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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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Editorial

During the last 12 years *Neotropical Primates* has achieved the remarkable task of providing a network and forum of communication for all primatologists and university students involved in New World primate conservation, ecology and behavior, in both captive and field-based research settings. This has been possible mainly to the tireless work of its founding editors, Dr. Anthony Rylands and Dr. Ernesto Rodríguez-Luna, a dedicated team of assistant editors and designers, and the generous support of the Margot Marsh Biodiversity Foundation, Los Angeles Zoo, Earthkind, the Houston Zoological Society Conservation Program, the Columbus Zoo, Wildlife Preservation Trust International, the Jersey Wildlife Preservation Trust, Penscynor Wildlife Park, the Detroit Zoological Institute, the Brazilian National Biodiversity Working Group (GTB), the Primate Society of Great Britain (PSGB), and Conservation International. As a result 51 issues have been published to date, including about 370 articles and 60 thesis abstracts. Starting with volume 14, *Neotropical Primates* now has a new editorial team, with the challenge of continuing to make *Neotropical Primates* a frequently cited and well-respected journal, providing information on activities related to the study and conservation of primates, and the conservation of their forest habitats throughout Central and South America, and encouraging non-governmental and governmental institutions to keep these efforts going. We are committed to this endeavour and as such want to renew an invitation to contributors to send us their manuscripts, and to thank in advance all the institutions which make it possible for *Neotropical Primates* to continue being a widespread and easily accessible journal of primatology.

Erwin Palacios
Liliana Cortés-Ortiz
Júlio César Bicca-Marques
Eckhard Heymann
Jessica Lynch Alfaro

Articles

DENSITY, HABITAT USE, AND RANGING PATTERNS OF RED HOWLER MONKEYS IN A COLOMBIAN ANDEAN FOREST

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Abstract

We studied habitat use and ranging patterns of five red howler monkey troops for six months in a lower montane forest in the Colombian Andes. The study area is a mosaic of mature and secondary forest and non-commercial ash, pine and oak plantations that were established as part of a reforestation program. Home ranges (10 ± 3 ha) and daily distances traveled (554 ± 248 m) were similar to those reported for lowland habitats. Home range use differed between groups using mature forest versus secondary forest and plantations, reflecting structural differences between habitat types. We estimated a density of 0.72 individuals and 0.1 groups per hectare. This high density is related to the protected status of the study area and the howler monkeys' behavioral plasticity, which has allowed them to colonize new environments such as plantations.

Key Words: *Alouatta seniculus*, cloud forest, Colombia, density, home range, habitat use, mature and secondary forest, tree plantations

Resumen

Estudiamos los patrones de uso del espacio de cinco grupos de mono aullador rojo durante seis meses en un bosque montano bajo en los Andes de Colombia. El área de estudio es un mosaico de bosques maduros y de regeneración, y plantaciones no comerciales de urapán, pino y roble que fueron establecidas en un programa de reforestación. Las áreas de actividad (10 ± 3 ha) y las distancias recorridas diariamente (554 ± 248 m) fueron similares a las reportadas para poblaciones de tierras bajas. Los patrones de uso del área de actividad difirieron entre los grupos que usaban bosque maduro y los que usaban combinación de bosque secundario y plantaciones, lo cual refleja las diferencias estructurales entre los tipos de hábitat. Estimamos una densidad de 0.72 individuos y 0.1 grupos por ha. Esta alta densidad está relacionada con el estado de protección del área y con la plasticidad conductual de estos monos, que les ha permitido colonizar nuevos ambientes como las plantaciones.

Palabras Clave: *Alouatta seniculus*, bosque nublado, Colombia, densidad, área de dominio vital, uso de habitat, bosque maduro y secundario, plantaciones de árboles

Introduction

Home ranges and population densities of animals vary in relation to factors such as body size, diet, habitat type, social system, and human disturbance (Milton and May, 1976; Crockett and Eisenberg, 1987; Peres, 1997; Chapman and Balcomb, 1998). In general, for energetic reasons, animals of large body size require larger home ranges and have lower population densities than smaller animals within the same trophic level (Fleagle, 1999; MacNab, 2002). Population density is also modulated by habitat productivity and position in the trophic pyramid for a particular species (Eisenberg, 1980; Fleagle, 1999; MacNab, 2002). In addition, for animals like primates that live in groups, population density depends on home range, troop size and the degree to which ranges of different troops overlap (Eisenberg, 1980; Crockett and Eisenberg, 1987).

The red howler monkey (*Alouatta seniculus*) is one of the largest Neotropical primates, with females reaching up to 6.3 kg and males 7.5 kg (Defler, 2003). Home ranges of red howlers vary between 7 and 25 ha (Crockett and Eisenberg, 1987), but may reach up to 182 ha (Palacios and Rodríguez, 2001). Small home ranges have been associated with

the highly folivorous diet and sedentary habits of howler monkeys, but may also vary on the basis of interspecific interactions (Milton, 1980; Gaulin and Gaulin, 1982; Braza *et al.*, 1983; Crockett and Eisenberg, 1987). Depending on habitat and group composition, among other factors, population densities of red howlers vary widely, with a mean of 34–55 ind/km^2, but densities as high as 150 ind/km^2 have been reported in some habitats (Crockett and Eisenberg, 1987; Chapman and Balcomb, 1998).

Throughout its broad distribution in northwestern South America, the red howler is found from lowland rain forest, gallery forest, and dry woodlands to montane forest. In the Colombian Andes it ranges up to 2400 m and occasionally up to 3200 m (Hernández-Camacho and Cooper, 1976; Defler, 2003). Montane populations of red howlers in the Colombian Andes are threatened by habitat destruction and fragmentation. Few tracts of continuous forest still exist in the Central and Western Cordilleras (Kattan and Álvarez-López, 1996), and many howler populations are isolated in small fragments, sometimes as small as 10 ha (Gómez-Posada *et al.*, 2005). Protecting and managing these populations requires an understanding of patterns of spatial and habitat use and population densities.

Humid montane forest differs from lowland rain forest in having lower productivity (correlated with a decrease in temperature) and lower plant diversity, especially when above 1500 m (Gentry, 1992; Cavelier, 2001). Thus, population densities of howlers may be expected to be lower in montane forest than in the lowlands. Relatively low densities have been reported for two sites in the Colombian Andes (Gaulin and Gaulin, 1982 = *ca.* 15 ind/km^2; Morales-Jiménez, 2002 = 31.3 ind/km^2), but patterns of habitat and space use and population densities have not been rigorously documented. In this study, we present data obtained over six months on population density and space use of five red howler troops in a cloud forest in the Central Cordillera of the Colombian Andes. Our study site is a mosaic of habitat types, including old-growth and secondary forest, and monodominant patches of both exotic and native trees that were established in a reforestation program. Our study area is within an extensive, continuous forest (several thousand hectares) and our data provide baseline information for a more extensive study documenting responses of red howlers to fragmentation (Gómez-Posada, unpublished data).

Study Area

The study was conducted at Otún Quimbaya Flora and Fauna Sanctuary (Otún Quimbaya), a 489 ha protected area located on the western slope of the Central Cordillera of the Colombian Andes, east of the city of Pereira. The study area ranges between 1800 and 2100 m. Otún Quimbaya is contiguous with Ucumarí Regional Park, encompassing 3980 ha. Both areas protect the Otún River drainage between elevations of 1750 and 2600 m. The study area lies in the very humid lower montane forest life zone of the Holdridge classification system (Londoño, 1994). Mean annual rainfall is 2712 mm (El Cedral weather station, Cenicafé, 1995–2001), with a bimodal pattern. Rainy periods occur in April–June and September–November. There is a mild dry season in December–February, and a stronger one in July–August (Aguilar and Rangel, 1994). In 2001 total precipitation was 2117.8 mm. Mean annual temperature is 15°C.

Native forest in the Otún River drainage was largely cleared during the first half of the 20th century, for the establishment of cattle pastures. Some old-growth forest fragments remained, mainly in deep canyons, although hardwoods were extracted from most of the region. In the 1960s a reforestation program was initiated by local authorities with the objective of stabilizing soils and stopping erosion in the watershed. Some patches were planted with exotic Chinese ash (*Fraxinus chinensis*) and cypress (*Cupressus lusitanica*), and with native Andean oak (*Quercus humboldtii*). Most of the area currently included in Otún Quimbaya, however, was abandoned to natural regeneration, with seeds provided by native forest remnants.

Currently, the Otún drainage is 80% forested, with a mosaic of old-growth forest, secondary forest of different ages, and interspersed patches of monospecific tree plantations. As these plantations were established for reforestation purposes, they were not managed and are presently invaded by native vegetation, particularly in the understory and edges (Durán and Kattan, 2005). The canopy remains monodominant, though. Presently the Otún Quimbaya area is covered by a mosaic of old-growth and secondary forest on the mountainsides, and strips of ash plantations on the valley floor, along the river. Oak and cypress plantations occur in small patches near the river, neighboring ash stands. A narrow dirt road cuts across the park and the ash plantations.

Methods

Between July and December 2001 we identified all red howler monkey troops in 113 ha of Otún Quimbaya, which included native forest of different ages, and ash, cypress and oak patches. We selected five groups (labeled C-G) for intensive observation. Each of these troops was followed for a maximum of three days per month. Daily travel routes involved going from a sleeping tree in the morning at 0630–0800, through a series of feeding trees throughout the day, to a different sleeping tree in the afternoon at 1600–1700. We identified individuals by age and sex following Defler (1981) and Soini (1992).

During observation periods, we recorded data on activity patterns and diet (Martinez, 2003; Giraldo *et al.,* submitted). To evaluate habitat use, we followed each troop, taking note of its location and habitat type every half hour. We superimposed a ¼ ha grid over a map of the study area,

and plotted all troop locations to obtain frequencies of use of each ¼ ha quadrant within their home ranges (NRC, 1981). To quantify patterns of habitat use, we added all records in quadrants in each habitat type for each group, and used a χ^2 test to compare habitat use among groups. To establish whether quadrant use frequency distributions differed from random (Poisson), we used a χ^2 test. This distribution is zero-truncated because in theory some cells will remain unused (Robinson, 1986; Di Bitetti, 2001). We used a Spearman rank correlation coefficient to correlate the number of feeding and sleeping trees in each quadrant and the quadrant's frequency of use. We pooled troops in two categories according to the main habitat type they used (two troops in old-growth forest versus three troops in secondary forest/plantations), and used a Mann Whitney U test to compare the number of quadrants used per day, and the mean number of records per quadrant between the two habitat types. To test whether groups used habitat types in proportion to their availability, we compared the frequency of use of each habitat with its area within the home range with a χ^2 test.

We estimated the home range size of each troop as the number of ¼ ha quadrants used at least once (NRC, 1981). Home range overlap was calculated using the formula O = HR*D/GS, where O is overlap, HR is mean home range, D is population density and GS is mean group size. This index reveals the number of troops that can overlap at any point within the study area (Terborgh, 1983; DiBitetti, 2001). We correlated home range size and group size with a Spearman rank correlation coefficient. Daily distance traveled was defined as the distance covered by a group from one sleeping tree to the next (NRC, 1981). We joined all half-hour location points of each group with straight lines to obtain the distance traveled in a day. Daily distances traveled by different groups were compared with a Kruskal-Wallis test. The number of trees visited by groups in old-growth forest versus secondary forest/plantation was compared with a Mann-Whitney U test.

Results

Eleven red howler monkey troops with a total of 82 individuals inhabited the 113 ha study area (Table 1, Fig. 1), for a density of 72.6 ind/km^2 and 9.73 groups/km^2. We observed other groups outside the core study area, and solitary adult males throughout the study area. Red howler troops were stable throughout the study period (Table 1). Mean group size was 7.3 individuals (DS=2.5, range 3–10) and increased to 7.5 after an infant was born and a subadult male joined group G. Groups were composed of one adult male, one to three adult females, one or two subadults and one to four juveniles and infants. Sex ratio was biased toward females (1:0.6) and the ratio of adult females to immature individuals (juveniles and infants) was 1:1.2.

Habitat use. The five more intensely studied troops used different habitat types in different proportions (χ^2 = 1351.6, df = 8, $p < 0.01$; Table 2). Cypress plantations were used as corridors between forest patches and as sleeping trees, but were used infrequently during the day. Sometimes when howlers were foraging in secondary forest, where few large trees were available, they moved to cypress patches for diurnal resting periods. Oak stands also were only used as routes between ash stands and forest patches. Ash stands had some dispersed *Cecropia* and *Ficus* trees that were used as sleeping and feeding trees. Howlers also fed on immature ash fruits and used big ash trees as sleeping trees (Giraldo *et al.,* submitted).

Home range use was not random, as howlers used some quadrants more than expected (Fig. 2). The more inten-

Table 1. Size and composition of 11 red howler monkey troops at Otún Quimbaya Flora and Fauna Sanctuary, Central Andes of Colombia.

Group	Adult		Subadult		Juvenile		Infant	Unknown	Total
	M*	F*	M	F	M	F			
A	1	1	2	1	1				6
B	1	3			1		2	3	10
C	1	2				1	1		5
D	1	3	1	1	1	1	2		10
E	1	2	1	1	1		2		8
F	2	2	1	1	2		2		10
G	1	2	1	1		1	2		8
H								10	10
I								7	7
J	1	2	1			1			5
K	1	1						1	3
Total	10	18	7	5	6	4	11	21	82
Mean	1.1	2.0	1.2	1.0	1.2	1.0	1.8		7.5

* M: males; F: females

sively used quadrants, corresponding to dormitories, latrines, and feeding trees (r = 0.63, p < 0.01), did not form a core area but were dispersed throughout the home range. The number of sleeping and feeding trees per quadrant was lower for the three groups that mainly used plantations and secondary forest than for the two troops using mature forest (Z = 2.2, n = 143 and 63, p = 0.02) (Table 3). Home range use was different between groups using mature forest and groups using secondary forest and plantations. The latter usually used one or two quadrants intensively for several days, feeding and sleeping in the same area. After crops were exhausted in these feeding trees, monkeys moved throughout their home range in a haphazard way until finding a new feeding tree. In contrast, troops in mature forest used several quadrants each day, moving between feeding trees, sleeping trees, and latrines, traversing their home ranges in three or four days. The mean number of quadrants visited per day was similar for mature forest and

Table 2. Home range composition by habitat type, and proportion of observations in each habitat type, for five red howler monkey troops in Central Andes of Colombia.

Group	Habitat Type						N
	Mature Forest		Secondary Forest		Plantation		
	% home range	% obs.	% home range	% obs.	% home range	% obs.	
C	90.9	97.2	9.1	2.8*			246
D			58.9	63.3	41.1	36.7	297
E			31.4	17.3*	68.6	82.7*	272
F	17.3*	24.0	57.7	52.7	25.0	23.3	146
G	100	100					267

* Significant difference between observed and expected frequencies ($p < 0.05$, χ^2 test)

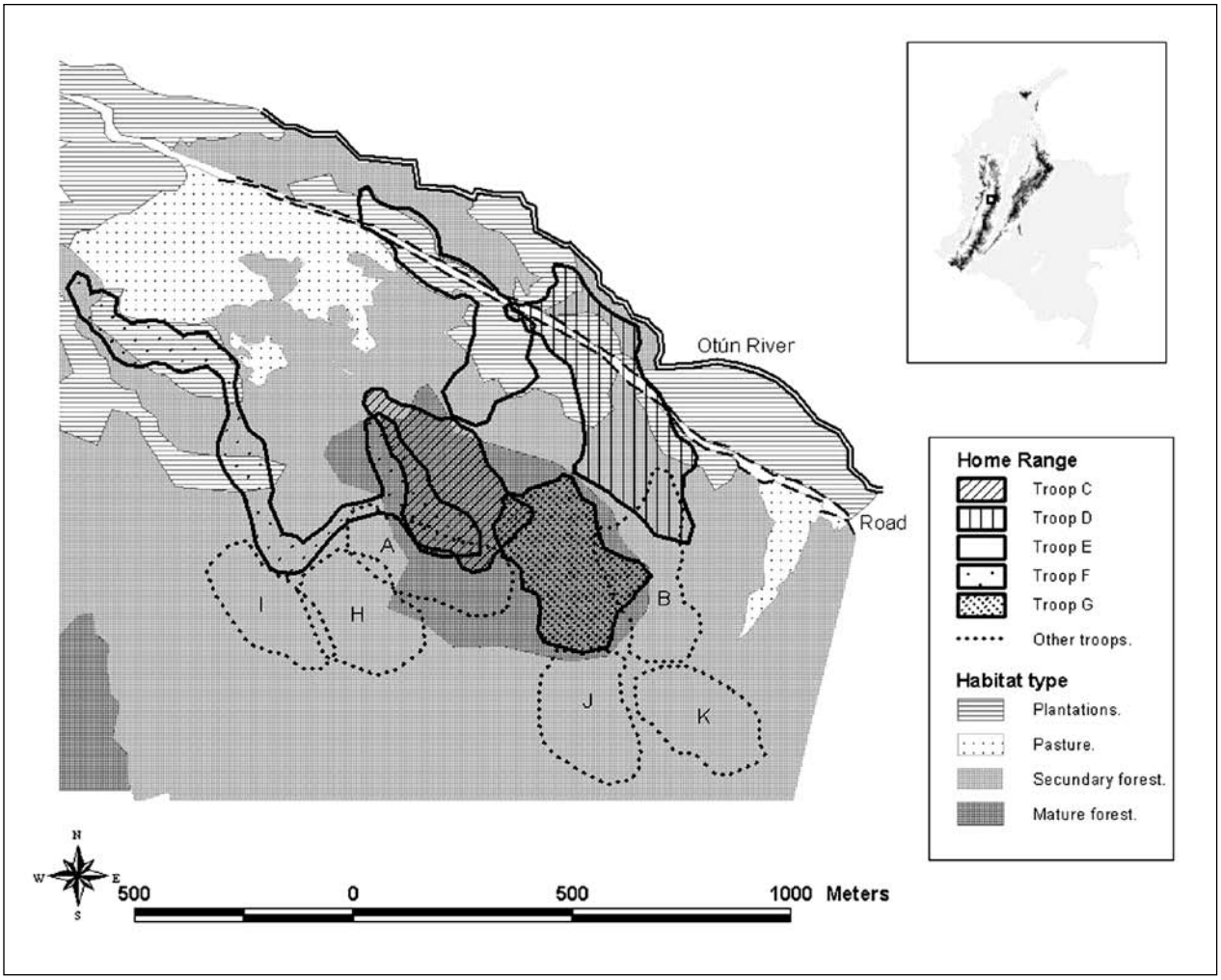

Figure 1. Map of Otún Quimbaya Flora and Fauna Sanctuary, Central Cordillera, Colombian Andes, showing habitat types and home ranges of red howler groups.

for secondary forest/plantation groups (U = 88, n = 17 and 12, p = 0.5; Table 3), but coefficients of variation were larger for the latter. The percent use of each quadrant was larger for mature forest troops (Z = 1.9, n = 143 and 63, p = 0.05) (Table 3).

Home range and daily distance traveled

Home ranges of the five troops varied between 7.5 and 14 ha, with a mean ± SD of 10.2 ± 3.03 ha (Table 4, Fig. 2). Bigger groups showed a tendency to have larger home ranges (r_s = 0.87, n = 5, p = 0.05). Groups C and G had small, compact home ranges 7.8 ± 0.4, with an area/perimeter ratio of 48:1, while the other groups had larger (11.9 ± 2.8) and elongated home ranges, with an area/perimeter ratio of 35:1 (Table 4, Fig. 2). Home ranges of the five troops were contiguous and had an overlap index of 0.98 (i. e., any point within the study area was used by 0.98 groups). Unused areas between home ranges were early second growth forest, which lacks the structure and resources required by howlers (Fig. 1). On average, each group shared 20.9% ± 12.9% of its home range with other groups. When groups met at feeding trees, they engaged in vocal displays and usually the smaller group retreated.

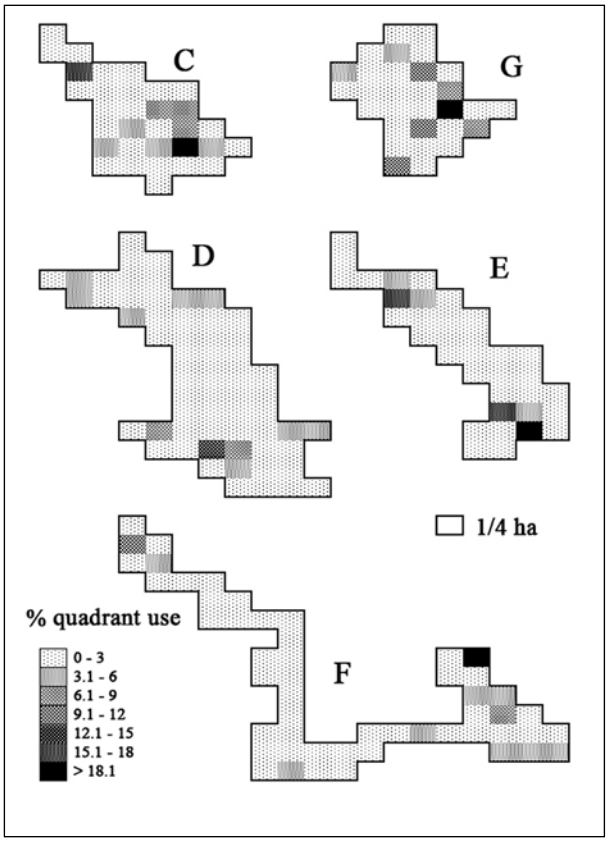

Figure 2. Intensity of use of quadrants in home ranges of five groups of howler monkey at Otún Quimbaya. Frequency distribution of quadrant use was significantly different from Poisson in all cases (group C: χ^2 = 1389.7, df = 31, p < 0.01; group D: χ^2 = 590.9, df = 55, p < 0.01; group E: χ^2 = 1977.1, df = 34, p < 0.01; group F: χ^2 = 98, df = 51, p < 0.01; group G: χ^2 = 3963, df = 29, p < 0.01).

Daily distance traveled varied between 317.5 m (group D) and 1321.2 (group E), with a mean of 553.9 ± 247.9 (Table 4). Mean daily distance was similar among groups (H = 4.38, df = 4, p = 0.3). However, the coefficient of variation for groups using mature forest was much smaller (28%) than for groups using secondary forest/plantation (53%). This reflected different patterns of habitat use. When trees in plantations produced fruit, howlers exploited them intensively, remaining near this tree for one or more days. After the crop was exhausted, they traveled throughout the home range in search of fruiting trees. In mature forest, in contrast, howlers fed from several trees each day and traveled through their home range in three or four days. The number of feeding trees visited per day was lower for secondary forest/plantation groups (5.7 ± 1.6) than for mature forest groups (9.1 ± 4.4) (U = 54, n = 17 and 12, p = 0.05).

Discussion

Group sizes of red howler monkeys observed at Otún Quimbaya are within the range of 2–16 individuals (mean = 6–9) usually reported for this species (Neville, 1972; Izawa, 1988, 1997; Soini, 1992; Chapman and Balcomb, 1998; Defler, 2003). Group composition is also typical, with a slightly higher proportion of adult females to adult males (Defler, 1981), reflecting the red howler's social organization: one dominant male, one to four adult females and their offspring, and zero to three subadults (Izawa, 1988, 1997; Soini, 1992; Crockett, 1996). The ratio of adult females to immature (juveniles and infants) may give an idea of population health (Heltne *et al.*, 1976). A high ratio may indicate a declining population, and a low ratio may indicate an expanding population. At Otún Quimbaya we found 1.2 immature individuals for each adult female, suggesting a growing population (Defler, 1981).

Red howler monkeys usually have densities of 34–55 ind/km^2 (Defler, 1981; Freese *et al.*, 1982; Braza *et al.*, 1983; Terborgh, 1983; Soini, 1992; Chapman and Balcomb, 1998), but may vary from 4 to 150 (Neville, 1972; Klein and Klein, 1976; Rudran, 1979; Freese *et al.*, 1982; Crock-

Table 3. Number of feeding and sleeping trees per quadrant, number of quadrants visited per day and percent use of each quadrant (mean ± SD, CV), for five red howler troops using two habitat types in the Central Andes of Colombia.

	No. Trees	No. Quadrants	% Use
Mature forest (groups C and G)	2.0 ± 2.5	9.6 ± 3.5, 36.3	3.2 ± 5.0, 157.8
Secondary forest and plantation (groups D, E and F)	0.9 ± 1.3 p = 0.02	11.7 ± 6.9, 60 p > 0.05	2.1 ± 3.7, 178.5 p = 0.05

Table 4. Home range and daily distance traveled (x ± SD, n) for five red howler monkey troops at Otún Quimbaya Flora and Fauna Sanctuary, Central Andes of Colombia.

Group	Home range (ha)	Distance (m)	No. hours of observation	No. days of observation
C	8.0	526.7 ± 150.4, 6	119.4	18
D	14.0	412.2 ± 120.2, 6	136.4	19
E	8.7	661.3 ± 341.1, 9	132.0	15
F	13.0	660.0 ± 481.9, 2	52.1	9
G	7.5	528.3 ± 154.6, 6	117.4	15
Mean	10.2	553.9 ± 247.9, 29		

ett and Eisenberg, 1987; Rylands and Keuroghlian, 1988; Palacios and Rodríguez, 2001). Population densities of red howler monkeys vary depending on factors such as habitat characteristics (e. g., plant diversity and abundance, forest productivity and structure; Freese *et al.*, 1982; Crockett, 1985) and habitat heterogeneity and seasonality (Peres, 1997). Competition with other frugivorous species or with other primates may keep densities low (Klein and Klein, 1976; Defler, 1981; Palacios and Rodríguez, 2001). Much variability in red howler populations is related to their recent history, such as human disturbance (habitat alteration and fragmentation, hunting), fruit crop failure, and disease (Freese *et al.*, 1982; Crockett, 1985; Rylands and Keuroghlian, 1988; Peres, 1990; Sussman and Phillips-Conroy, 1995; Chapman and Balcomb, 1998).

