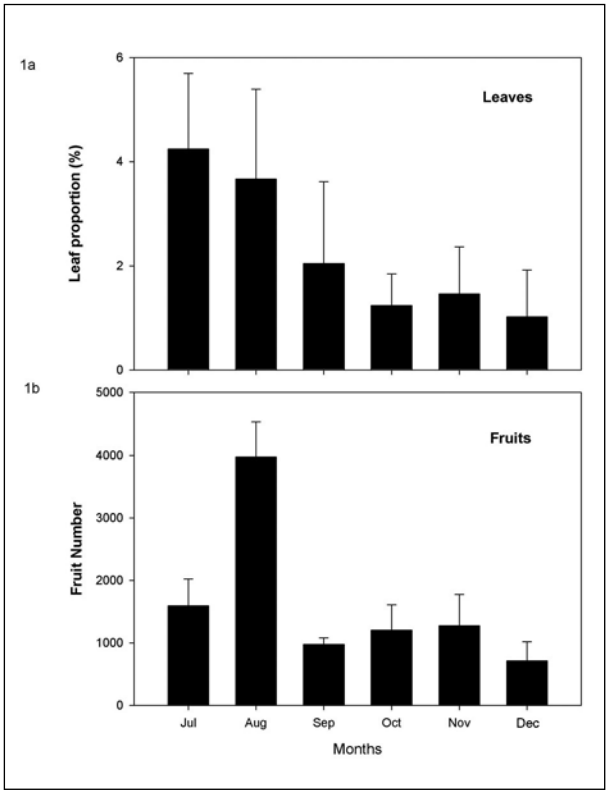

Figure 1. Resource availability for howler monkeys in the Cordillera Central of Colombia. Graph **1a** shows the mean proportion per transect of tree canopy with new leaves, and graph **1b** shows the mean number of fruits per transect (N = 3 transects).

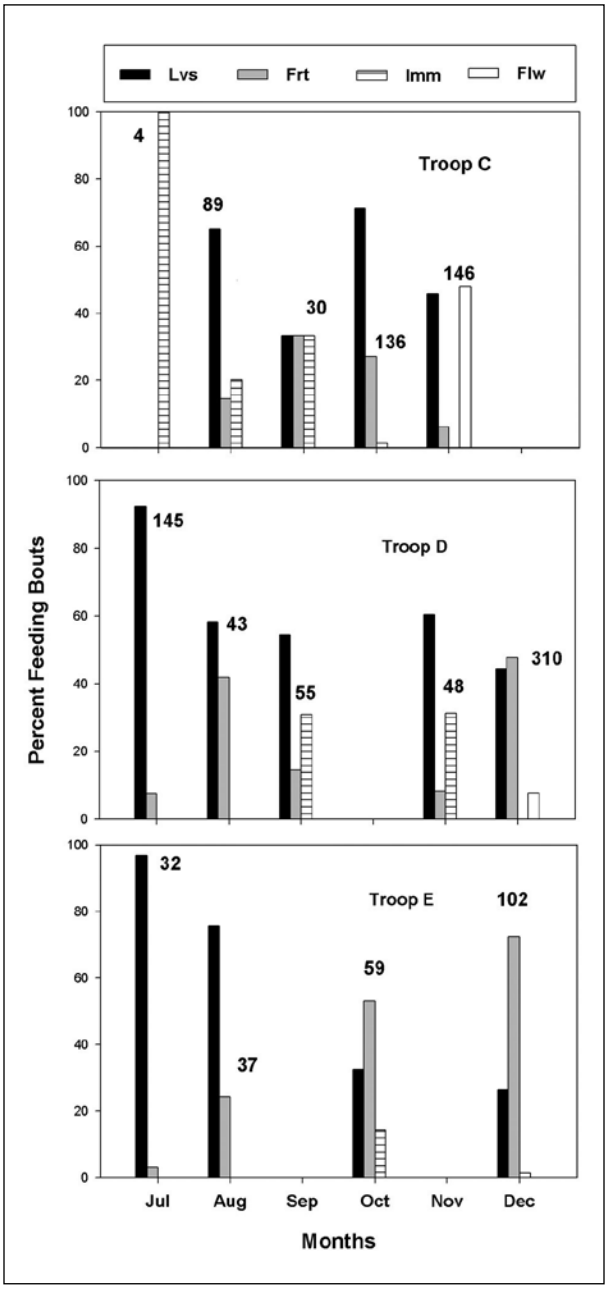

Figure 2. Diet composition of three groups of red howler monkeys in the Central Cordillera of the Colombian Andes. Bars show the proportion of feeding bouts of four items (Lvs = leaves, Frt = ripe fruits, Imm = unripe fruits and Flw = flowers) in the diet, in observations made between July and December 2001. Numbers above bars indicate number of observations per month.

Troop C, with a home range in mature forest, fed on a total of 21 tree species and visited a mean of 5.4 (SD = 1.6) species per day. The most important items in the diet of this group were leaves of *Paullinia* sp. and *M. colombianum*, and leaves and fruits of *C. telealba* and two species of *Ficus*, in combination accounting for 65 percent of feeding records (Appendix). Another important species in this group's diet was *Otoba lehmannii*, which produced fruit continuously during this study, representing most of the immature fruit category (Fig. 2); however, howlers only took a small bite of the tissue of the area of insertion of the peduncle and dropped the rest of the fruit. In July we were able to follow this group for only one day, hence the small number of observations, all on *O. lehmannii* (Fig. 2). During November, this group fed heavily on flowers of *Macrolobium colombianum* (Fig. 2), which flowered synchronously throughout the forest.

Troop D, which had a mixture of ash and pine plantations and secondary forest in its home range, had a more varied diet. This troop fed on a total of 27 species, visiting a mean of 4.7 (± 2.1) species per day. This group fed to some extent on immature fruits of Chinese ash (September and November; Fig. 2), but mostly relied on fruits and leaves of *Cecropia telealba* and several species of *Ficus* (Appendix). In July, little fruit was available within this group's home range, and monkeys relied heavily on leaves (mostly *Cecropia*; Fig. 2).

Finally, troop E had a home range mostly restricted to ash plantation, with some secondary forest. The diet of this group was limited to 12 species, with a mean of 4.4 (± 1.9) species visited per day. However, three species represented 82.9 percent of feeding records (Appendix). This group relied heavily on leaves of a small number of trees, except during October and December, when it fed on fruits of a particular *Ficus killipii* tree for 58.4 percent of feeding records (Fig. 2). Other important items were *C. telealba* (fruits and leaves) and *Paullinia* sp. (leaves). This troop also fed to some extent on immature ash fruits in October (Fig. 2 and Appendix).

Only 27 of the 48 species eaten by the howlers were represented in the three transects. Several species that were important in the monkey's diet, such as *Ficus killipii* and *Paullinia* sp. (Appendix), were not found in transects. Some *Macrolobium colombianum* and *Garcinia* sp. trees were present in transects, but these species fruited asynchronously throughout the study area. Howlers fed on these species, but not at the time when they were fruiting in transects; thus, we have no monthly estimate of fruit availability for these species, and could not calculate any preference index. There was no correlation between fruit and new leaf availability (Fig. 1) and consumption of these items by each group (Fig. 2; $P > 0.3$ in all cases). However, leaf consumption in groups D and E decreased when fruit availability increased.

Seed dispersal

Each troop defecated two to four times daily, usually under a single tree. It was difficult to keep individual feces separate because they were scattered around when hitting vegetation under the tree, so we collected all feces from each group defecation bout, combined them into a single sample, and identified and counted numbers of seeds. Fecal samples contained a mean of 2.3 (SD = 1.04) species of seeds. We found a total of 9 species of intact seeds and 290,174 seeds in 60 samples. Seed size was highly variable, but most seeds (99.9%) were less than 5 mm long; this was the case with *C. telealba* (<3 mm), *Ficus* spp. (<0.8 mm) and *Miconia acuminifera* (<0.5 mm), which were the most abundant species in fecal samples (Table 3). The largest seeds found in feces were *Garcinia* sp. (33.8 ± 0.54 mm, $N = 20$) and *Allophylus mollis* (8.2 ± 0.05 mm, $N = 20$). Only five of the 9 seed species found in feces were observed in feeding records, while the other four species occurred in small numbers and we could not identify them. All seeds of *Ficus* spp. are very similar and we could not separate the different species, however, we observed consumption of fruits of at least five species of *Ficus* so the total number of species in the feces could be 13 or more. Dispersed seeds showed no evidence of parasitism, except for *A. mollis*, which had some seeds parasitized by a coleopteran larva. We obtained 33 direct dispersal distances from the feeding point in the parent tree to the defecation site (we could not obtain more dispersal distances because howlers sometimes fed on different trees of the same species in a single day and because we could not obtain 20 h of continuous following). In 14 cases, this distance was between 6 and 8 m (defecation under same tree). In the other 17 cases, mean dispersal distance was 116.1 m (SD = 92.1). Because howlers frequently visited the same feeding tree several times in a single day, it was not possible to determine retention times.

Table 2. Diet composition of three red howler monkey troops in the Andes of Colombia, measured as percent of feeding bouts observed.

Item Consumed	Troop			Three troops combined
	C	D	E	
Leaves	57.3	59.2	34.5	49.2
Ripe Fruits	17.0	31.4	60.6	39.2
Unripe Fruits	8.4	5.3	4.9	5.9
Flowers	17.3	4.0	0	5.7
N (feeding bouts)	**405**	**601**	**637**	**1,643**

Table 3. Number of seeds of nine species of plants found in 60 troop-composite fecal samples of three red howler monkey troops in the Andes of Colombia.

Plant species	Monkey troop		
	C	D	E
Cecropia telealba	54,545	56,587	58,276
Ficus spp.	5,461	4,870	100
Miconia acuminifera	43,076	38,986	28,085
Allophylus mollis	100	11	2
Garcinia sp.	7	0	0
Dendropanax macrophyllus	30	0	7
Simplocus sp.	2	11	0
Unidentified 1	8	0	0
Unidentified 2	2	8	0
Total	**103,231**	**100,473**	**86,471**

Discussion

Resource availability and diet composition

We observed three important differences between montane and lowland howler populations in their feeding ecology. First, during our six-month study, we observed no times of generalized fruit scarcity at the level of the entire forest, as is the case in lowland forest (Milton, 1980; Julliot, 1996a; Stevenson *et al.*, 2000; Palacios and Rodríguez, 2001). Instead, fruit was available in small but relatively constant amounts, although localized scarcities within the howlers' home ranges occurred (but our study included only six months, so we have no information on long-term patterns). Intra- and interspecific asynchrony in the phenology of cloud forest trees has been reported for other Andean sites (Ataroff, 2001; Cavelier *et al.*, 2001). Fruiting of many species, especially those important in the monkeys' diet (*Ficus*, *Cecropia*), tended to occur asynchronously. Howlers at our site usually combined fruit and leaves in their diet, although leaf use tended to decrease when fruits were available. They fed on the leaves of a wide variety of species, but each species was consumed in small amounts (as proportion of feeding bouts), although some species (*Paullinia* sp., *Ficus* spp. and *C. telealba*) produced new leaves all the time and were more continuously used (Appendix). The same general feeding pattern was reported by Gaulin and Gaulin (1982) for another site on the same mountain range. We did not observe consumption of oak leaves (*Quercus humboldtii*), as Gaulin and Gaulin (1982) did, even though home ranges of two groups included oak stands.

Second, the number of species of plants on which howlers fed was small, probably reflecting lower plant diversity compared to the lowlands. This is particularly true at our study site, which is a restored, secondary forest. We recorded a total of 48 species in their diet (fruits and leaves combined), but for one group this number was as low as 12 species in four months, and *Ficus* spp. and *C. telealba* represented more than 60 percent of the diet of the three groups. The three groups fed on a total of 14 fruit species but these numbers may increase with longer study. The group studied by Gaulin and Gaulin (1982) in a mature forest fed on a total of 34 fruit species in one year; in contrast, studies on lowland populations usually report higher numbers. For example, a 2-year study of one troop of red howler monkeys in French Guiana reported a total of 195 species in the diet, including 97 species of fruits (Julliot and Sabatier, 1993). Two other studies in eastern Colombia reported 17 species of fruits consumed by one troop in 9 days (Yumoto *et al.*, 1999), and 43 species consumed in 12 months by one troop (Stevenson *et al.*, 2002). The third difference is in the size and color of fruits. Howler monkeys are reported to prefer large, yellow or orange-colored fruits (Janson, 1983; Julliot, 1996b). At our site, most fruits consumed by howlers were small (10–40 mm, except for *C. telealba*) and many were green or whitish (such as some *Ficus* spp. and *A. mollis*) or purple (*Miconia acuminifera*), and the only large and yellow fruit in their diet was *Garcinia* sp. Our study did not encompass a full year cycle, but few large and yellow or orange fruits in canopy trees are available at this cloud forest site (Rios *et al.*, 2004), and most were not consumed by howlers.

Availability of resources varied among the three groups, reflecting the heterogeneous nature of our study area. In particular, the group living in ash plantation had a restricted diet, and resorted to leaves when little fruit was available within its home range. Most resources used by troops in ash plantations are in neighboring secondary forest and a few native trees dispersed within the plantations. Our measures of monthly fruit and leaf availability did not correlate with consumption, but this could be a result of our transects not adequately representing resource availability and our study not covering a full year cycle. The observed intra- and interspecific asynchrony in fructification suggests that a better estimate of fruit availability in montane forest could be obtained by placing more but shorter transects dispersed throughout the study area and inside howler home ranges.

Monkeys at our study site depended heavily on a few species in the Moraceae, especially *Ficus* spp., and *Cecropia telealba*. This capacity to rely on a limited set of fruit species, in addition to folivory, allows howler monkeys to survive in small and degraded forest fragments, and in anthropogenic habitats (Rylands and Keuroghlian, 1988; Schwartzkopf and Rylands, 1989; Coates-Estrada, 1996; Estrada *et al*., 1999, 2002; Gómez-Posada *et al*., 2005). Throughout tropical America, the Moraceae (particularly *Ficus*, *Morus*, *Brosimum*, *Poulsenia* and *Pseudolmedia*) and Cecropiaceae have emerged as critical resources for different species of howlers, in particular in second-growth habitats (Gaulin and Gaulin, 1982; Milton, 1991; Julliot and Sabatier, 1993; Silver *et al*., 1998; Estrada *et al*., 1999, 2002; Gómez-Posada *et al*., 2005).

Seed dispersal

Howler monkeys are important members of the seed-disperser guild in tropical forests, because of their abundance, biomass, flexibility of habitat use, and the sheer number of seeds they move within and between habitats (Estrada and Coates-Estrada, 1984; Julliot, 1996a; Silver *et al*., 1998; Yumoto *et al*., 1999). At our study site, howlers defecated intact seeds of at least nine species that were able to germinate (Giraldo, 2003). The number of dispersed seed species at our site, however, is small compared to lowland forest sites. For example, one group of howlers dispersed nine species in 9 days in eastern Colombia (Yumoto *et al*., 1999) and one group in French Guiana dispersed 86 species in 2 years (Julliot, 1996a).

On the other hand, howlers were seed predators for three species at our site (*Fraxinus chinensis*, *Wettinia kalbreyeri* and *Otoba lehmannii*) because they ate unripe fruits. They also sometimes dropped the large seeds of *Garcinia* sp. under the parent tree after partially eating the fruit. Howler feces at our site always had seeds, usually of several species. Most seeds were small, and in preliminary tests many were removed by dung beetles (Giraldo and Gómez-Posada, unpublished data), so were less likely to be predated by rodents. Removal of seeds by secondary dispersers such as dung beetles contributes to increased seed survival (Estrada and Coates-Estrada, 1986; Andresen, 1999, 2002). Although many seeds were deposited under the parent tree, monkeys also moved seeds to different areas of their home ranges. Most importantly, they moved seeds between habitats, in particular to the ash plantation, enriching the ash plantation and catalyzing secondary succession.

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Appendix. Plant species eaten by three troops of howler monkey at Otún-Quimbaya Flora and Fauna Sanctuary, in the Central Andes of Colombia. Table shows the percentage of each species in the diet and the type of item consumed (F = mature fruits, I = immature fruits, L = leaves and R = flowers).

