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Front cover: *Callimico* clinging to vertical support at Camp Callimico, Department of Pando, Bolivia. Photo by Edilio Nacimento Becerra.

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ARTICLES

SYMPATRIC *ALOUATTA SENICULUS* AND *CEBUS CAPUCINUS* IN AN ANDEAN FOREST FRAGMENT IN COLOMBIA: A SURVEY OF POPULATION DENSITY

Néstor Roncancio Duque[1], **Carolina Gómez-Posada**[2]

[1] *Universidad de Caldas. Present address: WCS Colombia, e-mail: nroncancio@wcs.org*
[2] *Fundación EcoAndina / WCS Colombia. Present address: Department of Biology, University of Washington, e-mail: cgomez@u.washington.edu, carogomezposada@hotmail.com*

Abstract

Due to human activities, the Colombian Andean forests have lost about 85% of their original cover and very few species of primates persist in these fragmented landscapes. In the Western Cordillera, we evaluated the population density of *Alouatta seniculus* and *Cebus capucinus* by line transect census methodology, in a pre-montane isolated forest fragment of 559 ha, between 1200 to 1700 m of altitude. This is one of the few localities where the two species coexist naturally and the first study of their abundance in this cordillera. As we expected according to their diet and strategies, howlers had a higher density, 169 indv/km2 and an abundance of ~943 individuals. By contrast, the capuchins had a lower density, 13.5 ind/km^2 with a population of ~76 individuals. Despite contrasting abundance, both species' conservation in this isolated fragment will depend on landscape-level management to decrease isolation and increase habitat availability in the long term.

Key Words: red howler, white-faced capuchin, premontane forest fragment, abundance, line transect surveys

Resumen

Debido a actividades humanas, los bosques Andinos de Colombia han perdido cerca del 85 % de la cobertura boscosa original y muy pocas especies de primates subsisten en estos paisajes fragmentados. En la cordillera Occidental, evaluamos la densidad de *Alouatta seniculus* y *Cebus capucinus* por medio de muestreo por censos por transectos lineales, en un fragmento aislado de bosque premontano de 559 ha, entre 1200 y 1700 m de altitud. Esta es una de las pocas localidades donde las dos especies coexisten naturalmente y el primer estudio sobre su abundancia en dicha cordillera. Tal como era esperado de acuerdo a su dieta y estrategias, los aulladores presentaron una alta densidad (169 ind./km^2) y una abundancia de ~943 individuos. Por el contrario los capuchinos presentaron una densidad menor, de 13,5 ind./km^2 con una población de ~76 individuos. A pesar de presentar abundancias contrastantes la conservación de estas especies en dicho fragmento dependerá de un manejo de paisaje que disminuya el aislamiento y provea más hábitat disponible en el largo plazo.

Palabras clave: Mono aullador rojo, mono cariblanco, fragmento de bosque premontano, abundancia, transectos lineales.

Introduction

Due to historical, geographical and ecological reasons, most of Colombia's human population is concentrated in the Andean region and in the Caribbean plateau. The ridges and valleys between 1000 and 2500 m have been highly transformed and fragmented and some regions are virtually deforested (Kattan and Alvarez-Lopez, 1996). In some forest remnants a few primates have been able to survive, including *Alouatta seniculus,* the red howler monkey, and *Cebus capucinus,* the white-faced capuchin monkey. These two species are not considered threatened; but the rapid conversion of the forests to isolated fragments in the Colombian mountains may carry a risk to primates and other wildlife found there (Defler, 2004).

Alouatta seniculus occurs from the north Colombian Andes to southern Bolivia. In Colombia, this herbivorous primate is found from 0 to 3200 m of altitude, in different forest types, including isolated remnants and secondary growth forest (Defler, 2004). *C. capucinus* is distributed from Central America to Colombia and northwestern Ecuador, between the Pacific Ocean and the Western Andes Mountains, reaching 1800 to 2000 m altitude. This omnivorous species prefers primary forest or advanced secondary forest, but is also found in degraded forest remnants (Hernández-Camacho and Cooper, 1976; Defler, 2004). In Colombia, the capuchins were found in the valley of the upper Cauca River, between Central and Western mountain ranges (where the Western cordillera is not high), but most of those population are locally extinct and the current distribution is not well documented (Hernández-Camacho and Cooper, 1976; Defler, 2004).

In the eastern slope of the Western Cordillera of Colombia, *A. seniculus* and *C. capucinus* coexist in an isolated premontane forest fragment (Yotoco), and this is one of the few known localities where these species are sympatric. We estimated the population density of these two species in the fragment. For howlers, this is the first density survey in the Western cordillera and in the premontane forest life zone. For white-faced capuchins, this is one of the first population density reports for South America and this fragment is one of the last remnants in Colombia where the species survives other than the Pacific coast.

We expected to find a high density and abundance of howlers, due to their herbivorous diet, reduced space requirements, energy-saving strategy, and recognized ability to persist in fragmented environments (Crockett and Eisenberg, 1987; Crockett, 1998; Terborgh *et al.*, 2001; Bicca-Marques, 2003; Arroyo-Rodriguez and Dias, 2010). By contrast, for capuchins, we expected to find a low density in this isolated fragment, due to their high space requirements, high activity levels, and omnivorous diet (Oppenheimer, 1990; Fragaszy *et al.*, 2004). In past decades, capuchins and howlers were confiscated and released in Yotoco by the local environmental authority (Corporación Regional del Valle del Cauca, CVC), but no records were maintained. Therefore, the origin of the individuals in this fragment is unknown. It is possible that the current populations are a mixture of native and introduced individuals.

Methods

Study area

The Bosque de Yotoco Natural Reserve is an isolated forest fragment of 559 ha located in the eastern slope of the Western Cordillera of Colombia (3° 50' N, 76° 20' W) (Fig. 1), between 1200 and 1700 m of altitude. Yotoco has an average temperature of 20 °C and an average rainfall of 1500 mm per year (Escobar, 2001). The reserve is in transition between wet and dry pre-montane life form, according to Holdridge (Orejuela *et al.*, 1979). Yotoco was designated as a reserve in 1959 by local institutions for watershed protection. Most of the reserve is covered by mature forest and secondary vegetation in different stages of succession, due to the strong human disturbance that happened prior to its establishment as a protected area (logging, burning, and hunting, among others). Three species of primates inhabited this fragment: howlers, capuchins and owl monkeys (*Aotus* cf. *lemurinus*). Yotoco is immersed in a matrix of pastures for livestock. In these privately owned farms it is possible to find small forest remnants (< 10 ha), which are under pressure from hunting and logging. Despite the close proximity of these small remnants, the whole region is isolated from other primate populations (> 30 km).

Data collection

We conducted a line transect survey to estimate the density of primates from February to June 2004 (Peres, 1999). We established ten transects across the reserve (with an average length of 1.19 km). Each transect was walked 21.2 times on average, at a speed of approximately 0.5 km / hour on average. We carried out each census at 8:00 am (the presence of fog in the mountain forests prevents census earlier) with a return census walk at 14:00. We estimated the primate population density using DISTANCE 6.0 (Thomas *et al.*, 2009). This software calculates the probability of detection, modeled as a function of observed distances from the transect (using perpendicular distances), and then uses this probability to estimate the proportion of primate groups that were not detected in the sample (Thomas *et al.*, 2002). We compared six theoretical models on the distribution of observed distances: 1) half-normal with cosine expansion, 2) half-normal with hermite polynomial, 3) uniform with cosine, 4) uniform with simple polynomial, 5) hazard-rate with cosine, and 6) hazard-rate with simple polynomial. As recommended by Buckland *et al.* (2001) we chose for each species the model with the lowest Akaike Information Criterion (AIC) value.

Due to the short time interval to observe the groups during the census, we followed several groups of howlers out of the census routine for longer periods of time. This enabled

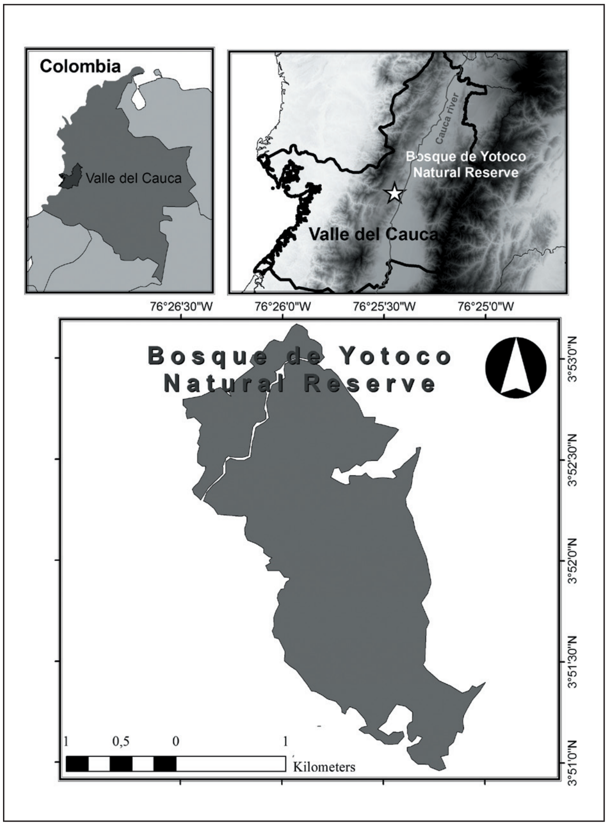

Figure 1. The Bosque de Yotoco Natural Reserve is an isolated forest fragment of 559 ha located in the eastern slope of the Western Cordillera of Colombia, between 1200 and 1700 m of altitude.

us to determine a more accurate group size, through direct counts of individuals (Pruetz and Leasor, 2002). Then, we calculated the howlers' density of individuals, introducing in DISTANCE as constants, the average and the standard error of the group size based on direct counts. In the case of capuchins, it was not possible to follow groups outside the census routine, due to time limitations. Therefore, we estimated the group size with data collected during the census (which implies that the population density may be underestimated). From preliminary analysis of the data, we found an inverse relationship between the perpendicular distance from the transect, and the number of individuals counted in a group ($F = 4.9$, $P < 0.05$, $R^2 = 0.19$). For this reason, we worked with the group size estimated from the perpendicular distance at zero meters, according to the regression model. We calculated the capuchins' density of individuals by multiplying the group density and the average group size (Peres, 1999). We calculated empirically the variance of population density for both species, using the sum of the group size, its sample variance of encounter rate and its detection probability (Thomas *et al.*, 2002).

Results

Our survey effort was a cumulative two-way distance of 241.1 km. We recorded 451 independent detections of howlers, from which 128 were solitary adults and subadults. We did not include solitary individuals in the analysis, since it is known that those individuals are usually attempting to join a group and the solitary condition is thus temporary. The mean number of howler groups observed per kilometer in each census was 1.5 (ranging from 0.5 to 2.6). The histogram of detection distances showed some outliers recorded further than 50 m, which affected the trend of this distribution. Then, the detection function was truncated at 50 m by removing 29 records of outliers. The uniform expansion model was used to estimate group density (Table 1), since this model yielded the best fit for distribution of perpendicular distances for howlers. For the howlers' density of individuals calculations, we estimated an average group size of 8.2 individuals (CI 95% = 6.5 - 9.9), which ranged from 4 to 14 (based on direct counts of 17 groups of howlers) (Table 1). Encounter rate for howlers was the variable that contributed the most to the variance of this species density (63%), followed by group size (32.2%) and detection probability (4.8%). The coefficient of variation for the individual and group density was 18.25 and 15.42%, respectively.