The density of 72.6 ind/km^2 at Otún Quimbaya corresponded to the upper part of the range. The red howler is the largest frugivore in our study area and is in sympatry with only one other primate species, the night monkey (*Aotus lemurinus*). Howler monkey populations at our site were likely greatly reduced when this forest was exploited in the early- to mid-20th century (Londoño, 1994). Forest protection and restoration have presumably allowed howler populations to recover in the last 40 years. Flexibility in habitat use has allowed howlers to exploit new habitats such as ash plantations, and they are not limited to mature forest (Estrada and Coates-Estrada, 1996; Fedigan *et al.*, 1998; Fedigan and Jack, 2001). At Hato Masaguaral in Venezuela, for example, densities over 70 ind/km^2 have been reported (Neville, 1972; Rudran, 1979; Crockett and Eisenberg, 1987). Population size at this site has increased in part in response to forest recovery (Crockett and Eisenberg, 1987; Crockett, 1996). Fedigan and Jack (2001) found that in 28 years since the creation of Santa Rosa National Park in Costa Rica, the population of black howler monkey (*Alouatta palliata*) has increased seven-fold, due to protection and increase in forest cover.

Habitat use

Howler monkeys at Otún Quimbaya used the different habitat types in proportion to their availability, as has also been found in the lowlands, where howlers are reported as habitat generalists (Neville, 1972; Soini, 1982; Stevenson *et al.*, 1991; Palacios and Rodríguez, 2001). In our six-month study we observed low intra- and interspecific synchrony in fruit and new leaf production, and no absolute fruit scarcity for howlers (Giraldo *et al.*, submitted). Tropical montane forests do not present drastic periods of fruit scarcity, in contrast to the lowlands (Giraldo, 1990; Ataroff, 2001; Cavelier *et al.*, 2001). Quadrant use by monkeys at our site was dictated by the presence of feeding trees. Probably for this reason, there was no core area in the home range and quadrant use was not random.

Differences in structure and composition among habitat types at Otún Quimbaya generated differences in habitat use by howlers. In mature forest, the canopy is heterogeneous and densities of feeding and sleeping trees are high. Howlers used feeding trees for a short time and moved among them, traversing their entire home range in a few days, as occurs in lowland forest (Stevenson *et al.*, 1991; Izawa, 1997). Plantations, in contrast, are more homogeneous (monodominant canopy) and resource trees are more dispersed. Thus, howlers spent several days at one or two fruiting trees until exhausting the fruit crop, and then moved to another tree, which could be located in a far quadrant of their home range. This resulted in some quadrants being used intensively, whereas others were used only as movement routes. Groups living in plantations also had a less diverse diet than mature forest groups (Giraldo *et al.*, submitted). It is unlikely that monkeys could survive in plantations without neighboring tracts of native forest, and without having dispersed *Ficus* and *Cecropia* trees within the plantation (Giraldo *et al.*, submitted). The Moraceae are very important for howler survival in isolated forest patches, and in disturbed and second-growth forest (Rylands and Keuroghlian, 1988; Schwartzkopf and Rylands, 1989; Estrada and Coates-Estrada, 1996; Fedigan *et al.*, 1998).

Home range and daily distance traveled

Red howler home ranges vary widely, but tend to be small (6–30 ha). Home ranges at our site were similar to those reported for lowland forest (Neville, 1972; Defler, 1981; Crockett and Eisenberg, 1987; Soini, 1992; Izawa, 1997). Small home ranges in howler monkeys reflect their high use of leaves, a low-quality nutritional resource that is abundant and widely distributed (Milton, 1980; Gaulin and Gaulin, 1982; Braza *et al.*, 1983). A study in the Central range of the Colombian Andes at 2300 m of elevation (Gaulin and Gaulin, 1982), about 300 km south of our study area, re-

ported a home range of 22 ha and a density *ca*. 15 ind/km^2 for a red howler group in a mature forest. At this site howlers are at the limit of their elevational range, and are sympatric with *Cebus apella*, a very active frugivore-insectivore that could represent strong competition for howlers.

A previous study at Otún Quimbaya (Morales-Jiménez, 2003) reported a home range of 14.5 ha for a troop in mature forest and 21.2 ha for a troop in ash plantation. This author suggested that the larger home range of the plantation troop was due to lower resource availability, as found in our study (Giraldo *et al.*, submitted). The plantation troop studied by Morales-Jiménez (2003) coincides with our troops D and E, which could suggest that a new group formed in this area. Fedigan and Jack (2001) found that population increase of mantled howler monkey at Santa Rosa National Park in Costa Rica was due to new group formation as forest recovered. Mantled howlers rapidly colonized secondary forest as trees reached a sufficient diameter at breast height to support their weight.

Home ranges of howler monkeys may decrease when population densities increase (Crockett and Eisenberg, 1987). For example, at La Macarena, Colombia (67 ha, 17–30 ind./km^2; Stevenson, *et al.*, 1991, 2000) and Caparú, Colombia (182 ha, 4 ind./km^2; Palacios and Rodríguez, 2001), densities are low and home ranges large. In contrast the opposite is observed at Hato Masaguaral in Venezuela (7–10 ha, 83–118 ind/km^2; Crockett and Eisenberg, 1987) and Otún Quimbaya (10.2 ha, 72.6 ind./km^2; this study). Home ranges of troops using mature forest at Otún Quimbaya were compact and small, whereas they were elongated and larger for plantation troops. This reflects structural and compositional differences between habitat types, as well as patch shape. In plantations the forest canopy is homogeneous and more discontinuous, and feeding trees and sleeping trees are more dispersed. In addition, plantations are in strips along the river and the road. Groups D and E could cross the road only at certain points where tree canopies provided a bridge. Thus, movement routes for plantation troops sometimes were long and linear. In mature forest, in contrast, movement routes were more tortuous and uniform, covering similar distances each day.

Daily travel routes of howlers are usually around 500–600 m in lowland habitats (Neville, 1972; Rudran, 1979; Stevenson *et al.*, 1991). Howler troops tend to be stable and use the same routes repeatedly. For example, in ten years of following a troop at La Macarena, Colombia, Izawa (1997) observed little changes in travel routes. Mean daily movements at Otún Quimbaya (317–1321 m/day) were similar, with variations related to habitat structure.

Home ranges and space requirements of montane red howler monkeys observed in this study are similar to those reported for lowland forest populations. The relatively high population density estimated for Otún Quimbaya is related to the recent history of protection and forest recovery in the area. Plasticity in habitat use has helped the howler population to recover, as they have been able to use tree plantations that offer some resources. Patterns of movement and home range use, however, differ between habitat types (mature forest vs. secondary forest and plantations). These differences are related to differences in resource distribution and availability in the different habitats.

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References

Aguilar, M. and Rangel, J. O. 1994. Clima del Parque Regional Natural Ucumari y sectores aledaños. In: *Ucumari, Un Caso Típico de la Diversidad Biótica Andina,* J. O. Rangel (ed.), pp.39–56. Corporación Autónoma Regional de Risaralda, Pereira.

Ataroff, M. 2001. Venezuela. In: *Bosques Nublados del Neotropico,* M. Kappelle and A. Brown (eds.), pp.397–442. Instituto Nacional de Biodiversidad, Santo Domingo de Heredia.

Braza, F., Álvarez, F. and Azcarate, T. 1983. Feeding habits of the red howler monkeys (*Alouatta seniculus*) in the Llanos of Venezuela. *Mammalia* 47: 205–214.

Cavelier, J., Lizcano, D. and Pulido, M. 2001. Colombia. In: *Bosques Nublados del Neotropico,* M. Kappelle and A. Brown (eds.), pp.443 – 496. Instituto Nacional de Biodiversidad, Santo Domingo de Heredia.

Chapman, C. and Balcomb, S. 1998. Population characteristics of howlers: Ecological conditions or group history. *Int. J. Primatol.* 19: 385 – 403.

Crockett, C. 1985. Population studies of red howler monkeys (*Alouatta seniculus*). *Nat. Geo. Res./Spring* 1:264–273.

Crockett, C. 1996. The relation between red howler monkey (*Alouatta seniculus*) troop size and population growth in two habitats. In: *Adaptive Radiation of Neotropical Primates,* M. A. Norconk, A. L. Rosenberg and P. A. Garber (eds.), pp.489–510. Plenum Press, New York.

Crockett, C. and Eisenberg, J. 1987. Howlers: Variations in group size and demography. In: *Primate Societies,* B. Smuts, D. Cheney, R. Seyfarth, R. Wrangham and T. Struhsaker (eds.), pp.54–68. The University of Chicago Press, Chicago.

Defler, T. 1981. The density of *Alouatta seniculus* in the eastern llanos of Colombia. *Primates* 22: 564–569.

Defler, T. 2003. *Primates de Colombia*. Serie de Guías Tropicales 4. Conservación Internacional, Bogotá.

Di Bitetti, M. 2001. Home range use by the tufted capuchin monkey (*Cebus apella nigritus*) in a subtropical rainforest of Argentina. *J. Zoo. Lond.*: 253: 33–45.

Durán, S. and Kattan, G. 2005. Test of the utility of exotic tree plantations for understory birds and food resources in the Colombian Andes. *Biotropica* 37: 129–135.

Eisenberg, J. 1980. The density and biomass of tropical mammals. In: *Conservation Biology*, M. E. Soule and B. A. Wilcox (eds.), pp.35–55. Sinauer Associates, Massachusetts.

Estrada, A. and Coates-Estrada, R. 1996. Tropical rainforest fragmentation and wild populations of primates at Los Tuxtlas, Mexico. *Int. J. Primatol.* 17: 759–783.

Fleagle, J. G. 1999. *Primate Adaptation and Evolution*. Second edition. Academic Press, San Diego.

Fedigan, L. and Jack, K. 2001. Neotropical primates in a regenerating Costa Rica dry forest: A comparison of howler and capuchin population patterns. *Int. J. Primatol.* 22: 689–713.

Fedigan, L. M., Rose, L. M. and Morera, R. 1998. Growth of mantled howler in a regenerating Costa Rican dry forest. *Int. J. Primatol.* 19: 405–432.

Freese, C., Heltne, P. G., Castro, N. and Whitesides, G. 1982. Patterns and determinants of monkey densities in Peru and Bolivia, with notes on distributions. *Int. J. Primatol.* 3: 53–90.

Gaulin, S. and Gaulin, C. 1982. Behavioral ecology of *Alouatta seniculus* in Andean cloud forest, Colombia. *Int. J. Primatol.* 3: 1–32.

Gentry, A. H. 1992. Diversity and floristic composition of Andean forests of Peru and adjacent countries: Implications for their conservation. *Mem. Mus. Hist. Nat. U. N. M. S. M.* 21: 11–29.

Giraldo, J. E. 1990. Estudio fenológico de una comunidad vegetal en bosque montano húmedo de la cordillera Occidental. *Cespedesia* XVI–XVII: 53–76.

Giraldo, P., Gómez-Posada, C., Martínez, J. and Kattan, G. Submitted. Resource use and seed dispersal by red howler monkey (*Alouatta seniculus*) in Andean forest. *Neotropical Primates.*

Gómez-Posada, C., Roncancio, N. and Hincapié, P. 2005. Evaluación de las poblaciones de mono aullador rojo (*Alouatta seniculus:* Primates) en fragmentos de bosque en el Valle del Cauca. Unpublished report, Corporación Regional del Valle del Cauca, Cali.

Heltne, P. G., Turner, D. C. and Scott Jr., N. C. 1976. Comparison of census on *Alouatta palliata* from Costa Rica and Panamá. In: *Neotropical Primates: Field Studies and Conservation,* R. Thorington and P. G. Heltne (eds.), pp.10–19. National Academy of Sciences, Washington DC.

Hernandez-Camacho, J. and Cooper, R. 1976. The nonhuman primates of Colombia. In: *Neotropical Primates: Field Studies and Conservation*, R. Thorington and P. G. Heltne (eds.), pp.35–69. National Academy of Sciences, Washington DC.

Izawa, K. 1988. Preliminary reports on social changes in red howlers (*Alouatta seniculus*). *Field Stud. New World Monkeys La Macarena Colombia* 1: 29–33.

Izawa, K. 1997. Stability of the home range of red howler monkeys. *Field Stud. Fauna Flora La Macarena Colombia* 11: 41–46.

Kattan, G. and Álvarez-López, H. 1996. Preservation and management of biodiversity in fragmented landscape in the Colombian Andes. In: *Forest Patches in Tropical Landscapes,* J. Schelhas and R. Greenberg (eds.), pp.3–18. Island Press, Washington DC.

Klein, L. and Klein, D. J. 1976. Neotropical primates: Aspects of habitat usage, population density and regional distribution in la Macarena, Colombia. In: *Neotropical Primates: Field Studies and Conservation,* R. Thorington and P. G. Heltne (eds.), pp.70–78. National Academy of Sciences, Washington DC.

Londoño, E. 1994. Parque Regional Natural Ucumarí: Un vistazo histórico. In: *Ucumari, Un Caso Típico de la Diversidad Biótica Andina,* J. O. Rangel (ed.), pp.13–24. Corporación Autónoma Regional de Risaralda, Pereira.

Martínez, J. 2003. Densidad poblacional, rango vital y patrón de actividad del mono aullador *Alouatta seniculus* (Primates: Cebidae) en el Santuario de flora y fauna Otún Quimbaya, Risaralda. Tésis de grado, Universidad del Valle, Cali, Colombia.

McNab, B. K. 2002. *The Physiological Ecology of Vertebrates: A View from Energetics.* Cornell University Press, Ithaca and London.

Milton, K. 1980. *The Foraging Strategy of Howler Monkeys: A Study in Primate Economics.* Columbia University Press, New York.

Milton, K. and May, M. 1976. Body weight, diet, and home-range area in primates. *Nature* 259: 459–462.

Morales-Jiménez, A. L. 2002. Densidad de los monos aulladores (*Alouatta seniculus*) en un bosque subandino, Risaralda, Colombia. *Neotrop. Primates* 10: 141–144.

Morales-Jiménez, A. L. 2003. Área de acción de los monos aulladores (*Alouatta seniculus*) en un bosque nativo y uno reforestado, Risaralda (Colombia). In: *Primatología del Nuevo Mundo: Biología, Medicina, Manejo y Conservación,* V. Pereira, F. Nassar and A. Savage (eds.), pp.113–132. Centro de Primatología Araguatos, Bogotá.

National Research Council. 1981. *Techniques for the Study of Primate Population Ecology.* National Academy Press, Washington DC.

Neville, M. K. 1972. The population structure of red howler monkeys (*Alouatta seniculus*) in Trinidad and Venezuela. *Folia Primatol.* 17: 56–86.

Palacios, E. and Rodríguez, A. 2001. Ranging pattern and use of space in a group of red howler monkeys (*Alouatta seniculus*) in a southeastern Colombian rainforest. *Am. J. Primatol.* 55: 233–251.

Peres, C. 1990. Effects of hunting on western Amazonian primate communities. *Biol. Conserv.* 54: 47–59.

Peres, C. 1997. Effects of habitat quality and hunting pressure on arboreal folivore densities in Neotropical forests: A case study of howler monkeys (*Alouatta* spp.). *Folia Primatol.* 69: 199–222.

Robinson, J. G. 1986. Seasonal variation in use of time and space by the wedge-capped capuchin monkey, *Cebus olivaceus*: Implications for foraging theory. *Smithsonian Contr. Zool.* 431: 1–60.

Rudran, R. 1979. The demography and social mobility of a red howler (*Alouatta seniculus*) population in Venezuela. In: *Vertebrate Ecology in the Northern Neotropics,* J. Eisenberg (ed.), pp.107–126. Smithsonian Institution Press, Washington DC.

Rylands, A. and Keuroghlian, A. 1988. Primate population in continuous forest and forest fragment in central Amazonia. *Acta Amazonica* 18: 291–307.

Schwarzkopf, L. and Rylands, A. 1989. Primate species richness in relation to habitat structure in Amazonian rainforest fragments. *Biol. Conserv.* 48: 1–12.

Soini, P. 1992. Ecología del coto mono (*Alouatta seniculus*, Cebidae) en el río Pacaya, reserva Pacaya–Samiria, Perú. *Folia Amazonica* 4: 103–118.

Stevenson, P., Quiñones, M. and Ahumada, J. 1991. Relación entre la abundancia de frutos y las estrategias alimenticias de cuatro especies de primates en el Río Duda, Macarena. Unpublished report, Fundación para la Promoción de la Investigación y la Tecnología, Banco de la República, Bogotá.

Stevenson, P., Quiñones, M. and Ahumada, J. 2000. Influence of fruit availability on ecological overlap among four Neotropical primates at Tinigua National Park, Colombia. *Biotropica* 32: 533–544.

Sussman, R. and Phillips-Conroy, J. 1995. A survey of the distribution and density of the primates of Guyana. *Int. J. Primatol.* 16: 761–791.

Terborgh, J. 1983. *Five New World Primates: A Study in Comparative Ecology*. Princeton University Press, New Jersey.

DISTRIBUTION OF THE BLACK HOWLER MONKEY *(ALOUATTA PIGRA)* AND THE MANTLED HOWLER MONKEY *(A. PALLIATA)* IN THEIR CONTACT ZONE IN EASTERN GUATEMALA

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Abstract

We studied the geographic distribution of the endangered black howler monkey, *Alouatta pigra,* in its southeastern range in eastern Guatemala along its putative contact zone with the mantled howler monkey, *A. palliata*. A distributional survey of both species was conducted through direct observations and interviews, and the data analyzed with GIS to detect potentially limiting geographic and ecological factors. *Alouatta pigra* was not associated with any specific vegetation type or altitudinal range, as it occurred in many forest types from the lowlands up to elevations of 2705 m a.s.l., in contrast to prior reports of it being restricted to elevations below 400 m a.s.l. and having a strong affinity for riverine forests. *Alouatta palliata* did not occur at the higher elevations. Distribution of both howler monkey species was unaffected by the presence of *Ateles*, by protection status of the survey site, or by hunting activities. Deforestation appears to have restricted both species in some areas. Throughout the southeastern range of *A. pigra*, we found no evidence for current sympatry with *A. palliata,* as their distributions are separated by a river barrier and unsuitable dry shrubland. Ecological preferences also seem to reinforce allopatry, with only *A. pigra* occurring in wet and cold montane forests of the Sierra de las Minas. Our data indicate that highland habitats in Mexico and Guatemala, previously considered unsuitable for *A. pigra*, may need to be evaluated for distribution assessments and management plans. Populations of *A. pigra* in the diverse protected ecosystems in eastern Guatemala may be an important component for conservation of the species.

Key Words: *Alouatta pigra*, *A. palliata*, geographic distribution, allopatry, eastern Guatemala

Resumen

Se estudió la distribución geográfica del mono aullador negro, *Alouatta pigra*, y el mono aullador de manto, *A. palliata*, en el este de Guatemala, en donde reportes previos proponen traslape de rangos. Esta región constituye el límite sureste del rango de *A. pigra*, especie en peligro de extinción y endémica del sur de México, Belice y Guatemala. La distribución de ambas especies se determinó mediante observaciones directas y encuestas. Los datos fueron analizados con SIG para detectar posibles factores limitantes, tanto ecológicos como geográficos. La presencia de *A. pigra* no estuvo asociada con ningún tipo de vegetación particular o rango altitudinal, encontrándose la especie en varios tipos de bosque desde los 0 hasta los 2705 msnm. Estos datos no coinciden con estudios previos que describen a *A. pigra* como una especie restringida a elevaciones por debajo de los 400 msnm y con alta afinidad por bosques ribereños. *Alouatta palliata* no se registró en altitudes elevadas. La distribución de ambas especies de monos no se vio afectada por la presencia de *Ateles*, por el estado de protección del sitio de muestreo, ni por actividades de cacería. En algunas áreas las especies se ven restringidas por la deforestación. No se encontró evidencia de simpatría ni traslape de rangos. Los rangos de ambas especies se separan por un río y por hábitat inadecuado de bosque seco. Además, preferencias ecológicas parecen reforzar la alopatría, puesto que únicamente *A. pigra* ocurre en los bosques húmedos y fríos de la Sierra de las Minas. Nuestros datos sugieren que hábitats montanos en México y Guatemala previamente categorizados no aptos para *A. pigra*, necesitarían considerarse en evaluaciones de distribución y planes de manejo. Las poblaciones de *A. pigra* en los diversos ecosistemas protegidos en el este de Guatemala podrían ser importantes componentes en la conservación de la especie.

Palabras Clave: *Alouatta pigra*, *A. palliata*, distribución geográfica, alopatría, oriente de Guatemala

Introduction

The black howler monkey, *Alouatta pigra*, is endemic to Guatemala, Belize and southern Mexico. Recently, it was categorized as endangered in the IUCN Red List of Threatened Species due to population size reduction based on habitat decline (Cuarón *et al.,* 2003). Conservation assessments and action plans for the species mandate updating distribution maps and describing the status of wild populations (Rodríguez-Luna *et al.*, 1996; Matamoros *et al.*, 1997).

Limited knowledge of the geographic distribution of *A. pigra* is based on museum specimens (Smith, 1970;

Hall, 1981) and broad field studies done in Belize and Mexico (Horwich and Johnson, 1986; Watts *et al*., 1986) and Guatemala (Curdts, 1993). Recent fieldwork in the Yucatán peninsula detailed the species' distribution and habitat preferences (Navarro *et al*., 2003; Serio-Silva *et al*., 2006), but other areas of Mexico and Guatemala need similar detailed studies. Of particular importance are potential contact zones with the mantled howler monkey, *A. palliata,* at the northwest and southeast range limits, where sympatry has been reported in Tabasco, Mexico (Smith, 1970; Cortés-Ortiz *et al*., 2003) and suspected in eastern Guatemala (Horwich and Johnson, 1986; Curdts, 1993). Contact zones are important for the preservation of primate biodiversity (Jones and Bicca-Marques, 2004) and essential for the study of genetics and ecology of speciation (Jiggins *et al*., 1996).

The studies in southern Belize and eastern Guatemala have resulted in ambiguous and inconclusive definition of ranges for the two species. For example, Horwich and Johnson (1986) identified sympatry at the Belize-Guatemala border around the Sarstún River, based on suggestions of *palliata*-like individuals on the Guatemala side of the river, where only *A. pigra* was expected. Curdts (1993) proposed large areas of sympatry in the mountains of Baja and Alta Verapaz and Sierra de las Minas, Guatemala, but provided no empirical evidence. The objective of the present study was to define the geographic distribution of *A. pigra* and *A. palliata* in their contact zone in eastern Guatemala at the southeastern range limit of *A. pigra*. In addition we hoped to identify ecological factors and geographic barriers that might affect both species' distributions.

Methods

Study area

The contact zone and putative area of sympatry of *A. pigra* and *A. palliata* lies within 88°–90° W longitude and 15°–16° N latitude, encompassing the eastern part of Guatemala, bounded by Belize, Honduras and the Atlantic Ocean (Fig. 1). Five Guatemalan departments are partly or totally within the area: Alta Verapaz, Baja Verapaz, Izabal, Zacapa and El Progreso. The area is topographically and ecologically heterogeneous with elevations ranging from sea level to 3,000 m a.s.l. (CONAP, 2005) and ecosystems varying from flooded coastal forest to montane cloud forest. The region is transversed by several mountain ranges and large rivers (Fig. 1). Continuous tracts of tropical forests are restricted primarily to protected areas. Forest conversion by traditional slash-and-burn maize cultivation is combined with intensive socioeconomic activities: coffee and cardamom plantations in the highlands, and cattle ranching, banana, African palm and rubber plantations in the lowlands. The Department of Izabal, which occupies a large part of the study area, has 20% of its total area in cattle pastures and crop monocultures (INAB, 2001).

Surveys

Following Brockelman and Ali (1987), we conducted a distributional field survey during the dry season, February to April 2005. Cartographic maps (1:25000), vegetation maps, and a Landsat TM satellite image (2003) were used to identify suitable monkey habitat, access routes, and survey sites. Survey sites were selected to test potential geographic barriers and to cover the altitudinal ranges and vegetation types of the region. Additionally, site selection was dependent on the presence of suitable forest cover and existence of key persons who would facilitate entrance to villages, contact appropriate interviewees, and serve as translators in K'ekchi villages. Survey sites were accessed using vehicle, boat, mule or by foot. At each survey site geographic location and altitude were recorded with a Garmin GPS 72.

Howler monkey occurrences were detected by two methods: interviews (Pinto and Rylands, 1997; Iwanaga and Ferrari, 2002) and broad forest surveys along trails and rivers (Brockelman and Ali, 1987). Interviews consisted of non-leading questioning about the primates in the area, as well as other questions related to the interviewee's occupation, residence time in the area, and hunting activities. Additionally, interviewees were asked to recognize photographs of possible local primate species (*Alouatta, Ateles, Cebus*) and South American *Alouatta* species, as well as playbacks of loud calls of *A. pigra* and *A. palliata*. People interviewed were mainly subsistence hunters, town elders with knowledge of the forest, park rangers, landowners, and field biologists. Forest surveys were made during 3-day visits to key sites in early mornings and late afternoons during peak hours of howler monkey vocal activity, in order to locate individuals and make visual and/or auditory identification.

Species presence/absence records obtained from valid interviews and/or direct observations at each site were incorporated into a Geographic Information System (ArcView version 3.3). Digital maps of the vegetation types of Guatemala (INAB, 2001; CCAD-WB, 2003), protected areas, and elevation curves were overlaid with the geographical coordinates of sites to create joined attribute tables and allow analyses of the distribution of howler monkeys in relation to physical and ecological features. Information collected through interviews on hunting pressure and on the occurrence of the spider monkey, *Ateles geoffroyi*, was also related to the presence/absence records of the howler monkeys. A search of collection databases of 18 natural history museums in North America and Europe and a review of literature were made to obtain any historic records of the occurrence of *A. pigra* and *A. palliata* in the region.