Family / Species	Troop C			Troop D			Troop E	
	%	Item		%	Item		%	Item
MORACEAE								
Ficus killipii							58.4	L, F
Ficus cuatrecasana	5.7	L						
Ficus tonduzii	9.6	L, F						
Ficus aff. hartwegii				3.0	L			
Ficus humboldtii	2.7	L, F		3.7	L			
Ficus sp. 1				15.3	L, F			
Ficus sp. 2				10.5	F			
Ficus sp. 3				5.2	L			
Ficus sp. 4				2.2	L			
Ficus sp. 5				0.7	L			
Ficus sp. 6				0.5	L			
Ficus sp. 7				0.5	F			
Sorocea sp.				2.3	R			
Morus insignis							0.5	L
Pseudolmedia sp.	3.7	L						
Moraceae sp. 1				0.8	L			
Moraceae sp. 2	4.9	L						
CECROPIACEAE								
Cecropia telealba	9.6	L, F		27.1	L, F		12.6	L, F
SAPINDACEAE								
Paullinia sp.	22.0	L		3.7	L		11.9	L
Allophylus mollis	1.0	F						
LEGUMINOSAE								
Macrolobium colombianum	18.3	L, R		3.7	L, R		4.1	L
Inga aff. oerstediana				2.3	L			
OLEACEAE								
Fraxinus chinensis				5.3	I		4.9	I
CLUSIACEAE								
Garcinia sp.	3.0	F						
Chrysochlamys colombiana							4.1	L
Chrysochlamys sp.				0.8	L			
ROSACEAE								
Prunus integrifolia	1.7	L						
ARALIACEAE								
Dendropanax macrophyllus	0.3	L		0.8	L		0.2	L
MYRISTICACEAE								
Otoba lehmannii	7.9	I						
ARECACEAE								
Wettinia kalbreyeri	0.5	I						
FLACOURTIACEAE								
Casearia sylvestris	1.0	L						

continued on next page

Appendix, *continued from previous page*

Family / Species	Troop C			Troop D			Troop E	
	%	Item		%	Item		%	Item
MELASTOMATACEAE								
Miconia acuminifera				0.8	F			
SOLANACEAE								
Solanum sycophanta				2.0	L		0.2	L
TILIACEAE								
Heliocarpus americanus				0.8	L		0.3	L
Unidentified								
Sp. 1	3.7	L, F						
Sp. 2	1.5	L						
Sp. 3	1.0	L						
Sp. 4	1.0	L						
Sp. 5	0.5	L						
Sp. 6	0.5	L						
Sp. 7							3.0	L
Sp. 8							0.3	L
Sp. 9				4.3	L			
Sp. 10				1.3	L			
Sp. 11				1.0	L			
Sp. 12				0.7	L			
Sp. 13				0.3	L			
Sp. 14				0.3	L			
Total Frequencies	**405**			**601**			**637**	
Total Species	**21**			**27**			**12**	

CEBUS PARAGUAYANUS IN ZOOS: THE SPONTANEOUS EXPRESSION OF SPECIES-SPECIFIC BEHAVIORS

Aldo M. Giudice[1] and Romina Pavé[2]

[1] GIBE (Grupo de Investigaciones en Biología Evolutiva), Departamento de Ecología, Genética y Evolución, Facultad de Ciencias Exactas y Naturales, Universidad de Buenos Aires, Pab. II, Lab. 47, 4° piso, Ciudad Universitaria (C1428EHA), Buenos Aires, Argentina, e-mail: <aldogiudice1@yahoo.com.ar>
[2] Estación Biológica Corrientes. Museo Argentino de Ciencias Naturales (MACN), Av. Angel Gallardo 470, 1405, Buenos Aires, Argentina

Abstract

Captive *Cebus paraguayanus* were observed to express spontaneously a wide variety of species-specific behaviors in different zoos from Argentina. The monkeys were kept in old-style wire mesh cages with cement floors, as well as island enclosures. We collected qualitative data on nine species-specific behaviors, and all the sex-age classes analyzed expressed some of these behaviors. The results indicated that in spite of living under predictable captive conditions without environmental enrichment, *Cebus paraguayanus* were able to react to the incidental opportunities that were presented in these environments.

Key words: *Cebus paraguayanus*, captivity, natural behavior, zoos

Resumen

Cebus paraguayanus alojados en zoológicos de Argentina, expresaron de manera espontánea una amplia variedad de conductas especie-específicas. Los ejemplares estaban alojados en recintos de exhibición tradicionales, con suelo de cemento y alambrado perimetral, inclusive en una isla. Se observaron nueve conductas especie-específicas y todas las clases sexo-etarias expresaron algunos de ellos. Los resultados indican que a pesar de ocupar ambientes altamente predecibles y monótonos, *Cebus paraguayanus* fue capaz de reaccionar de manera natural hacia oportunidades que brindaban los recintos de exhibición donde se alojaban.

Palabras clave: *Cebus paraguayanus*, cautiverio, conductas naturales, zoológicos

Introduction

Capuchin monkeys, genus *Cebus* (Platyrrhini: Cebidae), are omnivorous primates with a diet consisting mainly of fruit, and in lesser quantity, insects and other plant parts (Freese and Oppenheimer, 1981). Terborgh (1983) has pointed out that capuchins use a destructive feeding strategy; by means of their strength, they can exploit food resources not available to other animals. Both in natural and captive conditions, capuchin monkeys use a wide variety of manipulative skills. They have been observed to crack open hard-shelled fruit (i.e.: Izawa and Mizuno, 1977; Izawa, 1979), hunt different vertebrates and invertebrates (i.e.: Isawa, 1979; Robinson and Janson, 1987; Rose, 1997; Ferreira *et al*., 2002), use tools like stones and branches (i.e: Anderson, 1990; Visalberghi, 1990; Ottoni and Mannu, 2001; Fragaszy *et al*., 2004a; Moura and Lee, 2004), tap scan for presence of hidden animals (Isawa, 1978; Phillips *et al*., 2003), and fur rub with different plant and animal materials (Baker, 1996; Gilbert *et al*., 1998).

Cebus paraguayanus (also called *Cebus apella paraguayanus* Fisher, 1829, or *Cebus libidinosus paraguayanus*) finds its southern limit of distribution in Argentina (Mudry, 1990; Martinez *et al*., 2002). Its natural habitat is shrinking and, in addition, commercial traffic is affecting its populations (Giudice and Mudry, 1995), and is increasing their vulnerability to local extirpation (Diaz and Ojeda, 2000). In Argentina, *C. paraguayanus* is one of the Neotropical primates most frequently found in zoos (Giudice, 2000). Zoos in Argentina can be defined as "old-style zoos," following Crockett (1998), with conditions that lack furnishings and bedding materials. Here we use "old style" zoos to refer to zoos that have enclosures of either old or modern architecture but that lack the physical, biological and social stimuli necessary to favor the acclimatization of the animals. These zoos often practice highly deficient management procedures. In extremely predictable enclosures, with little environmental complexity, animals find it difficult to move freely, are unable to choose when and what to eat, with whom to associate with, where to sleep and where to shel-

ter. Under these circumstances, behavioral problems arise and it seems unlikely that a normal range of species-specific behaviors will be expressed (IPS, 1993; Mateos Montero, 1994).

While several studies of capuchin monkeys have been conducted in research laboratories (i.e.: Visalberghi and Trinca, 1989; Visalberghi and Fragaszy, 1995; de Waal, 2000; Brosnan and de Waal, 2003), there is limited published information about capuchin behavior in zoos. Observations of species-specific behaviors recorded for *Cebus* in zoos are mostly anecdotal (*C. olivaceus*: Urbani, 1999; *C. apella*: Mendes *et al.*, 2000; Urbani and Urquiza-Haas, 2002). The groups of *C. paraguayanus* studied here in the "old-style zoos" from Argentina were made up of monkeys that were: a) illegally captured and then confiscated, b) pets highly habituated to humans, c) obtained from institutional exchange or d) born in zoos. Our study aim was to examine to what extent captive *C. paraguayanus* express species-specific non-social behaviors. This study clarifies how *C. paraguayanus* behave in the captive conditions of old-style zoos, and it gives insight into the degree of behavioral plasticity found in this Neotropical primate in an environment with no human-directed enrichment protocol.

Materials and Methods

Study sites, subjects and husbandry

Data were collected in four zoos from Argentina: Jardín Zoológico de Buenos Aires (JZBA), Jardín Zoológico de La Plata (JZLP), Estación de Cría de Animales Silvestres de Berazategui, Buenos Aires province (ECAS), and Estación Zoológica Experimental de Santa Fe (EZE). The enclosures, constructed for public viewing, varied in size from 34 m^3 to 127 m^3. They contained wire-meshed walls and roofs, soil or cement floors, indoor and outdoor rooms, crossbars, ropes, platforms, dry tree trunks, and some refuges. We also present data from a 100 m^2 island enclosure at JZBA. The composition of the groups of *C. paraguayanus* in each zoo is summarized in Table 1.

The monkeys were fed once a day around 09:00 with vegetables, fleshy fruit, bird eggs, and, except at EZE, meat and bread. Both food and water were placed on trays on the floor. None of the groups observed were presented with any routines of environmental enrichment.

Table 1. Sex-age classes of the studied colonies of *Cebus paraguayanus*.

Zoos	Adult males	Adult females	Juveniles	Infants	Total
JZBA	6	5	6	2	19
JZLP	5	3	-	-	8
ECAS	1	7	4	-	12
EZE	5	3	4	-	12
Total	**17**	**18**	**14**	**2**	**51**

Behavioral observations

The observations were collected between 1994 and 2002 during the course of other studies by AMG (1994–1998, see Giudice, 2000), and RP (1994/2002, see Pavé, 2003). The total observation time was 1232 hours (Table 2). Research projects had similar study goals, and in all the observation periods, scan and *ad libitum* sampling were used (Altmann, 1974) in 30 minute blocks. Data were collected between 9:00 and 19:00.

In this study, nine species-specific behaviors (as defined in Table 3) are described and analyzed qualitatively. For hunting activity, we were able to obtain hourly occurrence rates across all the study periods, and we calculated these as the frequency of the hunting events divided by the total observation time per group.

Results

Hunting behavior

We estimated an hourly frequency of hunting behavior at the different zoos: 0.85 events per hour at JZBA (n = 164 events), 0.56 events per hour at ECAS (n = 206 events), 0.52 events per hour at JZLP (n = 130 events), and 0.40 events per hour at EZE (n = 109 events). Note that these frequencies do not take group size into account. More than 98% of hunting activity was directed toward invertebrates, mainly flies. Adults and juveniles of each sex hunted flying insects and even a three-month old infant was observed in hunting attempts. In the JZBA cage enclosure, an adult female hunted and consumed a house sparrow (*Passer domesticus*). At ECAS, an adult female hunted a rufous hornero (*Furnarius rufus*). Also at ECAS, the final phase of hunting a duck (Fam. Anatidae) was observed. The duck was grabbed through the wire mesh, and while the duck body remained outside the cage, each capuchin approached the prey, took a piece of it and ate its share away from other individuals. At EZE, the capture of a hornero (*Furnarius* sp.) was also observed; the bird got into one of the enclosures and was immediately chased by the alpha male of the group until it was captured through the wire mesh. The monkey killed the bird by biting its head and then ate parts of the head and carcass, which he also shared with an adult and two juvenile males in the group. At the JZBA cages, an adult male scattered food outside of the enclosure, apparently in order to attract pigeons (*Columba livia*) for capture

Table 2. Study periods in four zoos of Argentina.

Study sites and lodging conditions	Study periods	Observation hours
JZBA (Cages)	1994 – 1995	192
JZBA (Island)	1995 – 1996	50
ECAS (Cages)	1995 – 1997	366
JZLP (Cages)	1996	250
JZLP (Cages)	1998	100
EZE (Cages)	1999, 2002	274

when they came close enough to reach through the wire mesh. In addition, a juvenile male unsuccessfully hunted a kitten. The small cat was handled and pressed against the mesh, as the juvenile tried to pulled it into the enclosure. At JZBA island, an adult female handled an approximately 20 cm long aquatic turtle (*Trachemys* sp.); she repeatedly hit the turtle against the floor, examined it, bit it, and finally lost interest and left it.

Tool use

Capuchins were able to attain food out of their reach by using sticks, and occasionally, leaves and petioles that they stuck through the mesh wire. At EZE, an adult female took a stick from the adjoining cage, broke it up in two pieces and used one of them to acquire a piece of meat from that cage. The same monkey also used dry leaves that she had removed from her cage roof to try to acquire meat from the adjoining cage as well as a peanut from outside the cage (note that at EZE the monkeys did not receive meat or peanuts in their diet). Similarly, at ECAS, an adult male and female used branches to reach a slice of bread and grapes that were outside the cage and out of their reach. At ECAS and EZE, sticks and leaves were used to explore the soil or the grass growing outside the enclosures. Monkeys used sticks to dig in the ground and at the bark of dry trunks, to explore the holes of trunks or the wall, and to explore the water depth in the pond at the JZBA island. In the JZBA cages, an adult female was observed to use a little piece of straw from a broom to remove splinters from her hand.

Capuchins also used objects to kill animals. At EZE, an adult male killed a 25 cm long non-venomous snake by using the brim of a metal container. This monkey struck the brim of the container several times over the snake's head; then he bit the head and continued eating the rest of the snake. Other types of tool use included striking two objects against one another. At EZE, an adult male used sticks and stones to crack open fruit of the Pindó palm (*Syagrus* sp.). At JZBA, this activity took place at preferential locations in two cages: the objects were placed in a deep-set square metallic grate, which was used as an anvil. At EZE on two occasions monkeys used sticks like a lever to separate the wire mesh wall from the cage floor.

Foraging

This activity includes the handling and consumption of plant resources accessible from the enclosure. At EZE, monkeys consumed bermuda grass (*Cynodon dactylon*), which grew outside the front of the enclosures and, in some cases, the capuchins consumed leaves and twigs either with or without buds of poplar (*Populus deltoides*), plane tree (*Platanus acerifolia*), and tipu tree (*Tipuana tipu*). A tala tree (*Celtis tala*) next to one of the enclosures at ECAS had branches overhanging the cage roof that were not accessible to the monkeys. In autumn, monkeys were seen eating fruit from this tree when it fell into the enclosure. In one cage at JZBA in the early spring, some foliage from an ombu tree (*Phytolacca dioica*) fell on the roof of the enclosure, and monkeys consumed the inflorescences. Once, keepers at EZE put some soil outside the cages and near the wire mesh, and adults and juveniles consumed grass leaves and roots present in the new soil.

Manipulative events

A frequent observation was that the capuchins hit apples, potatoes, walnuts, or almonds several times against some

Table 3. *Cebus paraguayanus* behaviors recorded in the study.

Behavioral units	Definition
Hunting behavior	To obtain animal products by means of an active search process; prey is caught with the hunter's limbs and mouth and immediately consumed.
Tool use	To use an unattached environmental object to alter more efficiently the form, position or condition of another object, another organism or the user itself (Beck, 1980). A tool is employed as a functional extension of the animal's body to bridge between itself and its target (Visalberghi, 1990).
Foraging	To direct behavior toward a potential food source not included in the zoo diet. Actions include directed search, processing and consuming (Fragaszy, 1990).
Manipulative events	To use hands and mouth to alter the form, position or condition of another object, which involved two or more coordinated acts. For example, digging in the ground as a necessary step toward acquiring a hidden piece of food was registered as a manipulative event, but picking up a piece of food lying on the ground was not (Jalles-Filho, 1995).
Tap scanning	To give soft hits to a surface with the fingertips of one hand. Tapping lightly and rapidly (Phillips *et al.*, 2003).
Fur rubbing	To apply a foreign substance over the body pelage using hands, feet and tail, in a highly energetic way (Baker, 1996).
Drinking behavior	To introduce hand and arm in the water source, soak their hairs and then lick the water that drains off the arm or hand. Dipping-and-licking technique (Wrangham, 1981).
Behavioral thermoregulation	To rest keeping arms and legs flexed and close to the body while the back is bent, to conserve the heat during periods of low ambient temperature (curled posture). And to rest extending the back and all members, to dissipate heat under hot conditions (stretched posture) (Bicca-Marques and Calegaro-Marques, 1998).
Vertical flight response	To climb suddenly to the enclosure roof and to remain expectant (Giudice, 2000). In the wild, capuchins react to aerial predators moving upwards in the trees and scanning (Rose *et al.*, 2003).

hard surface, like the floor or the mesh, in order to eat the bits stuck to the surface or to the food. At EZE, another common food processing strategy was that adult and juvenile males rubbed dry leaves, grass, small sticks, food, or other items between their hands or against the enclosure floor.

Tap scanning
This activity is used by the capuchins in natural conditions to detect the presence of vertebrates or invertebrates hidden inside tree trunks. At EZE three adults and one juvenile were observed to tap scan on a dry tree trunk several times. They were also observed to tap scan on some sticks. In some cases, after tap scanning, they bit the tree bark. Also, these animals explored the holes of dry trunks with their fingers and in some cases, they employed a technique observed in natural conditions; they ripped up the bark of the tree with their mouths and hands and then licked the surface.

Fur rubbing
At EZE, an adult male took some water with bleach from the recently washed drinking dish and used his hand to rub it over his back. On another occasion, an adult male smelled the enclosure floor, rubbed his cheek on the same place, and then was imitated by one of the juveniles. At JZLP, two adult males were observed to rub onion over their bodies.

Drinking behavior
At ECAS a keeper left a bucket with water outside the enclosure, next to the mesh. The monkeys could not reach the bucket with their mouths, but they introduced their hands into the water, and then drank the water dripping from their arms.

Behavioral thermoregulation
In each of the zoos, energy-conserving or energy-dissipating postures were observed. In winter, animals rested using the curled posture in the sunny places of the enclosure. In summer, monkeys adopted the stretched posture leaning their ventral region on the floor or on thick crossbars, especially in shady places. These behaviors were observed in all the sex-age classes studied.

Vertical flight response
At EZE, in response to calls emitted by a group member or by monkeys from adjoining cages, the capuchin group would suddenly climb to the upper part of the enclosure, or run into the indoor room. They also reacted daily in this way in response to the presence of a zookeeper near the enclosures. This vertical flight response was observed upon detection of southern crested caracaras (*Polyborus plancus*) flying overhead, after vocalizations emitted by dogs and captive flamingos (*Phoenicopterus* sp.), and on two occasions in response to spider monkeys (*Ateles paniscus*) emitting loud vocalizations in adjoining cages. At ECAS vertical flight behavior was observed at least once a day. A call made by a capuchin group member was the most frequent stimulus that triggered this response. The individual that made the call would climb rapidly up the mesh wire to the cage roof, and this behavior was immediately imitated by other group members. In all cases, after a few seconds on the roof or in the indoor room, the monkeys returned to the floor.