For capuchins, we recorded 35 independent detections, with 6 detections of solitary individuals (not included in the analysis, for reasons stated above). The average of capuchins groups registered per km during censuses was 0.15 (ranging from 0 to 0.29). A uniform model with cosine series expansion best fitted the distribution of perpendicular distances. With this model, we calculated the capuchins' density of groups (Table 1). The largest group size observed in capuchins was 9 individuals. From the census, we calculated a group size of 3.6 (CI 95% = 2.8 - 4.6) for this species. This value is lower than the estimated group size at the perpendicular distance at 0 m (according to the regression), which was 4.69 (CI 95% = 3.5 - 6.3). With these data, we calculated the density of individuals (Table 1). The component that contributed to the most variance of the density of this species was the encounter rate (62%), followed by group size (25.5%), and detection probability (12.5%). The coefficient of variation for the density of individuals and groups were 29.9 and 26.25% respectively.

Discussion

The density of howlers in this locality exceeds densities reported for this species in continuous lowland and montane forests, which usually range from 35 to 55 indv/km^2 (Gaulin and Gaulin, 1982; Crockett and Eisenberg, 1987; Chapman and Balcomb, 1998; Gomez-Posada *et al.*, 2007). However, it is consistent with densities found in fragmented landscapes of the Colombian Andes, which tend to exceed 150 indv/km^2 (Gomez-Posada *et al.*, 2009, in press). For the genus *Alouatta*, higher densities have been reported in forest fragments compared to continuous forest, and even some fragments have been reported overcrowded (Estrada and Coates-Estrada, 1996; Terborgh *et al.*, 2001; Cristobal-Azcárate *et al.*, 2005; Van Belle and Estrada, 2005). Forest fragments can act as refuges for species when former distribution ranges are reduced by habitat destruction, thus forcing the populations to be concentrated in protected spaces (Defler, 1981; Pruetz and Leasor, 2002).

The howler population size found in Yotoco is about 1000 individuals. A high population number could maintain the genetic variability in the long term (Robinson and Ramirez, 1982). Although the conditions of total isolation and high-density could cause negative effects in the population, it is known that this genus has the ability to persist in fragmented and disturbed environments (Rylands and Keuroghlian, 1988; Estrada and Coates-Estrada, 1996; Crockett, 1998; Mandujano *et al.*, 2004; Van Belle and

Table 1. Density and abundance of *A. seniculus* and *C. capucinus* in Yotoco Reserve (average / 95% interval of confidence).

Species	Density group/km^2	Density individuals/km^2	Abundance of groups	Abundance of individuals
Alouatta seniculus	20.6 (14.7-28.9)	169 (116-246)	131 (82.2-165.6)	943 (646-1376)
Cebus capucinus	3.02 (1.7-5.3)	13.5 (7.3-25.1)	16.88 (9.5-29.1)	76 (41-140)

Estrada, 2005). It is important to monitor birth and death rates, and changes in size and abundance of howler groups in the isolated Yotoco fragment over the long term.

Studies of *C. capucinus* in Central America have estimated densities from 5 to 50 individuals/km^2 in continuous forest (Fedigan *et al.*, 1985; Robinson and Janson, 1987; Oppenheimer, 1990) and up to 60 individuals/km^2 in fragments (Pruetz and Leasor, 2002; DeGama-Blanchet and Fedigan, 2005). The capuchin density estimated in Yotoco is toward the low end of this range. Unlike howlers, capuchins in Yotoco had low population density and low population size (between 41 to 140 individuals). Low population size is one of the main mechanisms of extinction, as smaller populations have greater probabilities of extinction (Kattan and Alvarez-Lopez, 1996). A small, isolated population, such as the capuchins in Yotoco, could suffer loss of genetic diversity and inbreeding depression, with negative consequences for long term survival (Estrada and Coates -Estrada, 1996; Crockett, 1998; DeGama-Blanchet and Fedigan, 2005).

As expected, population densities of the two species of primates in Yotoco are conspicuously different. These species differ widely in terms of behavior, physiology and morphology. The red howler is a facultative folivore, with an energy saving strategy that allows great flexibility in their diet and behavior and enables low space requirements. For example, a group of howlers in Yotoco has a home range of about 13.5 ha (Palma *et al.* in press), much lower than the space required by a group of capuchins. These characteristics allow howlers to survive in forest fragments (Milton, 1980; Crockett and Eisenberg, 1987; Crockett, 1998; Bicca-Marques, 2003). In contrast, for capuchins, their omnivorous diet and high rates of activity necessitate large space requirements. In Panama, home range was estimated at 164 ha for one group (Oppenheimer, 1990). The capuchins consume mainly fruits and insects and supplementing their diet with flowers, invertebrates and small vertebrates including some eggs. Capuchins' diet should therefore be rich in energy and forces them to be very active in searching for food (Robinson and Janson, 1987; Oppenheimer, 1990; Defler, 2004; Fragaszy *et al.*, 2004). These features can cause stress on capuchins inhabiting isolated localities, such as Yotoco.

For both species, rate of encounter was the component that most contributed to variance in the estimation of population density. For future surveys, we suggest using a greater number of transects to decrease the sampling error. The second component that contributed most to the variance was group size. This result reflects the high variation in the social structure of groups of both species. Alternatively, this variation may be an effect of the difficulty of counting the whole groups during the census, due to the inconspicuous behavior of howlers and the evasive actions of capuchins.

Forest protection and human interference largely determine the status of primate populations (Crockett, 1998; Chapman and Balcomb, 1998). In Yotoco after a long period of extractive human activities, bans on wildlife hunting activities and forest protection beginning in 1959 have probably benefited primate populations. For howler and capuchin monkeys, populations have reportedly grown with forest recovery (Crockett and Eisenberg, 1987; Fedigan and Jack, 2001). Unfortunately there are no previous studies in Yotoco, to verify population trends of these species in this fragment. The main threat to primate populations and other species in Yotoco is the high degree of isolation. However, the local environmental authority CVC has already started programs to purchase and protect adjacent lands. For example, on the south side of Yotoco there are several small fragments where capuchins have recently been observed (N. Roncancio, pers. obs). The protection and connection of these forests by corridors (such as live fences, forestry plantations, and shade plantations) may benefit the primates. In the short term, capuchins might benefit from forest regeneration in adjacent areas, as their morphology would allow rapid colonization of areas that are in a recovery process. In the medium term, howlers would use the new forests, where trees are large enough to support their weight and provide canopy connectivity (Fedigan and Jack, 2001; DeGama-Blanchet and Fedigan, 2005). However, the whole region is isolated from other primate populations, so the long-term survival of these two species depends on landscape-level management to reestablish physical and functional connectivity with other primate populations.

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RELAÇÕES SOCIAIS, EMIGRAÇÃO E FISSÃO DE UM GRUPO DE *ALOUATTA GUARIBA CLAMITANS* EM UM REMANESCENTE DE FLORESTA OMBRÓFILA MISTA

Rodrigo Fernando Moro-Rios[1], **João Marcelo Deliberador Miranda**[1] **e Fernando de Camargo Passos**[1]

[1] *Departamento de Zoologia, Universidade Federal do Paraná, Centro Politécnico, Caixa Postal 19020, Curitiba 81531–990, Paraná, e-mails: rodrigocrotalus@gmail.com, guaribajoao@yahoo.com.br, fpassos@ufpr.br.*

Resumo

Os comportamentos sociais correspondem a uma pequena parcela do orçamento de atividades dos bugios, mas podem desempenhar um importante papel na definição das estratégias de sobrevivência dos indivíduos e suas proles. Esse trabalho teve por objetivo analisar quantitativamente as relações sociais e o espaçamento entre os indivíduos de um grupo de *Alouatta guariba clamitans* cujas relações de parentesco são bem conhecidas para grande parte dos indivíduos devido a um acompanhamento de longo prazo. Durante 140 h distribuídas ao longo de dois anos foram coletados dados pelo método de varredura instantânea. As interações sociais representaram apenas 1,4% dos registros. A brincadeira foi a interação mais frequente e foi realizada principalmente por indivíduos imaturos aparentados. A catação foi realizada principalmente pelas fêmeas adultas em seus filhotes e parece auxiliar na manutenção da coesão do grupo. Interações agonísticas e cópulas foram raras. Também foi observada a emigração de um macho juvenil e a fissão do grupo. As relações de espaçamento entre os indivíduos evidenciam a maior proximidade das fêmeas adultas com seus filhotes imaturos. Dessa forma, o parentesco parece ser determinante nas relações sociais dos bugios.

Palavras-chave: Catação, brincadeira, bugios, demografia, dispersão

Abstract

Although howlers devote a small proportion of their time to socializing, social behaviors play an important role in the survival and reproduction of all individuals. The aim of this work was to analyze the spacing and social interactions among individuals of a group of *Alouatta guariba clamitans* with known relatedness for almost all individuals. Field data were gathered through 140 h of observation carried out over two years. Social interactions were just 1,4% of all activity. Infant play was the most frequent interaction and usually involved related immature individuals. Grooming was performed mainly by adult females over their offspring. Agonism and mating were rarely observed. The emigration of a juvenile and group fission were also reported. Adult females and its offspring exhibited great proximity. It seems that kinship may have an important role in the social structure of some howler groups.

Keywords: Grooming, play, howler monkeys, demography, dispersal

Introdução

O gênero *Alouatta* Lacépède, 1799 é singular dentre os Platyrrhini quando se remete à sua dieta, composta em grande parte por folhas, item geralmente pobre em compostos de alto retorno energético e cuja digestão é difícil (Milton, 1980; Mendes, 1989). Desse modo, *Alouatta* spp. empregam uma estratégia ecológica e comportamental que visa a redução das perdas energéticas (Milton, 1980) na qual os animais passam longos períodos em inatividade e as interações sociais representam uma pequena parcela do orçamento diário de atividades (Mendes, 1989). Apesar de sua baixa frequência, as interações sociais intra- e intergrupais desempenham um importante papel no desenvolvimento ontogenético (Miranda *et al.*, 2005), na reprodução (Calegaro-Marques e Bicca-Marques, 1993) e na dinâmica populacional (Crockett e Pope, 1988; Calegaro-Marques e Bicca-Marques, 1996). Neste trabalho avaliamos as interações sociais e o espaçamento entre os integrantes de um grupo de bugios-ruivos habitante de um remanescente de Floresta Ombrófila Mista.

Materiais e Métodos

O presente estudo foi realizado em um remanescente de Floresta Ombrófila Mista (Floresta com Araucária) com aproximadamente 700 ha no Distrito do Bugre, município de Balsa-Nova, Estado do Paraná, Brasil (25° 29'52" S, 49° 39' 24" O; 900–1200 m a.n.m.). A área é caracterizada por um mosaico de floresta primária alterada, floresta secundária e campos gerais. A temperatura média anual é de 17,9°C e o índice pluviométrico de 1600 mm (Miranda e Passos, 2005).

Um grupo composto em agosto de 2003 por dois machos adultos (MA), três fêmeas adultas (FA), um macho subadulto

(MS), três juvenis (JU) e um infante (IN) foi observado durante 140 h no período de agosto de 2003 a junho de 2005. O grupo era habituado à presença de observadores e vinha sendo monitorado desde 2002 (Miranda & Passos, 2005), o que permitiu conhecer o parentesco entre muitos de seus membros. Durante o primeiro ano do estudo houve a morte de um MA, a fissão do grupo, o nascimento de dois indivíduos e a mudança de faixa etária do MS para MA. Devido a essas alterações, em julho de 2004 o grupo estava composto por um MA, duas FA, três JU e dois IN (Miranda e Passos, 2005). No final do estudo o grupo entrou novamente em processo de fissão resultando na formação de dois grupos, um composto por um MA, uma FA, um JU e um IN e outro por uma FA e dois JU (Fig. 1). O comportamento social e o vizinho mais próximo foram registrados pelo método de varredura instantânea (Altmann, 1974) em unidades amostrais de 2 min. e intervalos de 10 min. entre as observações. As observações foram realizadas pela manhã e à tarde. Nesse trabalho analisamos os registros obtidos em dias completos de observação (amanhecer ao pôr-do-sol) e incompletos (observação em apenas um dos turnos). Enquanto o comportamento social foi anotado ao longo de todo o estudo, o vizinho mais próximo foi anotado entre julho de 2004 e junho de 2005. Anotações *ad libitum* (Altmann, 1974) foram incluídas na descrição de eventos raros.