Statistical analyses

We used tests for homogeneity of proportions with a logistic analysis approach to detect habitat-specific distributional patterns. Specifically, we used a nominal model to test if vegetation type had an effect on the probability of occurrence of each species and an ordinal model to test for

a trend in probability of occurrence along an altitudinal gradient. Also, tests of independence were used to assess howler monkey association with (a) the presence of *Ateles* and (b) the protection status of the site. All statistical tests were performed with SAS version 9.0.

Results

A total of 58 sites were visited (Fig. 1); interviews were conducted at 47 sites and direct observations at 23 sites. We conducted 97 interviews, 59% with ladino and 41% with K'ekchi interviewees. Five interviews were classified as invalid due to inconsistencies in descriptions or identifications of photographs. Playbacks proved useful only to identify *A. palliata*, as interviewees clearly distinguished the calls. In contrast, at *A. pigra* sites, interviewees could not distinguish between the two species' calls. Overall, *Alouatta pigra* was found at 26 sites: seven through both interviews and direct observations, seven through observations only, and 12 sites through interviews only (Table 1). *Alouatta palliata* was found at 12 sites: five through interviews and direct observation, three through observations only, and four through interviews only (Table 2).

Alouatta pigra was verified along both banks of the Río Sarstún, the Atlantic coast, the north shore of Lake Izabal-Río Dulce, both banks of the Río Polochic and inland in the Purulhá mountains, Sierra Yalijux, Sierra Santa Cruz, and Sierra de las Minas (Fig. 1, Table 1). *Alouatta palliata* was verified along the Atlantic coast south of the Río Dulce and inland along the Río Motagua valley and in Sierra Caral (Fig. 1, Table 2).

Of five potential vegetation types, *A. pigra* was found in four and *A. palliata* in three (Table 3). Neither species occurred in "seasonal evergreen shrubland with mixed forest". Only *A. pigra* occurred in "tropical evergreen and semievergreen mixed forest" typical of cloud forest. *Alouatta palliata* was most often in "agroproductive systems with significant portions of broad-leaved forest", although the association was not statistically significant (test of homogeneity of proportions $\chi^2 = 7.6$, df = 4, p = 0.10). In contrast, *A. pigra*, was less frequent in this disturbed vegetation type and more commonly associated with flooded forests, mixed forests and broad-leaved forest (test of homogeneity of proportions $\chi^2 = 14.41$, df = 4, $p < 0.01$). Survey sites were distributed across elevations from sea level to more than

Table 1. Localities where *Alouatta pigra* occurs (see Fig. 1), protection status, and detection method.

Site No.	Locality	Protection status	Method
1	Chelemá	private reserve	sighting, interview
2	Lowland south of Chichipate village	None	sighting, interview
4	Selich village	None	interview
6	Secacar village	None	interview
7	Boquerón	None	sighting
8	Sakitzul finca	proposed private reserve	interview
9	Guitarra village	None	interview
14	Calajá village	None	interview
15	Río Sarstún, Belize side	Sarstoon Temash Reserve	sighting
16	Río Sarstún, Guatemala side	Río Sarstún Multiple Use Area	sighting
17	Río Sarstún, Belize side	Sarstoon Temash Reserve	sighting
18	Sarstún village	Río Sarstún Multiple Use Area	sighting, interview
19	Calix – Black creek finca	None	interview
20	Chocón-Machacas scientific station	Chocón Machacas Biotope	interview
21	Mario Dary Biotope	Mario Dary Biotope	interview
22	Las Cabañas scientific station	core area SM BR[1]	sighting, interview
24	trail to Volcán Las Palomas	core area SM BR[1]	sighting
25	Alejandría finca	multiple use zone SM BR[1]	sighting, interview
26	Los Angeles village	buffer zone SM BR[1]	interview
27	San Vicente II village	buffer zone SM BR[1]	interview
28	Manguitos II village lowlands	None	interview
30	Semuy II village lowlands	Bocas Polochic Wildlife Reserve	interview
32	Selempín biological station	Bocas Polochic Wildlife Reserve	sighting, interview
33	Río Oscuro	Bocas Polochic Wildlife Reserve	sighting
34	Lake Izabal shore	Bocas Polochic Wildlife Reserve	sighting
35	Naranjal Yaxte village	None	sighting, interview

[1] SM BR: Sierra de las Minas Biosphere Reserve.

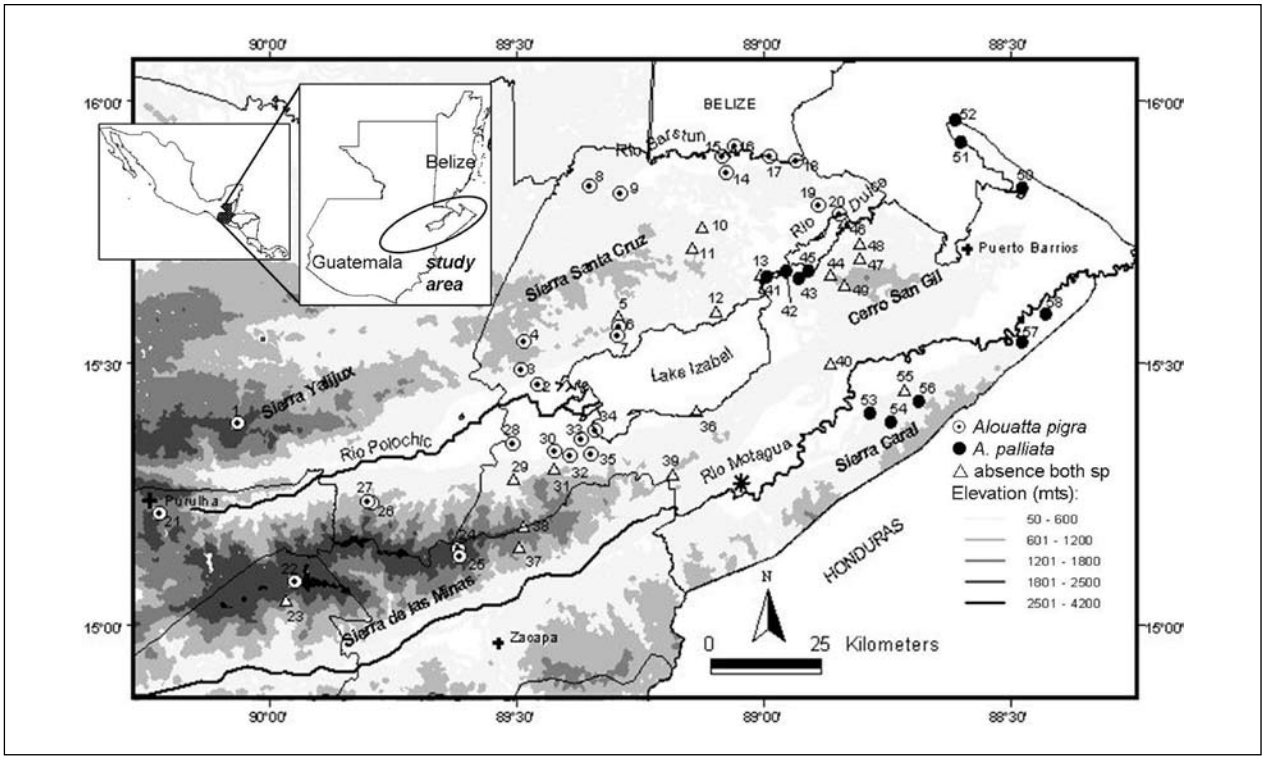

Figure 1. The study area in eastern Guatemala, showing the location of the survey sites, mountains, major rivers, and department limits. Asterisk shows the historic location of *A. pigra* in Quiriguá, Izabal.

Table 2. Localities where *Alouatta palliata* occurs (see Fig. 1), protection status, and detection method.

Site No.	Locality	Protection Status	Method
41	Juan Vicente Creek	Río Dulce National Park – none	sighting, interview
42	Casa Guatemala	Río Dulce National Park – none	sighting, interview
43	Río Frío lowland	None	interview
45	Cayo Piedra finca	Río Dulce National Park – none	sighting
50	Laguna Santa Isabel shore	Punta Manabique Wildlife Reserve	sighting
51	Estero Lagarto village	Punta Manabique Wildlife Reserve	sighting, interview
52	Cabo Tres Puntas village	Punta Manabique Wildlife Reserve	sighting, interview
53	San Vicente Paul village	None	interview
54	San Vicente Paul highlands	proposed Sierra Caral reserve – none	interview
56	Animas village highlands	proposed Sierra Caral reserve – none	interview
57	Champas finca lowlands	None	sighting, interview
58	Cacao village	None	sighting

Table 3. Vegetation types (UNESCO classifications following INAB, 2001) of the survey sites and number of sites with presence/absence records for each species.

Vegetation type	No. of sites	No. of sites with *A. pigra*	No. of sites with *A. palliata*	No. of sites with both spp.	No. of sites without howler monkeys
1. Tropical evergreen broad- leaved periodically flooded forest	13	10	3	0	0
2. Tropical evergreen and semievergreen broad-leaved forest	21	9	3	0	9
3. Tropical evergreen and semievergreen mixed forest[1]	6	4	0	0	2
4. Seasonal evergreen shrubland with mixed forest[1]	3	0	0	0	3
5. Agroproductive systems with significant portions of Broad-leaved forest	15	3	6	0	6
Total	58	26	12	0	20

[1]Mixed forest = broad-leaved and needle-leaved forest

Table 4. Altitudinal ranges (following INAB, 2001) of the survey sites and number of sites with presence/absence records for each species.

Altitudinal descriptor	Elevation (m)	Number of sites	No. of sites with *A. pigra*	No. of sites with *A. palliata*	No. of sites with both spp.	No. of sites without howler monkeys
Lowland	0–499	39	18	10	0	11
Sub-montane	500–999	8	1	2	0	5
Lower montane	1000–1499	5	2	0	0	3
Upper montane	1500–2000	3	2	0	0	1
Altimontane	>2000	3	3	0	0	0
	Totals	58	26	12	0	20

2500 m a.s.l. (Table 4). *Alouatta pigra* was found in all altitudinal ranges (Table 4) and no ordinal association was detected (test of homogeneity of proportions, ordinal model $\chi^2 = 1.61$, df = 1, p = 0.20). The altimontane survey sites (> 2000 m a.s.l.) were all occupied by *A. pigra*, the highest being 2705 m a.s.l. in Sierra de las Minas. In contrast, *A. palliata* occurred significantly more frequently in lowland sites and was not recorded at elevations higher than 1000 m a.s.l. (test of homogeneity of proportions, ordinal model $\chi^2 = 4.07$, df = 1, $p < 0.05$).

Of the 10 major protected natural areas surveyed, 80% sustained howler monkey populations: *Alouatta pigra* was found in six and *A. palliata* in two (Tables 1 and 2). Of the total survey sites, 32 sites (55%) were in protected areas with enforcement and 26 sites (45%) were located outside protected areas or in protected areas without vigilance. Occurrence of howler monkeys was not associated with the protection status of the survey site (test of independence $G^2 = 0.33$, df = 1, p = 0.59).

Of 97 interviewees, 76% denied hunting or ever hearing of anyone hunting howler monkeys. Most (19 of 22) of the remaining 24% responded that they had only heard of other people killing howler monkeys and did not consider them a valuable bush meat; two respondents used howler monkeys as bait for river shrimp, and one hunted these primates for meat and medicine (howler monkey broth was used as treatment for respiratory illness). Howler monkeys kept as pets were rare. The reports on hunting activity were distributed across the survey sites, unrelated to ethnic group of interviewees or geographic region. The only other primate species in the area reported in the interviews was the spider monkey *Ateles geoffroyi.* The white-faced capuchin monkey, *Cebus capucinus*, was not known to locals and probably does not extend into Guatemala. Records for *Ateles geoffroyi* presence were slightly lower than those for *Alouatta* species (34% and 40% of interview sites, respectively), and its range overlapped with both *A. palliata* and *A. pigra*. *Ateles* occurred in sites with and without howler monkeys and there was no evidence of association or dissociation with *Alouatta* (test of independence $G^2 = 0.11$, df = 1, p = 0.76).

No evidence was found for a current zone of sympatry between *Alouatta pigra* and *A. palliata*. Only one interviewee claimed to have seen both species in mixed troops, but this was disputed by other interviewees at the same site (site 19) and it conflicted with records from surrounding sites as well. The identified range limits for *A. pigra* are: Lake Izabal and Río Dulce in the east, unsuitable habitat of pine forest west of Purulhá in Baja Verapaz in the southwest and pine forest and dry shrubland in foothills of Sierra de las Minas in the south (Fig. 1). The southeastern range limit is not associated with any barrier. We found the most southeasterly populations of *A. pigra* in the tip of Sierra de las Minas (site 35), and historical records place the species farther east in Quiriguá in the middle Motagua valley (Salvin and Goodman, 1879; museum specimen in the Smithsonian National Museum of Natural History, USNM 238704) (Fig. 1). The western range limit of *A. palliata* is dry deciduous shrubland. The heavily disturbed area to the south of Lake Izabal in the lower Motagua valley is the northwest limit and the Río Dulce the north limit.

Discussion

This study reports the distribution of the endangered black howler monkey, *Alouatta pigra*, in its southern geographic range in topographically and ecologically heterogeneous eastern Guatemala, providing needed information on detailed occurrence localities (Rodríguez-Luna *et al.*, 1996; Matamoros *et al.*, 1997) and new reports of its ecological tolerances. It also contributes to the limited knowledge of the status and distribution of the mantled howler monkey, *A. palliata,* in Guatemala. *Alouatta pigra* was widespread and occupied several different habitat types across altitudinal ranges from sea level up to 2705 m. Our results show no evidence of significant association with a specific vegetation type or altitude. In his preliminary study in Guatemala, Curdts (1993) also found *A. pigra* at high elevations above 2000 m a.s.l. These results contrast with the reports that *A. pigra* is restricted to elevations below 400 m a.s.l., with a strong affinity for riverine forest (Horwich and Johnson, 1986; Watts *et al.*, 1986; Ostro *et al.*, 2000). Models of the species' current range based on preference for lowland forests (Luecke, 2004) need to consider potential

premontane and montane habitats to avoid underestimation of actual range.

Forest disturbance by humans influences the distribution patterns of *A. palliata* and *A. pigra* in the region mainly by eliminating suitable monkey habitat. This is especially the case along the Río Motagua Valley and south shores of Lake Izabal and Río Dulce. Here extensive monocultures and cattle pastures have replaced the original tropical forest (INAB, 2001), which may account for the high frequencies of *A. palliata* in disturbed vegetation types. The ability of *A. palliata* to survive in fragmented habitats is widely recognized by other authors (e.g., Estrada and Coates-Estrada, 1984; Silva López *et al.*, 1988; Clarke *et al.*, 2002). Deforestation in the range of *A. pigra* occurs mainly in the upper and middle Río Polochic valley, where the species was once very common (Salvin and Godman, 1879), as well as north of Lake Izabal. The species was present in some disturbed sites, in accordance with other reports of *A. pigra* thriving in forest fragments (Horwich and Johnson, 1984; Baumgarten, 2000; Estrada *et al.*, 2002).

The absence of *A. palliata* from the Cerro San Gil area (sites 44, 47, 48, 49) was unexpected, since the area has protected status and extensive forest cover with other wildlife, including the spider monkey. The premontane and montane elevations at these sites may act as a limiting factor for the species. Other studies have also found that *A. palliata* is absent from elevations above 700 m a.s.l. in mountainous ranges in Mexico (Silva López *et al.*, 1988; Estrada and Coates-Estrada, 1996). The species is present at elevations up to 1500 m a.s.l., but only at lower latitudes in Central America (Timm *et al.*, 1989). The red howler monkey, *Alouatta seniculus*, occurs at high elevations in the Colombian Andes (Hernández-Camacho and Cooper, 1976; Gaulin and Gaulin, 1982).

We found little evidence for hunting pressure on howler monkeys and no association between hunting and the distribution of the two species. Hunting of howler monkeys is also limited in Belize (Horwich and Johnson, 1984) but more common in Mexico (Estrada and Coates-Estrada, 1984; Horwich and Johnson, 1984; Silva López *et al.*, 1988). In contrast, subsistence hunting has accounted for local extinctions of *Alouatta* in localities in the Brazilian Amazon (Peres, 1990) and the Peruvian and Bolivian Amazon (Freese *et al.*, 1982). *Alouatta* occurrence may be influenced by competition with other primates in some habitats (Eisenberg, 1979), although not always (Peres, 1997; Iwanaga and Ferrari, 2002). We found no evidence for competitive exclusion between *Ateles* and *Alouatta* species. In Mexico the spider monkey *Ateles* is more widespread than *Alouatta* and sympatric with it in only a few places (Watts *et al.*, 1986; Rodríguez-Luna *et al.*, 1987; Silva López *et al.*, 1988).

The study region has a high potential for the conservation of the endangered black howler monkey, *A. pigra*, since six of its protected areas harbor the species (Table 1), the largest being the Sierra de las Minas Biosphere Reserve (246,803 ha) (CONAP, 2005). Furthermore, the low hunting pressure and the occurrence of the species outside protected areas provides the opportunity for community-based conservation projects and sustainable resource programs, which have proven effective for howler monkey conservation in Belize and Mexico (Horwich, 1998). The occupied habitats are ecologically heterogeneous in comparison with the species' range in the Yucatán Peninsula, which is predominantly lowland rainforest (Horwich and Johnson, 1986; Watts *et al.*, 1986; Navarro *et al.*, 2003). The populations of *A. pigra* living in cloud forests at high elevations are an important component in conserving the species variability and its gene pool. Previously considered to be unsuitable habitats, highlands will have to be considered in distribution assessments and management plans for the species. The severe deforestation south of Lake Izabal-Río Dulce puts the populations of the mantled howler monkey *A. palliata* at risk in Guatemala. These are the most northerly populations of the subspecies *A. palliata palliata*. Important conservation actions here include conservation in the protected areas without enforcement, the legal declaration of the proposed Sierra Caral protected area, and the establishment of the Mesoamerican Biological Corridor project that connects Punta de Manabique Wildlife Reserve with protected areas in Honduras.

The results of this study are relevant to clarifying the distribution of *Alouatta pigra* and *A. palliata* in their contact zone in eastern Guatemala. We found no evidence for current range overlap or sympatry as well as no support for the previous proposed sympatric areas around Río Sarstun (Horwich and Johnson, 1986) or in the highlands of Baja Verapaz, Alta Verapaz, and Sierra de las Minas (Curdts, 1993). In the northwestern part of the putative contact zone, the Río Dulce acts as a physical barrier separating both species. Curdts (1993) also reported *A. pigra* on the north bank and *A. palliata* on the south bank of this river. River boundaries are often limiting factors for the distribution of primates (Ayres and Clutton-Brock, 1992; Wallace *et al.*, 1996). In the eastern part of the contact zone, *A. pigra* occurs on the southwest side of Lake Izabal and tip of Sierra de las Minas. South of Lake Izabal suitable monkey habitat has been removed and *A. pigra* is known only from historic records. Further east in the lower Motagua Valley we registered exclusively *A. palliata*. It is possible that a narrow sympatry existed south of the lake before forest loss. Further range overlap is not evident, probably explained by ecological differences. Our results suggest that *A. palliata* is associated with forests found at low elevations, precluding its expansion into the wet and cold habitats of Sierra de las Minas where *A. pigra* is found. Habitat preferences seem to act as a barrier between howler monkey species in other cases of near sympatry (Crockett, 1998) as reported for *A. fusca* and *A. caraya* in northern Argentina (Di Bitetti *et al.*, 1994) and *A. seniculus* and *A. caraya* in southwestern Amazonia (Iwanaga and Fer-

rari, 2002). Further, *A. pigra*'s lack of wide expansion into *A. palliata*'s range in the lowlands may perhaps involve assortative mating or hybrid inviability.

In the extreme south of the potential contact zone, the ranges of both species are interrupted by dry deciduous shrubland south of the Sierra de las Minas. The semidesert characteristics of this vegetation clearly constitute an effective ecological barrier between the species. In contrast to the scenario in Guatemala, *A. pigra* and *A. palliata* in Mexico have a broad sympatric area that extends over the lowlands of the states of Tabasco and Campeche. Nevertheless, species introgression seems to be limited as Smith (1970) found no evidence for hybridization based on museum specimens from the same localities, although occasional interbreeding may occur in mixed troops of howler monkeys in the area (Cortés-Ortiz *et al.*, 2003).

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References

Ayres, J. M. and Clutton-Brock, T. H. 1992. River boundaries and species range size in Amazonian primates. *Am. Nat.* 140: 531–537.

Baumgarten, A. 2000. Características poblacionales y uso de hábitat del mono aullador negro (*Alouatta pigra*) en la zona de influencia del Parque Nacional Laguna Lachuá, Alta Verapaz. Tesis de Licenciatura, Universidad de San Carlos de Guatemala, Guatemala.

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.

CCAD-WB. 2003. Ecosystems of Central America (ArcView regional map files at 1:250,000). Comisión Centroamericana de Ambiente y Desarrollo (CCAD), World Bank (WB), World Institute for Conservation and Environment (WICE), and the Centro Agronómico Tropical de Investigación y Enseñanza (CATIE), Washington, DC. Website: <http://servir.nsstc.nasa.gov/>. Accessed 15 July 2005.

Clarke, M. R., Collins, D. A. and Zucker, E. L. 2002. Responses to deforestation in a group of mantled howlers (*Alouatta palliata*) in Costa Rica. *Int. J. Primatol.* 23: 365–381.

CONAP (Consejo Nacional de Areas Protegidas). 2005. Consejo Nacional de Áreas Protegidas de Guatemala. Website: <http://www.conap.gob.gt/>. Accessed 27 June 2005.

Cortés-Ortiz, L., Berminghan, E., Rico, C., Rodríguez-Luna, E., Sampaio, I. and Ruiz-García, M. 2003. Molecular systematics and biogeography of the Neotropical monkey genus *Alouatta. Mol. Phyl. Evol*. 26: 64–81.

Crockett, C. M. 1998. Conservation biology of the genus *Alouatta*. *Int. J. Primatol.* 19: 549–578.

Cuarón, A. D., de Grammont, P. C., Cortés-Ortiz, L., Wong, G. and Serio-Silva, J. C. 2003. IUCN Red List of Threatened Species, IUCN. *Alouatta pigra*. Website: <http://www.iucnredlist.org/search/details.php/914/summ>. Accessed 20 January 2005.

Curdts, T. 1993. Distribución geográfica de las dos especies de mono zaraguate que habitan en Guatemala: *Alouatta palliata* y *Alouatta pigra*. In: *Estudios Primatológicos en México, Vol. 1*, A. Estrada, E. Rodríguez-Luna, R. López-Wilchis and R. Coates-Estrada (eds.), pp.317–329. Universidad Veracruzana, Mexico.

Di Bitetti, M. S., Plací, G., Brown, A. D. and Rode, D. I. 1994. Conservation and population status of the brown howling monkey (*Alouatta fusca clamitans*) in Argentina. *Neotrop. Primates* 2: 1–4.

Eisenberg, J. F. 1979. Habitat, economy, and society: Some correlations and hypotheses for the Neotropical primates. In: *Primate Ecology and Human Origins: Ecological Influences on Social Organization*, I. S. Bernstein and E. O. Smith (eds.), pp.215–262. Garland Press, New York.

Estrada, A. and Coates-Estrada, R. 1984. Some observations on the present distribution and conservation of *Alouatta* and *Ateles* in southern Mexico. *Am. J. Primatol.* 7: 133–137.

Estrada, A. and Coates-Estrada, R. 1996. Tropical rain forest fragmentation and wild populations of primates at Los Tuxtlas, Mexico. *Int. J. Primatol.* 17: 759–783.

Estrada, A., Mendoza, A., Castellanos, L., Pacheco, R., Van Belle, S., García, Y. and Muñoz, D. 2002. Population of the black howler monkey (*Alouatta pigra*) in a fragmented landscape in Palenque, Chiapas, Mexico. *Am. J. Primatol.* 58: 45–55.

Freese, C. H., Heltne, P. G., Castro, N. and Whitesides, G. 1982. Patterns and determinants of monkey densities in Peru and Bolivia, with notes on distributions. *Int. J. Primatol.* 3: 53–90.

Gaulin, S. J. C. and Gaulin, C. K. 1982. Behavioral ecology of *Alouatta seniculus* in Andean cloud forest. *Int. J. Primatol.* 3: 1–32.

Hall, E. R. 1981. *The Mammals of North America. Vol. 1.* Second edition. John Wiley & Sons, New York.

Hernández-Camacho, J. and Cooper, R. W. 1976. The nonhuman primates of Colombia. In: *Neotropical Primates: Field Studies and Conservation*, R. W. Thorington

Jr. and P. G. Heltne (eds.), pp.35–69. National Academy of Sciences, Washington DC.

Horwich, R. H. 1998. Effective solutions for howler conservation. *Int. J. Primatol*. 19: 579–598.

Horwich, R. H. and Johnson, E. D. 1984. Geographic distribution and status of the black howler monkey. *IUCN/SSC Primate Specialist Group Newsletter* 4: 25–27.

Horwich, R. H. and Johnson, E. D. 1986. Geographical distribution of the black howler (*Alouatta pigra*) in Central America. *Primates* 27: 53–62.

INAB (Instituto Nacional de Bosques de Guatemala). 2001. Mapa de Ecosistemas Vegetales de Guatemala: Memoria técnica. Instituto Geográfico Nacional de Guatemala, Guatemala.

Iwanaga, S. and Ferrari, S. F. 2002. Geographic distribution of red howlers (*Alouatta seniculus*) in southwestern Brazilian Amazonia, with notes on *Alouatta caraya*. *Int. J. Primatol*. 23: 1245–1256.

Jiggins, C. D., McMillan, W. O., Neukirchen, W. and Mallet, J. 1996. What can hybrid zones tell us about speciation? The case of *Heliconius erato* and *H. himera* (Lepidoptera: Nymphalidae). *Biol. J. Linnean. Soc.* 59: 221–242.

Jones, C. B. and Bicca-Marques, J. C. 2004. Contact zones and their importance for scientific primatology and the preservation of primate biodiversity. *Neotrop. Primates* 12(3): 159.