Discussion

In the four study populations of *C. paraguayanus* kept in old-style zoo enclosures, we observed the normal expression of nine species-specific behaviors, and all the sex-age classes analyzed expressed at least some of these behaviors. Monkeys hunted flying insects and different vertebrates, mainly birds. The hunting of invertebrates and vertebrates has been recorded often in capuchin monkeys in natural and semi-free ranging conditions (Isawa, 1979; Freese and Oppenheimer, 1981; Janson, 1985; Brown *et al.*, 1986; Robinson and Janson, 1987; Rose, 1997; Ferreira *et al.*, 2002; Sampaio and Ferrari, 2005). In one case, in our study an adult male scattered food outside the cage, apparently to attract pigeons as potential prey. This may suggest a certain cognitive ability, and is in line with similar observations in other captive capuchins, documented to attract ducklings and fishes (McGrew and Marchant, 1997; Mendes *et al.*, 2000). This observation also highlights the ability of capuchins to take great advantage of the opportunities that are presented in the zoos and to develop alternative foraging strategies to meet them.

Tool use was observed in a variety of contexts. Branches and leaves were spontaneously used like arm extensions to obtain food that was out of reach, or to explore distant or hidden surfaces. As observed in wild *Cebus* (Moura and Lee, 2004), individuals in this study used objects to dig in the ground. An adult female used a small piece of straw from a broom to remove splinters from her hand. Monkeys also cracked fruits with sticks and stones using the same actions as described by Izawa and Mizuno (1977). An adult male used the brim of a metal container to kill a non-venomous snake. Although Boinski (1988) reported the use of a branch by wild *Cebus capucinus* to attack a venomous snake, the case observed here with a potential prey item can be considered a prey processing technique equivalent to the use of objects as hammers to crack open oysters (see Fernandez, 1991), and to the cases described above with fruits and reported in wild *Cebus* (i.e.: Izawa and Mizuno, 1977; Anderson, 1990; Moura and Lee, 2004). Our monkeys often hit different foods against hard surfaces and then ate the bits; this food processing technique has been observed in captive (Urbani and Urquiza-Hass, 2002) and wild *Cebus* (Moura and Lee, 2004). In one zoo (JZBA), individuals used a square metallic grate as an anvil to facilitate the cracking open of fruits. This anvil technique has been reported in several *Cebus* studies (i.e.: Ottoni and Mannu, 2001; Fragaszy *et al.*, 2004a). Perhaps the most interesting tool use was by an adult female, who took a stick from the adjoining cage, broke it up in two pieces, and used one of

them to obtain meat from that cage. The sequence is interesting for various reasons. First, it shows the ability of capuchins to solve problems. It also shows the capacity of the female to modify the stick before using it like a tool. Similar actions have been documented in *Cebus apella libidinosus* (Moura and Lee, 2004) and *Pan troglodytes* (Boesch and Boesch, 1990; Pruetz and Bertolani, 2007).

Captive capuchins employed tap-scanning to detect the presence of hidden animals inside trunks and sticks. They used their fingers to explore inside holes of different substrates and in some occasions they ripped up bark to obtain something or just to lick the surface. All these species-specific behaviors show that capuchins continue to use sensory cues to guide their search for prey and display the manual dexterity and extractive foraging characteristic of capuchin monkeys (Izawa, 1978, 1979; Phillips *et al*., 2003), even when in captive conditions with minimal enrichment. The captive monkeys displayed fur rubbing and dipping and licking behaviors. Monkeys in this study fur rubbed with a water-bleach solution and with onion over their bodies. Fur rubbing using several plant and animal materials has been observed in wild and captive *Cebus* (Baker, 1996; Gilbert *et al*., 1998), and it has also been reported in owl monkeys, *Aotus* (Zito *et al*., 2003). Dipping and licking behavior allows for access to drinking water even when it cannot be directly obtained by the mouth, and it has been observed in Old World Primates (*Cercopithecus aethiops*: Wrangham, 1981; *Procolobus badius temminckii*: Starin, 2002) as well as in wild and captive Neotropical primates (*Cebus capucinus*: Freese, 1978; *C. olivaceus*: Urbani, 1999; *Alouatta caraya*: Bicca-Marques, 1992; Giudice and Mudry, 2000; *Saimiri* sp.: Baldwin and Baldwin, 1981). In primates behavioral thermoregulation is important to conserve heat during cold periods and to dissipate heat in hot periods (Bicca-Marques and Calegaro-Marques, 1998). In winter, animals rested huddling in sunny places using the curled posture. In summer, *C. paraguayanus* rested using the stretched posture especially in shady places (Paterson, 1986). These strategies have been observed in wild capuchins (Fragaszy *et al*., 2004b) and other Neotropical primates (*Alouatta caraya*: Zunino, 1989; Bicca-Marques and Calegaro-Marques, 1998; *A. palliata*: Muñoz *et al*., 2002).

We also observed the vertical flight response in the captive groups. In wild conditions, capuchins produce different alarm calls toward aerial and terrestrial predators and they react differently to each type of call (Fedigan, 1993; Di Bitetti, 2001; Rose *et al*., 2003). The same antipredator responses were expressed daily by our *C. paraguayanus* groups. They moved upwards or downwards in the cages in response to the detection of caregivers or flying raptors or in response to vocalizations of dogs and flamingos. The only species of raptor that the individuals detected and gave alarm calls for was a southern crested caracara (*Polyborus plancus*). Rose *et al*. (2003) reported that *Cebus capucinus* in Costa Rica often alarm-called for *Polyborus plancus* but they did not observe predation attempts by this raptor. Interestingly, vertical flight response was observed in capuchins after loud vocalizations emitted by spider monkeys (*Ateles paniscus*) kept in adjoining cages. Other interactions observed between *Cebus* and *Ateles* were initiated by the capuchins and included both affiliation, in the form of gentle touching (n = 2 events), and aggression, including tail and limb pulling, chases over the wire mesh, and pinches (n = 9 events). Although interactions have been observed between *Cebus capucinus* and *Ateles geoffroyi* in Costa Rica (Rose *et al*., 2003), this is the first report of of *Cebus* responding to *Ateles* alarm calls. Inter-specific responses to alarm calls do exist in other primates (*Saguinus labiatus* / *S. fuscicollis*: Buchanan-Smith, 1990; *Saguinus mystax* / *S. fuscicollis*: Heymann, 1990; *Cercopithecus mitis* / *C. ascanius*: Cords, 1990).

While the present study is about non-social behaviors, two social behaviors observed in the study deserve mention. First, food sharing occurred subsequent to the hunting of a bird (*Furnarius* sp.). This cooperative behavior has been reported in free-ranging conditions for *C. capucinus* (Perry and Rose, 1994; Rose, 1997) and in semi-free-ranging conditions for *C. apella* (Ferreira *et al*., 2002). In the observed case the hunter, the alpha male, shared part of the prey by allowing other group members to take scraps that fell on the floor. This sort of food transfer is the most common type observed by Rose (1997) and Ferreira *et al*. (2002). Second, the attempt at hunting by a three month old infant may have been a result of local or object enhancement, as the infant had the opportunity to watch adults hunting for the same prey items. As previously noted in other studies of capuchins (Perry and Rose, 1994; Ottoni and Manu, 2001), through the observations of older animals, the infants learn by trial and error to be more proficient at hunting.

Our results confirm the behavioral plasticity of the capuchin monkeys, their flexible foraging strategies, and their ability to explore and manipulate the environment, including through the use of tools. They displayed a high capacity to take advantage of the opportunities that were presented often inadvertently in the highly predictable conditions studied. Taking into consideration that modern zoos should be conservation agents not only of genetic diversity but also of the behavioral diversity (Rabin, 2003), zoos should be encouraged to increase the opportunities to stimulate the expression of species-specific behaviors in capuchin monkeys and other species.

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Short Articles

Registro de Alimentação Noturna em Macaco-Prego (*Cebus apella*)

Claudia R. Silva

Os primatas do gênero *Cebus* Erxleben 1777 possuem pronunciada destreza manual, cérebro grande com quantidade elevada de circunvoluções, alta sociabilidade, forte capacidade de manipulação e dieta onívora (Defler, 1979; Freese e Oppenheimer, 1981; Auricchio, 1995; Sussman, 2000; Defler, 2004). Estas características presumivelmente garantem a estes primatas a capacidade de explorar o ambiente de forma diferenciada. Macacos-prego são generalistas e flexíveis no uso de recursos alimentares através de grande variedade de hábitats (Fragaszy *et al.,* 1990). Sua plasticidade evolutiva é elevada, tornando-os aptos a aproveitar oportunidades ecológicas diferentes sem apresentar adaptações muito específicas a ambientes particulares (Auricchio, 1995). *Cebus apella* (sensu Silva Junior, 2002 = *Cebus apella apella* sensu Hill, 1960) possui uma ampla distribuição geográfica, ocorrendo na Amazônia centro oriental, em pelo menos cinco países, Brasil, Venezuela, Suriname e as Guianas (Silva Júnior, 2002). Esta espécie é amplamente distribuída no Estado do Amapá, ocorrendo desde os mangues altos da costa litorânea até as florestas de terra firme. Os macacos-prego têm hábitos generalistas, com dieta baseada principalmente em frutas e artrópodes (Terborgh, 1983; Robinson e Janson, 1987). Flores, brotos, ovos, aves, pequenos anfíbios, répteis e mamíferos também são consumidos, embora menos freqüentemente (Freese e Oppenheimer, 1981). Os macacos-prego são conhecidamente de hábitos diurnos, no entanto Rimoli (2001) registrou deslocamento noturno entre *Cebus nigritus* enquanto acompanhava o grupo até sua área de dormir. Segundo o autor, os macacos se mantiveram em atividade por cerca de uma hora após anoitecer.

Esse trabalho relata observações de um bando de macaco-prego (*Cebus apella*) se alimentando à noite, no Parque Nacional Montanhas do Tumucumaque, Estado do Amapá, Brasil. O Parque do Tumucumaque localiza-se na região noroeste do Estado do Amapá. Possui uma área de 3.867.000 ha de floresta de terra firme, bem conservados. O clima é considerado tropical úmido, com uma curta estação seca, culminando nos meses de outubro e novembro. Cinco expedições, de cerca de 20 dias de duração, foram efetuadas ao Parque Tumucumaque para inventariar a fauna de vertebrados, crustáceos e plantas superiores pelo Projeto Inventários Biológicos no Corredor de Biodiversidade do Amapá. Na primeira delas, no período de 11 a 29 de setembro de 2004, foi explorada uma área situada na confluência dos rios Amapari e Anacuí (52°29'32"W, 01°35'45"N, Fig. 1).

Nesta expedição durante o censo de mamíferos, um bando de macacos-prego (*C. apella*) foi observado em atividade, vocalizando e se deslocando, na copa de um piquiá-amarelo (*Caryocar villosum*), apesar da noite escura. O piquiá é uma árvore característica da floresta de terra firme, ocorre em toda a Amazônia, principalmente na região do estuário do rio Amazonas (Lorenzi, 1992). Esta árvore alcança até 45 metros de altura, pode ser vista compondo o dossel ou como emergente, e floresce durante os meses de agosto, setembro e outubro (Lorenzi, 1992; Ribeiro, 1999). Os macacos foram observados na mesma árvore por duas noites consecutivas, 17 e 18 de setembro de 2004. Com o auxílio de um binóculo (Bushmaster 10 × 50) e de uma lanterna de foco amplo, foi possível verificar que na copa do piquiá, a aproximadamente 30 m de altura, os macacos se alimentando de flores. As observações se deram no período das 20:00 às 24:00 do primeiro dia, e das 19:00 às 24:00 do dia seguinte. Na primeira noite de observação, foi possível registrar apenas dois indivíduos se alimentando. As observações se iniciaram às 20:00, quando um juvenil se alimentou por 15 minutos e depois um adulto, por aproximadamente 20 minutos. Embora o bando fosse maior, não foi possível verificar o tamanho do bando nem quantos indivíduos estavam se alimentando. No entanto, os macacos se mantiveram em atividade, vocalizando e se movimentando no alto da árvore, até às 21:45. Nós permanecemos embaixo da árvore, no entanto não foi verificada atividade alguma até às 24:00 quando abandonamos as observações. Na segunda noite, o primeiro registro efetuado foi de um juvenil às 20:25, se alimentando por 15 minutos e, em seguida, foi registrado um adulto se alimentando por aproximadamente 25 minutos. Nesta noite, os animais apresentaram menos atividade (movimentação e vocalização) do que na anterior, provavelmente devido à presença dos observadores desde o início da noite.

Estudos sobre padrão de uso espacial de primatas são consistentes com a hipótese de que macacos de vida livre conhecem a localização de suas árvores de alimento e se deslocam eficientemente entre elas (Sigg e Stolba, 1981; Garber, 1989). Di Bitetti (2000) estudando áreas de dormir de *Cebus nigritus*, encontrou padrões na escolha das árvores onde passariam a noite, sendo árvores de grande porte e altas em floresta madura as escolhidas. Os macacos podem distribuir-se em árvores próximas não estando todo o bando em uma mesma árvore. Provavelmente, os macacos observados no Parque do Tumucumaque se deslocaram para a árvore de alimentação durante o dia e permaneceram até o anoitecer. Muitos estudos com primatas têm mostrado que o olfato pode ser considerado na escolha do alimento (Laska e Hudson, 1993; Ueno, 1994a, b; Laska *et al.*, 1996; Hubener e Laska, 1998; Drapier *et al.*, 2002). Uma característica das flores de piquiá é o forte odor, o que pode auxiliar a sua localização. É provável que durante a noite os macacos estivessem utilizando do olfato para a localização das flores na copa da árvore. As flores do piquiá são utilizadas na alimentação de várias espécies de mamíferos. As câmeras-trap utilizadas durante os inventários realizados no Corredor de Biodiversidade do Amapá registraram tatugalinha (*Dasypus novemcinctus*) e veado-mateiro (*Mazama*

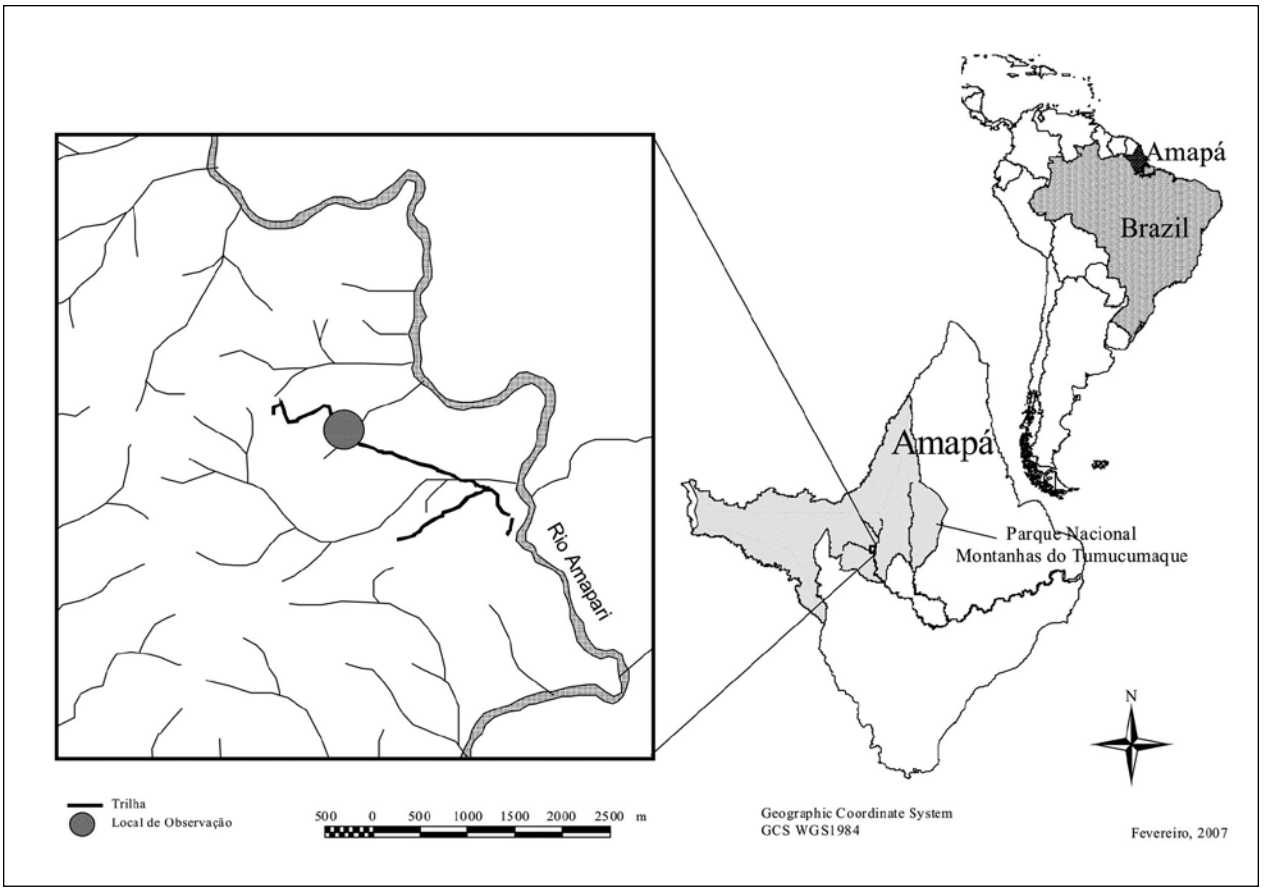

Figura 1. Local onde foi realizada a 1ª expedição de inventários biológicos ao Parque Tumucumaque com a localização do ponto de observação do bando de macaco-prego (*C. apella*).

americana) se alimentando das flores de piquiá (*Caryocar villosum*) durante o dia.