Resultados

Foram obtidos 3545 registros comportamentais, dos quais 50 foram referentes a interações sociais (0,36 interações/hora ou 1,4% dos registros) distribuídas em brincadeira (62% das interações, n = 31), catação (26%, n = 13), comportamento agonístico (10%, n = 5) e cópula (2%, n = 1). A brincadeira foi a interação mais frequente (0,22 eventos/hora) e ocorreu em duplas (65%, n = 20), trios (16%, n = 5) e quartetos (19%, n = 6). Todas as classes participaram de brincadeiras (JU: 26 eventos; IN: 15; MS: 7; MA: 4; FA: 1). Brincadeiras envolvendo apenas JU representaram 40% dos eventos, JU e IN 30%, JU e MS 13%, MA, MS e IN 7%, MA e MS 3% e MA, MS e JU 3%. Quando animais adultos participaram das brincadeiras, os iniciadores das interações sempre foram os indivíduos imaturos (JU e IN) que empurravam e puxavam o adulto até que esse participasse. Brincadeiras envolvendo irmãos ocorreram em 77% das ocasiões. Em 20% dos registros de brincadeira a interação ocorreu entre indivíduos não aparentados matrilinearmente e em 3% dos casos não foi possível determinar a relação de parentesco dos participantes.

As catações (0,09 eventos/hora) foram realizadas principalmente por FA (92%), sempre como executoras (FA catando seu IN, 54%; FA catando filho JU, 31%; FA catando filho MS, 8%). Catação entre JU representou 8% dos casos. Em apenas um dos casos de comportamento agonístico, cuja taxa de ocorrência foi de 0,04 eventos/hora, houve contato físico entre os participantes (duas FA). Esse episódio resultou na expulsão de uma FA e seu filhote da árvore frutífera ocupada pela agressora. A única cópula registrada ocorreu no começo da manhã, quando um casal se afastou do grupo antes do início das atividades de forrageio. O evento foi precedido por catações executadas pela FA, seguida por catações e inspeção da genitália executadas pelo MA (esses registros de catação não estão incluídos acima porque foram registrados *ad libitum*). A cópula durou 27 s. Após a cópula, o casal permaneceu inativo por um período de 15 min., antes de se reintegrar ao grupo.

A partir do início do segundo ano do estudo, após a fissão do grupo, os animais que permaneceram costumavam se dividir para forragear em dois subgrupos durante o dia, mas se reuniam no crepúsculo vespertino na mesma árvore de dormida. O subgrupo 1 era composto pela FA I e seus filhos IN I, JU I e JU II, enquanto o subgrupo 2 era composto por um MA e pela FA II e seus filhos IN II e JU III. A análise de proximidade (N = 558 registros) entre os indivíduos revelou as FA como vizinhos mais próximos na maioria das ocasiões (Tabela 1). A FA I apareceu como indivíduo mais próximo no subgrupo 1 em 52% dos registros, enquanto a FA II foi o vizinho mais próximo em 45% das ocasiões no subgrupo 2. Indivíduos dos dois subgrupos foram vizinhos mais próximos em apenas 7% dos registros e esses ocorreram com maior frequência durante os primeiros meses do segundo ano de estudo, decaindo até se tornarem inexistentes a partir de dezembro de 2004.

A partir dos 2,5 anos do JU I nenhuma observação de interação social envolvendo este indivíduo foi registrada. Além

Tabela 1. Porcentagem de registros nos quais cada indivíduo foi vizinho mais próximo dos demais membros do grupo.

	Vizinho mais próximo							
Indivíduo	**FA I**	**JU I**	**JU II**	**IN I**	**FA II**	**JU III**	**IN II**	**MA**
FA I (N=140)	-	21	0	79	1	0	0	0
JU I (N=112)	77	-	3	19	1	0	1	0
JU II (N=46)	0	43	-	0	0	57	0	0
IN I (N=74)	88	11	0	-	0	0	1	0
FA II (N=74)	3	0	0	3	-	7	71	16
JU III (N=14)	0	0	14	0	50	-	21	14
IN II (N=19)	4	0	0	4	83	7	-	3
MA (N=79)	6	0	0	0	57	22	13	-

disso, os dados de proximidade mostram que ele passou a ocupar uma posição periférica no grupo, a qual perdurou por cinco meses, culminando na sua emigração em dezembro de 2004. Durante o segundo ano também não foram observadas interações afiliativas entre indivíduos que viriam a pertencer aos dois distintos grupos resultantes do processo de fissão. Entre janeiro e março de 2005, indivíduos dos grupos formados após a fissão passaram a ser observados emitindo vocalizações de rugido (*sensu* Mendes, 1989), após as quais os grupos partiam em direções opostas.

Discussão

A maior frequência de brincadeiras sociais observada nos juvenis em relação aos infantes pode ser reflexo da inexperiência dos últimos e do maior desenvolvimento físico e motor dos primeiros (Cabrera, 1997). O fato das duplas observadas nas brincadeiras terem sido na maioria das vezes aparentadas pode ser devido à proximidade que os indivíduos mantinham com a progenitora, permanecendo mais tempo em proximidade e assim interagindo com mais frequência. A taxa de catações observada neste trabalho (0,09 eventos/hora) foi menor do que a taxa observada para a mesma espécie nos estudos de Mendes (1989) (0,31 eventos/hora) e Chiarello (1995) (0,40 eventos/hora) e também do que o observado para *A. seniculus* (0,93 eventos/hora) (Sanchez-Villagra *et al.*, 1998) e *A. caraya* (0,66 eventos/hora) (Miranda, 2009). Por outro lado, ela foi superior aos valores observados para *A. palliata* (0,02 e 0,04 eventos/hora) (Bernstein, 1964; Jones, 1979). Sanchez-Villagra *et al.* (1998) relacionam o número de catações entre os indivíduos adultos à sua importância na formação de coalizões e no reforço das ligações entre os indivíduos. O fato do grupo aqui estudado não ter apresentado a formação de coalizões e estar passando por um período de instabilidade ao longo do estudo pode explicar a baixa taxa de catações observadas em relação aos outros estudos.

A predominância de relacionamentos de catação entre mães e filhotes pode estar relacionada à função primordial desse comportamento, a manutenção da higiene. Além do papel na higienização dos animais, as catações são um comportamento relacionado à coesão do grupo e das relações de proximidade entre os indivíduos (Lehmann *et al.*, 2007). Os resultados que apontam para um relacionamento de proximidade maior entre as fêmeas e seus filhotes dão suporte a um possível papel da catação na manutenção dessa proximidade. Assim, investimentos por parte das fêmeas para manter a proximidade de seus filhotes podem ter impacto no sucesso reprodutivo das mesmas através da diminuição das chances de predação sobre sua prole. A proximidade com a mãe pode ainda ser importante na termoregulação dos filhotes (Bicca-Marques e Calegaro-Marques, 1998).

No contexto do episódio de emigração observado, o grupo era composto por três machos irmãos (um MA, dois JUV), uma FA mãe desses indivíduos, uma FA e seu filhote não aparentados a eles. Assim, é possível que o reduzido número de oportunidades reprodutivas dentro do grupo tenha provocado o isolamento social e espacial do juvenil mais velho,

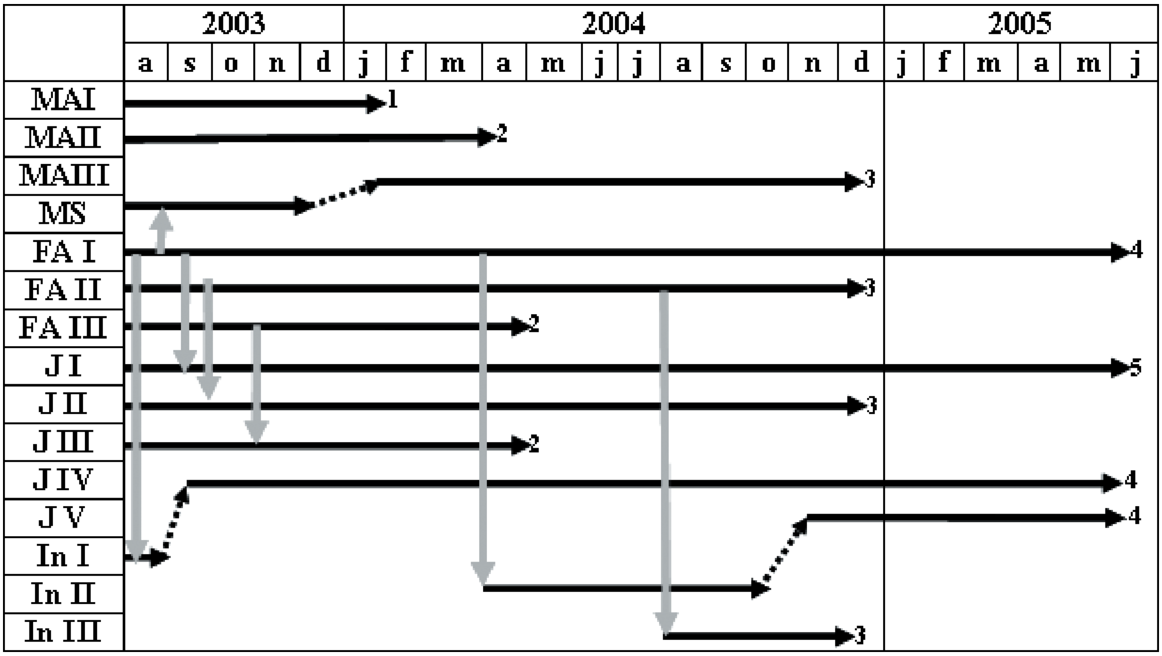

Figura 1. Relações de parentesco e mudanças na composição do grupo de estudo. As setas cinzas unem pares mãe-filho e as setas pontilhadas indicam mudanças de classe etária. Os números indicam a natureza dos eventos: (1) desaparecimento com causa indeterminada; (2) formação do grupo composto pelos indivíduos indicados pelo número 2 após a fissão; (3) formação do grupo composto pelos indivíduos indicados pelo número 3 após a fissão; (4) emigração.

reduzindo a probabilidade de conflito com seu irmão MA. Na área de estudo não são incomuns fêmeas transeuntes (Miranda e Passos, 2005), sendo plausível pensar na formação de novos grupos a partir da união dessas fêmeas com machos recém emigrados (Brockett *et al.*, 2000; Miranda e Passos, 2005). Além disso, o valor da densidade de bugios na área de estudo foi calculado em 0,38 indivíduos/ha, valor bastante inferior às estimativas de 1,1 indivíduos/ha e 1,7 indivíduos/ha realizadas por Mendes (1989) e Chiarello (1993), respectivamente, sugerindo que a espécie pode não ter atingido a capacidade de suporte da área de estudo. Nesse caso, os custos da emigração talvez sejam menores do que os de permanecer em um grupo com limitadas oportunidades reprodutivas. Já o processo de fissão e consequente formação de um grupo sem um macho adulto estariam relacionados à busca por oportunidades reprodutivas não endogâmicas por parte da fêmea adulta (Miranda *et al.*, 2004).

A comparação dos dados de catação com os de proximidade, a frequência da brincadeira entre irmãos e os comportamentos agonísticos, permitem afirmar que as relações afiliativas estiveram concentradas entre animais proximamente relacionados. Dessa maneira, parece que a estruturação familiar e avaliação da existência de oportunidades reprodutivas não endogâmicas foram preponderantes na definição das estratégias sociais neste grupo de *Alouatta guariba clamitans*.