Luecke, L. 2004. Distribution of the black howler monkey (*Alouatta pigra*) in Mesoamerica: A GIS analysis. *Am. J. Primatol*. 62: 75–76.

Matamoros, Y., Asa, C., Byers, O. and Seal, U. (eds.). 1997. Conservation assessment and management plan for Mesoamerican primates: Briefing Book. IUCN/SSC Conservation Breeding Specialist Group. Apple Valley, MN.

Navarro, E., Pozo de la Tijera, C. and Escobedo, E. 2003. Afinidad ecológica y distribución actual de primates (Cebidae) en Campeche, México. *Rev. Biol. Trop*. 51: 591–600.

Ostro, L. E. T., Silver, S. C., Koontz, F. W. and Young, T. P. 2000. Habitat selection by translocated black howler monkeys in Belize. *Animal Conserv.* 3: 175–181.

Peres, C. A. 1990. Effects of hunting on western Amazonian primate communities. *Biol. Conserv.* 54: 47–59.

Peres, C. A. 1997. Effects of habitat quality and hunting pressures on arboreal folivore densities in Neotropical forests: A case study of howler monkeys (*Alouatta* spp.). *Folia Primatol*. 68: 199–222.

Pinto, L. P. de S. and Rylands, A. B. 1997. Geographic distribution of the golden-headed lion tamarin, *Leontopithecus chrysomelas*: Implications for its management and conservation. *Folia Primatol*. 68: 161–180.

Rodríguez-Luna, E., Cortés-Ortiz, L., Mittermeier, R., Rylands, A., Carrillo, E., Matamoros, Y., Nuñez, F. and Motta-Gill, J. 1996. Hacia un plan de acción para los primates mesoamericanos. *Neotrop. Primates* 4: 119–132.

Rodríguez-Luna, E., Fa, J. E., García-Orduña, F., Silva López, G. and Canales-Espinosa, D. 1987. Primate conservation in Mexico. *Primate Conservation* (8): 114–118.

Salvin, D. and Godman, F. D. C. (eds.). 1879. *Biologia Centrali-Americana. Vol. I Mammalia*. London.

Serio Silva, J. C., Rico-Gray, V. and Ramos Fernández, G. 2006. Mapping primate populations in the Yucatan Peninsula, Mexico: A first assessment. In: *New Perspectives in the Study of Mesoamerican Primates: Distribution, Ecology, Behavior and Conservation,* A. Estrada, P. A. Garber, M. S. M. Pavelka and L. A. Luecke (eds.), pp.489–511. Springer, New York.

Silva López, G., García-Orduña, F. and Rodríguez-Luna, E. 1988. The status of *Ateles geoffroyi* and *Alouatta palliata* in disturbed forest areas of Sierra Santa Marta, Mexico. *Primate Conservation* (9): 53–61.

Smith, J. D. 1970. The systematic status of the black howler monkey *Alouatta pigra* Lawrence. *J. Mammal.* 51: 358–369.

Timm, R. M., Wilson, D. E., Clauson, B. L., LaVal, R. K. and Vaughan, C. S. 1989. Mammals of the La Selva–Braulio Carrillo Complex, Costa Rica. *North American Fauna* Nr. 75. US Fish and Wildlife Service.

Wallace, R. B., Painter, R. L. E., Taber, A. B. and Ayres, J. M. 1996. Notes on a distributional river boundary and southern range extension for two species of Amazonian primates. *Neotrop. Primates* 4: 149–151.

Watts, E. S., Rico-Gray, V. and Chan, C. 1986. Monkeys of the Yucatán Peninsula, Mexico: Preliminary survey of their distribution and status. *Primate Conservation* (7): 17–22.

AN EXPERIMENTAL CENSUS METHOD AND ESTIMATES OF POPULATION DENSITY OF A BLACK HOWLER MONKEY (*ALOUATTA PIGRA*) HIGHLAND POPULATION IN THE SIERRA YALIJUX, GUATEMALA

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Abstract

Groups of the Guatemalan black howler monkey (*Alouatta pigra*) in a fragmented northern Guatemalan cloud forest in the Sierra Yalijux were analyzed for group composition and size using an ornithological census technique. Audio and visual records were combined to estimate each group's home range size. The 361 observations in 2002 estimated 50 individuals in seven groups. Two home range classes were observed with ≤ 1.87 ha and ≥ 2.87 ha. Compared to other recent studies, the density of *A. pigra* in the Sierra Yalijux is considerably higher than in other areas (83.3/km^2 vs. 15.1/km^2 in Quintana Roo and 23.0/km^2 in Palenque) but about half the density found in Belize (178/km^2). We discuss the relevance of the ornithology assessment method for howler monkeys.

Key words: *Alouatta pigra*, Neotropics, Guatemala, cloud forest, Sierra Yalijux, ecology, GIS, home range, minimal convex polygon, saraguate

Resumen

Utilizando una técnica ornitológica de censos se analizaron la composición y tamaño de grupos del mono aullador negro Guatemalteco (*Alouatta pigra*) en un bosque nublado fragmentado al norte de Guatemala en la Sierra Yalijux. A partir de 361 observaciones hechas en 2002 se estimaron 50 individuos en siete grupos. Se encontraron dos clases de tamaño de área de uso vital ≤ 1.87 ha y ≥ 2.87 ha. Comparada con aquellas de otros estudios recientes, la densidad de *A. pigra* en la Sierra Yalijux es considerablemente más alta que en otras áreas (83.3/km^2 vs. 15.1/km^2 en Quintana Roo y 23.0/km^2 en Palenque) pero cerca de la mitad de la densidad encontrada en Belice (178/km^2). Discutimos la relevancia del método de evaluación ornitológico utilizado para los monos aulladores.

Palabras Clave: *Alouatta pigra*, Neotrópicos, Guatemala, bosque nublado, Sierra Yalijux, ecología, GIS, área de dominio vital, mínimo polígono convexo, saraguate

Introduction

The black howler monkey, *Alouatta pigra*, endemic to Mesoamerica, is threatened due to widespread habitat destruction causing severe population declines. The *IUCN 2004 Red List of Threatened Species* classifies *A. pigra* as Endangered (A4c) (see Rodríguez-Luna *et al*., 1996a, 1996b; Crockett, 1998; Cuarón *et al*., 2003), and it is listed on Appendix I of CITES – the Convention on International Trade in Endangered Species of Wild Flora and Fauna. *A. pigra* occurs in the tropical and semi-deciduous forests of Yucatán (Mexico), Belize, western Honduras and northern parts of Guatemala (Emmons and Feer, 1997; Reid, 1997). *A. pigra* is highly territorial, with each group (generally of about five to ten individuals) occupying relatively exclusive ranges (Reid, 1997).

Currently, there are considerable regional differences in the conservation status of the black howler, with populations in areas with high deforestation being more threatened than others. Populations of *A. pigra* in Belize are comparatively well-studied (e.g., Horwich and Johnson, 1984; Horwich *et al*., 2001a, 2001b; Estrada *et al*., 2002a, 2002b, 2004). Although *A. pigra* is thought to occur at lower elevations (Horwich and Johnson, 1986), the status of *A. pigra* in the central mountains of Guatemala remains relatively unknown. We here add data on a highland population of *A. pigra* and discuss the use of an ornithological census method applied to assess howler monkeys. We discuss density and territoriality of the *A. pigra* highland population.

Methods

Study site

We studied a population of *A. pigra* in a tropical cloud forest on the northern slopes of the central mountain ridge of northern Guatemala (Fig. 1), in the southernmost part of the species' distribution (Emmons and Feer, 1997). The study site is near the community of Chelemhá, 10.8 km north of Tucurú, Alta Verapaz (central co-ordinates: 90°04'W, 15°23'N; 1,980–2,550 m a.s.l.). The site is part of the Sierra Yalijux which merges in the west with the Sierra Caquipec (90°11'W, 15°23'N, 2,000–2,200 m a.s.l.) 12 km west of Chelemhá. To the north are the lowlands of El Petén.

Human disturbance in the primary forest of the study area is limited to subsistence hunting and occasional logging. The forests of the highlands of the Sierra Yalijux, while isolated from other forests, are relatively intact, with only 3.08% being lost between 1986 and 2000. This is a relatively low mean annual deforestation rate of 0.2% (Voigt, 2004; Markussen and Renner, 2005; Renner *et al.,* 2006). Neighboring the forests of the Sierra Yalijux are two further large forest fragments, totaling 5,500 ha (Sierra Yalijux: 2,200 ha; Sierra Caquipec: 3,200 ha; unnamed fragment in between: ~ 100 ha) of mature pine-oak cloud forests (Markussen, 2004; Renner *et al.,* 2006). All three forest fragments are separated from each other (Markussen and Renner, 2005; Renner *et al.,* in press), and are 52 km east and 15 km north, respectively, from the nearest mature highland cloud forests of Sierra de Chamaa and Sierra de las Minas. The nearest lowland rainforest of El Petén is 25 km north of the forest fragments. *A. pigra* is not reported there and is most unlikely to migrate such a distance, even though they may cross open areas on the ground. The three fragments are not fragmented themselves and each consists of closed forest cover. Further forest patches of small size (< 20ha) are found in the surrounding areas of these three major fragments. All forest is surrounded by different land use, including secondary vegetation and taller secondary forest. This tall secondary forest is approximately 15 years old and 20 m tall and has already established two vegetation strata (Renner *et al.,* 2006b).

The deforestation rate in the Sierra Yalijux was around 0.2% for 1986 to 2000 (Markussen, 2004; Voigt, 2004; Markussen and Renner, 2005; Renner *et al.*, in press) and low for Guatemala (country mean 1.7%). For further details on the region refer to Markussen and Renner (2005), Renner (2003, 2005) and Renner *et al.* (2006a, 2006b).

Census protocol

We applied a survey method in Chelemhá that is commonly used in bird surveys. Triangulation and assessment of vocalizing male individuals has been established in ornithology for a long time. The method is commonly used to assess individual bird territories or relative abundance for birds in temperate forests and in the tropics either applying point counts or transect-assessments. An observer records all songs and sights along a transect or point count grid and notes species, time, date and estimated or measured distance from the census grid. Here we used the established ornithological transect grid (Renner, 2003; Renner *et al.,* 2006) to assess the howler monkey population. The observers (SCR, RR) noted time, direction and estimated distance of howling individuals. One observer (RR) then located the howling groups and visually observed the groups in greater detail.

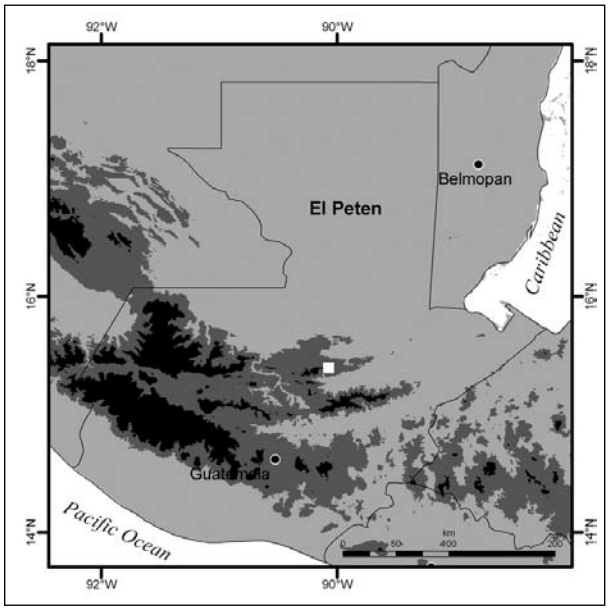

Figure 1. The study site (*white circle*) in Guatemala and altitudes >1,000 m (*gray shaded area*) and >2,000 m (*black shaded area*).

We carried out a survey of *A. pigra* along a 2,000 m transect line near the community of Chelemhá between March and October in 2001 and 2002. We surveyed all transects on a monthly basis for five days per month, from 08:00 to 14:30. From July 22 to September 26, 2002, surveys were carried out daily. Each survey day we proceeded slowly along transects. We recorded all instances of howling, determining the direction by compass bearing and estimating the distance in three categories (close: < 100 m, medium: 100–300 m, and far: > 300 m). To determine the exact observer's location we established fixed points every 25m along transects using global positioning systems (GPS). When two observers were carrying out the survey the troops were located by triangulation. Once we heard or saw a howler group we followed it as long as possible to determine their troop composition as to age and sex as described by Reid (1997) and Emmons and Feer (1997).

Groups were considered to be discrete units when audio observations indicated spatial distances of more than 100 m. Groups A to D and G (exceptions: E and F; Table 1) were recorded by simultaneous vocalizations four

times during the study period with an indicated in-between difference of more than 100 m. Often adjacent groups will roar at each other in close proximity at territorial borders. Sometimes it is impossible to tell whether they are different troops until they move away from each other and the territory border (Horwich, pers. obs.). Thus, in addition to the audible locating procedures, all groups (A to G; Table 1) were observed visually several times. Groups that could not be seen were not included.

Analysis

We mapped all locations of *A. pigra* troops in the study region with ArcGIS 9.1 and classified the land cover by analyzing a Landsat ETM+ scene (path 020, row 049 of January 23, 2000) with ground-truthing data (Renner and Markussen, in press). For analyses of the home range we used the ArcView 3.3 Animal Movement extension to calculate the minimal convex polygon (MCP) and the kernel home range (KHR). For the KHR we used the 25, 50, 75 and 95% confidence intervals and plotted the results. For the total population estimate we added the maximum observed troop sizes and assumed this cumulative number represents the total number of individuals in the study plot.

We also established a transect of 2,000 m in the Sierra Caquipec close to the small village of Chicacnab, and for 14 days surveyed the *A. pigra* population. The Sierra Caquipec is the western extension of the Sierra Yalijux but the forests, with similar pine-oak cloud forest vegetation, are isolated by a 500 m gap. This second site was included so that we could have some idea as to whether the population density in Chelemhá is high or low compared to other forest fragments in the region.

Results

We observed seven groups of *A. pigra* with 50 individuals in the 60.05 ha study site near Chelemhá (Fig. 2, Table 1). All groups were separable by territorial vocalizations and visual observations. Home range size varied from 1.01 to 5.53 ha (mean 3.03 ha ± 1.69 sd.) as measured with the minimal convex polygons (Table 1). The seven groups ranged in size from six to ten individuals with 50 individuals in total. The mean number of males per group was 1.50 ± 0.55, and the number of females was 1.33 ± 0.55 (Table 1). The population density of the forest fragment was 83.3 individuals per km^2.

Further groups were registered by their vocalizations outside our study plot (Fig. 2). One group occupied a primary forest patch (isolated from the Sierra Yalijux; 17.80 ha) approximately 700 m to the south of group D. Two other groups were located 500 m north and 900 m west of group A, and another two troops approximately 1.1 km and 2.2 km, east-north-east of group G; the latter four all within the Sierra Yalijux. However, the home range size estimate for the distant groups is very rough, because they were far away and never seen. The distance increased the error for area-estimation. We also observed howlers in the vicinity of the study area along a path of 4,500 m; that path was used on a monthly basis during the study period.

A. pigra in Chelemhá exhibited more frequent territorial howling than in Chicacnab (12 km west of Chelemhá). In Chicacnab we only heard one group howling 500 m away but never could observe them. The surveys close to Chicacnab (Sierra Caquipec) revealed only one howling individual in the far distance of the settlement in primary forests. Density estimates could not be determined here. In the Sierra Yalijux, *A. pigra* used mainly primary forest or old secondary growth at least 15 m in height with at least two strata (see Renner *et al.*, 2006, for further description of the vegetation). Thus, 90% (= 1,800 m) of the survey transects were in primary cloud forest and 10% in old secondary forest.

Discussion

Remote assessment using vocalization and triangulation

We applied a survey method in Chelemhá howlers that is commonly used in bird surveys. While we could determine the howling units of *A. pigra* by triangulation and remote assessment, visual contact for group census and composition is essential since usually only one or two adult monkeys participate in howling while the remainder of the group stays silent. Thus a combination of both methods is needed for a detailed census of howlers. However, the method could be useful to estimate gross

Table 1. Groups of *Alouatta pigra* observed in the Sierra Yalijux near Chelemhá in 2002.

Group	Total	Adult Male	Adult Female	Sub-Adult Male	Sub-Adult Female	Sub-Adult	Infant	Area (ha)
A	9	1	1	-	-	-	1	1.05
B	8	2	2	-	-	-	3	4.87
C	9	2	1	-	1	-	1	4.01
D	-	-	-	-	-	-	-	5.53
E	8	1	2	1	-	-	-	1.02
F	6	1	-	-	-	-	1	1.87
G	10	2	2	-	-	3	1	2.87

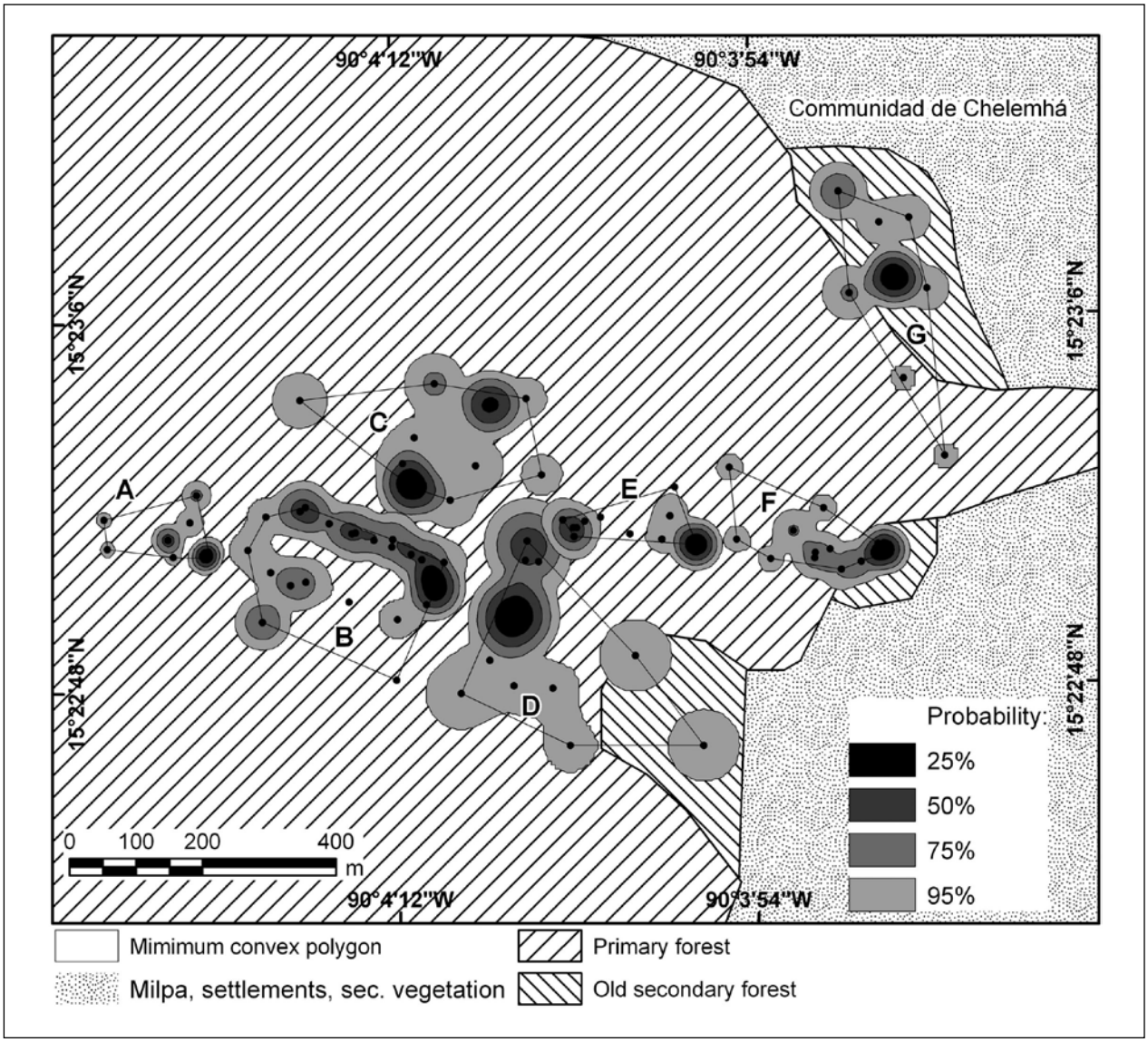

Figure 2. Records of the black howler monkey (*Alouatta pigra*) in the Sierra Yalijux, near the settlement of Chelemhá in 2002. For observations on the groups (A to G) see Table 1. Probabilities are derived from the Kernel Home Range; Minimum Convex Polygons are derived from the outermost border of observations per group. Groups were separated according to simultaneously observed howling of groups.

densities of howlers in unstudied areas in shorter time periods by vocalization records alone. The distinction between *A. pigra* groups in the Sierra Yalijux was generally reliable and clearly separable due to the observations and territorial howling of the group members, however we cannot exclude the possibility that in some instances solitary males were howling.

Howler density and territorial overlap

Howling has been observed to have a territorial function in *A. seniculus* and *A. pigra* (Sekulic, 1982; Estrada *et al.*, 2004) although this may not always be the case (Estrada *et al.*, 2002b, 2004). Some authors have argued that howling is more correctly a mechanism only for "intergroup spacing" (Kitchen *et al.*, 2004), and Sekulic (1982b), studying *Alouatta seniculus*, reported on "floating territories".

There is evidence that *A. pigra* troops occupy their own exclusive range (Reid, 1997) and that they defend this range (Horwich 1983a). However, for *A. pigra* (Ostro *et al.*, 2001; Pavelka *et al.*, 2003), *A. seniculus* (Crockett and Janson, 2000), and other mammals (Pen and Weissing, 2000), home range overlap has been reported. If this were true in Chelemhá by this survey method, territory size might decrease and the separation of groups might not be apparent. *A. pigra* populations in Belize always showed some range overlap (Horwich 1983a, b) especially as densities increased (Horwich, pers. obs.). Horwich (1983a) reported a female crossing into another territory to breed with the male away from her troop, who later threatened the same male in an inter-troop territorial dispute. Thus, there appear to be clear boundaries where adjacent troops howl at each other across the territory line and distinctions are possible only by a combination of audio and visual ob-

servations. Audible and remote detection as well as distinguishing the troops by howling alone, as suggested here as an alternative, might be more difficult, since in some cases two troops are howling at one location and are not recognizable as two distinguished troops without a visual double check. Our data for groups E and F (Fig. 2) illustrate this since no simultaneous or interactive howling was observed. Thus, they could be merged into one group. However, since troops over 10 individuals are rare in *A. pigra,* these are probably distinct troops.

Home ranges in this study are larger than from other study sites (see Estrada *et al*., 2004), and the population density in this study is intermediate compared to other sites. For example, lower densities are reported for *A. pigra* in various sites in Mexico (Gonzales-Kirchner, 1998; Estrada *et al*., 2002a; Estrada *et al*., 2004), including Yaxchilán (12.8/km^2), Quintana Roo (15.1/km^2), Calakmul (15.2/km^2), and Palenque (23.0/km^2). Black howlers in Tikal (El Petén, Guatemala) also show low population density (17.8/km^2). However, higher density estimates as in Chelemhá have been reported in Belize, with up to 178 individuals per km^2 (Horwich *et al*. 2001). The population was considered to be crowded due to fragmentation (Silver *et al*., 1998; Ostro *et al*. 1999, 2000; Horwich *et al*., 2001). The Sierra Yalijux has a clearly higher population density than the Mexican and northern Guatemalan sides but is still below numbers from more fragmented landscapes of Belize.

Crowding populations?

As observed by Ostro *et al*. (2001), low density populations consist of one male with two females and high density populations of multi-males with > 2 females. The groups we observed in Chelemhá consist of more than one male and several females (with some exceptions, Table 1), and therefore are most likely high-density groups. The comparatively high population density of *A. pigra* in Chelemhá implies crowding in the remaining cloud forest. However, distribution in Chelemhá is patchy. Several groups in addition to the seven groups as shown in Figure 2 are present in the area. While the seven groups in Chelemhá seem to clump together, there is no indication of other individuals between the widely spaced groups. Therefore we conclude that the populations have a patchy distribution, probably due to patchy distribution of nutrition in the Chelemhá mature forests. However it remains open whether or not *A. pigra* crowds in response to the decreased habitat (Markussen and Renner, 2005). Other research teams report crowded populations from fragmented forest patches in Belize (Silver *et al*., 1998; Chapman and Balcom, 1998; Ostro *et al*. 1999, 2000; Horwich *et al*., 2001) with approximately twice as high population densities than we found in the Sierra Yalijux (compare above).

Fragmentation and deforestation in the Sierra Yalijux

Fragmentation and deforestation influences behavior and distribution of *A. pigra* (e.g., Silver *et al*., 1998; Estrada *et al*., 2002b). Forests are the major habitat for *A. pigra* as for most of the other howler species (Estrada *et al*., 2002b), even when disturbed (Lyon and Horwich, 1996). No individual of any group in the Sierra Yalijux has been observed in any vegetation used by humans, except for tall secondary forest (Fig. 2). Only once during our study an individual of *A. pigra* was reported in a corn field and shot by a local farmer (A. Schumacher, pers. comm.). This individual was likely to have been hunted in mature forest, where the hunter feigned a case of food competition, as only rarely are the howlers consumed by locals following poor harvesting seasons (D. Unger, pers. comm.). Normally, consumption of howler meat is despised by the local community. Secretive behavior in Chicacnab might be one howler response to hunting (K. Eisermann, pers. comm.). However, *A. pigra* can utilize almost any kind of habitat and will come to the ground to cross narrow forest gaps and will feed in scrub areas or in areas low to the ground (Horwich, pers. obs.).