Durante a expedição ao rio Amapari cinco espécies de primatas foram encontradas em simpatria, *C. apella*, *Saimiri sciureus*, *Alouatta seniculus*, *Ateles paniscus* e *Saguinus midas* e duas outras espécies foram relatadas por barqueiros, exímios conhecedores da região: *Chiropotes satanas* e *Pithecia pithecia*. Sendo *Ateles paniscus, Cebus apella* e *Saimiri sciureus* as espécies mais comumente encontradas durante as procuras ativas desenvolvidas na área. Em duas outras oportunidades, bandos de *Saimiri sciureus* foram registrados em atividade noturna (vocalizando/deslocando). No entanto, devido às dificuldades de observação de primatas durante a noite, não foi possível verificar o comportamento dos grupos através de observação de longa duração.

Agradecimentos

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Claudia R. Silva, Instituto de Pesquisas Científicas e Tecnológicas do Estado do Amapá (IEPA), e-mail: <crsilva.ap@gmail.com>.

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A Case of Spontaneous Tool-Making by a Captive Capuchin Monkey

Tiago Soares Bortolini
Júlio César Bicca-Marques

Introduction

Tool use, the use of a free object in the environment as a functional extension of one's own body (Beck, 1980), has been reported in invertebrates, fish, birds, and mammals, including primates (Alcock, 1989). However, tool use is not common or widespread in nonhuman primates. It has been observed in a small number of species including chimpanzees, bonobos, gorillas, orangutans, some macaques and baboons, and capuchin monkeys (van Schaik *et al.*, 1999). Captive capuchin monkeys (*Cebus* spp.) were long reported to use tools in a variety of contexts (Visalberghi, 1990; Urbani, 1999). Recently, however, a growing body of evidence shows that semi-captive and free-ranging capuchins in several populations and species use tools, including the use of stones as hammers and anvils to crack and open nuts (Ottoni and Mannu, 2001; Fragaszy *et al.*, 2004; Moura and Lee, 2004; Waga *et al.*, 2006). Tool-making is a cognitively complex process that involves an intentional modification of the tool for improving its efficiency (Beck, 1980). Reports of non-human primate tool-making have been restricted to the great apes (Boesch and Boesch, 1990; Fontaine *et al.*, 1995; Tomasello and Call, 1997; Schick *et al.*, 1999; van Schaik *et al.*, 2003) with the exception of a few experimentally induced cases in captive capuchins (Westergaard and Suomi, 1994, 1995; Westergaard *et al.*, 1995). Here we report a case of spontaneous tool-making by a captive capuchin monkey.

Methods

A group of capuchin monkeys (*Cebus* sp.) composed of an adult male, two adult females and three immature males living in an enriched enclosure 7.0 m long × 8.7 m wide × 2.9 m high at the Sapucaia do Sul Zoological Park, State of Rio Grande do Sul, Brazil, was opportunistically (*ad libitum*) observed and video-taped in January and February 2007. The enclosure included sand on the floor, trees, stones, and perches for the monkeys. For enrichment purposes, food was concealed inside ice cubes, PVC pipes, and bags.

Results

On 12 January 2007, an adult female (putative *Cebus nigritus*) was observed banging a twig with a piece of stone against a larger stone, licking/chewing and likely extracting something from it with her mouth. She was then observed probing an unseen structure (probably a hole in the enclosure's drinking fountain) with the modified twig (Fig. 1). This sequence of events occurred very rapidly. The latency

Figure 1. Adult female capuchin monkey (putative *Cebus nigritus*) using a hammer stone and an anvil stone to pound on a twig that was then inserted into a crevice (photos from video frames).

Figure 2. Adult female using a stone to crack open an ice cube with food inside.

between the end of banging and the start of probing was 3 to 4 seconds, during which time the female moved from the banging site to the probing site. After this observation, the group was monitored for 15 days and no additional cases of tool-making were observed. The capuchins, however, often used stones as hammers to crack nuts and other foods, including ice cubes containing food (Fig. 2).

Discussion

Although we do not know what happened immediately prior to this behavioral sequence and could not see whether the female acquired anything as a result of probing, the speed at which this sequence of events occurred is highly suggestive of a causal understanding during object manipulation and seems to qualify as a case of spontaneous tool-making. Future research will focus on confirming the capuchin monkeys' capability to make tools, an ability that would suggest less cognitive difference than is presently thought to exist between capuchins and the great apes (Visalberghi, 1990, 1997; Urbani and Garber, 2002). In addition to suggesting that capuchin monkeys understand cause and effect relationships during object manipulation, these findings strengthen the argument that the maintenance of captive animals in enriched environments is an important strategy to allow the expression of the species' fullest behavioral repertoire. A previous study of the same group (200 hours during 2002–2003) in this enclosure, but with minimum enrichment (paved ground, a single swing and no feeding enrichment), failed to record any case of tool use (D.B. Montano, personal observation). Environmental enrichment serves an important function in improving capuchin monkeys' welfare by reducing boredom and eliciting tool use.

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Tiago Soares Bortolini, Instituto de Biociências, Universidade Federal do Rio Grande do Sul, Avenida Bento Gonçalves 9500, Campus do Vale, Prédio 43323 Sala 115, Porto Alegre, RS 91501-970, Brazil, e-mail: <tbortolini@gmail.com>, and **Júlio César Bicca-Marques,** Laboratório de Primatologia, Faculdade de Biociências, Pontifícia Universidade Católica do Rio Grande do Sul, Avenida Ipiranga 6681 Prédio 12A, Porto Alegre, RS 90619-900, Brazil, e-mail: <jcbicca@pucrs.br>.

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Power Lines and Howler Monkey conservation in Porto Alegre, Rio Grande do Sul, Brazil

Luisa Xavier Lokschin
Rodrigo Cambará Printes
Juliane Nunes Hallal Cabral
Gerson Buss

Introduction

Urban growth affects ecosystems in several ways**,** leaving them more vulnerable (Alberti and Marzluff, 2004). In Porto Alegre, the combined effects of human presence including deforestation, hunting and other indirect effects are reducing howler's area distribution with consequences still unknown (Lokschin *et al.*, 2005). Human density within a primates' geographical area should be considered by the World Conservation Union (IUCN) in the evaluation of species status (Harcourt and Parks, 2003). The southern brown howler monkey (*Alouatta guariba clamitans*, Cabrera 1940) is considered an endangered species in Rio Grande do Sul (Marques, 2003); in Brazil and globally it is considered near threatened (Machado *et al.*, 2005; Rylands *et al.*, 2006).

There are many species of Neotropical primates living close to urban areas, including: *Alouatta clamitans* (Buss, 1996), *Alouatta caraya* (Codenotti *et al.*, 2002), *Callicebus nigrifrons* (Oliveira *et al.*, 2003), *Saguinus leucopus* (Poveda and Sánchez-Palomino, 2004) and *Saguinus bicolor* (Vasconcelos *et al.*, 2005). Problems and threats linked to urbanization, such as danger from vehicles when crossing roads, predation by dogs and electric hazard, are already documented for *A. clamitans* (Printes, 1999; Alonso *et al.*, 2005)*, C. jacchus* (Menezes, 2005) and *S. bicolor* (Vasconcelos *et al.*, 2005). Ecosystems close to urban areas are important for wildlife (Dickman, 1987) and measures must be taken to guarantee their existence. Howler monkeys (*A. g. clamitans*) utilize areas of forests close to urban developments and are suffering from contact with several electric hazards. Here we describe a way to mitigate the occurrence of such accidents around Porto Alegre.

Methods

Porto Alegre is the capital city of the state of Rio Grande do Sul, Brazil (Fig. 1), with a population of 1.4 million (IBGE, 2006). Approximately 10% of the municipal area is natural semi-deciduous seasonal forest, influenced by Atlantic rainforest (Brack *et al.*, 1998; Velez *et al.,* 1998). The southernmost area of the municipality (Fig. 2) is a rural landscape containing a number of small villages. The most important natural areas are also in this zone, which is also the most important area for howler monkeys (*Alouatta guariba clamitans*) (Romanowski *et al.*, 1998; Lokschin *et al.*, 2005). Lami Biological Reserve, the only biological

reserve of the city, is located in this region (30°14'13,2"S, 51°05'43,4"W). In its buffer zone there are some forest fragments and a district named Lami, which is an urban area holding around 2,700 people (Porto Alegre, 2006), with many native trees still remaining around the houses. Most of the power lines in Brazil are aerial. Since 1999, the '*Programa Macacos Urbanos*' (Urban Monkeys Program) has been documenting howler monkey mutilations and deaths caused by electric hazards in Lami (Printes, 1999). We conducted a survey to identify the critical areas where electric cables, responsible for the majority of accidents, should be insulated. These areas were identified based on previously documented howler distribution (Romanowski, 1998), the presence of vegetation, known accidents and reports from local people. Areas where electric cables pass through tree branches (especially those of *Ficus organensis*), and riparian forests were prioritized for cable insulation. Areas where howlers died or were mutilated were plotted on a Global Positioning System (GPS) and photographed. String bridges were also installed on three critical points, based on assessment of risk of animals being electrocuted (Figure 2, a, b and c).

Results and Discussion

From 2000 to 2006 eight howlers were electrocuted and three of them died as a result of injuries sustained. This number is lower than that found by Printes (1999) who recorded three cases in one year in the same locality. But our results may have underestimated the total number of deaths and mutilations caused by electric discharge since not all accidents are reported or recorded. When animals attempt to use cables as a bridge or as a base (Fig. 3), they support two of their limbs on two different cables causing a short circuit. Electric current, passing through the animals' body, may cause burns, hemorrhage and cardiac arrest, which can eventually kill them. Low tension cables (127 – 380 v) are the main cause of accidents, due to their frequent use by howlers as bridges between forest fragments. Howlers are not the only victims of such accidents in the region. Birds with large wing spans are also susceptible; these include the southern screamer (*Chauna torquata* Oken, 1816) and striped owl (*Rhinoptynx clamator* Vieillot, 1807).

The first step to reduce electric hazards was the installation of a bridge in 1999. It consisted of two parallel vertical strings. This model of bridge had no success and was replaced by another one, similar to a 'ship ladder' but in a horizontal orientation (Figures 4 and 5). The 'steps of the ladder' are used by howlers in a horizontal plane (the same way ladders are used by humans vertically). We reported accidents to the relevant authorities every time we became aware of their occurrence and requested the insulation of the cables, at least in critical areas. As nothing was done by 2003 a legal strategy was adopted; in March 2003, a legal case was presented based on National Legislation for Environmental Crimes (nº 9605/98), citing known cases. This resulted in Civil Inquiry nº 21/03 and the legal authorities judged that the Electric Energy State Company (CEEE) should insulate cables in critical areas. The insulation work started in 2004 costing approximately US$ 30,000. The '*Programa Macacos Urbanos*' was ordered by the court to designate priority areas, identifying those in which cables presented a higher risk of accidents. We decided that close

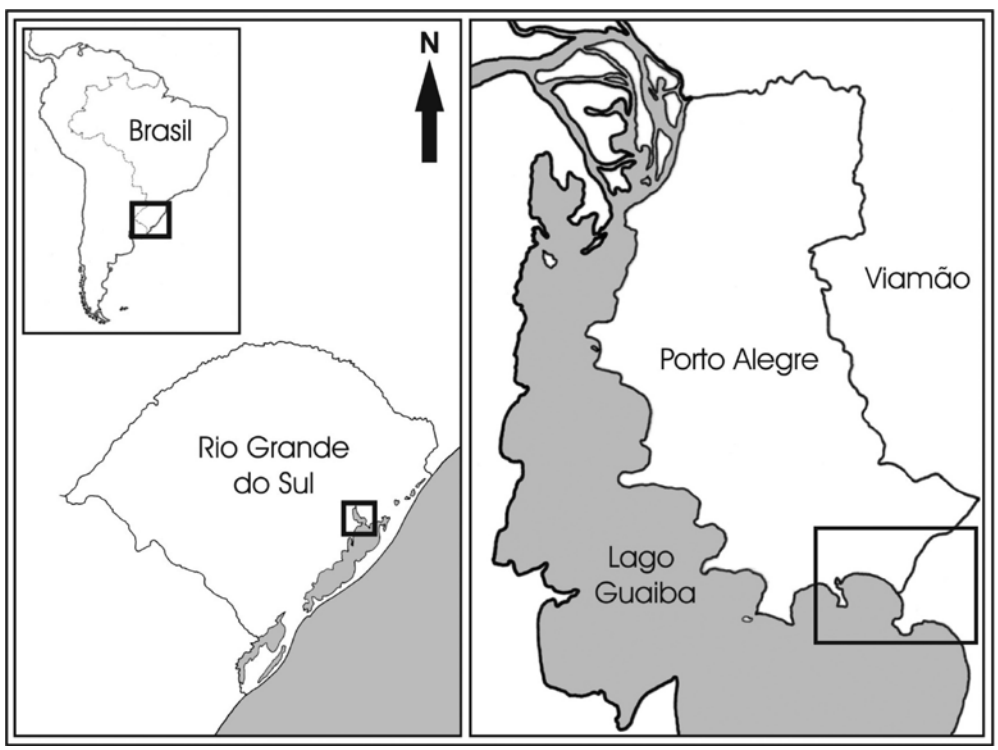

Figure 1. Porto Alegre, RS, Brazil. (30° S, 51° W)

collaboration with local communities was vital for the successful implementation of any conservation activities. The first step taken to engage with local communities was to use about 10 local residents to monitor the occurrence of howler electrocutions pre-installation and use of bridges post-installation. Thus, the presence of houses and people's availability to collaborate was a decisive point in choosing areas for new bridges. Two other bridges were installed in critical areas in 2003 and 2004, with local people reporting occasional use by howlers. In March 5, 2006, we saw a group of howlers crossing one of these bridges (Fig. 2c and Fig. 5). There seems to be a seasonal pattern to the use of bridges by howlers, probably linked to the availability of food resources.

We suggest that bridges should be considered a complementary activity to the insulation of electric cables. In addition to insulation, the three low tension cables must be braided forming only one cable, thereafter reducing the possibility of animal use. Since the first bridge was installed and critical areas were isolated accidents have become rare. One accident was recorded in 2005 in an already insulated area, which had its terminal poles exposed. Since then, the CEEE arranged to insulate all terminals. In 2006, another howler was hurt on high tension cables, in an area already requested to be insolated. The CEEE does not have a way to isolate this type of cables, so pruning was requested. These two last cases suggest that prioritized areas are actually being used by howlers and that they are exposed to danger. If cables are not insulated, they offer potential risks to the animals. Nowadays, to reduce accidents, CEEE has taken the responsibility for keeping cables insulated and trees cut. This legal decision in favor of wild animals was the first one in the country and might set a precedent in Environmental

Figure 2. Southernmost area of Porto Alegre, and the neighboring city of Viamão, Itapuã district. a, b and c are critical points where bridges for howler monkeys were installed in Lami, Porto Alegre, RS, Brazil.

Figure 4. String bridge, 'ship ladder' model, before being installed in Lami, Porto Alegre. (Photo by L. X. Lokschin).

Figure 3. Howler monkeys (*Alouatta guariba clamitans*) using cables as a bridge, at Lami, Porto Alegre. (Photo by L. X. Lokschin).

Figure 5. String bridge where howlers were seen crossing between forest fragments at Lami, Porto Alegre. (Photo by G. Buss).

Justice. The '*Programa Macacos Urbanos*' will keep supervising selected areas around Porto Alegre, monitoring risks to howler monkeys from power lines and installing bridges in critical points. In 2006, a howler died from electrocution crossing low tension cables at Itapuã Village (30°17'00"S, 51°01'19"W), in the neighboring municipality of Viamão, 20 km from Lami (Fig. 2). This resulted in a preliminary study of other cases at Itapuã Village that revealed at least five other deaths caused by contact with electric cables. The first one was in 1995. At present, we are mapping critical points where cables must be insulated at Itapuã.

Conservation Consequences

In 2002, a Municipal Law (Nº 9.971) was created regulating the use of 'ecological' power lines in Porto Alegre. These lines can be either underground or aerial, with an insulating or semi-insulating cover, and built in a compact form. With appropriate monitoring and community participation the enforcement of this law (Decree nº 14.196/03) should guarantee a lower impact of cables on wild howler populations. However, the application of this law is not retroactive; areas where cables were installed before 2003 are still dangerous and should be monitored. Other municipalities should create laws concerning power lines and their impact on flora and fauna; we suggest that researchers should collaborate in this long process. Brazilian researchers should meet in a forum to discuss primates in urban areas. The aim of this forum should be getting to know common problems and standardizing proposals and actions to be taken.

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Luisa Xavier Lokschin, Rodrigo Cambará Printes, Juliane Nunes Hallal Cabral and **Gerson Buss,** Programa Macacos Urbanos, Departamento de Zoologia – Instituto de Biociências – Universidade Federal do Rio Grande do Sul (UFRGS), Av. Bento Gonçalves, n º9500 prédio 43435, sala 218, CEP 90501-970, Porto Alegre, RS, Brasil, e-mail: <lxlokschin@yahoo.com.br>, <cambara7@gmail.com>, <paccifica@hotmail.com>, <gbuss_pmu@yahoo.com.br>.