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SHORT ARTICLES

NECTAR FEEDING ON AN EXOTIC TREE (*GREVILLEA ROBUSTA*) BY *ALOUATTA CARAYA* AND ITS POSSIBLE ROLE IN FLOWER POLLINATION

Romina Pavé
Silvana M. Peker
Mariana Raño
Carolina Ramírez Orjuela
Gabriel E. Zunino
Martin M. Kowalewski

Introduction

Several species of primates consume nectar and/or pollen (Sussman, 1979; Torres de Assumpção, 1981; Puertas *et al.*, 1992; Peres, 1994; Carthew & Goldingay, 1997; Birkinshaw & Colquhoun, 1998; Passos & Kim, 1999; Riba-Hernández & Stoner, 2005; Marín-Gómez, 2008). Nectar is a high-energy resource and an important food source for mammals living in habitats with marked seasonality (Janson *et al.*, 1981; Garber, 1988; Ferrari & Strier, 1992). Also, mammals including primates can be possible pollinators of different plant species (Kress *et al.*, 1994; Carthew & Goldingay, 1997).

Black and gold howler monkeys, *Alouatta caraya*, are characterized by a folivore-frugivore opportunistic diet (Milton, 1998). This arboreal species inhabits different types of tropical and subtropical forests in NE Argentina, SE Brazil, Paraguay, and Bolivia (Crockett & Eisenberg, 1987; Zunino & Kowalewski, 2008). *Grevillea robusta* (Family Proteaceae) is a tree native to eastern Australia and it has been widely planted in subtropical and tropical environments of Africa, America, and Asia (Harwood, 1992). In Argentina, this species was introduced in the late nineteenth century for construction of furniture (Moscovich *et al.*, 2004). *Grevillea robusta* has hermaphroditic and bright yellow-orange flowers (approximately 23 mm long) grouped into terminal racemes. Fruits are black leathery dehiscent follicles with two seeds. The pollen is deposited onto a cone around the stigma and the nectary secretes yellow nectar that accumulates in a large drop between the style and the perianth segment (McGillivray, 1993; Kalinganire *et al.*, 2000). The species shows both protandry (anthers dehisce prior to stigma receptivity) and a self-incompatibility mechanism (Kalinganire *et al.*, 2000). Therefore, the flowers need pollinators to produce fruits. The species of Proteaceae are not specialized to certain groups of pollinators; they are generalists (Collins & Rebelo, 1987). The clustering of flowers on the ends of branches, brush-type presentation, bright color, and copious nectar production suggest that *G. robusta* is pollinated by diurnal animals, similar to other proteaceous species (Collins & Rebelo, 1987; Kalinganire *et al.*, 2000).

For exotic plants like *G. robusta* in forests in northeast Argentina, pollination success depend on density of plant populations which may affect the attractiveness of enough pollinators, the competition with native vegetation for pollinator attention, and the low number of suitable generalist pollinator species (Stout *et al.*, 2006). However, if generalist native species pollinate introduced plants and these pollinators are abundant, exotic species may be reproductively successful and spread rapidly (Parker, 1997). The aim of this study is to describe the nectar feeding behavior of *Alouatta caraya* on an exotic tree (*Grevillea robusta*, Proteaceae) and suggest the possible role of this primate in flower pollination.

Materials and methods

The study was carried out at San Cayetano (27° 30' S, 58° 41' W), Corrientes Province, Argentina (Rumiz, 1990). The climate is subtropical with an average annual temperature of 21.7° C and an average annual of rainfall of 1,230 mm; the rainfall decreases slightly in the winter (July to August) (Zunino *et al.*, 2007). The site presents a fragmented forest and the vegetation is characterized by dense, semideciduous upland and riparian forests, open lowland forests with palm trees, and grasslands (Zunino *et al.*, 2007). The forest has been heavily modified by logging, the presence of cattle, and burning (Zunino *et al.*, 2007). In addition, there are some individuals of exotic vegetation such as *Citrus* spp, *Grevillea robusta*, *Hovenia dulcis*, and *Melia azedarach*.

Observations were collected on two groups of howlers (Ariscos and Huerta) between 2005 and 2008 during a long-term ecological and behavioral study on *A. caraya* in San Cayetano. We used scan and focal sampling techniques (Altmann, 1974) from sunrise to sunset. During the scan sampling we recorded behaviors and spatial distributions of the whole group every 10 min. During focal sampling we recorded the behavior, height and tree species used, and distance to the nearest individual. We present data from the two sampling techniques but quantitative data on nectar-feeding behavior are based only on scan sampling. We calculated the percentage of feeding records and the rate of nectar-feeding per group per hour. In Table 1 we present the two study groups including study period, date of nectar-feeding, sampling technique, sex-age composition, and flower damage.

Results

The home range size of Ariscos and Huerta groups are 3.78 ha y 6.26 ha respectively. There are two *G. robusta* trees (separated by 80m) within Ariscos's home range, and one within Huerta. Howlers were observed exploiting the flowers of *G. robusta* in spring (October and November). The nectar-feeding records are the following:

- Ariscos group. November 2005 (Table 1). We observed nectar-feeding on one of the two trees within the home range. Nectar-feeding accounted for 6.2% of the 97 scan sampling feeding records (rate: 0.004 records per hour). The whole group consumed nectar and two of them (an adult female and a juvenile male) fed simultaneously on the same tree 1m one from the other. Howlers brought their mouth near to the flowers attached to the inflorescence and licked nectar. They obtained nectar from different inflorescences of the same tree. They did not eat any other part of the flower except the nectar. After each feeding bout, howlers carried abundant yellow pollen on their snouts.
- Ariscos group. October 2007 (Tabla 1). Nectar-feeding accounted for 5.5% of the 165 scan sampling feeding records (rate: 0.24 nectar-feeding records per hour). Two individuals (a subadult male and a juvenile male) consumed nectar and the same tree was visited 2 consecutive days. Howlers fed on nectar in the same way as observed in November 2005. They fed simultaneously on the same tree 3–4 m one from the other.
- Huerta group. October 2007 (Table 1). In October 26, we observed one juvenile male eating one flower of *G. robusta* and drinking rainwater accumulated in the flowers (1h total of focal sampling). On October 27th, the same individual drank rainwater from the flowers. Two juvenile females and the infant were observed drinking rainwater from the flowers at 1m of the juvenile male (1h total of focal sampling). In the two days of focal after drinking the juvenile male carried pollen on its snout.
- Huerta group. October, 2008. During the scan sampling, we observed nectar-feeding by four individuals (Table 1). This accounted for 4% of the 99 scan sampling feeding records (rate: 0.17 nectar-feeding records per hour). One individual obtained nectar from different inflorescences of the same tree and two individuals fed simultaneously on the same tree between 0.5 and 2m of distance. Howlers fed on nectar as was observed in Ariscos group. They did not eat any other part of the flower except the nectar. After feeding bouts, howlers carried abundant yellow pollen on their snouts. During the focal sampling, we only observed the infant feeding on nectar. This infant consumed nectar in three occasions for a total of 21.24h of focal sampling. On one occasion, the infant consumed both nectar and flower parts.

Discussion

This study shows that nectar-feeding was a rare behavior in the feeding repertory of *A. caraya* (the average rate of nectar-feeding was 0.14 records per hour). The nectar is an opportunistic food resource. Only young individuals ate part or all of the flowers together with the nectar. In this regard, Pereira & Fairbanks (1993) show that juveniles spent more time exploring novel objects, including food, in comparison to adult individuals. The rest of the age-classes licked the nectar and did not eat any other part of the flower. Garber (1988) and Riba-Hernández & Stoner (2005) found that adult individuals of *Ateles geoffroyi*, *Saguinus mystax*, and *S. fuscicollis* destroy the flowers of *Symphonia globulifera* (Guttiferae) when they were feeding on nectar. In contrast, studies on *Aotus trivirgatus*, *Ateles paniscus*, *Brachyteles arachnoides*, *Callithrix flaviceps*, *Cebuella pygmaea*, *Cebus albifrons*, *C. apella*, *Eulemur macaco*, *Saguinus fuscicollis*, *S. imperator*, and *Saimiri sciureus* (Janson *et al.*, 1981; Torres de Assumpção, 1981; Ferrari & Strier, 1992; Birkinshaw & Colquhoun, 1998) found that animals did not eat or caused little damage to the flowers when they were feeding on nectar.

Every time howlers visited flowers to feed on nectar they removed pollen with their snouts. They moved between different inflorescences on the same tree, potentially facilitating pollen movement between flowers of the same tree. However, monkeys did not engage in cross-pollination because in Huerta's home range there was just one tree of *G. robusta* and in Ariscos's home range there were two trees but separated by 80m. Nevertheless, we observed effective seed production in the three *G. robusta* trees used by the howlers. Other non-human primates appear to be involved

Table 1. Summary of nectar-feeding records in two groups of *Alouatta caraya* in San Cayetano.

Group	Study period	Days followed	Sampling technique	Date of nectar-feeding	Group composition	Flower damage
Ariscos	Sep 2005-Sep 2006	65	Scan (5 days/month)	Nov 22, 2005	**1 AM, 1 AF, 1 JM**	No
Ariscos	Sep 2007-Feb 2008	18	Scan (3 days/month)	Oct 16-17, 2007	1 AM, 1 AF, **1 SAM**, **1 JM**, 1 I	No
Huerta	Feb-Dec 2007 Jan-Jun 2009	38	Focal	Oct 26-27, 2007	1 AM, 1 SAM, 2 AF, 4 JF, **1 JM**	Yes
Huerta	Sep 2008-Jun 2009	20	Scan (2 days/month), Focal	Oct 14, 2008	2 AM (**1 AM**), 2 AF (**1 AF**), 2 SAF, 2 JF (**1 JF**), 1 JM, **1 I**	Yes

References. **AM:** adult male, **AF:** adult female, **SAM:** subadult male, **SAF:** subadult female, **JM:** juvenile male, **JF:** juvenile female, **I:** infant. Group composition: In bold case, individuals engaged in nectar-feeding.

in pollination, i.e *Aotus lemurinus* (Marín-Gómez, 2008), *B. arachnoides* (Torres de Assumpção, 1981), *C. apella* (Torres de Assumpção, 1981), and *E. macaco* (Birkinshaw & Colquhoun, 1998).

Grevillea robusta has features that can allow its pollination by diurnal vertebrates such as *A. caraya* including a partially fused perianth, brightly colored flowers in terminal racemes, simultaneous flower opening, and abundant nectar and pollen production (Janson *et al*., 1981; Carthew & Goldingay, 1997). In Australia, 28 species of Proteaceae are visited by non-flying mammals for nectar-feeding (Carthew & Goldingay, 1997). Also, in some proteaceous species, large vertebrates as the marsupials are important pollinators (Goldingay *et al*., 1991). In the study area, two species of nectar-feeding bats and at least 320 species of birds have been identified (Zunino & Kowalewski, 2008) and some of them may act as effective pollinators of *G. robusta*. *Grevillea robusta* is not a threat to native biodiversity because it did not become invasive (Mooney & Cleland, 2001). The role of primates and other vertebrates in the maintenance of this plant species remains unclear. Experimental research is needed to evaluate the real importance of *A. caraya* in pollination. Also, further research is critical as exotic species invasions and pollinator ecology are high priority issues in conservation biology.

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Romina Pavé, Estación Biológica Corrientes- Museo Argentino de Ciencias Naturales, C1405DJR, Buenos Aires, Argentina. E-mail: <rominaepave@yahoo.com.ar>, **Silvana M. Peker** Estación Biológica Corrientes- Museo Argentino de Ciencias Naturales, **Mariana Raño**, Estación Biológica Corrientes- Museo Argentino de Ciencias Naturales, **Carolina Ramírez Orjuela**, Estación Biológica Corrientes- Museo Argentino de Ciencias Naturales and Centro de Ecologia Aplicada del Litoral, Corrientes, Argentina, **Gabriel E. Zunino**, Estación Biológica Corrientes- Museo Argentino de Ciencias Naturales, **Martin M. Kowalewski**, Estación Biológica Corrientes- Museo Argentino de Ciencias Naturales and Department of Anthropology, University of Illinois at Urbana-Champaign, Urbana, Illinois, USA.