Acknowledgments

The study was performed in accordance with the current laws of Guatemala and CONAP (Comisión Nacional de Áreas Protegidas) authorized the study (No. 139-2001). We would like to thank Danielle Shanahan, Pia Terranova, and Anthony Rylands for help on English and valuable comments on earlier versions of the manuscript. In addition, our special thanks are going to Vera and Markus Reinhard, Armin Schumacher, and all local people of the Comunidad de Chelemhá for their great support during the study period in the field and accommodation, as well as to David Unger, Knut Eisermann, and Claudia Avendaño.

References

Chapman, C. A. and Balcomb, S. R. 1998. Population characteristics of howlers: Ecological conditions or group history. *Int. J. Primatol*. 19: 385–403.

Crockett, C. M. 1998. Conservation biology of the genus *Alouatta*. *Int. J. Primatol*. 19: 549–578.

Crockett, C. M. and Janson, C. H. 2000. Infanticide in red howlers: female group size, male composition, and a possible link to folivory. In: *Infanticide by Males and Its Implications*, C. P. van Schaik and C. H. Janson (eds.), pp. 75–98. Cambridge University Press, Cambridge.

Cuarón, A. D., de Grammont, P. C., Cortés-Ortiz, L., Wong, G. and Silva, J. C. S. 2003. *Alouatta pigra*. In: IUCN 2004. *2004 IUCN Red List of Threatened Species*. <www.redlist.org>. Accessed 6 February 2005.

Emmons, L. H. and Feer, F. 1997. *Neotropical Rainforest Mammals: A Field Guide*. Second edition. The Chicago University Press, Chicago.

Estrada, A., Luecke, L., van Belle, S., Barrueta, E. and Rosales Meda, M. 2004. Survey of black howler (*Alouatta pigra*) and spider (*Ateles geoffroyi*) monkeys in the Mayan sites of Calakmul and Yaxchilán, Mexico and Tikal, Guatemala. *Primates* 45: 33–39.

Estrada, A., Castellanos, L., Garcia, Y., Franco, B., Muñoz, D., Ibarra, A., Rivera, A., Fuentes, E. and Jimenez, C.

2002a. Survey of the black howler monkey, *Alouatta pigra*, population at the Mayan site of Palenque, Chiapas, Mexico. *Primates* 43: 51–58.

Estrada, A., Mendoza, A., Castellanos, L., Pacheco, R., van Belle, S., García, Y. and Muñoz, D. 2002b. Population of the black howler monkey (*Alouatta pigra*) in a fragmented landscape in Palenque, Chiapas, Mexico. *Am. J. Primatol*. 58: 45–55.

González-Kirchner, J. P. 1998. Group size and population density of black howler monkey (*Alouatta pigra*) in Muchukux forest, Quintana Roo, Mexico. *Folia Primatol.* 69: 260–265.

Horwich, R. H. 1983a. Breeding behaviors in the black howler monkey (*Alouatta pigra*) of Belize. *Primates* 24: 222–230.

Horwich, R. H., Brockett, R. C., James, R. A. and Jones, C. B. 2001a. Population growth in the Belizean black howling monkey (*Alouatta pigra*). *Neotrop. Primates* 9: 1–7.

Horwich, R. H., Brockett, R. C., James, R. A. and Jones, C. B. 2001b. Population structure and group productivity of the Belizean black howling monkey (*Alouatta pigra*): Implications for female socioecology. *Primate Report* 61: 47–65.

Horwich, R. H. 1983b. Species status of the black howler monkey, *Alouatta pigra*, of Belize. *Primates* 24: 288–289.

Horwich, R. H. and Johnson, E. D. 1984. Geographic distribution and status of the black howler monkey. *IUCN/SSC Primate Specialist Group Newsletter* (4): 25–27.

Horwich, R. H. and Johnson, E. D. 1986. Geographical distribution of the black howler (*Alouatta pigra*) in Central *America. Primates* 27: 53–62.

Lyon, J. and Horwich, R. H. 1996. Modification of tropical forest patches for wildlife protection and community conservation in Belize. In: *Forest Patches in Tropical Landscapes*, J. Shelhas and R. Greenberg (eds.), pp. 205–230. Island Press, Washington, DC.

Markussen, M. 2004. *Forest Conversion and Soil Degradation of Tropical Montane Cloud Forests in Guatemala (Alta Verapaz). Investigation in the Framework of Biodiversity Research in Sensitive Tropical Ecosystems*. Shaker Verlag, Berlin. In German.

Markussen, M. and Renner, S. C. 2005. Biotic and abiotic aspects as a base for the conservation of biodiversity in a tropical montane cloud forest (Guatemala). In: *Valuation and Conservation of Biodiversity – Interdisciplinary Perspectives on the Convention on Biological Diversity*, M. Markussen, R. Marggraf, R. Buse, H. Garrelts, M. A. Máñez-Costa and S. Menzel (eds.), pp.357–372. Springer, Berlin.

Ostro, L. E. T., Silver, S. C., Koontz, F. W., Young, T. P. and Horwich, R. H. 1999. Ranging behavior of translocated and established groups of black howler monkeys *Alouatta pigra* in Belice, Central America. *Biol. Conserv*. 87: 181–190.

Ostro, L. E. T., Silver, S. C., Koontz, F. W. and Young, T. P. 2000. Habitat selection by translocated black howler monkeys in Belize. *Animal Conservation* 3: 175–181.

Ostro, L. E. T., Silver, S. C., Koontz, F. W., Horwich, R. H. and Brockett, R. 2001. Shifts in social structure of black howler (*Alouatta pigra*) groups associated with natural and experimental variation in population density. *Int. J. Primatol*. 22: 733–748.

Pavelka, M. S. M., Brusselers, O. T., Nowak, D. and Behie, A. M. 2003. Population reduction and social disorganization in *Alouatta pigra* following a hurricane. *Int. J. Primatol*. 24: 1037–1055.

Pen, I. and Weissing, F. J. 2000. Optimal floating and queuing strategies: The logic of territory choice. *Am. Nat*. 155: 512–526.

Reid, F. A. 1997. *A Field Guide to the Mammals of Central America and Southeast Mexico*. Oxford University Press, New York.

Renner, S. C. 2003. Structure and diversity of cloud forest bird communities in Alta Verapaz, Guatemala, and implications for conservation. Niedersächsische Staats- und Landesbibliothek, Göttingen. <http://webdoc.sub.gwdg.de/diss/2003/renner/>. Accessed 27 January 2004.

Renner, S. C. 2005. The Resplendent Quetzal (*Pharomachrus mocinno*) in the Sierra Yalijux, Alta Verapaz, Guatemala. *J. Ornithol*. 146: 79–84.

Renner, S. C., Waltert, M. and Mühlenberg, M. 2006a. Comparison of bird communities in primary versus young secondary tropical montane cloud forest in Guatemala. *Biodiv. Conserv*. 15: 1545–1575.

Renner, S. C., Voigt, M. and Markussen, M. 2006b. Regional deforestation in a tropical montane cloud forest in Alta Verapaz, Guatemala. *Ecotropica* 12: 43 – 49.

Rodríguez-Luna, E., Cortés-Ortiz, L., Mittermeier, R. A. and Rylands, A. B. 1996a. *Plan de Acción para los Primates Mesoamericanos*. IUCN/SSC Primate Specialist Group, Xalapa, Veracruz, Mexico.

Rodríguez-Luna, E., Cortés-Ortiz, L., Mittermeier, R. A., Rylands, A. B., Wong Reyes, G., Carrillo, E., Matamoros, Y., Nuñez, F. and Motta Gill, J. 1996b. Hacia un plan de acción para los primates Mesoamericanos. *Neotrop. Primates* 4(Suppl.): 9–23.

Sekulic, R. 1982a. The function of howling in red howler monkeys (*Alouatta seniculus*). *Behavior* 81: 38–54.

Sekulic, R. 1982b. Daily and seasonal patterns of roaring and spacing in four red howler *Alouatta seniculus* troops. *Folia Primatol*. 39: 22 – 48.

Silver, S. C., Ostro, L. E. T., Yeager, C. P. and Horwich, R. H. 1998. Feeding ecology of the black howler monkey (*Alouatta pigra*) in northern Belize. *Am. J. Primatol*. 45: 263–279.

Voigt, M. 2004. Fernerkundungs- und GIS-gestützte Landnutzungsklassifikationen und Change Detection im Bergnebelwaldgebiet der Montaña Yalijux (Guatemala). Universität Göttingen, Göttingen.

Short Articles

Capuchin Monkey (*Cebus apella*) Vocalizations in Response to Loud Explosive Noises

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Introduction

Primates emit different kinds of vocalizations in different contexts (Struhsaker, 1967; Snowdon and Pola, 1978; Seyfarth *et al.*, 1980; Robinson, 1982; Boinski *et al.*, 1999; Oliveira and Ades, 1998; Maccowan *et al.*, 2001; Di Bitetti, 2001, 2003). For example, long calls can serve as localization cues for conspecifics and are often produced in the context of territorial encounters, mate attraction, and isolation/group cohesion (Waser, 1982; Miller and Ghanzanfar, 2002). Vocalizations used in close-range social interactions may be given in many different situations, such as resting, grooming, foraging or playing (Seyfarth, 1988). Some primates have different alarm calls for different predators (Struhsaker, 1967; Fichtel and Hammerschmidt, 2002; Fichtel and Kappeler, 2002). An often-cited example is the alarm repertoire of vervet monkeys. In this system, receivers respond differently to different calls: for example, they look up and move down or into cover just after an eagle alarm call, and they run into the trees just after a leopard call (Struhsaker, 1967; Seyfarth *et al.*, 1980). The appropriate response contingent upon danger increases chances for survival and reproduction, thus, improvement in fitness. Vervet alarm call specificity improves with age: at first, infants do not show much discrimination among predator classes (they may give eagle calls for non-raptors, for example); then, they give alarm calls for raptors that are not their predators; and finally they learn to vocalize only for the correct raptor predator (Seyfarth and Cheney, 1986; Seyfarth, 1988). Nevertheless, it is difficult to separate the role of genetics and environment affecting development (Seyfarth and Cheney, 1986; Seyfarth, 1988).

Tufted capuchins (*Cebus apella*) were studied by Robinson (1982) and, more recently, by Boinski *et al.* (1999) and Di Bitetti (2001, 2003). Di Bitetti (pers. comm.), studying wild *Cebus nigritus* from Iguazu, Argentina, recorded what he called the "wah wah wah": a vocalization produced by only the adult or subadult males, usually in response to a sudden loud and low frequency sound. The "wah wah wah" vocalization has a duration of 2–3 sec and consists of a repetitive series of 16–22 broad band sounds which contain some tonal components. Di Bitetti reported that males would usually stop doing the activity they were engaged in, and look alert and attentive while vocalizing in response to a loud, explosive sound. The two most common sounds Di Bitetti reported as eliciting this vocalization were thunder and falling branches or falling trees.

Preliminary observations

In our studies of both captive and wild capuchins, we also noted the "wah wah" or "rumble call" vocalization. In May and June 1998, BDR worked with a group of four captive capuchins (two adult males, two adult females) from Quinzinho de Barros Zoo, Sorocaba, São Paulo, Brazil, and she noticed that they emitted a particular vocalization just after explosions coming from a nearby quarry, and that the monkeys approached their cage mates after the explosions. Later that year, in August and September, she also noticed that four captive monkeys from Catanduva's Grove, Catanduva, São Paulo, Brazil, emitted what seemed to be the same vocalization just after firecracker explosions.

After we observed these vocalizations in various populations, we decided to study them in more detail, including the acoustic properties, contexts of emission and associated behaviors, to test our hypothesis that loud and sudden explosive noises are the proximate causes of this vocalization. In this paper, we report all the occurrences of the "rumble call" given by semifree-ranging capuchins of Tietê Ecological Park (TEP), and wild capuchins from Carlos Botelho State Park (CBSP) and Jaraguá State Park (JSP), all in the state of São Paulo, Brazil. For a description of the parks and the capuchin groups, see: TEP–Ottoni and Mannu, (2001); CBSP–Izar (2004); and JSP–Izar *et al.* (in prep.). We also describe a field experiment with a group of approximately 50 free-ranging monkeys in a 7 ha forest fragment in Florínea, São Paulo, to test the ability to elicit the "rumble call" vocalization by producing loud sudden noises. This fragment is surrounded by a sugar cane plantation and has a road running through it. We performed the experiment at this field site because staff from the other parks did not permit shooting fireworks, and because observations of the monkeys were easier in the forest fragment. We did not recognize individuals in this group.

Methods

Field observations

Monkeys from TEP were followed from March 2000 to April 2004 by BDR and Michele Verderane, for a total of 3500 hours of observation. Monkeys from CBSP were followed from November 2001 to December 2002 by Patrícia Izar, for a total of 1032 hours of observation, and monkeys from JSP were followed from January 2004 to July 2004 by EDRS, for a total of 485 hours of observation. All occurrences of these calls were collected in each site, and, whenever possible, we registered the precipitating sound (e.g.: thunder, firecracker, explosion), which individual emitted the call, and other behaviors that coincided with the vocalization. One limitation to the study was that there was only one researcher working at each site at a given time, and a single individual is unable to monitor all the group members simultaneously.

Field experiment

In order to generate more controlled observations of the behaviors and contexts involved in the rumble calls, we performed the following experiment with a group of free-ranging monkeys in Florínea. A total of eight firecrackers were shot into the air, with a minimum interval of 30 min between each shot. Two shots were executed on 20 June 2004, at 17:00 and 17:30; and six on 21 June 2004, from 07:00 to 11:00. To record the vocalizations, we used a Sennheiser ME-67™ microphone and a Sony TCD-D8™ DAT recorder. Recordings started 5 min before each shot and ceased 5 min after it. Whenever possible, the number of monkeys visible during the shots was registered, as well as their age class and the behaviors they displayed immediately after the explosions. However, it was not possible to register how many monkeys vocalized each time, or where all of them looked, or the behavior of every visible monkey.

We converted the audio recordings into wave files in an AMD Athlon XP™ computer with a Philips PSC-706™ soundcard and analyzed them with the Avisoft SASLab Pro™ software. We generated sonograms with a 22 kHz sampling rate and measured time and frequency parameters of calls.

Results

Field observations

Table 1 summarizes the frequency of rumble call events in capuchin monkey groups from three parks in São Paulo. In most observations, multiple individuals gave the rumble call and some group members were observed looking at each other, or running towards each other, giving the impression that they were looking for social contact. Capuchins never emitted this vocalization when there was no precipitating loud sudden noise. However, on some occasions when we were traveling with the monkeys, we heard thunder or other explosions but the monkeys did not respond with rumble calls. In these cases, the explosions tended to be quieter and more distant.

Table1. Frequencies of contexts of capuchin monkey rumble call events in three parks in São Paulo, Brazil. TEP = Tietê Ecological Park; JSP = Jaraguá State Park; CBSP = Carlos Botelho State Park. *Possible causes for rumble calls classified as unidentified in JSP include trucks passing by and objects falling to the ground. Each event that resulted in rumble calls is counted as one observation. Each observation may include vocalizations by several monkeys.

	TEP	JSP	CBSP
Thunder	12	3	7
Firecrackers	23	3	1
Quarry Explosions	0	9	0
Low-Flying Plane	0	0	1
Unidentified	3	19*	0
Total	38	34	9

Field experiment

In all of the eight cases in which we experimentally fired shots, the capuchin monkeys emitted rumble calls immediately after the shots. Capuchins in the sugar cane plantation or in the road ran towards the forest immediately after the shots and vocalized only after they had entered the forest. Both adults (males and females) and juveniles emitted the vocalization. It was not possible to determine if infants vocalized. Rumble calls (Fig. 1) occur as series of harsh pulses, with each pulse lasting about 100 to 120 ms. They reach 7–10 kHz, but the energy is concentrated between 0,9 – 3 kHz. They form quick trails of pulses (up to 15/second), with emissions lasting from 10 to 20 seconds after each firecracker was shot. The most intense calls took place immediately after the firecrackers exploded, with the vocalizations dampened by the noise of the firecracker. This fact, and the occurrence of simultaneous emissions by several individuals, complicates sound analysis. On 21 June 2004, while we were waiting 30 minutes between a shot and the next one, a vehicle with a damaged exhaust pipe passed along the road and emitted explosive noises that also elicited the monkeys' rumble calls.

Discussion

The rumble call is contingent on thunder, skyrockets, explosions or other explosive noises. Both juveniles and adults make the rumble vocalization. At the moment, we cannot determine the role of learning in the development of the rumble call, but it probably has a strong innate component, as the same vocalization was heard in different and distant populations, always contingent upon the same type of external stimulus (Argentina: Di Bitetti; Suriname: Boinski; Northeast and Southeast of Brazil: Izar, Resende, Verderane and Ramos da Silva). For example, Patrícia Izar reported that similar rumble calls were emitted on two occasions immediately after thunder by members of a group of *Cebus libidinosus* from Gilbués, Piauí, Brazil in the course of 42 hours of contact time (Patrícia Izar, pers. comm.).

Apparently, the sound is a stimulus that elicits the monkey's vocalizations. The signaler and the receivers fled from unprotected sites. If it is an adaptive behavior, with an innate component, we wonder what kind of fitness benefit it could provide. As the calls were mainly emitted in response to explosive noises, and as we have registered that monkeys ran to the trees just after listening them, we could hypothesize this vocalization is a sort of alarm call, impelling the monkeys to protect themselves, possibly from a thunderstorm, or from a tree falling. However, according to Di Bitetti (pers. comm.), the acoustic structure of the rumble call is not ideal for long-distance communication, and it does not seem to have any acoustic similarity to other spacing calls, which seem to be related to each other. As Seyfarth (1988) states, there is a direct relation between the function of a call and its

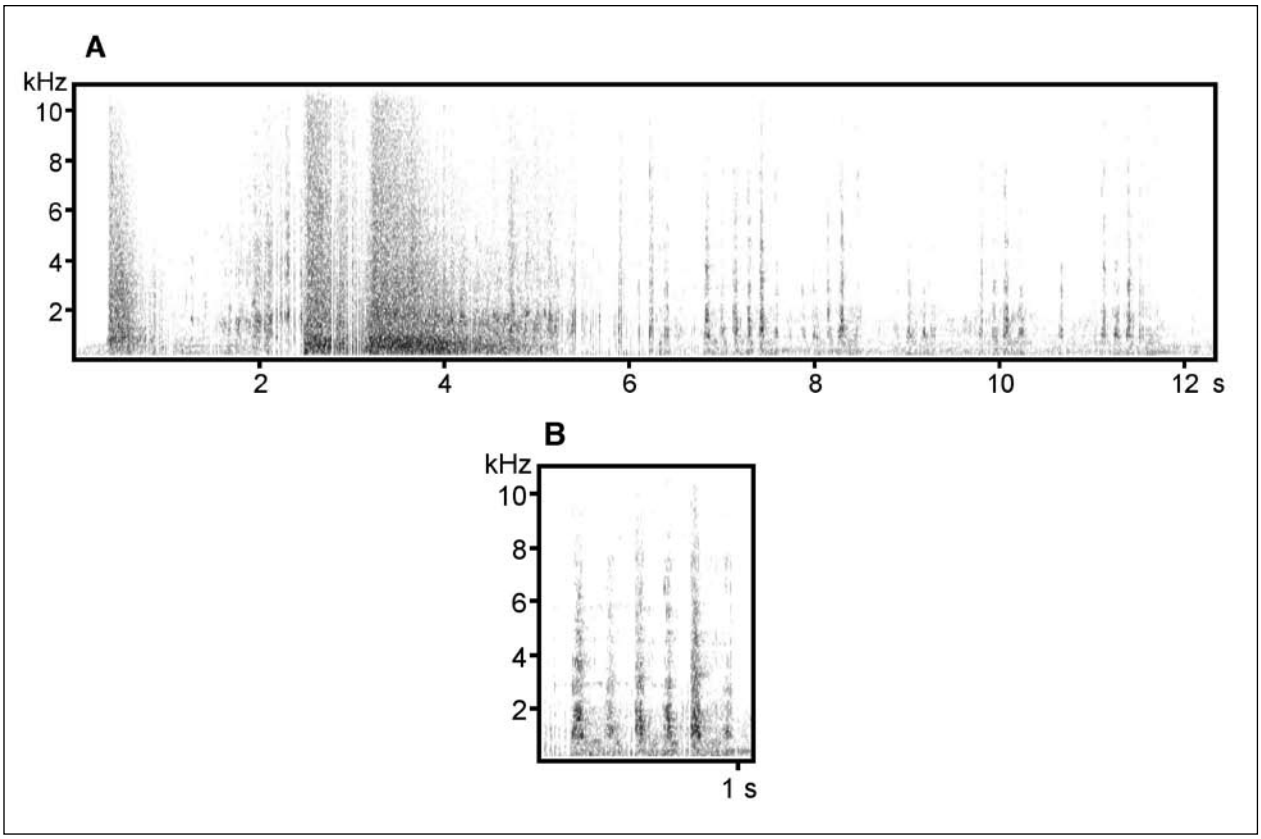

Figure 1. Sonograms depicting the noise stimuli and elicited vocalizations. A) An experimental session with skyrocket rumbles visible as most intense (darker) and longer sounds at approximately 0.3, 2.5 and 3.1 s. Rumble calls are more clearly visible after rumbles, as trails of pulses. B) An amplified section of the first sonogram, showing six calling pulses.

acoustic properties: a call that cannot be heard by subjects far from the signaler cannot be considered an alarm call. For Di Bitetti, the rumble call is a vocalization, produced mostly by adult or sub-adult males, that serves to mediate social relationships among them, and has no relationship with the cohesion-spacing vocal system or the alarm call system. In 16% of his records, this vocalization was produced in social contexts, mostly during reunion displays, without any previous explosive sound. That is why he believes it may function as an appeasement call; this could explain its occurrence during tense situations. The fact that we also scored female vocalizations indicates that, even if it is related to social mediation, this behavior is not exclusively male.

In conclusion, we know that loud explosive noises elicit this vocalization, and that it is similar across populations from different and distant parts of São Paulo State. Juveniles, males and females give rumble calls. As far as we know, non-tufted *Cebus* do not exhibit any rumble calls in response to explosive noises. The biological function of the rumble call and its ontogeny are interesting puzzles that demand more elaborate experimental designs. These experiments should focus on individual observations of subjects from different age and sex classes, scoring their vocal behavior, and the response exhibited just after explosions.

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References

Boinski, S., Gross, T. S. and Davis, J. K. 1999. Terrestrial predator alarm vocalizations are a valid monitor of stress in captive brown capuchins (*Cebus apella*). *Zoo Biology* 18: 295–312.

Di Bitetti, M. 2001. Food-associated calls in tufted capuchin monkeys (*Cebus apella*). Doctoral thesis, State University of New York at Stony Brook, New York.

Di Bitetti, M. 2003. Food-associated calls of tufted capuchin monkeys (*Cebus apella nigritus*) are functionally referential signals. *Behaviour* 140: 565–592.

Fichtel, C. and Hammerschmidt, K. 2002. Responses of red-fronted lemurs to experimentally modified alarm calls: Evidence for urgency-based changes in call structure. *Ethology* 108: 763–777.

Fichtel, C. and Kappeler, P. M. 2002. Anti-predator behavior of group-living Malagasy primates: Mixed evidence for a referential alarm call system. *Behav. Ecol. Sociobiol.* 51: 262–275.

Izar, P. 2004. Female social relationships of *Cebus apella nigritus* in a southeastern Atlantic forest: An analysis through ecological models of primate social evolution. *Behaviour* 141: 71–99.

Maccowan, B., Franceschini, N. V. and Vicino, G. 2001. Age differences and developmental trends in alarm peep responses by squirrel monkeys (*Saimiri sciureus*). *Am. J. Primatol.* 53: 19–31.

Miller, C. T. and Ghazanfar, A. A. 2002. Meaningful acoustic units in nonhuman primate vocal behavior. In: T*he Cognitive Animal*, C. Allen, M. Bekoff and G. M. Burghard (eds.), pp.265–273. The MIT Press, Cambridge.

Oliveira, D. A. G. and Ades, C. 1998. Proximity and grooming interactions as indicators of the social organization of brown howler monkeys (*Alouatta fusca clamitans*). *Neotrop. Primates* 6: 115–117.

Ottoni, E. B. and Mannu, M. 2001. Semifree-ranging tufted capuchins (*Cebus apella*) spontaneously use tools to crack open nuts. *Int. J. Primatol.* 22: 347–358.

Robinson, J. G. 1982. Vocal systems regulating within-group spacing. In: *Primate Communication*, C. T. Snowdon, C. H. Brown and M. R. Petersen (eds.), pp.94–116. Cambridge University Press, Cambridge, UK.

Seyfarth, R. M. 1988. Vocal communication and its relation to language. In: *Primate Societies*, B. B. Smuts, D. L. Cheney, R. M. Seyfarth, R. W. Wrangham and T. T. Struhsaker (eds.), pp. 440 – 451. The University of Chicago Press, Chicago.

Seyfarth, R. M., Cheney, D. L. and Marler, P. 1980. Vervet monkey alarm calls: Semantic communication in a free-ranging primate. *Anim. Behav.* 28: 1070–1094.

Seyfarth, R. M. and Cheney, D. L. 1986. Vocal development in vervet monkeys. *Anim. Behav.* 34: 1640–1658.

Seyfarth, R. M. and Cheney, D. L. 2003. Meaning and emotion in animal vocalizations. *Ann. N.Y. Acad. Sci.* 1000: 32–55.

Snowdon, C. T. and Pola, Y. V. 1978. Interspecific and intraspecific responses to synthesized pygmy marmoset vocalizations. *Anim. Behav.* 26: 192–206.

Struhsaker, T. T. 1967. Auditory communication among vervet monkeys (*Cercopithecus aethiops*). In: *Social Communication Among Primates*, S. A. Altmann (ed.), pp.281–324. The University of Chicago Press, Chicago.

Waser, P. M. 1982. The evolution of male loud calls among mangabeys and baboons. In: *Primate Communication*, C. T. Snowdon, C. H. Brown and M. R. Petersen (eds.), pp.117–143. Cambridge University Press, New York.