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Preliminary Survey on the Current Distribution of Primates in Belize

Siân S. Waters and Oscar Ulloa

Introduction

Black howler monkeys (*Alouatta pigra*) and Yucatan spider monkeys (*Ateles geoffroyi yucatanensis*) are the only non-human primate species found in Belize. Black howler monkeys occupy the most restricted range of any other species in the genus *Alouatta* (Wolfheim, 1983), and are listed as Endangered in the IUCN Red List (IUCN, 2006). The Yucatan spider monkey is listed as Vulnerable in the IUCN Red List (IUCN, 2006). Both species are threatened with ongoing habitat loss and degradation (IUCN, 2006). Howler monkeys are the focus of the Community Baboon Sanctuary Conservation Program in an area along the Belize River (Horwich, 1990) and have been reintroduced in the Cockscomb Wildlife Reserve (Horwich *et al.*, 1993). Data have been collected on black howler monkey group size and ranging behavior in two areas of Belize (Horwich *et al.*, 2001; Pavelka, 2003), but no countrywide survey of the species has taken place since the 1980s (Horwich and Johnson, 1986). Spider monkeys are vulnerable to habitat fragmentation because they occur in low numbers, have low fecundity rates, and rely on ripe fruit, a patchily distributed food resource (Meffe and Carroll, 1994). Basic information on this species in Belize is lacking. A known area of spider monkey distribution in the Chiquibul protected area (comprised of the Chiquibul Forest Reserve and the Chiquibul National Park) is heavily frequented by illegal collectors of xaté palm leaves (*Chamaedorea* sp.). This activity has been prevalent since 1998 (Anon, 2005) and up to 1,000 illegal xaté collectors have been reported to camp and hunt in the area while harvesting the leaf (Friends for Conservation and Development, 2005). This must give cause for concern for the species even in a protected area.

Methods

We undertook a countrywide assessment of human/wildlife conflict among subsistence farmers in Belize from March to May 2006 (the results of which will be published elsewhere). As part of the survey we asked questions about the presence of howler monkeys, spider monkeys and Baird's tapir (*Tapirus bairdii*). The latter two species were chosen because they are amongst the first species to disappear from over-exploited forests (Bodmer *et al.*, 1997) and are, as such, more vulnerable to population fragmentation and eventual extinction. Black howler monkeys were included in the list because they often inhabit similar riparian habitat to that of the Baird's tapir. Using a structured questionnaire, we surveyed all districts of Belize for evidence of crop raiding by wild animals. The villages surveyed were all outside protected areas and were selected because they were predominantly dependent on subsistence agriculture. Villages and communities whose livelihoods depended on employment in intensive agriculture such as cattle ranching, and sugar cane, citrus and banana plantations were excluded. The questionnaire was administered at every sixth house in a village to a person who worked on his/her farm. The respondents' farms or gardens were typically situated outside the villages surveyed and were visited when possible. When the questionnaire was completed, and if the respondent had not already mentioned the species as a crop raider, the respondent was asked about the presence of primates and tapirs in the area. GPS locations for each species were recorded if presence was reported by at least two respondents independently of one another in the village surveyed or, if the animals were directly observed, or if howler monkey vocalizations were heard. Howler vocalizations could occur at any time of the day or night. Early morning walks were taken in all forests where the focal species were reported as occurring. A GIS map was generated from these data.

Results

A total of 168 people were interviewed during the survey and 14.9% reported that howler monkeys were present near their farms or gardens. Reports of the presence of black howler monkeys came from all districts except Corozal,

and these were verified in 43% of cases either by sighting or hearing the monkeys. The GIS map of these locations can be seen in Figure 1. Black howler monkeys were not reported as a crop raider by any of the survey respondents. This species was heard frequently in the watershed of the Temash River in southwestern Toledo and was also heard in undisturbed coastal forest in the southeast of Belize. Groups were also commonly reported and heard in the northern part of Cayo District where riparian forest is still common (Fig. 1). Spider monkeys were reported by respondents on seven occasions from three districts, including reliable reports from Orange Walk (Fig. 1) in the northwest of the country, where a group of about 10 animals was reported as living in a forest on the edge of a working quarry on the western border with Guatemala. A respondent in Toledo stated that a group of about eight spider monkeys raided his pineapple crop when it was ripe. All other reports of the species were recorded in Cayo District (Fig. 1).

Discussion

Neither primate species were reported as a serious crop raider in Belize. Unsurprisingly, black howler monkeys are widespread in the villages participating in the Community Baboon Sanctuary Conservation Program (Horwich, 1990). They also are present in the upper watershed of the Temash River in the southwest of Toledo District, where much of the forest was damaged by Hurricane Iris in 2001. Additionally, we believe our auditory detection of a group in undisturbed coastal forest in the southeast of Belize is a new report for this species. This area of forest is presently undisturbed as the inhabitants of the nearby village rely on fishing for their livelihood. The groups reported from the upper Temash River and in Cayo District all occur in unprotected areas of forest increasingly utilized for logging and agricultural purposes. Reports of spider monkeys were less frequent and came from only three districts, Orange Walk, Cayo and Toledo, but the survey team was unable to verify their presence. This may be because there are fewer spider monkeys, and/or because spider monkeys are more difficult to locate because they are more quiet and wary. The spider monkey population in Belize needs further surveys on its areas of distribution, along with research on abundance, density, connectivity and demographics in order to determine appropriate conservation actions. This report on the distribution of both species of non-human primates in Belize is not meant to be definitive but is a useful first step in identifying populations outside protected areas that need active conservation management. These areas include the Cayo District for both species and the upper watershed of the Temash River in the southwest of Toledo District for black howler monkeys. These populations would benefit from closer scrutiny to ascertain their long-term sustainability and their suitability for a potential conservation effort involving local stakeholders. Although there are far fewer reports of the presence of spider monkeys, they may be more common than this survey demonstrates, particularly in Belize's extensive protected areas' network, but determining this will require further investigation.

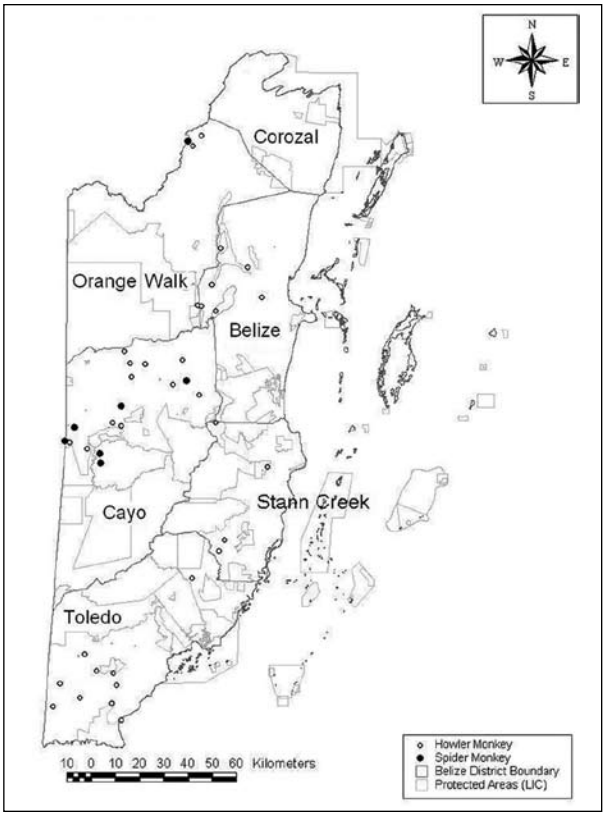

Figure 1. GIS map showing the distribution of black howler monkeys and spider monkeys in Belize.

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Siân S. Waters, 14 Lindsay Gardens, Tredegar, Gwent NP22 4RP UK, e-mail: <sian_s_waters@hotmail.com>, and **Oscar Ulloa,** Department of Forestry, 24/25 Unity Blvd., Belmopan City, Belize.

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Sympatric Occurrence of *Alouatta caraya* and *Alouatta sara* at the Río Yacuma in the Beni Department, Northern Bolivia

Anna B. S. Büntge
Lennart W. Pyritz

Introduction

Sympatry of two species belonging to the same genus occurs rarely in Neotropical primates. It has been observed regularly for *Cebus apella* and *Cebus albifrons* (Terborgh, 1983), and for *Saguinus fuscicollis* and *Saguinus* sp. (Heymann and Buchanan-Smith, 2000). In both cases, the species occupy different ecological niches, through the use of different forest strata or individual foraging strategies. For species of the genus *Alouatta* there are several limited cases of sympatry, for example *Alouatta palliata* and *Alouatta pigra* in Tabasco, Mexico and at the southern Belize-Guatemala border (Horwich and Johnson, 1986), *Alouatta caraya* and *Alouatta guariba* in southern Brazil (Júlio César Bicca-Marques, pers. comm.) and the El Piñalito Provincial Park in Misiones, Argentina (Di Bitetti, 2004), and *A. palliata* and *Alouatta seniculus* in northwestern Colombia (Hernández-Camacho and Cooper, 1976). Here we report for the first time a clearly sympatric occurrence of the two howler monkey species *Alouatta sara* and *A. caraya*.

Study area and Methods

The Río Yacuma is a small tributary of the Río Mamoré, approximately 10 km upstream of the village of Santa Rosa (14°10'S, 66°52'W, Fig. 1). The Río Yacuma flows through the alluvial plain of the Río Mamoré at an elevation of approximately 150 m a.s.l. Heavy floods during the rainy season transform the region into a vast swamp. Mean annual temperature is 26°C, and mean annual precipitation is approximately 1,800 mm (Montes de Oca, 1997; Navarro and Maldonado, 2002). The region is part of the biogeographic sector of the Moxos lowlands, characterized by tree savannahs and Várzea forests along the watercourses (Navarro and Maldonado 2002). Observations were made during a boat trip between April 10 and 12.

Results and Discussion

In April 2006, while travelling northeast of the city of Rurrenabaque in the Beni Department in northern Bolivia (Fig. 1), we observed two distinct howler species, *A. caraya* and *Alouatta sara* (taxonomy following Groves, 2001), foraging and resting in close proximity (at a minimum distance of approx. 100 m and in the range of vision of each other on the bank of a river). The two species were clearly distinguished by the different coloration of the fur (black in male and yellowish in female *A. caraya*, red in *A. sara*). Presumably, the Río Yacuma is not a natural barrier to the dispersal of the *Alouatta* species as both species were seen in the gallery forest on the left and right bank of the river. Water levels decline considerably during the dry season, probably enabling the howler monkeys to cross the river. Groups of *A. caraya* were observed three times. The observations included: an adult male and an adult female; an adult male and two adult females, one carrying a baby; and three adult females with a male. *Alouatta sara* was seen two times. Once we observed a group of three individuals — two adult males and an adult female — foraging in a *Cecropia concolor* tree. On another occasion, we saw a single adult male of *A. sara* resting in the tree canopy. Several minutes of howling of *Alouatta* groups were heard repeatedly in the morning and in the late afternoon on both sides of the river.

In Bolivia, *A. caraya* has been observed at two localities in the Santa Cruz Department and at various localities in the Beni Department including the mouth of the Río Yacuma. Distributional notes on *A. sara* in Bolivia include localities in the Beni, Cochabamba, La Paz, Pando, and Santa Cruz departments. There have been no reports for the central Beni or Río Yacuma region, though (Anderson, 1997). Both *Alouatta* species observed are assessed as Least Concern on

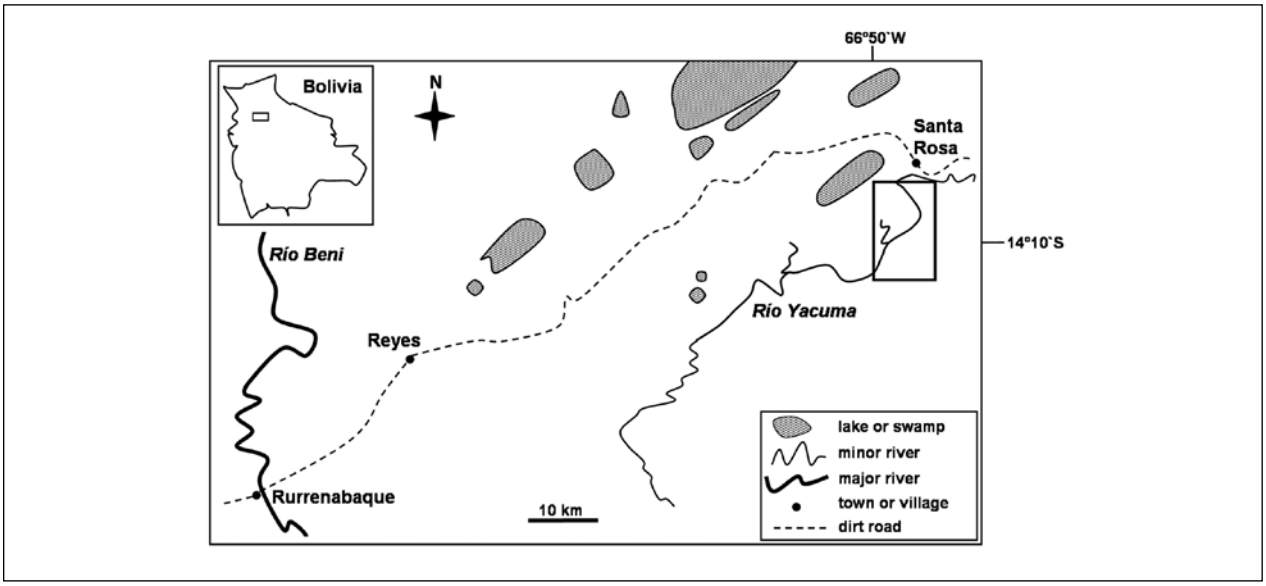

Figure 1. Location of the study area (black box) at the Río Yacuma in the Beni Department, Northern Bolivia.

a global level by IUCN – The World Conservation Union (2004) although declines have occurred in many parts due to hunting pressure and habitat loss. The sympatric occurrence of the two *Alouatta* species at the Río Yacuma raises the following questions: 1) Is the sympatry of *A. caraya* and *A. sara* a result of ecological differences (i.e., the use of different forest strata, different foraging strategies or activity patterns)?, 2) Is interspecific territoriality the same as within species territoriality?, and 3) Is the observed sympatry a recent phenomenon (i.e., caused by habitat loss and hunting pressure in the surrounding area) or has it existed for a longer time?

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Anna B. S. Büntge, Primate Genetics Working Group, German Primate Centre (DPZ), Kellnerweg 4, 37077 Göttingen, Germany, e-mail: <annabritta@gmx.de> and **Lennart W. Pyritz,** Ecological Department of the Johann-Friedrich-Blumenbach-Institute for Zoology and Anthropology, University of Göttingen, Berliner Str. 28, 37073 Göttingen, Germany, e-mail: <LennartPyritz@gmx.net>.

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Registro de Ocorrência de *Cebus kaapori* (Cebidae: Primates) na APA Lago de Tucuruí

Fernanda Almeida Cunha, Maria Aparecida Lopes, Sidnei de Melo Dantas, Nívia Aparecida Silva do Carmo, Suleima do Socorro Bastos da Silva

O caiarara ka'apor (*Cebus kaapori* Queiroz, 1992) tem uma área de distribuição geográfica relativamente pequena, se comparada às de outros primatas amazônicos. Esta espécie tem sido encontrada sempre em baixíssimas densidades em seu hábitat natural. Os fatores determinantes de sua distribuição e as causas de sua raridade local ainda permanecem desconhecidos. A área de ocorrência original do caiarara ka'apor coincide com a região de ocupação humana mais antiga da Amazônia, marcada por grandes desmatamentos e intensa fragmentação de hábitat. A soma destes fatores faz com que *C. kaapori* seja listada como uma das poucas espécies de mamíferos amazônicos criticamente em perigo de extinção (Ferrari e Queiroz, 1994; Lopes e Ferrari, 1996; Carvalho Jr., 2003; Silva Jr. e Queiroz, no prelo; SECTAM, em preparação). A área de ocorrência originalmente identificada deste primata é a Amazônia Oriental, a oeste do Estado do Maranhão (entre os rios Gurupi e Pindaré), com limites entre a Floresta Amazônica e a Zona dos Cocais (Queiroz, 1992). Posteriormente, esta área foi ampliada a noroeste do Maranhão e leste do Pará, entre os rios Tocantins e Grajaú, através de observações diretas e informações de habitantes locais durante inventários faunísticos realizados na região (Lopes, 1993; Ferrari e Lopes, 1996; Lopes e Ferrari, 1996; Silva Jr. e Cerqueira, 1998; Carvalho *et al.*, 1999, Silva Jr., 2001; Silva Jr. e Queiroz, no prelo). Porém, os limites da distribuição geográfica de *C. kaapori* ainda não estão bem definidos. O limite oeste da área de distribuição da espécie parece coincidir com a margem direita do rio Tocantins, mas os limites norte, leste e sul ainda estão indeterminados. Os limites orientais e meridionais da distribuição original podem ter sido retraídos devido à grande perda de hábitat natural conseqüente da ocupação humana (Silva Jr. e Queiroz, no prelo).

A Usina Hidrelétrica de Tucuruí (UHE-Tucuruí), construída entre 1984 e 1985, situa-se a cerca de 300 km ao sul de Belém, Pará (3°43'–5°15'S, 49°12'–50°00'O) (Eletronorte, 1985). Em 2002, foram criadas a Área de Proteção Ambiental, a APA Lago de Tucuruí, que abrange toda a área do entorno do reservatório e duas Reservas de Desenvolvimento Sustentável (Pucuruí Ararão e Alcobaça). Com o estabelecimento de duas Zonas de Proteção da Vida Silvestre (antigas áreas de soltura chamadas Base 3 e Base 4) dentro da APA em 2004, completou-se o mosaico de unidades de conservação do Lago de Tucuruí (Eletronorte, 2006). A fauna da área foi inventariada antes da realização do empreendimento e os animais capturados durante o enchimento do reservatório foram translocados para áreas de soltura ao redor do lago (Eletronorte, 1985). Desde então, estudos sobre a biota local foram realizados pela ELN em parceria com instituições como a Universidade Federal do Pará (UFPA) e o Museu Paraense Emílio Goeldi (MPEG) (por exemplo, Ferrari *et al.*, 2002; Santos, 2002; Ferrari, 2003; Silva, 2003; Sampaio, 2004; Camargo, 2005; Vieira, 2005; Veiga, 2006).