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YEASTS ISOLATED FROM *ALOUATTA PALLIATA*, *ATELES GEOFFROYI*, *CEBUS CAPUCINUS* AND *SAIMIRI OERSTEDII* (PRIMATES: CEBIDAE)

Norma Gross
Juan Diego Castro
Olga Guerrero
Misael Chinchilla
Ronald Sánchez
Gustavo Gutiérrez-Espeleta

Introduction

In the present study the presence of yeasts on the skin, and in the oral cavity and vagina of *Alouatta palliata* (mantled howler monkey), *Ateles geoffroyi* (black-handed spider monkey), *Cebus capucinus* (white-faced capuchin) and *Saimiri oerstedii* Reinhardt, 1872 (red-backed squirrel monkey) from several sites of Costa Rica was examined. These primates have been characterized with regard to their feeding patterns (Jones, 1983; Happel, 1986) and geographical distribution (Massey, 1987; Lippold, 1988, Rodríguez and Chinchilla, 1996). Also, the bacterial flora as well as the endo- and ectoparasites of Costa Rican primates have been reported (Troyo *et al.*, 2002; Calderón-Arguedas *et al.*, 2004; Gamboa-Coronado *et al.*, 2004; Chinchilla *et al.*, 2005; Chinchilla *et al.*, 2006). The present project is unique in being the first to assess the yeast flora in these Neotropical primates. The yeast *Candida* is a saprophyte in natural products, but has been isolated from the mucosa and skin of humans and animals (Mariat and Droulet, 1996). *Candida* is considered an opportunistic micro-organism that causes disease in hosts with a weakened immune system (Ostrosky-Zeichner, 2003). The most common clinical manifestations of candidiasis are cutaneous, mucocutaneous and invasive infections. In humans, *Candida* infections of the mouth and esophagus are frequently associated with AIDS (de Repentigny *et al.*, 2004). Vulvo-vaginal candidiasis is a common cause of vaginal discharge, soreness, vulvar burning, dysuria and local pruritus. *Candida* may be either a commensal or a pathogen of the vagina, which indicates that changes in the host vaginal defense mechanisms or changes in the vaginal micro-environment are generally necessary for *Candida* to induce pathology or association with clinical symptoms (Sobel, 1997). On the other hand, invasive candidiasis is reported in individuals with prolonged neutropenia such as those receiving treatment for leukemia or solid tumors, or transplantation therapy (García-Ruiz *et al.*, 2004).

The finding of yeast in an individual or in a group of healthy monkeys does not imply that this micro-organism is part of the normal flora of the respective species. It is likely, however, that the isolation of *Candida* in a particular population of monkeys is indicative of colonization, as has been well established for other animals (Mariat and Droulet, 1996). The purpose of the present work was thus to examine the presence of yeasts in the mucosa and skin of Neotropical monkeys.

Methods

Animals and darting procedure

Individuals of *A. palliata*, *C. capucinus*, *A. geoffroyi* and *S. oerstedii* were captured in five areas of the country: Central Pacific (Chomes, Manuel Antonio National Park and Isla San Lucas, Puntarenas), North Pacific (Palo Verde National Park, Guanacaste; San Carlos, Alajuela), Caribean Area (Cahuita, Limón; Sarapiquí, Heredia), South Pacific (Corcovado National Park, Puntarenas) and Central Valley (San Ramón, Alajuela). Captured animals included both adult and juvenile individuals. Detailed capture methods have been described in detail elsewhere (Chinchilla, *et al.*, 2005). Briefly, monkeys were sedated with a dart containing Telazol® (tiletamine and zolazepam), the estimated dose was approximately 20 mg/kg. During the period of restrain, skin, vaginal and oral cavity samples were obtained.

Sampling procedure

Samples were collected between January 2001 and December 2006. Samples from the skin were taken close to the genital area using a scalp and placed into small Petri dishes; samples from the oral cavity and vagina were taken with a sterile cotton swab and placed into a glass test tube containing 10 ml of sterile Sabouraud broth. All samples were then transported to the laboratory for microscopic examination and culture. Samples were centrifuged for 10 min at 5000 RPM and a direct exam with 20% KOH was performed with the pellet for the detection of fungal elements. The pellet was also cultured in Sabouraud glucose agar (SGA) and Mycosel® agar at 22–25°C for 14 days. Skin samples were directly examined with 20% KOH and cultured as indicated above; positive culture plates were examined with lactophenol cotton blue under the microscope for the detection of fungal elements. Filamentous fungi were identified by micro- and macroscopic morphological characteristics. The Germ tube test was performed on all yeast isolates, and positive samples were identified as *Candida albicans*. Germ tube negative isolates were identified by the commercial API-20X system (Bio Merieux, France).

Results

A total of 608 samples from 275 individuals (157 males, 118 females) were taken for fungal studies; of these samples, 279 were taken from the skin. Direct examination of skin samples did not reveal any fungal elements. Furthermore, cultures of skin samples were negative for fungal pathogens and only common environmental fungi were isolated including zygomycetes, *Penicillium* spp., *Aspergillus* spp., *Hormodendrum* spp., *Fusarium* spp. and *Geotrichum* spp. *Candida* spp. was isolated from 28 out of a total of 228 samples (12.3%) from the oral cavity, and in seven out of a total of 101 samples (6.9%) from the vagina. The relationship between the results of the direct exams and cultures is given in detail in Tables 1 and 2. The yeast isolates, the monkey species from which yeasts were isolated, and the place of collection are given in Table 3 (oral cavity) and Table 4 (vaginal samples). Some cultures of the oral cavity and vagina were positive for environmental fungi, including zygomycetes, *Penicillium* spp., *Aspergillus* spp., *Hormodendrum* spp., *Fusarium* spp., *Sepedonium* spp. *Geotrichum* spp., *Trichosporon* spp. and *Kloeckera* spp.

Discussion

Normal skin may harbor numerous pathogenic fungi. Among the most commonly encountered pathogens of the skin of animals are *Candida* and the dermatophytes, *i. e.*, *Microsporum*, *Trichophyton* and *Epidermophyton* (Zuber and Baddam, 2001). The occurrence of *Trichophyton simii* in primates has been described in India and Brazil (Londero and Benevenga, 1972, Monga and Mohapatra, 1980). In the present study, however, we did not isolate any skin-associated fungi from the samples taken or observed any positive direct exam. Actually, no skin lesions were in the animals studied. On the other hand, in the oral cavity 39.5% of the samples had a positive direct exam. More than half of the fungal cultures were, however, negative. This could be due to overgrowth of common fungal contaminants. *Candida albicans* was the most frequent species isolated in all four species of monkeys studied; *C. albicans* is considered the most frequent yeast isolate of human oral cavity (Teanpaisan and Nittayananta, 1998). *Candida krusei*, *Candida inconspicua*, *Candida lusitaniae* and *Candida prozopfii* followed *C. albicans* in frequency. Interestingly, *C. krusei*, a saprophyte of human oral mucosa, was isolated mostly in a colony of *A. palliata* from Isla San Lucas, Puntarenas, an island occupied as a jail several years ago. In humans, *Candida* species are commensal organisms capable of producing opportunistic infections within the oral cavity only when appropriate predisposing factors exist (Poirier *et al.*, 1997).

Table 1. Relationship between the direct exam and cultures of the oral cavity of 228 monkeys (*A. palliata*, *A. geoffroyi*, *C. capucinus* and *S. oerstedii*).

	Direct exam Positive	Direct exam Positive
Culture positive	28 (12.3%)	
Culture negative	62 (27.2%)	138 (60.5%)

Table 2. Relationship between the direct exam and cultures of vagina of 101 monkeys (*A. palliata*, *A. geoffroyi*, *C. capucinus* and *S. oerstedii*).

	Direct exam Positive	Direct exam Positive
Culture positive	9 (8.9%)	
Culture negative	27 (26.7%)	65 (64.3%)

Table 3. Yeasts isolated from oral cavity, species of monkey and sites of collection.

Yeast (# of isolates)N	Species	Site of collection (# of monkeys)
C. albicans (20)	*A. palliata*	Palo Verde National Park (3)
		Cahuita (5)
		Manuel Antonio National Park (2)
		Sarapiquí (2)
		Isla San Lucas (2)
	C. capucinus	Manuel Antonio National Park (2)
		Sarapiquí (1)
		San Carlos (1)
	S. oerstedii	Manuel Antonio National Park (1)
	A. geoffroyi	San Carlos (1)
C. krusei (4)	*A. palliata*	Isla San Lucas (3)
	C. capucinus	Limón (1)
C. inconspicua (2)	*S. oerstedii*	Corcovado National Park (1)
	A. geoffroyi	Corcovado National Park (1)
C. lusitaniae (1)	*S. oerstedii*	Manuel Antonio National Park
C. prozopfii	*A. palliata*	Sarapiquí

Table 4. Yeasts isolated from vagina, species of monkey and sites of collection.

Yeast (# of isolates)N	Species	Site of collection (# of monkeys)
C. albicans (3)	*A. palliata*	Chomes (2)
		Sarapiquí (1)
C. famata (1)	*C. capucinus*	Sarapiquí
C. inconspicua (1)	*A. geoffroyi*	Corcovado National Park
C. krusei	*A. palliata*	Palo Verde National Park
C. tropicalis (1)	*C. capucinus*	Manuel Antonio National Park

As to the direct exams of the vaginal samples 35.6 % were positive for fungi, but only about 9% were culture positive. Overgrowth of fungal contaminants, as mentioned, may have interfered with the growth of the microscopically observed fungi. As in the oral mucosa, *C. albicans* was the most common yeast isolate in vagina, but it was only isolated from *A. palliata*. The other yeasts isolated from vagina were *C. krusei*, *C. inconspicua*, *C. tropicalis* and *C. famata*. Thus, our findings indicate oral and vaginal *Candida* colonization of a particular monkey or a colony, but cannot establish that these yeast isolates constitute part of the normal oral or vaginal flora in these four species of primates.

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Norma Gross, Juan Diego Castro, Olga Guerrero, Centro de Investigación en Enfermedades Tropicales, Facultad de Microbiología, Universidad de Costa Rica, **Misael Chinchilla**, Departamento de Investigación, Universidad de Ciencias Médicas (UCIMED), Costa Rica, **Ronald Sánchez**, Escuela de Biología, Sede de Occidente, Universidad de Costa Rica, Alajuela, Costa Rica and **Gustavo Gutiérrez-Espeleta**, Escuela de Biología, Universidad de Costa Rica, San José, Costa Rica. Correspondence to: Norma Gross, E-mail: <norma.gross@ucr.ac.cr>

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NEW SIGHTINGS OF NORTHERN MURIQUI (*BRACHYTELES HYPOXANTHUS*) FEMALES IN FOREST FRAGMENTS SURROUNDING THE ESTAÇÃO BIOLÓGICA DE CARATINGA-RPPN FELICIANO MIGUEL ABDALA, MINAS GERAIS, BRASIL

Fernanda P. Tabacow
Carla B. Possamai
Fabiano R. Melo
Sérgio L. Mendes
Karen B. Strier

The northern muriqui (*Brachyteles hypoxanthus*) is a critically endangered primate with about 1,000 individuals distributed among 12 remaining populations (Mendes *et al.*, 2005). Nearly 300 individuals, representing nearly a third of the entire species, are distributed in the four mixed-sex groups at the RPPN Feliciano Miguel Abdala (RPPN-FMA; previously known as the Estação Biológica de Caratinga), a privately protected forest fragment of roughly 1,000 ha (updated from Strier *et al.,* 2006). This population has been monitored systematically since 1982, when it was estimated to consist of just 40–50 individuals (Valle *et al.*, 1984). Hunting had long been prohibited at this site, and the six-fold increase documented in the size of the population in less than 30 years can be attributed, at least in part, to improved habitat protection. There has been some habitat recovery within and around the RPPN-FMA due to the regeneration of small parcels of land that had previously been cleared for small coffee plantations and pasture, but the growth of the muriqui population has far exceeded the expansion of the forest.