Extragroup Copulations Among Brown Howler Monkeys in Southern Brazil

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Introduction

Like most other howler monkeys, brown howlers (*Alouatta guariba*) form one-male groups with up to 10 individuals. Even if there is more than one adult male, the alpha male howler monkey usually monopolizes all reproductive females and sires all young (Pope, 1990). However, extragroup copulations (EGCs) have been observed in *Alouatta pigra* (Horwich, 1983) and *A. seniculus* (Agoramoorthy and Hsu, 2000). Here we report the first EGCs observed in *A. guariba clamitans.*

Methods

We studied brown howler troops in hillside forest in Porto Alegre (30°12'S, 51°04'W), Brazil, during the summer (Nov 1998 – Jan 1999, 483 obs. hours) and winter (Jun – Aug 1999, 386 obs. hours; Fialho and Setz, 2000). Study group GA was comprised of three adult males, three adult females, and four immatures. An adult male had emigrated from this group in October 1999 (MMA Jardim, pers. comm.). A neighboring group (GB) had five individuals. The GB alpha male was larger and had a more intense reddish coloration than any GA adult male.

Results

Daily inter-group encounters between the study groups were accompanied by extended vocalizations, but they were usually peaceful. However, an aggressive encounter between GA and GB occurred on June 12. During this encounter, the GA group chased and bit individuals from GB, and one GB individual fled to the ground. Only the GB alpha male was not attacked. Shortly after this aggressive encounter, the GB alpha male copulated with a GA female, just a few meters away from other GA group members. The observing males of GA group did not react. On June 13, the same two individuals performed two more EGCs. In the morning, the male inspected the female's genitalia twice and copulated with her; an hour and a half later, the large GB male was feeding in a *Ficus* tree where GA group was resting. The GB male approached their group more closely, and GA group members became agitated. The GB alpha male vocalized within a few meters of the group, and the female left her group and followed him for about 50 meters. The female produced nasal sounds ("Hummm, hummm"), while flick-

ing her tongue rhythmically in and out of her mouth. The male approached and mounted her.

On the days that the EGCs were observed (June 12 and 13) no within-group copulations were observed for the GA group. We did not follow the group on June 14 and 15. Early on June 16, the GB alpha male visited GA's home range again; he approached, vocalized and left, followed by the same female as above. Simultaneously, another female disappeared from GA, but minutes later the two females reappeared in the group. Later on the same day we saw three copulations involving a resident GA male and the female that had copulated with the GB male. This was the first within-group sexual activity we had observed in GA. A group GA female carrying an infant observed the copulations but did not react. In summary, all EGC copulations occurred in the mornings, and each one lasted a minute or less. About five minutes after each EGC, the GB male chased the female for several meters. All EGCs involved the same pair and occurred at the periphery of GA's area, where home ranges overlapped. The GB male did not follow the GA group when it moved away from the edge of its range after these encounters.

Discussion

Extragroup copulations have been described both in Old (Smuts, 1987) and New World monkeys (Digby, 1999), and in monogamous (Mason, 1966; Palombit, 1994; Reichard, 1995) as well as polygynous species, including *Alouatta* spp. (Horwich, 1983; Agoramoorthy and Hsu, 2000). The behavioral repertoire of *A. pigra* during EGCs (Horwich, 1983) is more diverse than in *A. guariba.* However, the male vocalization in our study has not been described for either *A. pigra* or *A. seniculus*. In general, EGCs are similar across *Alouatta* species. For example, after male solicitation, the female moves towards the male (Horwich, 1983), and rhythmic tongue flicks precede copulations (Horwich, 1983; Mendes, 1989; Agoramoorthy and Hsu, 2000). Genital inspection was observed in both *A. seniculus* (Agoramoorthy and Hsu, 2000) and in *A. guariba* (this study). Extra-group copulations last about one minute across *Alouatta* species (Horwich, 1983; Agoramoorthy and Hsu, 2000; this study). After copulation the male chases the female (Horwich, 1983) and no agonistic behaviors are directed at the female by her group mates (Horwich, 1983; Agoramoorthy and Hsu, 2000). In 44% of observed EGCs in *A. seniculus*, one or more resident males had visual contact with the mating pair but did not react (Agoramoorthy and Hsu, 2000); group members also appeared indifferent to EGCs in this study.

EGCs may be rare in *Alouatta* compared to other primates. In the common marmoset, *Callithrix jacchus*, for example, EGCs occur frequently during group encounters, and males act aggressively and chase females after copulations (Digby, 1999). Among primates, females are responsible for most copulation solicitations (Smuts, 1987). In all *A. seniculus* EGCs, it was the female who took the lead (Agoramoorthy and Hsu, 2000). In *A. guariba* females also initiated EGCs. The few data available suggest that females are more prone to EGCs in multi-male groups (Horwich, 1983; Agoramoorthy and Hsu, 2000; Kowalewski *et al.,* 2006).

Observations of EGCs in *Alouatta* are consistent with two hypotheses proposed by Smuts (1987) to explain female mate choice: (a) the search for genetically superior males and (b) the preference for non-familiar males (see also Agoramoorthy and Rudran, 1993). The first hypothesis is supported by observations on *A. guariba* (this study) and *A. seniculus* (Agoramoorthy and Hsu, 2000) in which males involved in EGCs were noticeably larger than those belonging to the female's group. Agoramoorthy and Hsu (2000) suggested that by copulating with neighboring males a female could reduce the likelihood of infanticide if her group was taken over by a new male. Six out of seven *A. seniculus* females involved in EGCs had previously lost infants through infanticide (Agoramoorthy and Hsu, 2000). EGCs could also be a prelude to female dispersal to the neighboring group. However, in our group, this had not occurred by January 2000, when both GA females gave birth in GA (MMA Jardim, pers. comm.). The small number of EGCs observed in howler monkeys does not yet allow us to falsify any of these competing hypotheses.

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References

Agoramoorthy, G. and Hsu, M. J. 2000. Extragroup copulation among wild red howler monkeys in Venezuela. *Folia Primatol*. 71: 147–151.

Agoramoorthy, G. and Rudran, R. 1993. Male dispersal among free-ranging red howler monkeys (*Alouatta seniculus*) in Venezuela. *Folia Primatol*. 61: 92–96.

Digby, L. J. 1999. Sexual behavior and extragroup copulations in a wild population of common marmosets (*Callithrix jacchus*). *Folia Primatol*. 70: 136–145.

Fialho, M. S. and Setz, E. Z. F. 2000. Brown howler (*Alouatta fusca*) feeding ecology in hillside and coastal forests in southern Brazil. *Am. J. Primatol*. 51: 56–57.

Horwich, R. H. 1983. Breeding behaviors in the black howler monkey (*Alouatta pigra*) of Belize. *Primates* 24: 222–230.

Mason, W. A. 1996. Social organization of the South American monkey, *Callicebus moloch*: A preliminary report. *Tulane Studies in Zoology* 13: 23–28.

Mendes, S. L. 1989. Estudo ecológico de *Alouatta fusca* (Primates: Cebidae) na Estação Biológica de Caratinga, MG. *Revista Nordestina de Biologia* 6: 71–104.

Palombit, R. A. 1994. Extra-pair copulations in a monogamous ape. *Animal Behaviour* 47: 721–723.

Pope, T. R. 1990. The reproductive consequences of male cooperation in the red howler monkey: Paternity exclusion in multi-male and single-male troops using genetic markers. *Behav. Ecol. Sociobiol.* 27: 439–446.

Reichard, U. 1995. Extra-pair copulations in a monogamous gibbon (*Hylobates lar*). *Ethology* 100: 99–112.

Smuts, B. B. 1987. Sexual competition and mate choice. In: *Primate Societies,* B. B. Smuts, D. L. Cheney, R. M. Seyfarth, R. W. Wrangham and T. T. Struhsaker (eds.), pp.385–399. The University of Chicago Press, Chicago.

Golden Lion Tamarins, *Leontopithecus Rosalia* (Linnaeus, 1766) in the Taquara Municipal Natural Park (Duque De Caxias, RJ): A Southern Extension of the Known Range

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Introduction

The golden lion tamarin, *Leontopithecus rosalia* (Linnaeus, 1766), is an endangered species (IUCN, 2004) according to the World Conservation Union, Species Survival Commission. The first geographical study of this species, by Wied-Neuwied (1826), described *L. rosalia* as distributed along the coast of the state of Rio de Janeiro between 22˚and 23˚S, from the São Tomé Cape to the municipality of Mangaratiba. In 1969, Coimbra-Filho hypothesized that the historical distribution of this lion tamarin species extended across the length of the coast of the state of Rio de Janeiro in lowland forests and at low altitudes usually not exceeding 300 m a.s.l. (Coimbra-Filho, 1969; Kleiman and Rylands, 2002). According to Coimbra-Filho, the historical distribution of *L. rosalia* comprised several municipalities of the Fluminense lowlands, including Duque de Caxias. Based on population counts performed between 1962 and 1969, Coimbra-Filho reported that *L. rosalia* was extinct in 17 municipalities, including Duque de Caxias (Coimbra-Filho, 1969; Kleiman and Rylands, 2002).

In the 1990s, censuses across the range of *L. rosalia* by Kierulff (1993) and later, Kierulff and Procópio de Oliveira (1996) found *L. rosalia* in only four of the municipalities described by Coimbra-Filho: Silva Jardim, Casimiro de Abreu, Cabo Frio, and Saquarema. More recently, *L. rosalia* was found in Araruama in some mountainous areas of Macaé de Cima (Rylands *et al.*, 1993), but this recent expansion of their range clearly resulted from human interference and is not indicative of past distribution. In the most recent census of *L. rosalia* distribution (Kierulff and Rylands, 2003), the authors reported a population of 562 individuals distributed in groups of three to six and restricted to the aforementioned four municipalities. They also reported reintroduced populations throughout the length of the BR-101 road between the municipalities of Rio Bonito and Casimiro de Abreu in Rio de Janeiro state. Here, we report the occurrence of golden lion tamarins in the Taquara Municipal Natural Park, a conservation unit of the municipality of Duque de Caxias (RJ), where the species was considered extinct during the most recent census (Kierulff and Rylands, 2003).

Materials and Methods

In August 2006, golden lion tamarins were observed in the Taquara Municipal Natural Park (22º35' S, 43º14' W, approximately 76 m a.s.l.), municipality of Duque de Caixas, Rio de Janeiro. The 190 km^2 park was created according to Law 1157 (November 11, 1992), and its northern limit is the Taquara River, near the Núcleo Colonial of Duque de Caxias District Three (Fig. 1). The lion tamarins were observed by the authors during visits to the park guided by biologists.

Results and Discussion

Based on reports of the presence of golden lion tamarins near the conservation unit, we interviewed local inhabitants and showed them pictures to identify the species they had observed. When golden lion tamarins were confirmed as the species sighted, we began periodic morning surveys by walking existing trails close to the areas where the animals had been spotted. In the first encounter with lion tamarins, we observed a non-habituated group of approximately 12 animals that fled towards the Environmental Protection Area of Petrópolis (APA Petrópolis), a conservation unit contiguous with the Taquara Municipal Natural Park. Subsequent sightings of the same group were recorded at an altitude of approximately 76 m a.s.l. Occasionally, the group was observed foraging in sympatry with groups of *Callithrix jacchus*, *Callithrix penicillata* and, possibly, hybrids of these two introduced marmoset species.

Increased control of access into Taquara Municipal Natural Park will allow *L. rosalia* to safely utilize the forest

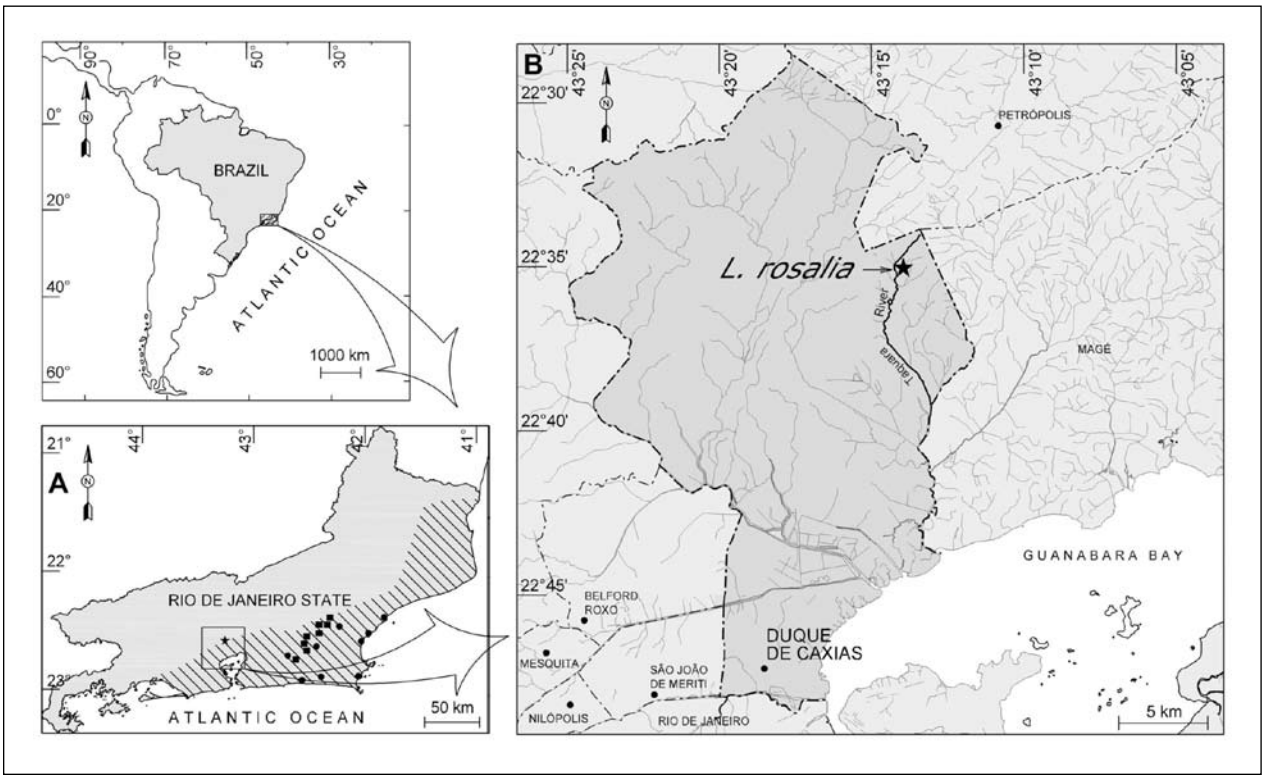

Figure 1. (**A**) State of Rio de Janeiro (RJ), with the original distribution of *Leontopithecus rosalia* (**lines**) and fragmented current distribution (< reintroduced population and =town, according to Rylands *et al*., 2002). (**B**) Map indicating the location of the *L. rosalia* group seen in the Taquara Municipal Natural Park (**star**) in the municipality of Duque de Caxias, Rio de Janeiro (RJ), the new southernmost location for the species.

here, as well as in the higher altitude protected area of the APA Petrópolis. Research on home range use, activity budget, and interspecific interactions with other monkey species by this lion tamarin group (possibly with the aid of radiotelemetry) at the park, as well as an assessment of the size of this golden lion tamarin population, its genetic structure, distribution, and possible threats to its survival, are urgently needed to evaluate its long-term viability. These data will also serve as baseline information for future programs of population supplementation or species reintroduction.

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References

Coimbra-Filho, A. F. 1969. Mico-Leão, *Leontideus rosalia* (Linnaeus, 1766): Situação atual da espécie no Brasil (Callitrichidae, Primates). *Anais Acad. Brasil. Ciências* 41 (Suppl.): 29–52.

IUCN. 2004. Red List of Threatened Species. <www.redlist.org>.

Kierulff, M. C. M. 1993. Status and distribution of the golden lion tamarin in Rio de Janeiro. *Neotrop. Primates* 1(4): 23–24.

Kierulff, M. C. M. and Procópio de Oliveira, P. 1996. Reassessing the status and conservation of the golden lion tamarin *Leontopithecus rosalia* in the wild. *Dodo*, *J. Wildl. Preserv. Trust* 32: 98–115.

Kierulff, M. C. M. and Rylands, A. B. 2003. Census and distribution of the golden lion tamarin (*Leontopithecus rosalia*). *Am. J. Primatol.* 59(1): 29–44.

Kleiman, D. G. and Rylands, A. B. 2002. *Lion Tamarins: Biology and Conservation*. Smithsonian Institution Press, Washington, DC.

Rylands, A. B., Coimbra-Filho, A. F. and Mittermeier, R. A. 1993. Systematics, geographic distribution, and some notes on the conservation status of the Callitrichidae. In: *Marmosets and Tamarins: Systematics, Behaviour and Ecology*, A. B. Rylands (ed.), pp.11–77. Oxford University Press, Oxford.

Rylands, A. B., Kierulff, M. C. M. and Pinto, L. P. S. 2002. Distribution and status of lion tamarins. In: *Lion Tamarins: Biology and Conservation*, D. G. Kleiman and A. B. Rylands (eds.), pp.42–70. Smithsonian Institution Press, Washington, DC.

Wied-Neuwied, Prinz Maximilian zu, 1826. *Beiträge zur Naturgeschichte von Brasilien, vol.2*.

Black-Tufted-Ear Marmoset *Callithrix Penicillata* (Primates: Callitrichidae) Following the Army Ant *Labidus Praedator* (Formicidae: Ecitoninae) in the Cerrado and the Atlantic Forest, Brazil

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Fernando José Zara

Introduction

Army ants have different intra- and extranidal symbiotic associations with invertebrates and vertebrates (Gottwald, 1995). Vertebrates that feed on arthropods disturbed by the army ants include the anuran *Bufo marinus*; lizards such as *Ameiva, Kentropyx, Anolis frenatus*, and *Tupinambis merianae*; a large number of birds; and callitrichids (Willis and Oniki, 1978, 1992; Rylands *et al.*, 1989; Martins, 2000; Melo Júnior and Zara, pers. observ.). The best studied associations between vertebrates and army ants in the Neotropical region are those between birds and ants. More than 50 species from the families Cuculidae, Cracidae, Dendrocolaptidae, Formicariidae, Thamnophilidae, Rallidae, Tinamidae and Thraupidae have been observed to follow army ants and to pick off arthropods flying or sitting on forest litter that was disturbed by the army ants *Eciton burchelli* and *Labidus praedator* (Willis and Oniki, 1978, 1992). According to Gottwald (1995), swarm-following birds have to compete with marmosets for this food resource stirred up by progressing army ants. However, marmosets only opportunistically exploit the arthropods flushed by swarms of *E. burchelli* and *L. praedator* (Rylands *et al.*, 1989; Martins, 2000). These two army ant species present a similar broad swarm-raiding pattern (Teles da Silva, 1982; Rylands *et al.*, 1989; Gottwald, 1995) that may cause higher prey disturbance in the forest litter than the columnar raiding pattern of *Eciton hamatum* (Teles da Silva, 1982).

In the Neotropics, five species from the genus *Callithrix*— *C. humeralifer, C. kuhli, C. flaviceps, C. geoffroyi,* and *C. aurita*— have been reported to take arthropods over swarms of army ants (Rylands *et al.*, 1989; Martins, 2000). Marmosets seem to associate more frequently with *E. burchelli* than with *L. praedator* (Rylands *et al.*, 1989), and *C. aurita* was only observed in association with *Labidus* sp. during the dry season (Martins, 2000). Association with army ants has not been recorded for *C. penicillata* and *C. jacchus* so far, possibly due to a relative scarcity or absence of army ants in the drier regions of cerrado (Brazilian savanna) and semi-deciduous scrub and woodlands of Brazilian caatinga (Rylands *et al.*, 1989). However, *L. praedator* has a wide geographic distribution and ranges from central Mexico (San Luis Potosi) to northern Argentina (Borgmeier, 1955; Rettenmeier, 1963); it has been collected in some regions of the Cerrado (Kempf, 1972; Watkins, 1976). Here we report the association between *Callithrix penicillata* and the army ant *L. praedator* on three different occasions at two localities in the Cerrado and the Atlantic Forest of Brazil.

Methods

One observation was made during a field study in the Parque Estadual Fernão Dias (44°04'W, 19°56'S), Minas Gerais, located in a transitional area between the Atlantic Forest and the Cerrado. This protected area has about 2000 ha and varies in altitude between 850 and 950 m a.s.l. (Melo Júnior, 2000). The other two observations were made at the Parque Estadual da Ilha Anchieta (45°01'W, 23°32'S), Ubatuba, São Paulo. This protected 828-ha island is located 600 m from the continent. Both observations on the island were made at different points of the Saco Grande trail, which crosses a fragment of rainforest. In March 1983, five *C. penicillata* were introduced to Ilha Anchieta by the Fundação Parque Zoológico de São Paulo (Guillaumon *et al.*, 1989), and now these marmosets are the most abundant primate on this island (Galetti, pers. comm.). Army ant samples were collected and identified as *L. praedator* according to Borgmeier (1955, p. 84: major worker) and Watkins (1976: worker key 8).

Results and Discussion

The first association was observed on 11 October 1999, in the late dry season. A group of seven black-tufted marmosets, *C. penicillata*, was seen following the army ant *L. praedator*. Total observation time lasted 42 minutes, but the total time that this group followed the army ants was longer, because the marmosets were already near the ground when observations began. On eight different opportunities, individual marmosets were seen to take insects on the ground, an uncommon behavior for marmosets. Two other observations of *C. penicillata* following the army ant *L. praedator* were made on 23 January 2000 and 7 February 2003, both during the rainy season on Ilha Anchieta. The first observation lasted for 12 min and occurred at 08:45. Two individuals from a group of six individuals were seen close to the swarm front, at about 0.5 m from the ground. The other members sat on branches at around 3–5 m above ground and emitted alarm calls towards the observers. To avoid interference, we retreated to a distance of 5 m and made further observations using binoculars. Marmosets were observed taking arthropods from the ground. The army ants showed a small swarm front (0.5 m wide) near the marmosets. Other swarm fronts (not exploited by marmosets) were observed, but most of the ants remained in columns. The raiding pattern seemed more columnar, similar to the description by Fowler (1979). The marmosets stopped foraging over the army ants due to disturbance from arriving tourists. The second record started at 09:15 when a group of seven marmosets was observed capturing flushed arthropods over the swarm front during 38 min. This time the army ants were foraging in a swarm raiding pattern, similar to descriptions by Borgmeier (1955) and Rettenmeier

(1963). This swarm raid was more vigorous than the first and more than 2 m wide. The marmosets were positioned at the front of the swarm and over the fan area on branches at 0.3–1 m above ground. Three different individuals were observed going down to the ground and capturing arthropods ahead of the swarm on seven different occasions.

Our observations indicate that *C. penicillata* may follow the army ant *L. praedator* and use disturbed arthropods as a food source, similar to what has been described for *C. humeralifer, C. kuhli, C. flaviceps, C. geoffroyi* (Rylands *et al.*, 1989), and *C. aurita* (Martins, 2000). Flushed arthropods captured by the marmosets included crickets, grasshoppers, cockroaches, and spiders, in line with what has been described for other *Callithrix* species (Rylands *et al*., 1989; Martins, 2000). Moths, true bugs (Hemiptera), and beetles that are usually preyed upon by *L. praedator* (Borgmeier, 1955; Rettenmeier, 1963; Gottwald, 1995) were also preyed upon by the marmosets during our observations. We did not observe the marmosets taking prey that had been captured by the army ants, as reported for *C. humeralifer* by Rylands *et al*. (1989).

The *C. penicillata* individuals that captured insects were located on branches below 1 m, similar to other *Callithrix* species during ant following (Rylands *et al.*, 1989). They were always in the center of the swarm front or fan area. This positioning resembles that described for dominant birds during ant following. According to Willis and Oniki (1978, 1992), large dominant birds occupy the central and probably best zone of high prey disturbance in the swarm front, while medium-sized birds were chased off to more peripheral zones with fewer flushed arthropods. According to Martins (2000), for *C. aurita* following army ants is more attractive during the dry months, when availability of arthropods and other resources is low. Paradoxically, during the dry and cold months, *L. praedator* performs fewer and less intense raids (Fowler, 1979). For *C. penicillata*, following behavior seems to be more opportunistic and related to the presence or absence of the army ants in swarm raid pattern rather than to season. Rylands *et al*. (1989) suggested that this association has not been observed for *C. penicillata* and *C. jacchus* possibly due to the relative scarcity or absence of this ant species in their ranges. This is probably true for *C. jacchus* in the Caatinga, where there are no records for *L. praedator*. In the Cerrado, however, *L. praedator* is one of the most common army ants collected (Zara, unpubl. data), and original records of these army ants in the Cerrado were presented in Kempf (1972) and Watkins (1976).

Acknowledgments

We are grateful to the directors of Parque Estadual da Ilha Anchieta (Instituto Florestal – SP) and Parque Estadual Fernão Dias for permits to visit these areas. TAMJ received grants from FAPESP (97/04642-2) and CNPq. FJZ extends thanks to FAPESP (proc. 05/04707-5). Our gratitude to Cynthia P. A. Prado for smoothing out the English, and to Simone Batalha Velten and Alexandre de Almeida for field assistance.

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References

Auricchio, P. 1995. *Primatas do Brasil*. Terra Brasilis, São Paulo.

Borgmeier, T. 1955. Die Wanderameisen der Neotropischen Region (Hym. Formicidae). *Studia Ent.* 1: 1–716

Eisenberg, J. F. and Redford, K. H. 1999. *Mammals of the Neotropics, Vol 3*: *The Central Neotropics: Ecuador, Peru, Bolivia, Brazil*. The Chicago University Press, Chicago.

Fowler, H. G. 1979. Notes on *Labidus praedator* (Fr. Smith) in Paraguay (Hymenoptera: Formicidae: Dorylinae: Ecitonini). *J. Nat. Hist.* 13: 3–10.

Gottwald Jr., W. H. 1995. *The Army Ants: The Biology of Social Predation*. Cornell University Press, London.

Guillaumon, J. R. *et al.* 1989. *Plano de manejo do Parque Estadual da Ilha Anchieta*. Instituto Florestal Série Registro, São Paulo.