Desde 2005, o MPEG e instituições colaboradoras – UFPA e Instituto Nacional de Pesquisas da Amazônia (INPA) – avaliam a situação das comunidades de anfíbios, répteis, aves e mamíferos na APA Lago de Tucuruí em convênio com a ELN através do projeto "Avaliação e monitoramento das comunidades de vertebrados na área de influência do reservatório da UHE Tucuruí". A fauna de mamíferos está sendo inventariada pelo método de transecção linear em nove pontos de amostragem (quatro na margem direita e cinco na margem esquerda). No período de janeiro de 2005 a agosto de 2006, mais de 900 km foram percorridos (473,5 km na margem direita e 457,6 km na margem esquerda) e 39 espécies de mamíferos foram registradas (28 na margem direita e 35 na esquerda). Até recentemente, *C. kaapori* não havia sido registrada na região de influência da UHE-Tucuruí, apesar de esta estar dentro da área de distribuição geográfica proposta para a espécie (Mascarenhas e Puorto, 1988, Lopes e Ferrari, 1996; Ferrari *et al.*, 2002; Silva Jr. e Queiroz, no prelo). Durante as atividades de censo e monitoramento de fauna do projeto supracitado, foram feitas três observações da espécie em floresta contínua de terra firme na margem direita do lago. Na primeira ocasião, um animal solitário foi observado. Na segunda, um indivíduo foi visto juntamente com um grupo de *Cebus apella*. Na terceira, foram gravadas vocalizações características da espécie, mas não foi possível estimar o tamanho e a composição do grupo.

Apesar de existirem diversas unidades de conservação dentro da área de ocorrência de *C. kaapori*, apenas na Reserva Biológica do Gurupi, no Estado do Maranhão, sua presença havia sido registrada. A falta de observações anteriores de *C. kaapori* na área de influência da UHE-Tucuruí e o pequeno número de observações realizadas em mais de 900 km de trilha percorridos corroboram a hipótese de sua raridade natural (Lopes e Ferrari, 1993, 1996; Ferrari e Queiroz, 1994; Ferrari e Lopes, 1996; Silva Jr. e Cerqueira, 1998; Carvalho Jr. *et al.*, 1999; Carvalho Jr., 2003; Silva Jr. e Queiroz, no prelo).

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As observações foram feitas durante trabalhos de campo do projeto "Avaliação e monitoramento das comunidades de vertebrados na área de influência do reservatório da UHE Tucuruí", com apoio financeiro da Eletronorte.

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Fernanda Cunha, Museu Paraense Emílio Goeldi, Belém, PA, e-mail: <fernandacunh@yahoo.com.br>, **Maria Aparecida Lopes,** Departamento de Biologia, Universidade Federal do Pará, Belém, PA, e-mail: <maria@ufpa.br>, **Sidnei Dantas,** Museu Paraense Emílio Goeldi, Belém, PA, e-mail: <smdantas@yahoo.com>, **Nívia Carmo,** Museu Paraense Emílio Goeldi, Belém, PA, e-mail: <nscarmo@museu-goeldi.br>, **Suleima Silva,** Museu Paraense Emílio Goeldi, Belém, PA, e-mail: <ssbsilva@yahoo.com.br>.

Consumption of *Carapa guianensis* Bark by *Cebus capucinus* in la Reserva Biológica Indo-Maíz, Nicaragua

Thor Hanson

Tree bark has been reported as a minor dietary component in many primate species, from western lowland gorillas (*Gorilla gorilla gorilla*) (Goldsmith, 1999) to red-handed howler monkeys (*Alouatta belzebul discolor*) (Pinto and Setz, 2004). Barbary macaques (*Macaca sylvanus*) commonly strip bark from cedar (*Cedrus atlantica*) trees in Morocco, where research suggests they are seeking water or scarce nutrients present in the cambium tissue (see Camperio-Ciani *et al.*, 2004). There is also mounting evidence of primate self-medication, the use of medicinal plants to treat a range of ailments from ectoparasites to intestinal worms (reviewed in Huffman, 1997). Increased consumption of known medicinal plants has been associated with seasonal trends of nematode infection in chimpanzees (*Pan*

troglodytes), while non-nutritive bark and wood are used as suspected purgatives by numerous great ape populations (Huffman *et al*., 1997). In the Neotropics, Gottlieb *et al*. (1996) noted a close higher-order similarity in the taxonomic groups of plants utilized by humans and primates, and also suggested a correlation between the choice of certain plant types and the medicinal properties of their secondary compounds.

White-faced capuchin monkeys (*Cebus capucinus*) inhabit a wide range of low- to mid-elevation forest types from Honduras to Ecuador (Reid, 1997). Their diet and behavior are well documented at several locations (e.g., Oppenheimer, 1968; Buckley, 1983). They are known to remove tree bark in search of insects (Rose, 1994) and to occasionally ingest the bark of at least two tree species, *Rhizophora mangle* and *Byrsonima crassifolia* (Buckley, 1983). Several authors have watched *C. capucinus* engage in fur-rubbing, the topical application of plants with known ethnomedicinal qualities in a possible attempt to treat ectoparasites or other skin conditions (Oppenheimer, 1968; Buckley, 1983; Baker, 1996). Self-medication for intestinal parasites has not been studied, but *C. capucinus* hosts a wide range of intestinal worms and pathogens (Thatcher and Porter, 1968) and the barks of both *R. mangle* and *B. crassifolia* are well-documented medicinals. *B. crassifolia* is a common rural remedy for diarrhea (Heinrich, 2003) and has shown efficacy in treating *Giardia* (Peraza-Sánchez *et al.*, 2005), while *R. mangle* is being studied as a treatment for gastrointestinal ulcers (e.g., Sanchez-Perera *et al.*, 2004). *Carapa guianensis* Aubl. (Meliaceae) is a widespread Neotropical canopy tree, characteristic of lowland forests from Belize south to the Amazon basin (Fournier, 2002). Its bark, seeds and leaves have a wide range of ethnobotanical uses, from fever reduction to the treatment of ulcers and skin conditions (Schultes and Raffauf, 1990; Fournier, 2002). Most notably, the bark tissue is used in a tea to expel intestinal worms and parasites (Schultes and Raffauf, 1990).

On 7 March 2006, I observed an adult male *C. capucinus* consuming bark from the trunk of a mature *C. guianensis* (~90 cm dbh) in the southwestern portion of La Reserva Indio-Maíz, Nicaragua (10°56'18.4"N, 84°19'54.3"W). At least eight other members of the troop were foraging nearby, but only a single individual was engaged in bark stripping. Balancing in the crown of a small sub-canopy tree, he used his weight to lean the tree against the straight bole of an adjacent *C. guianensis*, approximately 10 m above the ground. He then grasped at the smooth trunk and used his teeth to strip off long pieces of bark, chewing first the bark strips and then directly chewing the exposed inner bark and cambium of the trunk itself. In more than ten minutes of feeding he completely removed the bark from an area approximately 0.75 m by 0.5 m, leaving the cambium and sapwood exposed. The tree bore no signs of insect infestation and the individual appeared to be consuming the inner bark and cambium specifically.

Consumption of *C. guianensis* bark by *C. capucinus* has not been previously reported and authors of recent studies in Panama and Costa Rica have not observed this behavior (L. Fedigan, pers. comm.; E. Wehnke, pers. comm.). It remains to be learned whether the event described here is a local habit of the Indio-Maíz population, or a more widespread behavior that is simply unusual and rarely seen. Given the documented ethnobotanical uses of *C. guianensis* bark, as well as two other tree barks eaten by *C. capucinus*, this behavior should be looked for in other populations as a potential new example of self-medication in primates.

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Thor Hanson, Department of Forest Resources, University of Idaho, P.O. Box 441133, Moscow, Idaho 83844, USA, e-mail: <thor@rockisland.com>.

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News

I Reunião do Comitê Internacional para Conservação e Manejo dos Primatas Amazônicos: Resultados

Marcelo Marcelino de Oliveira
Marcos de Souza Fialho
Júlio César Bicca-Marques

Foi realizada entre os dias 17 e 18 de abril de 2007, em São Luís (MA), a I Reunião do Comitê Internacional para Conservação e Manejo dos Primatas Amazônicos. Participaram desta reunião Onildo Marini Filho e Juciara Pelles (IBAMA/Coordenação de Espécies da Fauna), Marcelo Marcelino, Marcos Fialho e Juliana Gonçalves Ferreira (IBAMA/Centro de Proteção de Primatas Brasileiros), Beatriz Gomes e Roberto Veloso (IBAMA/Superintendência do Maranhão), Juliana Shiraishi (IBAMA/Coordenação Geral de Unidades de Conservação), Fabiano Costa (IBAMA/Coordenação Geral de Florestas Nacionais e Reservas Equivalentes), Wilson Spironello (Instituto Nacional de Pesquisas da Amazônia), Marcelo Gordo (Universidade Federal do Amazonas), Helder Queiroz (Instituto de Desenvolvimento Sustentável Mamirauá), José de Souza e Silva Júnior (Museu Paraense Emílio Goledi), Fernanda Marques (Wildlife Conservation Society), Deyse Campista (Sociedade de Zoológicos do Brasil), Alcides Pissinatti (Centro de Primatologia do Rio de Janeiro), Anthony Rylands (Center for Applied Biodiversity Science/Conservation International), Dália Rizel Nogueira (Jardim Zoológico de Belo Horizonte), Júlio César Bicca-Marques (Pontifícia Universidade Católica do Rio Grande do Sul), Jean Philippe Boubli (Universidade de Auckland), Cibele Bonvicino (Fundação Instituto Oswaldo Cruz), Rosana Subirá (Secretaria de Defesa do Meio Ambiente de Manaus), Mariluce Messias (Fundação Universidade Federal de Rondônia), Lilian Pinto (Universidade Estadual de Campinas), Liza Veiga (Universidade Federal do Pará), Ricardo Santos (Universidade Estadual do Maranhão) e Adrian Barnett (Universidade de Roehampton). O Comitê foi instituído pelo Ibama no final de 2005, como órgão de assessoramento para identificação e proposição de medidas de manejo e conservação para as espécies de primatas amazônicos presentes na lista oficial da fauna brasileira ameaçada.

Foi definida a elaboração de dois planos de ação para 2008 com o objetivo de estabelecer medidas que sejam efetivamente úteis para a conservação das espécies. O primeiro plano de ação contemplará o sauim-de-Manaus (*Saguinus bicolor*), espécie considerada "criticamente em perigo" e com área de ocorrência restrita ao município de Manaus e arredores. O segundo plano contemplará quatro espécies: o guariba (*Alouatta ululata*) e o caiarara (*Cebus kaapori*) "criticamente em perigo", o cuxiú-preto (*Chiropotes satanas*) "em perigo" e o cuxiú (*Chiropotes utahickae*) "vulnerável". A situação de *C. kaapori* é especialmente preocupante pela raridade de populações remanescentes na natureza em conseqüência da perda de hábitat em sua área de ocorrência nos estados do Maranhão e Pará e da captura ilegal para o comércio de animais de estimação e caça.

Como prioridades de pesquisa foram definidos (1) inventários para as áreas no sul dos estados do Pará e Amazonas e no alto Solimões visando ampliar o conhecimento acerca dos limites de distribuição de algumas das espécies ameaçadas de extinção que deverão ser alvo de planos de ação a partir de 2009, tais como os uacaris (*Cacajao calvus calvus* e *Cacajao calvus rubicundus*), (2) estudos sobre as espécies "dados deficientes" que podem estar sob risco de extinção em decorrência de sua presença em áreas sob pressão de desmatamento ou de instalação de usinas hidrelétricas ou cuja ocorrência no território brasileira é incerta, tais como *Saguinus fuscicolis cruzlimai* e *Saguinus fuscicolis crandalli*. O Comitê também recomendou que sejam mantidas populações em cativeiro de *Cebus kaapori*, *Ateles marginatus*, *Saguinus bicolor* e *Chiropotes satanas* como "poupanças genéticas" para possíveis futuros programas de reintrodução.

Houve especial preocupação com a necessidade de uma melhor orientação para a destinação de primatas resgatados de áreas inundadas em projetos de implantação de usinas hidrelétricas. Um documento com sugestões será elaborado pelo Comitê para a Diretoria de Fauna e Recursos Pesqueiros do Ibama. Devido à relevância do tema, o Comitê recomendou que o impacto sobre as populações de primatas seja alvo de pesquisas de longo prazo nas áreas que serão

afetadas por futuros projetos hidrelétricos. Como exemplo, citou-se a operação de resgate de fauna da Usina Hidrelétrica de Tucuruí, na qual foram resgatados e soltos nas margens do reservatório 19.496 guaribas-de-mão-vermelha e 2.580 macacos-pregos, cujo impacto sobre a estrutura da comunidade é desconhecido.

Em sua próxima reunião, o Comitê deverá discutir a influência da caça sobre as populações de primatas amazônicos e a identificação de medidas que possam reduzir sua pressão, bem como o efeito do aquecimento global sobre algumas espécies ameaçadas, especialmente aquelas que habitam os ambientes de várzea. Modelagens matemáticas apontam para uma redução drástica das populações de algumas destas espécies em decorrência das mudanças climáticas.

Marcelo Marcelino de Oliveira e **Marcos de Souza Fialho,** IBAMA-Centro de Proteção de Primatas Brasileiros, Praça Anthenor Navarro 5, Varadouro, João Pessoa, Paraíba 58010-480, Brasil, e-mail: <primatas.sede@ibama.gov.br>.

Júlio César Bicca-Marques, Laboratório de Primatologia, Faculdade de Biociências, Pontifícia Universidade Católica do Rio Grande do Sul, Avenida Ipiranga 6681 Prédio 12A, Porto Alegre, Rio Grande do Sul 90619-900, Brasil, e-mail: <jcbicca@pucrs.br>.

The Lawrence Jacobsen Conservation Research Award

Joseph W. Kemnitz, Ph.D.

The Wisconsin National Primate Research Center (WNPRC) is pleased to announce the establishment of the Lawrence Jacobsen WNPRC Conservation Research Award. The award supports studies in applied conservation biology that protect non-human primate species and their habitat. The WNPRC at the University of Wisconsin – Madison has a long history of supporting work in primate conservation that has significantly impacted the survival of many primate species and the protection of forested habitat. The late J. Stephan Gartlan began the WNPRC's pioneering primate conservation studies in Cameroon and today the center continues to make significant strides in helping to protect the world's most threatened primates and their habitats. The award is available to students and/or faculty working in the field of primate conservation. Applicants must be affiliated with a university, college or non-governmental organization (NGO). Students and/or researchers from all countries are welcome to apply. Preference will be given to those working directly with a nonhuman primate species that IUCN lists as threatened or endangered. For more information (including the online application) see <http://pin.primate.wisc.edu/jacobsen>. Grant applications for this year should be received no later than August 1, 2007. Questions about the application can be directed to Joseph W. Kemnitz, Ph.D., e-mail: <kemnitz@primate.wisc.edu>.

Ecología y Comportamiento en Primates

La Estación Biológica Corrientes y el Museo Argentino de Ciencias Naturales invitan al curso teórico de posgrado de *Ecología y Comportamiento de Primates, Visión Clásica y Nuevos Enfoques*, el cual se llevará a cabo del 15 al 23 de Septiembre de 2007 en las instalaciones de la Estación Biológica Corrientes. El curso consiste en la lectura y discusión de artículos sobre primatología en inglés, por lo cual es requisito indispensable el buen manejo del idioma. Además durante el curso se realizará una salida al campo. El curso cubrirá los siguientes temas: Introducción del Orden primates, diversidad, patrones de organización social, sistemas de apareamiento; Modelos actuales que explican la organización social de primates no-humanos: modelo socioecológico, modelo de constreñimientos ecológicos, modelo de interacciones cooperativas; Estado actual de la discusión teórica en el campo de la Primatología; Ejemplo de trabajos de campo en diferentes lugares del mundo y Argentina; Efectos de la deforestación sobre los patrones comportamentales de los primates no humanos; Fragmentación de hábitat, efectos de la alteración del hábitat en la relación parásito/hospedador; Contribución de la genética molecular en la conservación, consecuencias genéticas de poblaciones pequeñas; Corredores biológicos, traslocación y conservación ex – situ; Diversidad de primates en Argentina y su estado de conservación. Para mayor información visitar: <http://ar.geocities.com/yacarehu/index.html>. Cualquier duda consultar con Martín Kowalewski, e-mail: <markowfield@yahoo.com.ar>.

Programa Trainee em Meio Ambiente

O Programa Trainee em Meio Ambiente da Fundaçâo O Boticário de Proteçâo à Natureza chega à sua quinta ediçâo. Após acompanhar por vários anos a realidade ambiental no Brasil e a atuaçâo dos profissionais na área de conservaçâo da natureza, a Fundaçâo O Boticário lançou, em 2003, o Programa Trainee em Meio Ambiente. Com a intençâo de contribuir para o desenvolvimiento das instituiçôes participantes do programa, a Fundaçâo O Boticário ofrece às organizaçôes da sociedade civil da área de conservaçâo da natureza e empresas que realizem açôes de meio ambiente selecionadas, um programa de formaçâo de profissionais que protagonizem soluçôes para a conservaçâo da natureza. Os trainees e tutores indicados pelas instituiçôes participam durante um ano de encontros presenciais com a equipe da Fundaçâo O Boticário, além de desenvolverem um projeto institucional. As inscriçôes para a turma de 2008 estâo abiertas. Para saber mais, acesse o site da Fundaçâo O Boticário <www.fundacaoboticario.org.br> ou entre em contacto: <trainee@fundacaoboticario.org.br>.