Previous analysis of this population's potential long-term viability identified the need for increasing the amount of suitable habitat available to this growing population (Strier, 1993/1994). The establishment of ecological corridors to connect neighboring forest fragments with the protected forest in the RPPN-FMA has been a critical component of ongoing and long-term management plans for this species (Strier and Fonseca, 1996/1997; Rylands *et al.*, 1998). However, until recently, nothing was known about the accessibility of these surrounding forest fragments or whether they could support muriquis. Here we report the first confirmed sightings of four female northern muriquis (1 adult and 3 subadults) in three of the fragments. The new findings indicate that these fragments provide a minimum structure for supporting muriquis and represent key areas for the establishment of the corridor.

Systematic censuses were conducted in eight forest fragments surrounding the RPPN-FMA between June 2008-October 2009; muriquis were sighted in three of these fragments (Figure 1). On 30 June 2008 a solitary adult female was encountered in one fragment (19° 45' 54" S, 41° 49' 23" W). The next year, on 23 July 2009, two subadult females were encountered together in a different fragment located on the same property as the fragment in which the first solitary female was sighted (19° 45' 27" S, 41° 48' 07" W). A few months later, on 11 October 2009, a third solitary sub-adult female was encountered in a more distant fragment located at least 3 km from the nearest boundary of the RPPN/FMA (19° 46' 50" S, 41° 48' 11" W).

Like all of the muriquis in our study population, all four of the females located in the forests surrounding the RPPN-FMA could be individually identified by their natural markings. All three of the subadult females encountered in these fragments were recognizable as females who originated from our study groups in the RPPN-FMA. The two subadult females (TP-M2 and NK-N) had previously dispersed from different natal groups (M2 and Nadir, respectively). TP-M2 visited NK-N's group before joining a third group (Matão), where she remained until at least 29 January 2009, when she was last seen in the RPPN-FMA. NK-N also visited the Matão group in February 2009, but then returned to her natal group where she remained until at least 19 April 2009, the last time she was seen in the RPPN-FMA. Importantly, both of these females were last seen in the fragment outside of the RPPN-FMA on 2 October 2009. By 11 November 2009, NK-N was observed back inside the Reserve, traveling with her natal Nadir group, and by the first week of January 2010, both females were seen traveling with the Matão group in the RPPN-FMA again. The subadult female (EE-M2) who was encountered alone in the most distant fragment was last seen in her natal group in the RPPN-FMA on 4 December 2007. She was not subsequently sighted in any other groups in the RPPN-FMA, but we do not know how long she remained in the Reserve before moving into the fragments. In contrast to the three subadult females, the solitary adult female encountered first was not recognizable to observers. The unfamiliarity of this female could be the result of her having emigrated from the RPPN-FMA prior to 2002, when only one of the muriqui groups in the forest was being systematically monitored. Alternatively, the solitary adult female could have originated from another relic population in the region that has not yet been discovered.

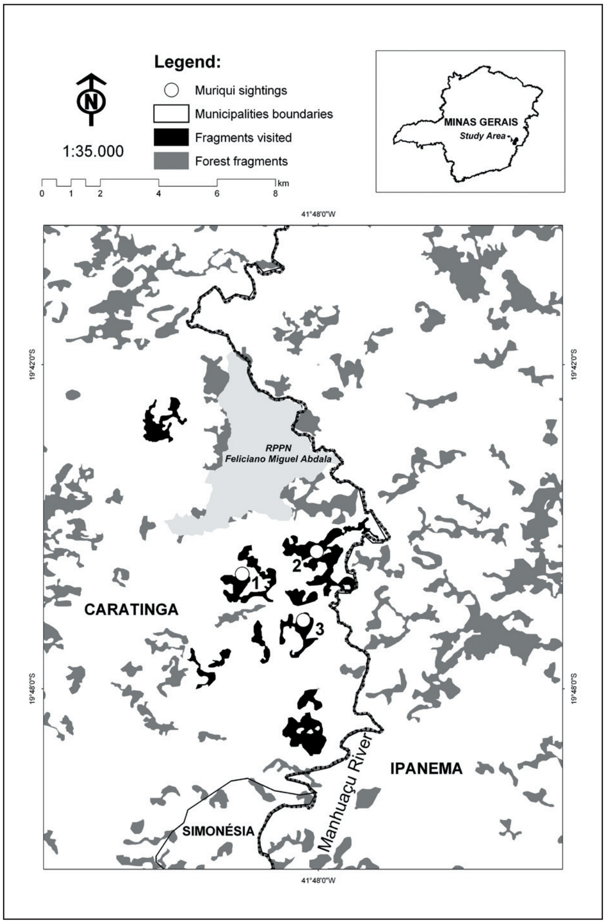

Figure 1. Location of forest fragments outside the RPPN-FMA with confirmed sightings of female northern muriquis (*Brachyteles hypoxanthus*). Points refer to each of the female sightings, as described in the text: 1 – Solitary adult female; 2 – Pair of subadult females; 3 – Solitary subadault female.

It is noteworthy that despite nearly three decades of research, no previous sightings of muriquis in forest fragments surrounding the RPPN-FMA have been reported. The discovery of the emigrant females in these forest fragments reveals that even in a relatively large population with more than one social groups, emigrant females might end up living alone in smaller fragments, confirming earlier recommendations about the need to increase the available habitat for this growing population. These discoveries also emphasize the importance of conservation management plans that include the protection and expansion of critical habitats through the creation of private protected areas, and the establishment of the ecological corridors for this and other populations of critically endangered Atlantic forest primates.

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Fernanda P. Tabacow, Departamento de Biologia Animal, Universidade Federal de Viçosa, Minas Gerais, Brasil, **Carla B. Possamai**, Departamento de Ciências Biológicas, CCHN, Universidade Federal do Espírito Santo, Vitória, ES, Brasil and Centro de Estudos Ecológicos e de Educação Ambiental (CECO), Carangola, Minas Gerais, Brasil, **Fabiano R. Melo**, Assessor de Pesquisa e Pós-Graduação, Universidade Federal de Goiás, Campus Jataí, Br 364, km 192, Parque Industrial, Jataí, Goiás, Brasil, **Sérgio L. Mendes**, Departamento de Ciências Biológicas, CCHN, Universidade Federal do Espírito Santo, Vitória, ES, Brasil and

Karen B. Strier, Department of Anthropology, University of Wisconsin-Madison, Madison, WI 53706, USA, e-mail <kbstrier@wisc.edu>.

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ON THE IDENTIFICATION OF *CALLICEBUS CUPREUS* AND *CALLICEBUS BRUNNEUS*

Jan Vermeer

Introduction

For many years, the preliminary taxonomic review of the genus *Callicebus* by Hershkovitz (1990) was the leading guide for most people involved in research on titi monkeys. The more extensive review of Van Roosmalen *et al.* (2002), illustrated with many pictures and colorful drawings by Stephen Nash, seems to have replaced the earlier work of Hershkovitz. However, closer examination of the publication shows some inaccuracies, which may cause difficulties in the identification of certain individuals. The confusion that the publication caused for the identification of the titi monkeys kept in European zoos encouraged me to study this subject in more detail.

The identification of *Callicebus cupreus*

The diagnostic characters of *Callicebus cupreus* are described by Van Roosmalen *et al.* (2002), and depicted in a drawing by Stephen Nash. The description and the drawing were compared to the lectotypes and the lectoparatypes of *Callicebus cupreus* at the Zoologische Staatssammlung in München (Nos. 10, 24, 89a and 89b). The most important difference between the drawing in the publication and the lectotype is the color of the tail (the color of the tail is not described by Van Roosmalen *et al.*, 2002). While the tail of the animal in the drawing is the same buff-brown agouti color as its hindlimbs, the tail of lectotype No. 10 is much lighter, comparable to that on the drawing of *Callicebus moloch* in the publication of Van Roosmalen *et al.* (2002). The tail of lectoparatype No. 24 is identical to that of the lectotype, while the tails of the paralectotypes 89a and 89b are somewhat darker. Most other specimens of *Callicebus cupreus* that I have examined in the collections of the American Museum of Natural History in New York and the Naturalis Museum in Leiden have lighter and more greyish colored tails than the ones depicted by Van Roosmalen and colleagues (2002).

Observations in the wild by Eckhard Heymann, at Estación Biológica Quebrada Blanco (4° 21' S, 37° 09' W), well within the known distribution of *Callicebus cupreus*, confirm that the tail of adult *Callicebus cupreus* is greyish-white (Eckhard Heymann, pers. comm.). The tail of young *Callicebus cupreus* is brownish, but has the greyish color of the adults by approximately 2 years of age (pers. obs. at La Vallée des Singes, Romagne, France). The captive population in European zoos is partly based on individuals that were captured near the Rio Maniti in Peru by the California National Primate Research Center of Davis. Rio Maniti is also within the distribution of *Callicebus cupreus*. All these animals have greyish tails, strikingly different than the color of their back and legs.

The identification of *Callicebus brunneus*

This species is described by Van Roosmalen *et al.* (2002) as having the forehead, forearms, legs, cheiridia and base of tail blackish to dark-reddish-brown, the rest of the tail contrasted pale or dominantly buffy mixed with blackish. The upperparts are brownish or reddish. The drawing of Stephen Nash is in agreement with this description. The description and the drawing were compared to the lectotype and lectoparatypes of *Callicebus brunneus* at the Naturhistorisch Museum in Vienna, Austria (No. B-3453, B-3454, ST122). The coloration of these specimens differs considerably from the description in Van Roosmalen *et al.* (2002). The upperparts of all specimens are dark brown, the arms and legs only slightly darker than the back, but brownish. The forehead is black, while the rest of the head is strikingly light-brown in all specimens. The tail is dark-brown, in one specimen somewhat lighter than its upperparts. The tip of

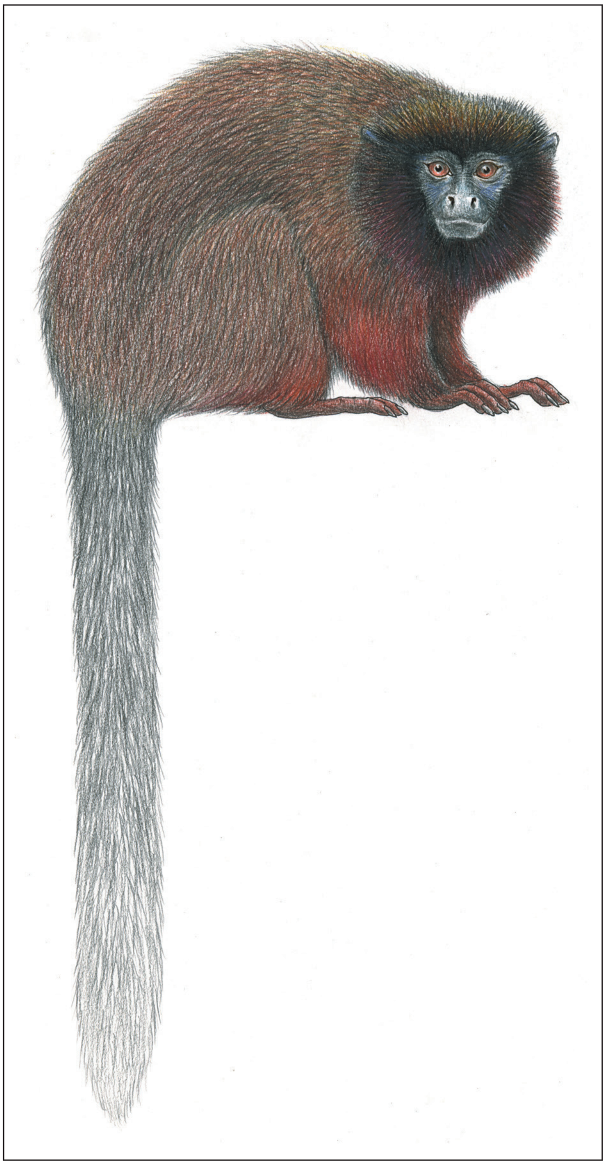

Figure 1. The red titi monkey, *Callicebus cupreus*. Illustration by Stephen D. Nash.