Kempf, W. W. 1972. Catálogo abreviado das formigas da Região Neotropical. *Studia Ent.* 15: 3–344.

Martins, M. M. 2000. Foraging over army ants by *Callithrix aurita* (Primates: Callitrichidae): Seasonal occurrence? *Rev. Biol. Trop* 48: 261–262.

Melo Júnior, T. A. 2000. Morfometria, comportamento alimentar e social do cuitelão, *Jacamaralcyon tridactyla* (Piciformes: Galbulidae) em duas reservas no Estado de Minas Gerais. Dissertação de Mestrado, UNESP, Rio Claro, SP.

Rettenmeyer, C. W. 1963. Behavioral studies of army ants. *Univ. Kans. Sci. Bull.* 44: 281– 465.

Rylands, A. B., Monteiro da Cruz, M. A. O. and Ferrari, S. F. 1989. An association between marmosets and army ants in Brazil. *J. Trop. Ecol.* 5: 113–116.

Teles da Silva, M. 1982. Behaviour of army ant *Eciton burchelli* and *E. hamatum* (Hymenoptera: Formicidae) in the Belen region. III. Raid activity. *Ins. Soc.* 29: 243–267.

Watkins, J. F. 1976. *The Identification and Distribution of New Word Army Ants (Dorylinae: Formicidae).* Baylor University Press, Waco.

Willis, E. O. and Oniki, Y. 1978. Birds and army ants. *Ann. Rev. Ecol. Syst.* 9: 342–263.

Willis, E. O. and Oniki, Y. 1992. Aves e as formigas de correição. *Bol. Mus. Paraense E. Goeldi* 8: 123–150.

News

Instalação de Cercas para Evitar a Predação de Frutos de Cacau por Macacos-Prego em Rondônia, Brasil

Marcelo Marcelino de Oliveira
Marcos de Souza Fialho

Na Estação Experimental em Ouro Preto do Oeste, no estado de Rondônia, Brasil, terá inicio a implementação de modelos experimentais de cercas para evitar a predação de frutos de cacau (*Theobroma cacao*) por macacos-prego (*Cebus apella*). Esta ação é resultado de um trabalho de negociação do Centro de Proteção de Primatas Brasileiros, órgão especializado em conservação e manejo de primatas do Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis (CPB-IBAMA), para resolver uma situação de conflito entre primatas e agricultores. A lavoura de cacau é uma cultura em expansão na Amazônia, fomentada pelo Ministério da Agricultura através da Comissão Executiva do Plano da Lavoura Cacaueira (CEPLAC), tendo como foco pequenos agricultores em áreas de assentamento rural. A predação de frutos de cacau por *Cebus apella* começou a ser constatada pela CEPLAC em sua Estação Experimental há mais de dois anos e registros de predação em propriedades rurais já foram comunicadas à Superintendência do IBAMA em Rondônia (Supes-RO). O aumento da predação nas áreas de experimento e de produção de cacau na estação, levou a CEPLAC a solicitar à Gerência Executiva do IBAMA em Ji-Paraná (RO) providências para retirada dos animais, pedindo inclusive apoio ao Ministério Público Federal visando pressionar o IBAMA nesse sentido. Um estudo elaborado pela Universidade Federal de Rondônia (UNIR) em setembro deste ano, a pedido da CEPLAC, identificou oito espécies de primatas na área e registrou a ocorrência de dois grupos de *Cebus apella*, além de alguns indivíduos solitários (Messias *et al*., 2006). O estudo recomendou a translocação de um desses grupos, constituído aparentemente por até 20 animais. Em reunião realizada em Porto Velho (RO) no dia 13 de novembro de 2006, com a participação da CEPLAC, da Supes-RO e da UNIR, os representantes do CPB conseguiram o convencimento de que a melhor solução para o conflito era o cercamento das áreas experimentais de plantio de cacau, mantendo-se assim a convivência com os animais. Em visita a área em Ouro Preto do Oeste foi definida a implantação de dois modelos de cerca, ao longo de aceiros já existentes, num total de 4,5 Km de extensão por 4 metros de largura. O primeiro modelo, já em uso pela CEPLAC em um pequeno trecho do aceiro, é o de uma cerca eletrificada de arame e tela, com amperagem adequada para apenas repelir os animais sem causar danos físicos, com 1,0 m de altura. O segundo modelo, trata-se de uma cerca de tela com 1,5 metro de altura, encimada por uma chapa galvanizada de 1,0 m de largura disposta em ângulo de 45º, com a extremidade voltada para a mata. A CEPLAC testará a aplicabilidade de ambos os modelos, verificando o custo de sua instalação e manutenção e sua eficiência na contenção dos macacos-prego, bem como, de outros potenciais predadores dos frutos. O CPB espera que o modelo com melhor resultado seja, a partir de então, incorporado no conjunto das técnicas e métodos que a CEPLAC transfere aos agricultores, para implantação da cultura do cacau.

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

Referência

Messias, M. R., Ferronato, M. L. e Oliveira, M. A. 2006. Inventário e estimativa populacional da mastofauna da EXTEX da CEPLAC Ouro Preto do Oeste – Subsídios para o manejo das espécies potencialmente predadoras dos frutos de cacau. UNIR e CEPLAC. Relatório Técnico.

Interspecific Association Between *Oreonax* and *Ateles* in Amazonas, Peru

On 13 April 2007, during a preliminary field survey of the current distribution and conservation status of the yellow-tailed woolly monkey (*Oreonax flavicauda*) in the departments of San Martín and Amazonas, Peru, we encountered a group of eight *O. flavicauda* consisting of five adults and three juveniles. The encounter took place in a privately owned, unprotected forest at an elevation of 1900 m a.s.l., 1 km NW of the village of Santa Rosa (05°40'13.5"S, 77°55'08.0"W). This area is highly disturbed primary montane forest interspersed with pasture. The group was followed for approximately one hour. During the entire encounter we observed the presence of a female white-bellied spider monkey (*Ateles belzebuth*) freely associating with all members of the *O. flavicauda* group. The female spider monkey continued to travel with the group as they entered the next valley, but we were unable to follow. Both species showed complete tolerance to each other and an equal intolerance of the presence of humans, with loud vocalizations and branch shaking. Observation was made easier by the aggressive approach of the group toward us. We believe this is the first record of such an association and highlights the need for further detailed study of both species in the wild, in particular the critically endangered yellow-tailed woolly monkey about which we know so little.

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Ecology and Conservation of Red Howler Monkeys (*Alouatta Seniculus*) in Montane Forest Fragments in the Main Coffee-Growing Region in Colombia

Carolina Gómez-Posada

At least seventy percent of the original montane ecosystems have been lost from the Colombian Andes. Forest remnants are mostly small, isolated, and on privately-held lands. Animals persisting in this landscape have adapted to human encroachment and some have managed to survive in highly degraded habitats. However, this does not guarantee the long-term survival and health of populations. Andean forests in Colombia urgently need management and conservation programs. We have developed a project aimed at evaluating how howler populations are responding to loss and fragmentation of their natural habitats in the Colombian Andes, with the expectation that this could lead to measures to prevent further losses. We are studying howler populations in montane forest in three provinces of Colombia in the coffee growing region and Cauca Valley (900 to 2200 m a.s.l.), evaluating the demographic and behavioral responses of howlers to habitat fragmentation and diminished resources. This research has included eleven theses of undergraduate and graduate students from nine Colombian universities, addressing the following topics:

- Status of wild populations of red howler monkey in forest fragments (natural forest, "guadua" bamboo forest, forestry plantations);
- Ranging patterns, use of food resources and habitat of red howler monkey in isolated Andean forest fragments;
- Genetic variability and endogamy of red howler monkey in isolated Andean forest fragments in the coffee region in Colombia;
- Use of anthropogenic habitats by monkeys and productive systems as alternative tools for conservation in private lands;
- Conservation strategy of the red howler monkey in the coffee region in Colombia.

We have interacted with government agencies, large private land owners, and small ranch farmers. We consulted with farmers and the largest forestry plantation company in Colombia to understand their points of view, in order to explore different management options that would allow them to use their land without destroying the resources needed for monkeys and other wildlife to survive. These results were used to develop the conservation strategy for this species in the region, and some of the proposed conservation actions now have been implemented by land owners and local environmental authorities.

This project is funded by national and international institutions: Corporación Autónoma Regional del Valle del Cauca CVC, Fundación para la Promoción de la Investigación y la Tecnología del Banco de la República, Instituto de Investigaciones Biológicas Alexander von Humboldt (Colombia), John D. and Catherine T. MacArthur Fundation, U. S. Fish and Wildlife Service, and Idea Wild.

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Marina Silva Recebe Maior Prêmio de Meio Ambiente Das Nações Unidas

A ministra do Meio Ambiente, Marina Silva, receberá o maior prêmio das Nações Unidas na área ambiental, o "Champions of the Earth" (Campeões da Terra) de 2007, como reconhecimento ao seu trabalho em favor da preservação da floresta amazônica e da valorização das comunidades locais e tradicionais da região. O anúncio foi feito nesta quinta-feira (01) pelo Programa das Nações Unidas pelo Meio Ambiente (PNUMA). Marina Silva é uma das sete personalidades que serão premiadas. O "Campeões da Terra" será entregue numa cerimônia prevista para o dia 19 de abril, em Cingapura. O sub-secretário da Organização das Nações Unidas (ONU) e diretor-executivo do PNUMA, Achim Steiner, em carta enviada à ministra, elogia a sua dedicação na defesa das questões ambientais. "Vossa Excelência reconheceu que a construção de uma aliança de apoio para proteger o meio ambiente exige adesão a um conjunto básico de valores. Sua crença de que o sucesso da luta para salvar a vida sobre a Terra exige que princípios estejam à frente de nossos esforços fez com que fosse merecedora do prêmio Champions of the Earth 2007", escreve ele. O prêmio existe desde 2004. Seu objetivo é contemplar pessoas que tenham uma contribuição significativa e reconhecida, global e regionalmente, na proteção e gestão sustentável do meio ambiente e dos recursos naturais.

Fonte: InforMMA.

Meu Pé de Mata Atlântica

O passado 27 de maio, durante a terceira edição do Viva a Mata, evento promovido pela Fundação SOS Mata Atlântica, o Instituto BioAtlântica (IBio) lançou o livro "Meu pé de Mata Atlântica – Experiências de recomposição florestal em propriedades particulares no Corredor Central". Resultado do Programa Conservação em Terras Privadas do IBio, o livro traz os primeiros dados do monitoramento iniciado no ano de 2004 em áreas de floresta restauradas em propriedades localizadas no Corredor Central da Mata Atlântica. O projeto de monitoramento e a publicação foram feitos com recursos do Fundo de Parcerias para Ecossistemas Críticos (Critical Ecosystem Partnership Fund – CEPF) e da Agência Americana para o Desenvolvimento Internacional (USAID). "Nas viagens a Bahia e Espírito Santo, no início das atividades do Programa de Conservação da Biodiversidade em Terras Privadas, tivemos contato com proprietários rurais do Corredor Central da Mata Atlântica que vêm desenvolvendo com recursos próprios ações de recomposição florestal. Em visitas às áreas e nas conversas com esses proprietários, constatamos a ausência de inventários e monitoramento. Ainda que por si só sejam dignas de reconhecimento, é preciso avaliar o papel dessas ações na redução dos efeitos da fragmentação do hábitat natural," explica o engenheiro florestal Beto Mesquita, coordenador do programa Conservação em Terras Privadas do IBio e um dos autores do livro. "De modo geral há uma lacuna de conhecimento a respeito do sucesso de projetos de recomposição florestal. Em nosso estudo, além de aspectos florísticos e fisionômicos consideramos avifauna como grupo bioindicador para avaliar o papel destas áreas como corredores de biodiversidade," comenta Ludmila Pugliese de Siqueira, gerente de projetos do IBio e autora do livro.

Fonte: <www.bioatlantica.org.br>

Parceria Pela Biodiversidade

Thiago Romero

O Museu Paraense Emílio Goeldi (Mpeg) e o Instituto Nacional de Pesquisas da Amazônia (Inpa) deram um passo importante para o monitoramento e a preservação da biodiversidade na Amazônia. As duas instituições, vinculadas ao Ministério da Ciência e Tecnologia (MCT), integraram suas bases de dados científicos sobre o bioma que ocupa quase a metade do território nacional. O novo ambiente on-line interliga os sistemas computacionais da Rede CT Petro Amazônia e do Programa de Pesquisa em Biodiversidade (PPBio-Amazônia), realizados em parceria pelas duas instituições. Todo o material gerado pelos dois projetos está disponível para consulta pública pela internet. Novas informações poderão ser inseridas em tempo real a partir de agora.

A Rede CT Petro Amazônia reúne instituições de ensino superior e de pesquisa da Amazônia e tem o objetivo de desenvolver tecnologias voltadas para a recuperação de áreas degradadas na floresta resultantes da exploração de recursos minerais, como o petróleo e o gás natural. O PPBio-Amazônia desenvolve ações de pesquisa voltadas para políticas de conservação e uso sustentável da biodiversidade na região, por meio da manutenção de acervos e coleções biológicas e inventário de espécies vegetais e animais. Mais informações: <http://ppbio.inpa.gov.br> ou <http://projetos.inpa.gov.br/ctpetro>.

Fonte: <http://www.agencia.fapesp.br/boletim_dentro.php?id=6557>.

Chicago Board of Trade Endangered Species Fund, First Grant Cycle of 2007

The Chicago Zoological Society is soliciting new proposals for the Chicago Board of Trade Endangered Species Fund for the first grant cycle of 2007. The Committee is looking for projects that will be conducted between June 2007 and February 2008. The Fund will support small projects, usually up to $5,000 (smaller requests will fare better). For more information contact: Daniel M. Brooks, Ph.D., Curator of Vertebrate Zoology, at <dbrooks@hmns.org>.

Mona Foundation will Present Courses on Primate Ethology

Starting next March, Mona Foundation will present courses on primate ethology. The main goal of these courses is to study and comprehend the behaviour of non-human primates, not only on a theoretical basis but also on a practical one. The estimated duration of each course will be of 15 hours (8.5 of theory and 6.5 of practice) along two days (Fridays and Saturdays) and will take place on the third weekend of each month. The schedule of the course will be from 10.00h to 18.30h each day. The application fee includes a file with a CD-ROM, a field notebook and a diploma. Next courses taking place on the 1st semester of 2007 (Basic Level), 16th and 17th of March, 20th and 21st of April, 18th and 19th of May, 15th and 16th of June. For more information regarding the courses, please contact: Miquel Llorente at <recerca@fundacionmona.org>, or visit <http://www.fundacionmona.org/final/castellano/noticies_marco.php?id=69&pag=0>.

Simposio de Recursos Genéticos Para América Latina y el Caribe

El Simposio de Recursos Genéticos para América Latina y el Caribe (Sirgealc) es el principal foro bianual americano, en el cual diversos expertos en el tema comparten las experiencias derivadas de la instrumentación y el seguimiento de los

proyectos científicos relacionados con los recursos genéticos, provenientes de las plantas, los animales y los microbios. En este evento se analizan además los avances en el tenor y se proponen las estrategias y las tareas prioritarias para la región latinoamericana. Esta sexta emisión del Sirgealc se llevará a cabo en la Ciudad de México, del 12 al 16 de Noviembre de 2007 y los temas principales serán: Estrategias de conservación de los recursos genéticos, Educación en recursos genéticos en todos niveles y Marco regulatorio de acceso a los recursos genéticos. Para mayores informes visitar <http://www.coyoacan-global.com/sirgealc/convocatoria.htm>.

Museu de Biologia Prof. Mello Leitão Novo Página Eletrônica

Temos a satisfação de anunciar o lançamento da página eletrônica do Museu de Biologia Prof. Mello Leitão. Lá você poderia encontrar a informação sobre a história, as atividades e a notícia relacionadas com o museu. Endereço: <www.melloleitao.iphan.gov.br>.

Pitheciine Action Group (PAG)

The Pitheciines include some of the most unusual and intriguing primates of the Neotropics. Several are threatened with extinction, and for many we lack all but the most basic information.

The Pitheciine Action Group (PAG) exists to promote the conservation of the genera *Callicebus, Cacajao, Chiropotes* and *Pithecia*. PAG's main objectives are to coordinate and encourage research, act as a clearinghouse for information and resource sharing, and provide scientific and technical information to guide conservation strategies and policy decisions.

Founded informally in 2005, PAG was launched officially at the *Pitheciins: Ecology and Conservation* symposium of the 2006 IPS Congress in Uganda, and is now part of the IUCN/SSC Primate Specialist Group. PAG has an Executive Committee of four, a 25-member Coordinating Committee and Sub-Committees for each genus that includes pitheciine experts from all range countries. There is also the PAG-Network with an open-list membership; this is the information exchange facet of the Group, to which institutions, researchers and interested individuals are invited to contribute.

PAG will soon launch a dedicated website and an electronic newsletter. As well as information about current group activities, website resources will include lists of priority taxa and research topics, key literature, theses and dissertations, photos and videos, recordings of vocalizations and distribution of museum specimens.

Current PAG activities include a 45-chapter, 82-author book, *Evolutionary Biology and Conservation of Titis, Sakis and Uacaris,* to be published by Cambridge University Press, and participation, together with the Brazilian Government's Environmental Protection Agency (IBAMA), in the formulation of Action Plans for endangered Brazilian taxa.

For further information about PAG, please e-mail <coordination@pitheciineactiongroup.org> or visit <http://www.pitheciineactiongroup.org>.

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Primate Conservation Incorporated

Primate Conservation, Incorporated (PCI) is a nonprofit foundation founded to fund field research that supports conservation programs for wild populations of primates. Priority will be given to projects that study, in their natural habitat, the least known and most endangered species. The involvement of citizens from the country in which the primates are found will be a plus. The intent is to provide support for original research that can be used to formulate and to implement conservation plans for the species studied. PCI will grant seed monies or provide matching grants for graduate students, qualified conservationists, and primatologists to study rare and endangered primates and their conservation in their natural habitat. All appropriate projects will be considered, but the regions of current interest are Asia and West Africa. For more information and grant applications, go to <http://www.primate.org/grant_in.htm> or contact Ray Hamel at <hamel@primate.wisc.edu>.

Primate Societies

PSGB Conservation Grants

The Primate Society of Great Britain (PSGB) awards small grants in support of primate conservation and education. These grants are administered by the Conservation Working Party, which considers applications at its biannual meetings. The following notes give details of elegibility and application procedure and should be read carefully before preparing an application.

Proposals are invited for grants to assist: Research of benefit to primate conservation; short surveys to identify locations of value to primate conservation; projects involving conservation education relevant to primates.

Obligations of grantees are as follows: To present a report on the progress of the project within six months of commencement; to present a final report on completion of the project, to be used by PSGB at its discretion in publications or in any way thought to be of value to primate conservation; to acknowledge the support received from PSGB in any publication resulting from the project and to supply PSGB with two copies of each publication; to produce, where appropriate, slides and/or sound recordings for non-commercial use by PSGB or others in the promotion of primate conservation.

Elegibility: Grants will be awarded to members of PSGB or to citizens of primate range states who are sponsored by a member. Only those projects which are judged to have attainable goals that will benefit primate conservation or conservation education will be considered. Group training projects will not be considered for these grants. Awards are made on a competitive basis and the decision of the Conservation Working Party is final. In some cases applicants may be invited to submit an amended application.

Application and award details: Individual awards tend to be in the range of £250 to £500. Two closing dates apply: the last day of February and the last day of August. Applications must be made on the Application Form, or following the same format, and should be sent by post to reach the Convener on or before the relevant closing date. Applications by e-mail or fax will not normally be accepted.

Applications forms are available on the PSGB website <http://www.psgb.org> or can be obtained directly from: David A. Hill (Convenor of the CWP), School of Biological Sciences, University of Sussex, Falmer, Brighton BN1 9QG, UK, Tel: +44 1273 606755 ext. 2755; Fax: +441273678433, e-mail: <d.a.hill@sussex.ac.uk>.

Recent Publications

Books

Key Topics in Landscape Ecology: Key Issues in Theory, Methodology, and Applications, edited by R. J. Hobbs and Jianguo Wu. 2007. Cambridge University Press. 400 pp. ISBN 0521850940. Landscape ecology is a relatively new area of study, which aims to understand the pattern of interaction of biological and cultural communities within a landscape. This book brings together leading figures from the field to provide an up-to-date survey of recent advances, identify key research problems and suggest a future direction for development and expansion of knowledge. Providing in-depth reviews of the principles and methods for understanding landscape patterns and changes, the book illustrates concepts with examples of innovative applications from different parts of the world. Forming a current 'state-of-the-science' for the science of landscape ecology, this book forms an essential reference for graduate students, academics, professionals and practitioners in ecology, environmental science, natural resource management, and landscape planning and design. *Contents:* 1. Perspectives and prospects on landscape ecology – R. Hoobbs and Jianguo Wu; 2. Adequate data of know accuracy are critical to advancing the field of landscape – L. R. Iverson; 3. Landscape pattern analysis: key issues and challenges – H- Li and J. Wu; 4. Spatial heterogeneity and ecosystem processes – M. G. Turner and J. A. Cardille; 5. Landscape heterogeneity and metapopulation dynamics – L. Fahrig; 6. Determining pat-

tern-process relationships in heterogeneous landscapes – R. H. Gardner, J. D. Forester and R. E. Plotkick; 7. Scale and scaling: a cross-disciplinary perspective – J. Wu; 8. Optimization of landscape pattern – J. Hof and C. Flather; 9. Advances in detecting landscape changes at multiple scales: examples of northern Australia – J. A. Ludwig; 10. The preoccupation of landscape research with land use and land cover – M. Antrop; 11. Applying landscape-ecological principles to regional conservation: the wild Country Project in Australia; 12. Using landscape ecology to make sense of Australia's last frontier – D. Bowman; 13. Transferring ecological knowledge to landscape planning: a design method for robust corridors – C. C. Vos, P. Opdam, E. G. Steingröver and R. Reijnen; 14. Integrative landscape research: facts and challenges – G. Fry, B. Tress and G. Tress; 15. Landscape ecology: the state of the science – J. Wu and R. Hobbs.

Primate Anti-Predator Strategies, edited by Sharon L. Gursky and K. A. I. Nekaris. 2007. Springer. 369pp. ISBN: 978-0387348070. Part of the Series: Developments in Primatology: Progress and Prospects. Since the 1960s, primatologists have recognized the impact of predation on the evolution of morphology, the social systems and cognitive behavior of monkeys and apes, but few studies considered its impact on the prosimians – lemurs, lorises, galagos and tarsiers. This comprehensive volume, written by experts in the field, narrows this gap by highlighting the effect of predation on the order Primates in general. Theoretical approaches to understanding how primates perceive predation threat, as well as proximate and ultimate causes to address threat and attack, are considered across the primate order. Although this volume concentrates on the least known group in this theoretical area – the prosimians – contributions by researchers on numerous primate taxa across four major geographical regions make this a novel and exciting contribution to students interested in primate evolution and ecology. *Contents:* 1. Predation and Primate cognitive evolution – K. Zuberbühler; 2. Predation on Primates: A biogeographical Analysis – D. Hart; 3. Primates and other prey in the seasonally variable diet of *Cryptoprocta ferox* in the dry forest of western Madagascar – L. Dollar, J. U. Ganzhorn and S. M. Goodman; 4. Predation on Lemurs in the rainforest of Madagascar by multiple predator species: Observations and experiments – S. M. Karpanty and P. C. Wright; 5. Predation, comunication and cognition in Lemurs – M. Scheumann, A. Rabesandratana and E. Zimmermann; 6. A consideration of leaping locomation as a means of predator avoidance in Prosimian Primates – R. H. Crompton and W. I. Sellers; 7. Anti-predator strategies of Cathemeral Primates: Dealing with predators of the day and night – I. C. Colquhoun; 8. Moonlight and behavior in nocturnal and cathemeral Primates, especially *Lepilemur leucopus:* Illuminating possible anti-predator efforts – L. T. Nash; 9. A comparison of calling patterns in two nocturnal primates, *Otolemur crassicaudatus* and *Galago moholi* as a guide to predation risk – S. K. Breader; 10. Predator defense by Slender Lorises and Pottos – K. A. I. Nekaris, E. R. Pimley and K. M. Ablard; 11. The response of spectral tarsiers toward avian and terrestrial predators – S. L. Gursky; 12. Talking defensively, a dual use for brachial and exudate of slow and pygmy Lorises – L. R. Hagey, B. G. Fry and H. Fitch-Snyder; 13. Anti-predator strategies in diurnal Prosimian, the ring-tailed lemur (*Lemur catta*), at the Beza Mahafaly Special Reserve, Madagascar – L. Gould and M. L. Sauther; 14. Howler monkeys and harpy eagles: A communication arms race – R. Gil-da-Costa; 15. Effects of habitat structure on perceived risk of predation and anti-predator behavior of vervet (*Cerocpithecus aethiops*) and patas (*Erythrocebus patas*) monkeys – K. L. Enstam; 16. Predation risk and habitat use in Chacma Baboons (*Papio hamadryas ursinus*) – R. A. Hill and T. Weingrill; 17. Reconstructing hominin interactions with mammalian carnivores – A. Treves and P. Palmqvist.

Ecological Census Techniques, edited by W. J. Sutherland. 2006. Cambridge University Press. 448 pp. ISBN: 978-0521606363. This is an updated version of the best selling first edition, Ecological Census Techniques, with updating, some new chapters and authors. Almost all ecological and conservation work involves carrying out a census or survey. This practically focussed book describes how to plan a census, the practical details and shows with worked examples how to analyse the results. The first three chapters describe planning, sampling and the basic theory necessary for carrying out a census. In the subsequent chapters international experts describe the appropriate methods for counting plants, insects, fish, amphibians, reptiles, mammals and birds. As many censuses also relate the results to environmental variability, there is a chapter explaining the main methods. Finally, there is a list of the most common mistakes encountered when carrying out a census. *Contents:* 1. Planning a research programme – W. J. Sutherland; 2. Principles of sampling – J. J. D. Greenwood and R. A. Robinson; 3. General census methods – J. J. D. Greenwood and R.A. Robinson; 4. Plants – J. M. Bullock; 5. Invertebrates – M. Ausden and M. Drake; 6. Fish – I. M. Côté and M. R. Perrow; 7. Amphibians – T. R. Halliday; 8. Reptiles – S. Blomberg and R. Shine; 9. Birds – D. W. Gibbons and R. D. Gregory; 10. Mammals – C. Krebs; 11. Environmental variables – J. C. Jones, J. D. Reynolds and D. Raffaelli; 12. The twenty commonest censusing sins – W. J. Sutherland.