VIII Curso Latino Americano em Biologia da Conservação e Manejo da Vida Silvestre

Na última década o Curso Latino Americano de Biologia da Conservação e Manejo da Vida Silvestre vem contribuindo para a formação de profissionais comprometidos com a conservação da diversidade socioambiental da América Latina. Durante as cinco semanas de capacitação os participantes compartilham experiências com renomados profissionais que atuam nas diferentes esferas da Biologia da Conservação. O conteúdo programático deste curso trata primeiramente de uma abordagem conceitual teórica, seguido de metodologias e ferramentas úteis em estudos de campo e por último, estudos de caso nos quais os alunos vivenciarão a realidade de um programa de conservação na região do Pontal do Paranapanema. As aulas serão ministradas na sede do IPÊ, em Nazaré Paulista - SP e no município de Teodoro Sampaio -SP, no período de 06 de novembro a 12 de dezembro de 2007. Mais informações: <www.ipe.org.br>.

Catalog of Vascular Plant Species of Central and Northeastern Brazil

Dr. Barbara M. Thiers, Director, New York Botanical Garden (NYBG)

This Catalogue will contain information from more than 90,000 specimens housed in The New York Botanical Garden Herbarium that represent vascular plant species occurring in Central and Northeastern Brazil. Specimens from the Distrito Federal and the following states are included: Ceará, Goiás, Maranhão, Mato Grosso, Mato Grosso do Sul, Minas Gerais, Piauí, and Tocantins. In addition, a digital image of one or two specimens of each species have been captured and attached to the database record. The collection locality of any specimen with geographic coordinates can be viewed on a map. The information in this catalogue is intended to provide a means to assess the geographic distributions of species in this region and the diversity and endemism of the flora. This Catalogue will present one of the jewels of the NYBG Herbarium — the set of about 42,000 specimens collected by New York Botanical Garden staff members, Howard S. Irwin and William R. Anderson, and several collaborators during a series of expeditions to the Brazilian Planalto funded by the National Science Foundation from 1964–1975 and carried out in collaboration with the University of Brasília. At the time of the Planalto program, the flora of the Planalto was relatively unknown, and many new species were discovered, most represented by types in the NYBG Herbarium. Creating this Catalogue is expected to take three years, after which it will be updated regularly with records of new specimens from the region accessioned at the NYBG Herbarium and with any changes to records already in the Catalogue. For more information go to: <http://sciweb.nybg.org/science2/hcol/planalto/index.asp>.

CBSG New Web Site

The Conservation Breeding Specialist Group (CBSG) announce the launch of its new website, which is the result of another collaboration between CBSG, Linda Malek, and Evenson Design Group — the same design firm that has donated the design of the Annual Reports. Visit the new website at <http://www.cbsg.org> where you will find all the same reports, newsletters and other documents, and new information on our activities.

First International Wildlife Reintroduction Conference

The IUCN / SSC Reintroduction Specialist Group (RSG) and Lincoln Park Zoo will host the 1st International Wildlife Reintroduction Conference April 15–16, 2008 in Chicago, IL, USA. The theme of the conference will be "Reintroduction programs: Applying science to conservation". Twenty speakers and 40 posters will be selected for presentation in addition to 12 already invited speakers. Registration is limited to 275 participants. More information about the conference theme and topics is available at the website <www.reintroduction.org>. We hope you will join us for this exciting event.

Amazon Protected Areas Network (RANPA)

The objectives of the Amazon Protected Areas Network (RANPA) are to update the information about protected areas in the Amazon basin, using a standard process; to establish an agreement to exchange experiences and information between the managers of the regional protected areas; to use standards of metadata to describe, evaluate and predict the state of the protected areas according to international standards; and to identify the areas that need financial support in order to improve their role in the conservation of the biodiversity in the Amazon region. The services that RANPA provides are a satellite image bank, a fire alert system, and databases that include complete information of the Amazon protected areas, publications and maps. The RANPA net has the support of organizations from Venezuela, Perú, Colombia, Ecuador, Guyana and Brazil. For more information about RANPA visit <http://RANPA.net> or contact Alvaro Espinel (Senior Environmental Information Specialist, Sustainable Development Department, Organization of American States) at <aespinel@oas.org>.

Primate Societies

IPS Grants and Awards for 2007

IPS Research Grants: Alison Behie (Canada) "The roles of nutrition, stress and parasites in determining population density in black howlers"; Sarah Carnegie (Canada) "Reproductive strategies and hormonal patterns in wild female white-faced capuchins"; Marietta Dindo (UK) "Investigating primate social learning and culture"; Kathelijne Koops (UK) "Elementary technology of foraging and shelter in the chimpanzees of Nimba Mountains, Guinea"; Marie Pele (France) "What is the influence of psychological traits in the ability of macaques to delay gratification?"; Fiona Stewart (UK) "The evolution of shelter: Modelling human origins through field study of chimpanzee nest building"; Michael Wasserman (USA) "The role of phytoestrogens in the feeding ecology of red colobus monkeys". *Charles Southwick Conservation Education Commitment Award:* Jerry Akparawa, CERCOPAN. *Lawrence Jacobsen Education Development Award:* Christos Astaras (University of Göettingen) "Raising Awareness About Drill Conservation Status Among Youth at Korup Region, Southwest Cameroon"; Marina Cords (Columbia University) "Kakamega Environmental Education Program: Building a Conservation Education Center at Kibiri"; Damodar Gaire (Institute of Forestry, Nepal) "Creation of Community Awareness on Primate Conservation among the School Students and Indigenous People in the Buffer Zone of Bardia National Park, Nepal". *IPS Captive Care Grants:* Sagan Friant "An Investigation of the Gastrointestinal Parasites in Wild and Captive Cercopithecine Primates of Southern Nigeria"; Natalia Ceballos-Mago "Survey of Margarita capuchin monkey, *Cebus apella margaritae and other monkey species in captivity on Margarita Island, Venezuela";* Doug Cress "Pan African Sanctuary Alliance (PASA) Population Project / Chimfunshi, Zambia". *IPS Conservation Grants:* Abby Baird "RAPID – Development of playback for rapid population assessment of the critically endangered brown-headed spider monkey (*Ateles fusciceps*) *in Ecuador";* Catherine Cooke "An assessment of primate species abundance and habitat use in Sette Cama and south Loango Park, Gabon"; Antje Engelhart "Reproductive biology of wild Sulawesi-crested black macaques (*Macaca nigra*) *in the Tangkoko-Batuangus Nature Reserve";* Nguyen Man Ha "Primate Survey, with special focus on Hatinh langur (*Trachypithecus laotum hatinhensis*), *red-shanked douc (Pygathrix nemaeus) and white cheeked gibbon (Nomascus leucogenys) in Huong Hoa district, Quang Tri province, Vietnam";* Stacy Lindshield "Bridging Conservation and Development: Applied Primate Conservation in the Talamanca Region, Costa Rica"; Alexandre Nascimento "Black-faced lion tamarin (*Leontopithecus caissara*) *Conservation Program: Implementing Action Plan through filling data gaps";* Felicia Ruperti "Population density and habitat preferences of the Sahamalaza sportive lemur (*Lepilemur sahamalazensis*)". *Martha J. Galante Award:* Martin Kowalewski.

Recent Publications

Books

Faces na Floresta (Faces in the Forest: The Endangered Muriqui Monkeys of Brazil), by Karen B. Strier. Portuguese translation by Luiz Roberto Mendes Gonçalves and Thäis Costa; preface by Miriam Leitão. Rio de Janeiro: Sociedade para a Preservação do Muriqui — "Preserve Muriqui", 2007. ISBN: 978-85-7650-101-5. If interested in obtaining a copy of the Portuguese version, contact: <preservemuriqui@hotmail.om.br>.

English version: Karen Strier, 1999. Harvard University Press. 170 pp. ISBN: 978-0674290082. The woolly spider monkey, or muriqui, is one of the most threatened primate species in the world. Because of deforestation in their natural habitat (the Atlantic coastal forests of southeastern Brazil) the muriquis are confined to less than three percent of their original range. As of 1987, there were only a dozen forest fragments known to support a total muriqui population of about 500. As of 1998, at least 20 forests are known to support at least 1000 muriquis. This book traces the natural history of the muriqui from its scientific discovery in 1806 to its current, highly endangered status. Karen Strier provides a case study of this scientifically important primate species by balancing field research and ecological issues. Through her accessible presentation, readers gain a broad understanding of primate behavior and tropical conservation.

Life in the Cerrado, a South American Tropical Seasonal Ecosystem, by Gerhard Gottsberger and I. Silberbauer-Gottsberger. 2005. The book describes the Cerrado (one of the top biodiversity hotspots in the world), a large scale South American ecosystem, its formation and origin, its plants and their adaptations, their rhythms of life, and their interactions with animals. The Central Brazilian Cerrado should be considered as a distinct vegetation type, distinguished from other topographically similar Central and South American vegetation types by its ecology, species composition and floristic diversity. Cerrado occurs frequently in savanna-like forms, but also as forest (closed arboreal canopy), woodland (open arboreal canopy), scrub and open grassland forms. Floristic similarities of Cerrado and Central and South American savannas and savanna-like vegetation are the result of a common origin of all these vegetation types and also testify to the floristic exchange between Neotropical savannas and Cerrado during the Tertiary and Quaternary. In the first volume is a detailed examination of its vegetation, its structure, dynamics and presumed origin. Emphasis is on the adaptational features of plants in relation to their physical environment, in particular climate, soil conditions and fire. Further, the utility to humans of Cerrado plants is discussed, as well as the influence of humans upon this ecosystem. We also discuss

some of the issues associated with conservation politics. In the second volume, pollination and seed dispersal phenomena are described, and emphasis is placed on how these processes, essentially plant-animal relationships, are critical to the maintenance and regeneration of this ecosystem. *Contents:* Vol. 1. Origin, Structure, Dynamics and Plant Use; Vol. 2. Pollination and Seed Dispersal. For more information and ordering of the book contact: Prof. Dr. Gerhard Gottsberger <gerhard.gottsberger@uni-ulm.de>.

The Mammals of Costa Rica: A Natural History and Field Guide, by Mark Wainwright and Oscar Arias. 2007. Cornell University Press. ISBN: 978-0801473753. From the raucous mantled howler monkeys and the charismatic white-nosed coatis to the elusive jaguar, *The Mammals of Costa Rica* offers authoritative accounts of the fascinating creatures of the Neotropics. With more than four hundred spectacular illustrations and a wealth of detailed information drawn from firsthand observation, new research, and synthesis of the scientific literature, this book describes all of Costa Rica's readily identifiable terrestrial and freshwater mammals. The clear and entertaining text is perfectly suited to meet the needs of naturalists, students, and researchers, as well as both experienced and first-time visitors to Costa Rica and the American tropics. The mammal descriptions include key identification features, range maps, vocalizations, local folklore and mythology, and comprehensive information about natural history and conservation. The color illustrations show not only the mammals themselves but also their tracks, foods, and skulls. Also included are illustrations of numerous other animals and plants with which the mammals have close ecological links. By presenting mammals in a broader context, *The Mammals of Costa Rica* provides an entry point into a general study of tropical ecology and conservation.

Feeding Ecology in Apes and Other Primates. Ecological, Physiological and Behavioural Aspects, edited by G. Hohmann, M. M. Robbins and C. Boesch. 2006. Cambridge University Press. 540 pp. ISBN: 978-0521858373. The book focuses on evolutionary perspectives of the complex interactions between the environment, food sources, physiology and behaviour in primates. This highly interdisciplinary volume provides a benchmark to assess dietary alterations that affected human evolution by putting the focus on the diet of hominid primates. It also offers a new perspective on the behavioural ecology of the last common ancestor by integrating corresponding information from both human and non-human primates. The potential of innovations of applied biotechnology are also explored to set new standards for future research on feeding ecology, and new information on feeding ecology in humans, apes and other primates is synthesized to help refine or modify current models of socioecology. By taking a comparative view, this book will be interesting to primatologists, anthropologists, behavioural ecologists and evolutionary biologists who want to understand better non-human primates, and the primate that is us. *Contents*: 1. Variability of the feeding ecology of eastern gorillas – M. M. Robbins, J. Bosco Nkurunungi and A. McNeilage; 2. Sympatric western gorilla and mangabey diet – D. M. Doran-Sheehy, N. F. Shah and L. A. Heimbauer; 3. Effects of fruit scarcity on foraging strategies of sympatric gorillas and chimpanzees – J. Yamagiwa and A. K. Basabose; 4. Chimpanzee feeding ecology and comparisons with sympatric gorillas in the Goualougo Triangle, Republic of Congo – D. Morgan and C. Sanz; 5. Frugivory and gregariousness of Salonga bonobos and Gashaka chimpanzees – G. Hohmann, A. Fowler, V. Sommer and S. Ortmann; 6. Feeding ecology of savanna chimpanzees at Fongoli, Senegal – J. D. Pruetz; 7. Food choice in Taï chimpanzees: are cultural differences present? – C. Boesch, Z. B. Goné Bi, D. Anderson and D. Stahl; 8. The effects of food size, rarity, and processing complexity on white-faced capuchins' visual attention to foraging conspecifics – S. Perry and J. C. Ordoñez; Part II. 9. Primate foraging adaptations: two research strategies – S. A. Altmann; 10. The predictive power of socioecological models: a reconsideration of resource characteristics, agonism, and dominance hierarchies – A. Koenig and C. Borries; 11. Hunger and aggression in capuchin monkeys – C. Janson and E. Vogel; 12. How does food availability limit the population density of white-bearded gibbons? – A. J. Marshall and M. Leighton; 13. Influence of fruit availability on Sumatran orangutan sociality and reproduction – S. A. Wich, M. L. Geurts, T. M. Setia and S. S. Utami-Atmoko; 14. Central place provisioning: the Hadza as an example – F.W. Marlowe; Part III. 15. Estimating the quality and composition of wild animal diets – S. Ortmann, B. J. Bradley, C. Stolter and J. U. Ganzhorn; 16. The possible application of novel marker methods for estimating dietary intake and nutritive value in primates – R. W. Mayes; 17. Energy intake by wild chimpanzees and orangutans – N. L. Conklin-Brittain, C. D. Knott and R.W. Wrangham; 18. The role of sugar in diet selection in redtail and red colobus monkeys – L. Danish, C. A. Chapman, M. B. Hall, K. D. Rode and C. O'Driscoll; 19. Primate sensory systems and foraging behavior – N. J. Dominy, P. W. Lucas and N. S. Noor.

New Perspectives in the Study of Mesoamerican Primates: Distribution, Ecology, Behavior, and Conservation, edited by Alejandro Estrada, Paul A. Garber, Mary Pavelka, and Leandra Luecke. 2006. Springer, New York. xvi + 600pp. ISBN-10: 0-387-25854-X (hardback, US$139.00). The ninth volume in the series *Developments in Primatology: Progress and Prospects*, Series Editor Russell H. Tuttle, University of Chicago, Chicago, Illinois. A timely overview of the taxonomy and biogeography of approximately 21 primates of the genera *Saguinus*, *Saimiri*, *Cebus*, *Aotus*, *Alouatta* and *Ateles* which occur in Mesoamerica and northwestern Colombia, and of the behavior, ecology and conservation of Mesoamerican *Cebus*, *Alouatta* and *Ateles*. Following a summary review by the editors ("Overview of the Mesoamerican primate fauna, primate studies and conservation concerns", pp.1–22), the book has a further 22 chapters divided into five parts (each with a short intro-