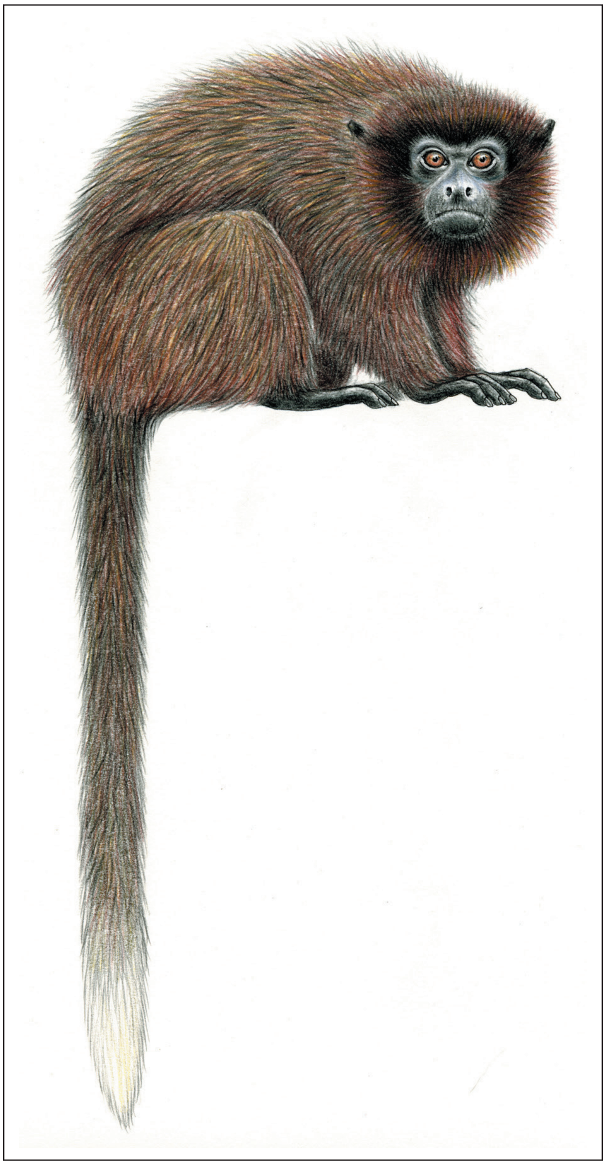

Figure 2. The brown titi monkey, *Callicebus brunneus*. Illustration by Stephen D. Nash.

the tail is buffy. The hands and feet of the lectotype are black, those of the lectoparatypes light-brown.

The coloration of the specimens in the Vienna museum match the picture of *Callicebus brunneus* published on page 85 in Rowe (1996). The animals depicted in Van Roosmalen *et al.* (2002), page 21, at the National Zoo in Washington, must be *Callicebus cupreus* and certainly are not *Callicebus brunneus.* The animals living at the Los Amigos Research Station near the Madre de Dios, Peru (12° 34' S, 70° 06'W) and at Tambopata are usually identified as being *Callicebus brunneus*, and they indeed resemble the drawing of this species in the publication of van Roosmalen *et al.* (2002). However, when comparing them to the type specimens of this species they are considerably different, and the titi monkeys in this area are most probably *Callicebus aureipalatii* (Wallace *et al.* 2006). Individuals of *Callicebus aureipalatii* were also observed by the author in the eastern part of Manu National Park, Peru (Pantiacolla Lodge, 12° 39'S, 71° 13' W). However, the situation in this area is quite confusing, as other animals were much darker, resembling a transitional coloration between *Callicebus aureipalatii* and *Callicebus brunneus*. Very dark animals in the collection of the Natural History Museum in Lima resemble *Callicebus brunneus* very closely, and were collected at Quebrada Aguas Calientes in Manu National Park. More research is urgently needed on the identification of the titi monkeys in and around Manu National Park.

Conclusion

The descriptions and drawings of *Callicebus cupreus*, and especially of *Callicebus brunneus*, published in the taxonomic review of Van Roosmalen *et al.* (2002) may lead to confusion. A study of the lectotypes and lectoparatypes and other evidence shows that the coloration of certain species is different on several points. With this publication, illustrated with new drawings by Stephen Nash that match the colors of the lectotypes and of animals in the wild, we hope to lessen some of the confusion involved in titi monkey identification (Figs. 1 and 2).

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I first want to thank Stephen D. Nash, who has kindly produced new drawings of both species. His work is indispensable for the publication and interpretation of taxonomic knowledge. I also thank Dr. Barbara Herzig (Natural History Museum in Vienna), Dr. Richard Kraft and Michael Hiermeier (Zoologische Staatssammlung in Munich), Eileen Westwig MS (American Museum of Natural History in New York), Dr. Victor Pacheco and Fanny Cornejo (Natural History Museum in Lima) and Dr. Dekker and Ing. Hein van Grouw (Naturalis Museum in Leiden) for allowing me to study their collection. Finally thanks to Eckhard Heymann (German Primate Center, Göttingen) and Darren Webster (Blackpool Zoo) for sharing their observations with me.

Jan Vermeer, Proyecto Mono Tocón, Moyobamba, Perú. E-mail: <jan.vermeer@telfort.nl>, www.callicebus.nl.

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CONFIRMATION OF *CALLICEBUS DUBIUS* (PITHECIIDAE) DISTRIBUTION AND EVIDENCE OF INVASION INTO THE GEOGRAPHIC RANGE OF *CALLICEBUS STEPHENNASHI*

Fabio Röhe
José S. e Silva-Jr.

Introduction

Titi monkeys, *Callicebus* Thomas 1903 (Pitheciidae), one of the most speciose platyrrhine genera, are distributed in the tropical forests of the Amazon and Orinoco basins, in the Atlantic forest of northeastern and southeastern Brazil, in the Chaco and in dry forests of Paraguay and Bolivia. The southern limits are the Pilcomayo and Paraguay rivers. The distribution of *Callicebus* is generally limited by river barriers (van Roosmalen *et al.* 2002). *Callicebus dubius* was described as a hybrid form by Hershkovitz (1988) and rearranged by van Roosmalen *et al.* (2002) as a valid species of the *C. cupreus* species group. The range of *C. dubius* is still uncertain. Hershkovitz (1990) assumed the type locality to be the right (east) bank of the Rio Purus, opposite to Lake Ayapuá. Two other species, *Callicebus caligatus* and *Callicebus cupreus*, occur in this area (van Roosmalen *et al.* 2002). Some specimens of *C. dubius*, deposited in the British Museum, were obtained in nearby Humaitá, a town on the left bank of the Rio Madeira. The holotype is an adult female (skin and skull), deposited in the Field Museum of Natural History, Chicago, number 38886, collected by Carl Lako in June 1931 (van Roosmalen *et al.* 2002).

According to van Roosmalen and colleagues (2002) the distribution of *C. dubius* corresponds to the "south of the Rio Ituxí, or maybe even the Rio Mucuím, both right bank tributaries of the Rio Purus, eastern limit the Rio Madeira south of the town of Humaitá, and west to the Rio Purus, southern limit unknown". This description is partially inconsistent with or at least not logically represented by the map in van Roosmalen *et al.* (2002) that shows the Rio de las Piedras (Bolivia) as the southern limit, with the Madre de Dios and Madeira defining the eastern limit of the species distribution. Rowe and Martinez (2003), however, have registered *Callicebus brunneus* in that region. Rowe and Martinez (2003) surveyed titi monkeys and found that their distribution in northern Bolivia is not consistent with the possible southern limit suggested by van Roosmalen *et al.* (2002) for *C. dubius*, but the distribution of *C. brunneus* coincides with reports by Anderson (1997) and Hershkovitz (1990). In addition, Robert Wallace (pers. comm.) has recorded a different species, which is not *C. dubius,* in the Department of Pando, Bolivia.

The map in van Roosmalen *et al.* (2002) indicates the Rio Mucuim as eastern limit for *C. dubius*, although there is a sampling gap between this river and the Rio Ituxí. In this paper we provide additional data on the geographic distribution of *C. dubius*, confirming (a) its occurrence between the rivers Ituxi and Mucuim (Fig. 1) and (b) the latter river as the eastern limit. We also report an observation of individuals of this species crossing eastward towards the right bank of the Rio Mucuim using a man-made wooden bridge, and discuss the implications of this observation.

Methods

The study area was located on the left bank of the Rio Madeira in the municipality of Canutama, state of Amazonas, Brazil. This is a transitional environment between grassland ('Campinas'), 'Campinaranas', and 'Terra firme' forest, with a high density of understory babaçu-palms (*Attalea speciosa*) and typical savanna ('Cerrado') and grassland ('Campinas') vegetation in open areas (M. Hopkins, pers. comm.). About 13 km of trail routes were used for a mammal survey for 15 days in April 2007. Rapid survey methods used for mammals (Fonseca, 2001; Young *et al.*, 2003) were applied, including linear transects, search for indirect evidence (tracks, scats/regurgitations, bones, etc.) and interviews with local inhabitants. However, only *C. dubius* sighting or vocalization areas were used for mapping purposes. One voucher specimen (INPA 5671) of *C. dubius* was collected to guarantee species identification on the basis of external features (such as pelt color and pattern) according to Hershkovitz (1988, 1990) and van Roosmalen *et al.* (2002). The site coordinates were obtained with a GPS Garmin unit, and maps were produced using ArcView GIS 3.2.

Results and Discussion

Nine groups of *C. dubius* were recorded in April 2007 (Table 1), eight of them within the Mucuim-Ituxi interfluvium. This confirms the distribution of this species (Fig. 1, 2) between the Ituxi and Mucuim rivers, as suggested by van Roosmalen *et al.* (2002) but without proof through locality records. The ninth group was recorded on the right bank of the Rio Mucuim (Table 1). *C. dubius* occupied areas of 'Campinarana' and 'terra-firme' open canopy forests covered by palms. During our survey, we did not observe *Callicebus stephennashi*, confirming its restriction to the area between the left bank of the Rio Ipixuna and the right bank of the Rio Mucuim.

Table 1. New records of *Callicebus dubius. Callicebus dubius* invasion on the right bank of the Rio Mucuim, which is in the range of *Callicebus stephennashi* (Record 1), and Callicebus dubius on the left bank of the Rio Mucuim (Records 2-8).

Localities	Coordinates
1. Rio Mucuim (2 individuals)	S -8° 42'02.4" W -64° 13'24.2"
2. 'Campina' (2 individuals) INPA 5671	S -8° 39'10.5" W -64° 21'31.3"
3. 'Campina' (3 individuals)	S -8° 39'12.9" W -64° 21'28.0"
4. 'Trilha norte' group 1 (3 individuals)	S -8° 39'10.0" W -64° 22'03.7"
5. 'Trilha norte' group 2 (vocal record)	S -8° 38'40.3" W -64° 22'04.4"
6. 'Curral' (2 groups vocalizing)	S -8° 38'54.3" W -64° 20'14.0"
7. 'Trilha sul' 1 (4 individuals)	S -8° 40'34.9" W -64° 21'52.2"
8. 'Trilha sul' 2 (vocal record)	S -8° 39'26.9" W -64' 19'21.7"

On 26th April 2007 we observed several *C. dubius* during an intraspecific agonistic interaction on an unpaved road that crosses the Rio Mucuim, in the hydrographic basin of the Rio Purus. The animals were on the right bank of the Rio Mucuim, close to the wooden bridge that crosses this river. The event was observed, photographed, and reported by M. Hopkins and P. Assunção, botanical researchers from INPA, during the first Geoma Madeira-Purus Expedition. This observation could imply a possible range expansion of *C. dubius* into the distributional range of *C. stephennashi*. Bridge crossing might be a more common event than

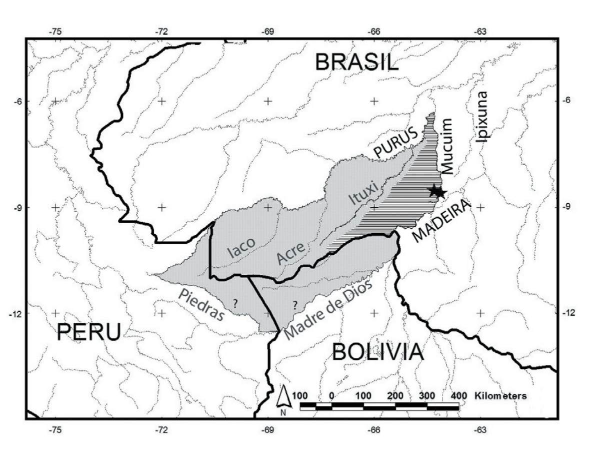

Figure 1. Geographic distribution of *Callicebus dubius*. The gray area represents van Roosmalen's *et al.* (2002) description of the distribution (not their map). The hatched polygon is the distribution between the rivers Mucuim and Ituxi confirmed in our study. The question marks indicate the inconsistencies in van Roosmalen´s and colleagues' map noticed by Rowe & Martinez (2003) and R. Wallace (pers. comm.).