Primates in Perspective, edited by C. J. Campbell, A. Fuentes, K. C. MacKinnon, M. Panger and S. K. Bearder, 2006. Oxford University Press. 736 pp. ISBN: 9780195171334. It is the first edited volume to offer a comprehensive overview of primatology since 1987. Forty-four original essays — by fifty-nine leading researchers in the field today — provide wide-ranging and contemporary coverage of all of the major areas of primatology. Arranged in six sections, the text begins with an introduction to primatology and a review of the natural history of the major taxonomic groups within the order Primates. It goes on to cover methodologies and research design for both field and captive settings; primate reproduction; primate ecology and conservation and their roles in the daily lives of primates; and such aspects of social

behavior and intelligence as communication, learning, and cognition. The volume ends with a concluding chapter by the editors that discusses the future of primatological research. Ideal for introductory primatology courses, Primates in Perspective can also be used in upper-division behavior and conservation courses. Additionally, it is an invaluable reference tool for primate researchers.

Mamíferos del Ecuador – Guía de Campo, por Diego Tirira. Ediciones Murciélago Blanco. 576pp. ISBN: 9978-44-651-6. La más completa obra sobre la fauna de mamíferos del Ecuador que se haya publicado hasta el presente, con más de 380 especies descritas. Para cada especie se incluye información sobre: Identificación (Principales medidas morfométricas, Descripción de características externas y patrones de coloración), Historia Natural (Ecología, patrones de actividad, sociabilidad, hábitos alimenticios, refugios, áreas de vida, territorios, locomoción, estrato utilizado y reproducción, Etología), Sonidos, Distribución y Habitat (región, rango altitudinal, tipos de bosques, más de 350 mapas de distribución), Situación Actual (Categorías de amenaza y protección según el Libro Rojo de los mamíferos del Ecuador, UICN y CITES, principales amenazas y perspectivas de sobrevivencia de la especie, Áreas protegidas). Además, claves de identificación, guía de huellas, comentarios taxonómicos, referencias bibliográficas seleccionadas y anexos. Para mayor información visitar: <http://www.murcielagoblanco.com/mamiferosdelecuador/publicaciones.htm#negro>.

Managing Protected Areas: A Global Guide. Edited by Michael Lockwood, Graeme Worboys and Ashish Kothari, 2006. Published with IUCN. 800PP. ISBN: 9781844073030. Managing Protected Areas is an authoritative handbook, produced by IUCN that spans the full terrain of protected area management and is the international benchmark for all professionals, students and academics worldwide. The book employs dozens of detailed international cases studies, hundreds of concise topical snapshots, maps, tables, illustrations and a colour plate section, as well as evaluation tools, checklists and numerous appendices to cover all aspects of park management from biodiversity to natural heritage to financial management. he book establishes a conceptual underpinning for protected area management, presents guiding principles for the 21st century, reflects recent work on international best practice and provides an assessment of skills required by professionals. The publication is relevant to the full range of management systems worldwide, balancing more traditional, developed country approaches with developing country systems including participatory, integrated, multi-sectoral and value-driven approaches. *Contents:* Introduction, *Part I: Setting the Context*, Natural Heritage, Social Context, Global Protected Area Framework, Values and Benefits, Threats to Protected Areas, Governance, Process of Management, Building Capacity, *Part II: Principles and Practice,* Establishing Protected Areas, Obtaining, Managing and Communicating Information, Management Planning, Finance and Economics, Administration, Sustainability Practice and Sustainable Use, Operations Management, Natural Heritage Management, Cultural Heritage Management, Managing Threats, Incident Management, Tourism and Recreation, Collaborative Management, Community Conserved Protected Areas, Linking the Landscape, Marine Protected Areas, Evaluating Management Effectiveness, Building Support, Futures and Visions.

The Conservation Project Manual. Edited by Colin Bibby and Claire Alder, 2003. BP Conservation Programme, Cambridge UK. ISBN: 1901930394. The basic aim of this book is to help people to improve the process by which they go about planning and managing small to medium-sized conservation projects. By using a number of tried and tested methods and illustrative examples, the manual will enable users to work through their own concepts and create a project plan. The manual is founded on the belief that a good plan makes the fundraising and subsequent implementation and management of a project easier and success more likely. The book is divided in seven sections: *Section 1* Why Plan?, *Section 2* Knowing where to fit in, *Section 3* Planning a Projetc, *Section 4* Fundraising principles, *Section 5* Project Implementation, *Section 6* Monitoring and Evaluation, and *Section 7* Sources for Further Information. This book is available in the web at <http://conservation.bp.com/advice/project.asp>.

Articles

Aguiar, L. M., Ludwig, G., Svoboda, W. K., Teixeira, G. M., Hilst, C. L. S., Shiozawa, M. M., Malanski, L. S., Mello, A. M., Navarro, I. T. and Passos, F. C. 2007. Use of traps to capture black and gold howlers (*Alouatta caraya*) on the islands of the Upper Paraná River, southern Brazil. *Am. J. Primatol.* 69(2): 241–247.

Anemone, R. L., Dirks, W., Moore, W. and Van Regenmorter, J. 2007. Primate fossils, geological marker beds, and anachronistic faunal assemblages from the early Paleogene of southwestern Wyoming. *Am.J. Phys. Anthropol.* Suppl. 44: 64–65.

Arroyo-Rodriguez, V., Serio-Silva, J. C., Alamo-Garcia, J. and Ordano, M. 2007. Exploring immature-to-mother social distances in Mexican mantled howler monkeys at Los Tuxtlas, Mexico. *Am. J. Prim*. 69(2): 173–181.

Barnett, A., Bezerra, B. and Andrade, E. 2007. Report of two visits to Jaú National Park, studying golden-backed uacaris (*Cacajao melanocephalus ouakary*) and their habitat, 13 Oct.–11 Nov. and 5–15 Dec., 2006. In: *Manaus: Igapo Study Project*. Pgs: 21 pp.

Bloch, J. I., Silcox, M. T., Boyer, D. M. and Sargis, E. J. 2007. New Paleocene skeletons and the relationship of plesiadapiforms to crown-clade primates. *Proc. Nat. Acad. Sci. USA*. 104(4): 1159–1164.

Clarke, M. R., Zucker, E. L. and Ford, R. T. 2007. Behavior and endocrine concentrations do not distinguish sex in monomorphic juvenile howlers (*Alouatta palliata*). *Am. J. Primatol*. 69(4): 477–484.

Colquhoun, I. C. 2007. Anti-predator strategies of cathemeral primates: Dealing with predators of the day and the night. In: *Primate Anti-Predator Strategies*, S. L. Gursky and K. A. I. Nekaris (eds.), pp.146–172. Springer, New York.

Cope, D. A., Townsend, K. E. and Rasmussen, D. T. 2007. Stratigraphic distribution of middle Eocene primates in the eastern Uinta Basin, Utah. *Am. J. Phys. Anthropol.* Suppl. 44: 91.

Couette, S. 2007. Morphologic and genetic differentiation of night monkey (*Aotus infulatus*, Primates, Platyrrhinians, Cebidae) populations from the right and left banks of Rio Tocantins (Brazil). *Comptes Rendus Biologies*. 330(2): 148–158.

Digby, L. J., Ferrari, S. F. and Saltzman, W. 2007. Callitrichines: The role of competition in cooperatively breeding species. In: *Primates in Perspective*, C. J. Campbell, A. Fuentes, K. C. MacKinnon, M. Panger and S. K. Bearder (eds.), pp.85–106. Oxford University Press, New York.

Di Fiore, A., Fernandez-Duque, E. and Hurst, D. 2007. Adult male replacement in socially monogamous equatorial saki monkeys (*Pithecia aequatorialis*). *Folia Primatol.* 78(2): 88–98.

Di Fiore, A. and Campbell, C. J. 2007. The Atelines: Variations in ecology, behavior, and social organization. In: *Primates in Perspective*, C. J. Campbell, A. Fuentes, K. C. MacKinnon, M. Panger and S. K. Bearder (eds.), pp.155–185. Oxford University Press, New York.

Dunn, R. H. 2007. New tarsals of *Ourayia* and *Chipetaia*, omomyine primates from the Uinta Formation, Utah. *American J. Phys. Anthropol.* Suppl. 44: 103.

Fernandez-Duque, E. 2007. Aotinae: Social monogamy in the only nocturnal haplorhines. In: *Primates in Perspective*, C. J. Campbell, A. Fuentes, K. C. MacKinnon, M. Panger and S. K. Bearder (eds.), pp.139–154. Oxford University Press, New York.

Franklin, S. P., Hankerson, S. J., Baker, A. J. and Dietz, J. M. 2007. Golden lion tamarin sleeping-site use and pre-retirement behavior during intense predation. *Am. J. Primatol.* 69(3): 325–335.

Franklin, S. P., Miller, K. E., Baker, A. J. and Dietz, J. M. 2007. Do cavity-nesting primates reduce scent marking before retirement to avoid attracting predators to sleeping sites? *Am. J. Primatol.* 69(3): 255–266.

Garber, P. A. 2007. Primate locomotor behavior and ecology. In: *Primates in Perspective*, C. J. Campbell, A. Fuentes, K. C. MacKinnon, M. Panger and S. K. Bearder (eds.), pp.543–560. Oxford University Press, New York.

Gil-da-Costa, R. 2007. Howler monkeys and harpy eagles: A communication arms race. In: *Primate Anti-Predator Strategies*, S. L. Gursky and K. A. I. Nekaris (eds.), pp.289–307. Springer, New York.

Hartwig, W. 2007. Primate evolution. In: *Primates in Perspective*, C. J. Campbell, A. Fuentes, K. C. MacKinnon, M. Panger and S. K. Bearder (eds.), pp.11–22. Oxford University Press, New York.

Hart, D. 2007. Predation on primates: A biogeographical analysis. In: *Primate Anti-Predator Strategies*, S. L. Gursky and K. A. I. Nekaris (eds.), pp.27–59. Springer, New York.

Jack, K. M. 2007. The Cebines: Toward an explanation of variable social structure. In: *Primates in Perspective*, C. J. Campbell, A. Fuentes, K. C. MacKinnon, M. Panger and S. K. Bearder (eds.), pp.107–123. Oxford University Press, New York.

Jones, C. B. and Van Cantfort, T. E. 2007. A schema for multimodal communication applied to male mantled howler monkeys (*Alouatta palliata*). *Lab. Prim. Newsl.* 46(2): 6–7.

MacKinnon, K. C. 2007. Social beginnings: The tapestry of infant and adult interactions. In: *Primates in Perspective*, C. J. Campbell, A. Fuentes, K. C. MacKinnon, M. Panger and S. K. Bearder (eds.), pp.571–591. Oxford University Press, New York.

Melin, A. D., Fedigan, L. M., Hiramatsu, C., Sendall, C. L. and Kawamura, S. 2007. Effects of colour vision phenotype on insect capture by a free-ranging population of white-faced capuchins, *Cebus capucinus*. *Anim. Behav.* 73(1): 205–214.

Moura, A. C. A. and McConkey, K. R. 2007. The capuchin, the howler, and the Caatinga: Seed dispersal by monkeys in a threatened Brazilian forest. *Am. J. Primatol.* 69(2): 220–226.

Moura, A. C. A. 2007. Stone banging by wild capuchin monkeys: An unusual auditory display. *Folia Primatol.* 78(1): 36–45.

Norconk, M. A. 2007. Saki, uakaris, and titi monkeys: Behavioral diversity in a radiation of primate seed predators. In: *Primates in Perspective*, C. J. Campbell, A. Fuentes, K. C. MacKinnon, M. Panger and S. K. Bearder (eds.), pp.123–138. Oxford University Press, New York

Ruiz-Garcia, M., Escobar-Armel, P., Alvarez, D., Mudry, M., Ascunce, M., Gutierrez-Espeleta, G. and Shostell, J. M. 2007. Genetic variability in four *Alouatta* species measured by means of nine DNA microsatellite markers: Genetic structure and recent bottlenecks. *Folia Primatol.* 78(2): 73–87.

Sabbatini, G., Stammati, M., Tavares, M. C. H. and Visalberghi, E. 2007. Response toward novel stimuli in a group of tufted capuchins (*Cebus libidinosus*) in Brasilia National Park, Brazil. *Am. J. Primatol.* 69(4): 457–470.

Stone, A. I. 2007. Responses of squirrel monkeys to seasonal changes in food availability in an eastern Amazonian forest. *Am. J. Primatol.* 69(2): 142–157.

Stone, A. I. 2007. Age and seasonal effects on predator-sensitive foraging in squirrel monkeys (*Saimiri sciureus*): A field experiment. *Am. J. Primatol.* 69(2): 127–141.

Sussman, R. W. 2007. A brief history of primate field studies. In: *Primates in Perspective*, C. J. Campbell, A. Fuentes, K. C. MacKinnon, M. Panger and S. K. Bearder (eds.), pp.6–10. Oxford University Press, New York.

Vogel E. R., Neitz, M. and Dominy, N. J. 2007. Effect of color vision phenotype on the foraging of wild white-

faced capuchins, *Cebus capucinus*. *Behav. Ecol.* 18(2): 292–297.

White, F. J., Overdorff, D. J., Keith-Lucas, T., Rasmussen, M. A., Kallam, W. E. and Forward, Z. 2007. Female dominance and feeding priority in a prosimian primate: experimental manipulation of feeding competition. *Am. J. Primatol.* 69(3): 295–304.

Abstracts

Selected abstracts from the 76th Annual Meeting of the American Association of Physical Anthropologists, Philadelphia, PA, USA, 28–31 March, 2007, in: *Am. J. Phys. Anthropol.* (Supp. 44): 60-256.

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Meetings

2007

25th Annual Conference of the Australasian Primate Society. March 9–11, Queensland, Australia, University of Queensaland St. Lucia Brisbane. For more information consult the web site: <http://www.primates.on.net/apsconf.htm>.

The Mind of the Chimpanzee. March 22–25, The Lincon Park Zoo, Chicago, Illinois. In the tradition of the "Understanding Chimpanzees" conferences, which started 20 years ago, "The Mind of the Chimpanzee" conference will bring together the top experts in the fields of chimpanzee cognition and conservation as well as the "next generation" of chimpanzee researchers in order share new research findings, generate new collaborative research partnerships and examine how studying chimpanzee cognition impacts chimpanzee conservation. The Lester E. Fisher Center for the Study and Conservation of Apes is proud to host this historic event organized by Dr. Elizabeth Lonsdorf and Steve Ross. For more information contact <chimpmind@lpzoo.org>, or visit the web site: <http://www.chimpmindconference.org/>.

Annual IACUC Conference. March 26–27, Town and Country Resort, 500 Hotel Circle, San Diego, CA. The Public Responsability in Medicine and Reseach will held the annual IACUC conference. This event will include a range of keynote addresses, panels, workshops, and didactic sessions, all of which are designed to help build, and then strengthen, an effective animal care and use program. For more information visit: <http://www.primr.org/education/2007_IACUC/overview_IACUC07.html>.

The Annual Meeting of the American Association of Physical Anthropologists. March 27–April 1, Philladelphia, PA. For program information contact Program Chair Dennis H.O'Rourke at <orourke@anthro.utah.edu, or visit the web site: <http://www.physanth.org/annmeet/>.

Workshop & Symposium on Laboratory Animal Diseases. 18–21 April. Chicago, Illinois. The Midwest Div. of The Charles Louis Davis, D.V.M. Foundation in Cosponsorship with The Biologic Resources Laboratory (BRL) of The University of Illinois at Chicago will present a Workshop and Symposium on Laboratory Animal Diseases. The Workshop will begin Wednesday the 18th of April, continuing through Friday the 20th of April. The Symposium will be held on Saturday April 21st. For more information contact James E. Artwohl at <jeart@uic.edu.> or visit the web site: <http://www.afip.org/CLDavis/CLDavis.meetings.htm#2007labdisease>.

Callitrichid Workshop 2007. May 12–13, Providence, Rhode Island. The 6th annual Callitrichid Husbandry Workshop will be a free workshop focusing on the education and development of callitrichid keepers and managers in zoos and aquariums. Some of the topics to be covered are: Biology and Husbandry, Veterinary care, In Situ conservation. For more information consult the web page: <http://www.rwpzoo.org/calendar/callitrichid.cfm>.

87th Meeting of the American Society of Mammalogists. June 6–10, Museum of the Southwestern Biology, Albuquerque, New Mexico. Some of the topics of the meeting are Biogeography, Conservation, Population Ecology and Genetics among others. For more information and registration go to the web site: <http://asm007.unm.edu/index.html.>

10th FELASA Symposium and the XIV ICLAS General Assembly & Conference. June 11–14. The FELASA-ICLAS Joint Meeting 2007, hosted by AISAL, Associazione Italiana per le Scienze degli Animali da Laboratorio, will take place in Northern Italy, on the shores of Lake Como. The international meeting will include the 10th FELASA Symposium and the XIV ICLAS General Assembly & Conference, and will provide a comprehensive overview of the most recent developments in the field of laboratory animal sciences and technologies. For more information go to <http://www.felasa-iclas2007.com/information.htm>, or contact Stefania Sella at <info@felasa-iclas2007.com>.

Training Workshop on Ethical Considerations and Biomedical Use of Non Human Primates for Research in Tropical Diseases. June 18–27, Karen, Nairobi, Kenya. Non human primates will continue to play a pivotal role as models of human diseases including tropical infections. However the use of these animals needs to be carefully applied so that proper consideration of ethical and welfare issues is incorporated in all aspects of research involving non-human primates (NHP). This workshop, supported by TDR and the Institute of Primate Research, National Museums of Kenya with coordinated assistance from SSI coordinators, is a ten-day training course with lectures, hands-on laboratory sessions and demonstrations. Emphasis will be placed on biomedical techniques used in primates in addressing TDR diseases, including the ethical and welfare aspects of using NHP in research. Details of the contents and tentative schedule can be viewed at <http://www.ssi-tdr.net/cbag/ipr-nmk/schdule.html.> Application deadline in 14th April 2007. For more in-

formation visit the web site <http://www.ssi-tdr.net/cbag/ipr-nmk/callforapplication.html>.

30th Meeting of the American Society of Primatologists. June 20–23, 2007, Winston-Salem, NC. Hosted by the Wake Forest University School of Medicine. For more information consult the web site: <http://www.asp.org/asp2007/index.htm>.

Pan African Sanctuary Alliance 2007 Management Workshop. June 21–24, Kigali, Rwanda. The Pan African Sanctuary Alliance (PASA) will focus on issues such as law enforcement, eco-tourism, and disease control at the PASA 2007 Management Workshop. PASA was formed in 2000 to promote unity and cooperation among the primate sanctuaries of Africa, and its members represent 17 sanctuaries in 12 African countries. The PASA Management Workshop has been an annual event since 2000. For more information go to <http://www.panafricanprimates.org/index.htm>.

XII Meeting of the Sociedade Brasileira de Primatologia. Julho 22–27, Minas Gerais, na Pontifícia Universidade Católica de Minas Gerais (PUC-Minas), Campus Coração Eucarístico, em Belo Horizonte. O campus se localiza à Av. Dom José Gaspar, 500, no Bairro Coração Eucarístico, região oeste de Belo Horizonte. Para mais informação visit o web page: <www.carangola.br/primatologia>.

Annual Meeting of the Association for Tropical Biology and Conservation. July 15–19, Morelia, Michoacán, México. The meeting will cover a wide array of basic and applied research topics on tropical biology and conservation, including: origin, evolution, and maintenance of tropical biodiversity (TD); structure, dynamics and functioning of tropical ecosystems (TEs); anthropogenic effects on TD and TEs; and socio-cultural-economical drivers of such effects. Registration, abstracts for symposium, and abstracts for contributed papers and posters must be submitted on-line by April 15th. More information and details may be found on the web page: <www.oikos.unam.mx/atbc2007>.

44th Annual Meeting of the Animal Behavior Society. July 21–25, Burlington Sheraton Hotel and Conference Center, Burlington, Vermont. For more information go to: <http://www.animalbehavior.org/ABS/Program/>.

Laboratory Animal Welfare Training Exchange 2007 Biennal Conference. August 8–10, Radisson Hotel, downtown Boston. The main issue will be to relieve pain in laboratory animals… and yourself. For more information, fees, schedule and registration go to: <http://www.lawte.org/conference.html>.

6th World Congress on Alternatives & Animal Use in the Life Sciences (WC6). August 21–25, Tokyo, Japan. With the support and organization of the Japanese Society of Alternatives to Animal Experiments (JSAAE), the Alternative Congress Trust (ACT), and the Science Council of Japan (SCJ). The WC6 is the first congress to be held in Eastern Asia and will be a good opportunity to review animal welfare issues and to strongly encourage research on alternative methods in this region. Some of the topics of the congress will be: Animal welfare, Moral Ethical and Cultural issues and public policies of animal usage, and Knowledge management and information services. For more information visit the web site: <http://www.ech.co.jp/wc6/index.html>.

2nd Congress of the European Federation for Primatology. September 3–7, Faculty of Education, Charles University, Prague. Organized by the Czech Group of Primatologists, 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 10–13, 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 24–27. 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 UNAM. For more information please visit the web site: <http://www.amp-ac.org.mx>.

VIII Curso Latino-Americano de Biologia 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 & Behavior Through Positive Reinforcement – Further Challenging and Advanced Issues. December 7–9, 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 11–14, 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 weg page: <http://www.soziobio.uni-goettingen.de/welcome.html>.

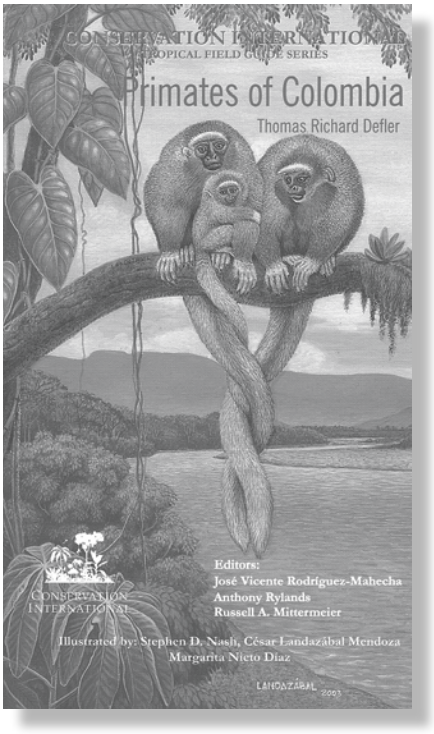
2008

XXII[nd] IPS Congress. August 3–8, Edinburg International Conference Center, Edinburg, Scotland. Sponsored by the Primate Society of Great Britain. For information consult the web site: <http://www.ips2008.co.uk/index.html>.

Primates of Colombia

Conservation International
Tropical Field Guide Series #5

Colombia is one of the most biologically diverse countries in the world due to its rich and varied flora and fauna and is superseded only by Brazil and Peru in terms of primate diversity. This field guide illustrates and describes 28 primate species comprising 43 different taxa, 15 of which are endemic to Colombia. It is a compilation of all primate field work done on Colombian primates both in and out of country and has quickly become an important tool for young primatologists to establish research priorities for study. The field guide also includes chapters on primate classification, fossil history, zoogeography, conservation and phylogeny, and is a first step towards the necessary conservation of this beautiful group of animals.



Colombia es uno de los países con mayor diversidad biológica del mundo debido a su rica y variada flora y fauna; sólo Brasil y Perú la superan en términos de diversidad de primates. Esta guía de campo ilustra y describe 28 especies de primates conteniendo 43 distintos taxones, 15 de los cuales son endémicos de Colombia. Es una recopilación de todo el trabajo de campo que fue realizado sobre primates colombianos dentro y fuera del país, y se ha convertido rápidamente en una importante herramienta para jóvenes primatólogos que desean establecer prioridades de investigación para sus estudios. La guía de campo también incluye capítulos sobre clasificación de primates, historia fósil, zoogeografía, conservación y filogenia, y es un primer paso hacia la conservación necesaria de este hermoso grupo de animales.

About the author, Thomas Richard Defler:

Tom Defler is a primatologist who has spent the last 28 years in the Orinoco and Amazonian regions of Colombia, focusing his studies on the ecology and conservation of primate species in these two regions of the country. His research began in 1976 with INDERENA of the Ministry of Agriculture (now superceded by the Ministry of the Environment) studying Colombian flora and fauna. He established two research stations, Caparú Biological Station and Ecological Station Omé. Defler has written more than 60 publications on diverse aspects of ecology, primate taxonomy and natural history. He is currently Professor at the Instituto Amazónico de Investigaciones, at the National University of Colombia in Leticia.

Thomas Richard Defler, biografía del autor:

Tom Defler es un primatólogo que ha pasado los últimos 28 años en las regiones del Orinoco y Amazonía de Colombia, enfocando sus estudios en la ecología y conservación de especies de primates en estas dos regiones del país. Inició sus investigaciones en 1976 con el INDERENA del Ministerio de Agricultura (ahora Ministerio del Ambiente), estudiando la flora y fauna colombiana. Estableció dos estaciones de investigación, la Estación Biológica Caparú y la Estación Ecológica Omé. Defler ha escrito más de 60 publicaciones sobre distintos aspectos de la ecología, taxonomía e historia natural de primates. En la actualidad, es profesor del Instituto Amazónico de Investigaciones, en la Universidad Nacional de Colombia en Leticia.

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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)…"

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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
Vol. 14(1), 2007

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