duction) as follows. Part 1. Taxonomy and Biogeography. Chapter 2. Taxonomy and distributions of Mesoamerican primates – A. B. Rylands, C. P. Groves, R. A. Mittermeier, L. Cortés-Ortiz and J. J. H. Hines, pp.29–79; Chapter 3. The biogeographic history of Mesoamerican primates – S. M. Ford, pp.81–114. Part 2. Population Responses to Disturbance. Chapter 4. Demographic features of *Alouatta pigra* populations in extensive and fragmented forests – S. Van Belle and A. Estrada, pp.121–142; Chapter 5. Population structure of black howlers (*Alouatta pigra*) in southern Belize and response to Hurricane Iris – M. S. M. Pavelka and C. A. Chapman, pp.143–163; Chapter 6. The effects of forest fragment age, isolation, size, habitat type, and water availability on monkey density in a tropical dry forest – H. N. DeGama-Blanchet and L. M. Fedigan, pp.165–188; Chapter 7. Forest fragmentation and its effects on the feeding ecology of black howlers (*Alouatta pigra*) from the Calakmul area in Mexico – A. Rivera and S. Calmé, pp.189–213; Chapter 8. Intestinal parasitic infections in *Alouatta pigra* in tropical rainforest in Lacandona, Chiapas, Mexico: Implications for behavioral ecology and conservation – K. E. Stoner and A. G. di Pierro, pp.215–240. Part 3. Behavior and Ecology. Chapter 9. Average body weight for mantled howling monkeys (*Alouatta palliata*): An assessment of average values and variability, K. E. Glander, pp.247–263; Chapter 10. An exploratory analysis of developmental plasticity in Costa Rican mantled howler monkeys (*Alouatta palliata palliata*) – C. B. Jones, pp.265–285; Chapter 11. Travel patterns and spatial mapping in Nicaraguan mantled howler monkeys (*Alouatta palliata*) – P. A. Garber and P. E. Jelinek, pp.287–309; Chapter 12. Use of landmark cues to locate feeding sites in wild capuchin monkeys (*Cebus capucinus*): An experimental field study – P. A. Garber and E. Brown, pp.311–332; Chapter 13. Leap, bridge or ride? Ontogenetic influences on positional behavior in *Cebus* and *Alouatta* – M. F. Bezanson, pp.333–348; Chapter 14. Food choice by juvenile capuchin monkeys (*Cebus capucinus*) in a tropical dry forest – K. C. MacKinnon, pp.349–365; Chapter 15. Why be alpha male? Dominance and reproductive success in wild white-faced capuchins (*Cebus capucinus*) – K. M. Jack and L. M. Fedigan, pp.367–386; Chapter 16. Post-conceptive mating in white-faced capuchins, *Cebus capucinus*: Hormonal and sociosexual patterns of cycling, noncycling, and pregnant females – S. D. Carnegie, L. M. Fedigan and T. E. Zeigler, pp.387–409. Part 4. Conservation and Management Policies. Chapter 17. Growth of a reintroduced spider monkey (*Ateles geoffroyi*) population on Barro Colorado Island, Panama – K. Milton and M. E. Hopkins, pp.417–435; Chapter 18. Primates in agroecosystems: Conservation value of some agricultural practices in Mesoamerican landscapes – A. Estrada, J. Saenz, C. Harvey, E. Naranjo, D. Muñoz and M. Rosales-Meda, pp.437–470; Chapter 19. Primate populations in the protected forests of Maya archaeological sites in southern Mexico and Guatemala – A. Estrada, S. van Belle, L. Luecke and M. Rosales-Meda, pp.471–488; Chapter 20. Mapping primate populations in the Yucatan Peninsula, Mexico: A first assessment – J. C. Serio-Silva, V. Rico-Gray and G. Ramos-Fernández, pp.489–511; Chapter 21. A metapopulation approach to conserving the howler monkey in a highly fragmented landscape in Los Tuxtlas, Mexico – S. Mandujano, L. A. Escobedo-Morales, R. Palacios-Silva, V. Arroyo-Rodríguez, and E. M. Rodríguez-Toledo, pp.513–538; Chapter 22. Quantifying fragmentation of black howler (*Alouatta pigra*) habitat after Hurricane Iris (2001), southern Belize – S. M. Alexander, M. S. M. Pavelka and N. M. Bywater, pp.539–560. Part 5. Synopsis and Perspectives. Chapter 23. New perspectives in the study of Mesoamerican primates: Concluding comments and conservation priorities – P. A. Garber, A. Estrada and M. S. M. Pavelka, pp.563–584. There are indices for species and for subjects. *Available from*: Springer, 233 Spring Street, New York, NY 10013, USA, Tel.: 1-212-460-1500 or 1-800-SPRINGER, Fax: 1-212-460-1575, e-mail: <service-ny@springer.com>. More information available on the Springer website at <http://www.springer.com>.

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Abstracts

Abstracts from the 2nd Congress of the European Federation for Primatology. Charles University, Prague, September 3–7, 2007.

Meetings

2007

2nd Congress of the European Federation for Primatology. September 3 to 7. The second congress of the European Federation for Primatology (EFP) will be organised by the Czech Group of Primatologists at the Faculty of Education, Charles University in Prague. This Congress aims to step in the future by inviting also those colleagues who are able to present anthropological topics interesting for primatologists and thus to encourage an interdisciplinary discussion among primatologists and anthropologists. The themes will be: Primate genetics, Primate ethology and socio-biology, Primate evolution and paleoathropology and Primate ecology and conservation among others. For more information and registration go to: <http://www.unipv.it/webbio/efp/efp_prague2007.pdf>, or visit the web page: <www.pedf.cuni.cz/kbio/efp>.

The 25th Annual Symposium for nonhuman primate models for AIDS. September 10 to 13, California National Primate Research Center, University of California, Davis. The main objective is to serve as a scientific forum for the dissemination and exchange of new research findings, ideas, and to utilize the knowledge gained from these crucial nonhuman primate studies to better understand how HIV and SIV cause disease, and to facilitate the development of new methods for the treatment, control and prevention of AIDS in human populations. The symposium will focus on the biology of primate lentivirus infection and the use of nonhuman primate models for the study of viral pathogenesis, vaccines, and therapeutic approaches against primate lentivirus infection and disease; primate genomics; viral agents associated with simian acquired immunodeficiency syndrome; and the mechanisms of natural resistance in several primate species to endemic primate lentiviral infection. All scientists interested in HIV/AIDS and related research topics are invited to participate. For more information go to: <http://www.cnprc.ucdavis.edu/NHPM2007/>.

III Congreso Mexicano de Primatología. Octubre 24 al 27. La Asociación Mexicana de Primatología convoca al Tercer Congreso Mexicano de Primatología, el cual se llevará a cabo en el auditorio del Instituto de Investigaciones Antropológicas de la Universidad Nacional Autónoma de México, Ciudad Universitaria, México DF. Las temáticas que se abordarán serán: Antropología Biológica / Psicología Evolutiva; Ecología Conductual / Etología; Conservación; Primatología Médica. Para mayor información visite: <http://www.amp-ac.org.mx>,Dudas: <ampmexico2004@yahoo.com.mx>.

XI Congreso de la Sociedad Mesoamericana para la Biología de la Conservación. Noviembre 26 al 30. La Sociedad Mesoamericana para la Biología y la Conservación invita a

su XI Congreso: *"Uniendo esfuerzos para enfrentar los retos del cambio climático en México y Mesoamérica"*, el cual se llevará a cabo en Cocoyoc, Morelos México. Durante este magno evento y con la participación de la comunidad mesoamericana, se presentarán y discutirán temas relevantes y actuales sobre biodiversidad, cambio climático y conservación que son importantes para científicos, pueblos indígenas, tomadores de decisiones y representantes de comunidades. El objetivo general del congreso es aportar e integrar conocimientos y herramientas para el desarrollo sostenible, la formación de capacidades y la gestión de los recursos naturales de la región Mesoamericana, especialmente en el contexto del cambio climático. Para mayores informes visitar: <http://www.socmesoamericana.org/ev.php>.

VIII Curso Latino-americano de Biología da Conservação e Manejo da Vida Silvestre. Novembro 06 a 12 de Dezembro. Na última década o Curso Latino Americano de Biologia da Conservação e Manejo da Vida Silvestre vem contribuindo para a formação de profissionais comprometidos com a conservação da diversidade socioambiental da América Latina. Durante as cinco semanas de capacitação os participantes compartilham experiências com renomados profissionais que atuam nas diferentes esferas da Biologia da Conservação. O conteúdo programático deste curso trata primeiramente de uma abordagem conceitual teórica, seguido de metodologias e ferramentas úteis em estudos de campo e por último, estudos de caso nos quais os alunos vivenciarão a realidade de um programa de conservação na região do Pontal do Paranapanema. As aulas serão ministradas na sede do IPÊ, em Nazaré Paulista – SP e no município de Teodoro Sampaio – SP. Para mais informação visit o web page: <http://www.ipe.org.br/html/cursos.asp?mes=Novembro&id=104>.

Animal Training and Behavior Through Positive Reinforcement – Further Challenging and Advanced Issues. December 7 to 9, Munich, Germany. The seminar will be imparted by Ken Ramirez, vice president for animal collections and animal training; he develops and supervises animal-care programs, staff training and development as well as public presentation programs for the animal collection at Shedd Aquarium. The Seminar will include themes related to operant conditioning, training situations and problem solving with positive reinforcement. For more information visit: <http://www.clickerreiter.de/KenRamirez1.htm>.

6.- Göttinger Freilandtage. Primate Behavior and Human Universals. December 11 to 14, Göttingen, Germany. This conference aims to bring together primatologists, evolutionary anthropologists and psychologists to summarise our current state of knowledge concerning behavioural variation and its determinants within the order Primates, including humans. Specifically, it will focus on three aspects: (1) comparative studies of behavioural adaptations across (human and non-human) primates that examine evolutionary principles, (2) the ability and failures of evolutionary theory to explain human behavioural traits that affect survival and reproduction, and (3) to identify and explain human behavioural universals. For additional details contact Prof. Dr. Peter Kappeler <gft@gwdg.de> or visit the web page: <http://www.soziobio.uni-goettingen.de/welcome.html>.

2008

III Conferência Nacional do Meio Ambiente. Em maio de 2008 será realizada a "III Conferência Nacional do Meio Ambiente", cujo objetivo será construir um espaço de convergência social para a formulação de uma agenda nacional do meio ambiente, por intermédio da mobilização, educação e ampliação da participação popular, com vistas ao estabelecimento de uma política de desenvolvimento sustentável para o País. Afinal, a definição de políticas públicas para um Brasil sustentável depende de mudanças na forma de atuação das esferas governamentais, do setor produtivo, das organizações da sociedade, chegando ao cotidiano de cada cidadão. Em suas edições, a conferência coloca para a sociedade temas estratégicos para o País, que visam a conservação da biodiversidade, da água, do clima e dos recursos energéticos, com vistas ao desenvolvimento sustentável, levando em consideração que é possível sim crescer sem degradar a natureza. Quem quiser enviar textos para compor a Comissão Nacional, pode enviá-los até dia 15 de dezembro para <arletegenrich@yahoo.com.br>. Informações sobre a Conferência Nacional em <www.mma.gov.br/conferencianacional> ou pelo e-mail <cnma@mma.gov.br>.

9th Student Conference on Conservation Science. March 25 to 27, 2008. Department of Zoology, University of Cambridge, United Kingdom. The SCCS is aimed at young researchers working in universities departments, conservation organisations, or resource management agencies. Approximately 170 postgraduate students attend the conference each year, from a broad range of disciplines in conservation, including ecology, geography, sociology and economics. The most important part of the three-day programme will be poster sessions and 33 fifteen minute talks by students on any aspect of conservation science. There will also be workshops, presentations by conservation NGOs and agencies and social events designed to give participants the opportunity to make new contacts in their own and related disciplines. Prizes are awarded to posters and talks of outstanding quality and relevance to conservation. For more information and applications go to: <www.sccs-cam.org>.

22nd Annual Meeting of the Society of Conservation Biology. The 22nd annual meeting of the SCB will be held at the Chattanooga Convention Center, Chattanooga, Tennessee, USA, from July 13 to 17, 2008. The chair of the meeting will be Dr. David A. Aborn, from the Department of Biological and Environmental Sciences, University of Tennessee at Chattanooga. As evidenced by several previous meeting themes, there are connections among many

aspects of the environment and its conservation, and recognizing those connections is critical for achieving the goals of conservation biology. To that end, the theme for the 2008 SCB annual meeting *"From the mountains to the sea"* will examine several major ecosystems, both as separate components and as a connected entity. For more information and submission dates, go to: <www.conbio.org/2008/>.

XXIInd IPS Congress. August 3 to 8, 2008, Edinburgh International Conference Center, Edinburgh, Scotland. Sponsored by the Primate Society of Great Britain. Abstracts for oral and poster presentations must be submitted by 30th November 2007. For information consult the web site: <http://www.ips2008.co.uk/index.html>.

XXth International Congress of Zoology. August 26 to 29, Jussieu Grand Campus, Paris, France. Held every four years, the International Congress of Zoology gives zoologists and professionals from all fields related to zoology the chance to come together to discuss the current status of zoology and to share ideas about future development of all its disciplines. The International Society of Zoological Sciences (ISZS) and the Societe Zoologique de France invite you to the XX International Congress of Zoology. It will be co-hosted by the Universities Pierre et Marie Curie (PVI), Paris-Sud (PXI) and the Museum National d'Histoire Naturelle. Registration will open on 1st December 2007. For information about the Congress, please visit: <http://icz2008.snv.jussieu.fr> or <http://www.globalzoology.org/index-new/20icz.htm>.

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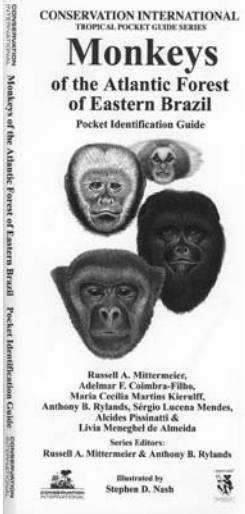

Notes to Contributors

Scope

The journal/newsletter aims to provide a basis for conservation information relating to the primates of the Neotropics. We welcome texts on any aspect of primate conservation, including articles, thesis abstracts, news items, recent events, recent publications, primatological society information and suchlike.

Submissions

Please send all English and Spanish contributions to: Erwin Palacios, Conservación Internacional – Colombia, Carrera 13 # 71-41 Bogotá D.C., Colombia, Tel: (571) 345-2852/54, Fax: (571) 345-2852/54, e-mail: <epalacios@conservation.org>, and all Portuguese contributions to: Júlio César Bicca-Marques, Departamento de Biodiversidade e Ecologia, Pontifícia Universidade Católica do Rio Grande do Sul, Av. Ipiranga, 6681 Prédio 12A, Porto Alegre, RS 90619-900, Brasil, Tel: (55) (51) 3320-3545 ext. 4742, Fax: (55) (51) 3320-3612, e-mail: <jcbicca@pucrs.br>.

Contributions

Manuscripts may be in English, Spanish or Portuguese, and should be double-spaced and accompanied by the text on CD for PC compatible text-editors (MS-Word, WordPerfect, Excel, and Access), and/or e-mailed to <epalacios@conservation.org> (English, Spanish) or <jcbicca@pucrs.br> (Portuguese). Hard copies should be supplied for all figures (illustrations and maps) and tables. The full name and address for each author should be included. Please avoid abbreviations and acronyms without the name in full. Authors whose first language is not English should please have their English manuscripts carefully reviewed by a native English speaker.

Articles. Each issue of *Neotropical Primates* will include up to three full articles, limited to the following topics: Taxonomy, Systematics, Genetics (when relevant for systematics and conservation), Biogeography, Ecology and Conservation. Text for full articles should be typewritten, double-spaced with no less than 12 cpi font (preferably Times New Roman) and 3-cm margins throughout, and should not exceed 25 pages in length (including references). Please include an abstract in the same language as the rest of the text (English, Spanish or Portuguese) and (optional) one in Portuguese or Spanish (if the text is written in English) or English (if the text is written in Spanish or Portuguese). Tables and illustrations should be limited to six, except in cases where they are fundamental for the text (as in species descriptions, for example). Full articles will be sent out for peer-review. For articles that include protein or nucleic acid sequences, authors must deposit data in a publicly available database such as GenBank/EMBL/DNA Data Bank of Japan, Brookhaven, or Swiss-Prot, and provide an accession number for inclusion in the published paper.

Short articles. These manuscripts are usually reviewed only by the editors. A broader range of topics is encouraged, including such as behavioral research, in the interests of informing on general research activities that contribute to our understanding of platyrrhines. We encourage reports on projects and conservation and research programs (who, what, where, when, why, etc.) and most particularly information on geographical distributions, locality records, and protected areas and the primates that occur in them. Text should be typewritten, double-spaced with no less than 12 cpi (preferably Times New Roman) font and 3-cm margins throughout, and should not exceed 12 pages in length (including references).

Figures and maps. Articles may include small black-and-white photographs, high-quality figures, and high-quality maps and tables. Please keep these to a minimum. We stress the importance of providing maps that are publishable.

Tables. Tables should be double-spaced, using font size 10, and prepared with MS Word. Each table should have a brief title.

News items. Please send us information on projects, field sites, courses, Thesis or Dissertations recently defended, recent publications, awards, events, activities of Primate Societies, etc.

References. Examples of house style may be found throughout this journal. In-text citations should be first ordered chronologically and then in alphabetical order. For example, "…(Fritz, 1970; Albert, 1980, 2004; Oates, 1981; Roberts, 2000; Smith, 2000; Albert *et al.*, 2001)…"

In the list of references, the title of the article, name of the journal, and editorial should be written in the same language as they were published. All conjunctions and prepositions (i.e., "and", "In") should be written in the same language as rest of the manuscript (i.e., "y" or "e", "En" or "Em"). This also applies for other text in references (such as "PhD thesis", "accessed" – see below). Please refer to these examples when listing references:

Journal article

Stallings, J. D. and Mittermeier, R. A. 1983. The black-tailed marmoset (*Callithrix argentata melanura*) recorded from Paraguay. *Am. J. Primatol.* 4: 159–163.

Chapter in book

Brockelman, W. Y. and Ali, R. 1987. Methods of surveying and sampling forest primate populations. In: *Primate Conservation in the Tropical Rain Forest,* C. W. Marsh and R. A. Mittermeier (eds.), pp.23–62. Alan R. Liss, New York.

Book

Napier, P. H. 1976. *Catalogue of Primates in the British Museum (Natural History). Part 1: Families Callitrichidae and Cebidae.* British Museum (Natural History), London.

Thesis/Dissertation

Wallace, R. B. 1998. The behavioural ecology of black spider monkeys in north-eastern Bolivia. Doctoral thesis, University of Liverpool, Liverpool, UK.

Report

Muckenhirn, N. A., Mortensen, B. K., Vessey, S., Fraser, C. E. O. and Singh, B. 1975. Report on a primate survey in Guyana. Unpublished report, Pan American Health Organization, Washington, DC.

Website

UNESCO. 2005. UNESCO Man and the Biosphere Programme. United Nations Educational, Scientific, and Cultural Organisation (UNESCO), Paris. Website: http://www.unesco.org/mab/index.htm. Accessed 25 April 2005. ("Acessada em 25 de abril de 2005" and "Consultado el 25 de abril de 2005" for articles in Portuguese and Spanish respectively).

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"Unpublished report" changes to "Relatório Técnico" and "Reporte no publicado" for articles in Portuguese and Spanish respectively.

Neotropical Primates
A Journal and Newsletter of the IUCN/SSC Primate Specialist Group
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