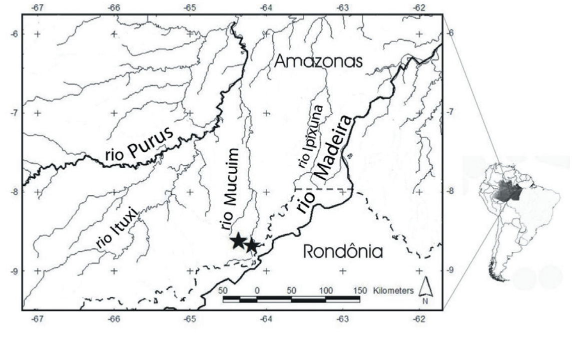

Figure 2. Sites of new records of *Callicebus dubius* on the left bank of the Rio Mucuim. The left star represents sites 2 to 8 and the right star represents site 1.

expected as other primate species have also been observed exhibiting this behavior. On November 2008 a group of more than 10 individuals of *Mico intermedius* was seen and three of them photographed crossing a small bridge on an unpaved road over the Rio Água Branca (9º 09' 41.4" S and 60 º 28' 03.7" W, road MT-206 connecting Colniza – Mato Grosso State and Machadinho D`oeste, Rondonia State), a small tributary of the Rio Guariba in northern Mato Grosso (I. Theobald, pers. comm.). These bridges over the rivers Mucuim and Água Branca do not exceed 30 and 15 m in length, respectively. These observations indicate that man-made structures may break down natural geographic barriers and thus interfere with biogeographic processes. The implications of such interference, e.g. potential for hybridization or displacement of one species by another, remain to be determined.

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Fabio Röhe, WCS – Wildlife Conservation Society/Projeto Sauim-de-Coleira, Department of Biology, Instituto de Ciências Biológicas, Universidade Federal do Amazonas. Av. General Rodrigo Octávio Jordão Ramos, 3000, Japiim, Manaus, Brazil. E-mail: <frohe@wcs.org>, **José S. e Silva-Jr.**, Museu Paraense Emílio Goeldi – MPEG, Setor de Mastozoologia. Caixa postal 399, 66040–170, Belém, PA, Brazil. E-mail: <cazuza.junior@gmail.com>.

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SLEEP TREE USE BY WHITE-FACED CAPUCHINS (*CEBUS CAPUCINUS*): IMPLICATIONS FOR DIFFERENCES IN SEEDLING COMPOSITION

Kim Valenta
Jeffrey A. Klemens
Linda M. Fedigan

Introduction

White-faced capuchins are highly frugivorous, diurnal animals, and previous studies indicate that they are effective primary seed dispersers (Wehncke *et al.*, 2003; Smith, 2004; Valenta and Fedigan, 2009a) across several measures of seed dispersal effectiveness: quantity of seeds dispersed (Wehncke *et al.*, 2003; Valenta and Fedigan, 2008), quality of seed dispersal (Chapman, 1989; Smith, 2004; Wehncke and Dalling, 2005; Valenta and Fedigan, 2009a), and diurnal spatial patterns of seed dispersal (Wehncke *et al.*, 2003; Wehncke and Dalling, 2005; Valenta and Fedigan, 2009b). One aspect of capuchin seed dispersal that has not been studied is nocturnal seed input at sleeping sites. White-faced capuchins spend approximately half of their lives sleeping in a limited number of trees (Fragaszy *et al.*, 2004). Although they have not been observed to consume fruit at night, their gut passage rate of 35 minutes to 5 hours (Rowell and Mitchell, 1991; Wehncke *et al.*, 2003; Valenta and Fedigan, 2009b), coupled with their consumption of fruit until minutes before they retire to a sleeping tree (pers. obs.) lead us to the inference that they defecate a large number of seeds beneath sleep trees. Additionally, a great deal of capuchin feces is observed beneath sleep trees the morning after capuchins sleep in them, and capuchins defecate first thing in the morning before leaving sleep trees. Unfortunately, attempts to quantify nocturnal seed rain have not been successful, but the combination of capuchin gut passage rates, with observations of high seed input the morning after sleep trees are utilized by groups indicate that seed rain beneath sleep trees used by this species is significant. Here, we test the effect of repeated sleep tree use by capuchins on forest regeneration by comparing seedling recruitment at two capuchin sleep trees to paired control trees. Given the increase in capuchin-dispersed seed input beneath sleep trees, we expect a higher density of capuchin-dispersed seedlings at these sites.

Methods

The study took place in the Area de Conservación Guanacaste (10.883611, -85.775), Santa Rosa Sector in Costa Rica. Sleep tree sites used by the group were flagged for each observation day that an observer remained with the group until 18:00 h (N = 59 observations). Two sleep tree sites were chosen for this study based on the existence of appropriate control sites. Both sleep trees were Guanacaste trees (*Enterolobium cyclocarpum,* FABACEAE) and were between 20 and 25 m tall. While there are two additional sympatric, diurnal primate species at the study site (*Alouatta palliata* and *Ateles geoffroyi*), *A. geoffroyi* have never been observed to enter into the home range of the capuchin study group, and *A. palliata* were never observed spending time in the capuchin sleep trees, and are primarily folivorous (Estrada and Coates-Estrada, 1985). Two control trees were chosen for sampling based on their similarity to sleep tree sites. Both are trees of the species *E. cyclocarpum*, and approximately the same height as the sleep trees. Control trees were in similar forest type (similar tree age in the immediate surroundings and similar location relative to forest edge) and located within 300 m of sleep trees. Over the course of 24 months of continuous researcher presence with this capuchin group, the monkeys were never observed to sleep in control trees.

One transect was laid out beneath each sleep tree and control tree. Transects consisted of a line running from the base of the trunk to the edge of the canopy, and were between 12 and 14.5 m long. All seedlings and saplings up to 200 cm in height lying within 2 m of the transect line (1 m on either side), or that were rooted within 2 m of the transect line, were identified to the species level in the field or transplanted to a shade house, where they were grown until positive identification could be made. Identifications were later confirmed by botanists at the Area de Conservación Guanacaste's plant inventory project (http://www.acguanacaste.ac.cr/paginas_especie/plantae_online/division.html). For a very small number of taxa, definitive identification below the genus level could not be made, and all individuals belonging to the genus were pooled for the purpose of analysis. In all such cases, dispersal syndrome did not differ among congeners. Each species recorded in a transect was assigned to one of four categories based on dispersal syndrome. This was accomplished using behavioral observations (see Valenta and Fedigan, 2009a for a detailed description), as well as a long-term database of capuchin food plants maintained by Dr. Linda Fedigan. The four categories were: Group I, wind or bird dispersed taxa not known to be dispersed by monkeys; Group II, taxa consumed by monkeys but whose seeds are destroyed by handling or gut passage; Group III, taxa consumed by monkeys but for which behavioral data are unavailable, with the result that seed survival after monkey handling/ gut passage is unknown; and Group IV, taxa known to be dispersed by monkeys, in that the seeds are known to survive monkey consumption of the fruit. Paired t-tests were performed to compare species richness, Shannon diversity and seedling density in each of the four dispersal categories for the two paired sleep tree and control units. Results were also compared graphically.

Results

Visual inspection of species abundances in the seedling community did not reveal any obvious effect of sleep tree status on the seedling communities beneath our target trees (Figure 1). The only differences between the control and sleep trees were significantly higher Shannon diversity in the control samples and a slight but significant difference in stem density of wind-dispersed taxa, with densities beneath sleep trees slightly higher than beneath the controls (Table 1).

Discussion

The lack of a significant increase in seedling recruitment of monkey-dispersed taxa at sleep tree sites is contra our expectation that increased seed input would result in increased capuchin-dispersed seedlings at these sites. It is possible that this lack of significant difference results from a density-dependent seed mortality effect – i.e. an increased clumping of seeds leading to the decreased survival of seeds

Table 1. Species richness and stem density beneath sleeping trees of a group of *Cebus capucinus* and control trees.

	Control 1	Sleep 1	Control 2	Sleep 2	t	p
Species Richness	25.00	24.00	54.00	34.00	1.11	0.47
Stem Density	5.03	10.55	6.25	8.25	2.14	0.28
Shannon Diversity	2.54	1.85	3.45	2.68	18.25	0.034
Group I Density	2.48	2.55	3.46	3.54	13.69	0.046
Group II Density	0.07	0.15	0.17	0.00	0.37	0.78
Group III Density	0.83	1.09	0.63	1.00	5.96	0.11
Group IV Density	1.66	6.53	2.00	3.46	1.85	0.31

and seedlings at these sites (Chapman and Russo, 2007). Increased seed mortality in areas of high seed input has been documented for other species. Julliot (1997) and Russo and Augspurger (2004) have shown significantly increased seed mortality beneath primate sleeping sites during the seed-to-seedling transition. In neither of these previous sleep tree studies, however, has increased seed mortality led to a decrease in primate-dispersed seedling density at sleep tree sites; the overall recruitment of seedlings of these species is still higher than at sites of limited input, *contra* our evidence for white-faced capuchin-dispersed seedling recruitment. This discrepancy may be due to differences in the nature of seed input between these three primate species — seedling recruitment in areas of high seed rain can be affected not only by the density of seed input, but by the diversity of seed input as well. Although white-faced capuchins disperse a high variety of seeds over time (Wehncke *et al.*, 2003; Valenta and Fedigan, 2008), the mean number of fruit species consumed per all-day focal follow is only 5 (range = 1–9), and 52% of capuchin defecations contain seeds of only one species (N = 281) (Valenta and Fedigan, 2008). The mean number of species per capuchin defecation during this study was 1.3 (range = 1–4, N = 349). This is in contrast to the defecation patterns of red howler monkeys where the mean number of species dispersed per defecation is 4.73 (N = 154; E. Andresen, pers. comm.).

Empirical support for density-dependent mortality at some life stages for some plant species has been documented (Clark and Clark, 1984; Howe, 1990; Condit *et al.*, 1992; Harms *et al.*, 2000). Harms *et al.* (2000) additionally documented a link between density-dependent seedling recruitment and community diversity. If a correlation exists between disperser-generated patterns of seed dispersal and seed and seedling mortality that is mediated by resistance against insect, pathogen or vertebrate predation (Howe, 1989) then the disruption of frugivore communities could have negative and cascading effects on forest regeneration. Howe (1989) has hypothesized that seedlings of scatter-dispersed species (seeds dispersed by small frugivores < 3kg) will rarely survive in clumps, as they will not evolve resistance to herbivores, pathogens, or other causes of density-dependent seed mortality. Scatter-dispersed plant species will thus be vulnerable to the loss of dispersal agents, due to reduced recruitment in situations of reduced dispersal (Howe, 1989). The lack of an increase of capuchin-dispersed species underneath sleep trees may indicate density-dependent seed mortality, an effect that may be mediated by the diversity of seed input as well as the density of seed input. Further research into repeated sleep tree use by frugivorous primates should include quantifying and qualifying seed rain beneath frequently used sleep tree sites and measuring the effect of variation of seed input (scattered versus clumped) on seed survival and seedling recruitment at these sites.

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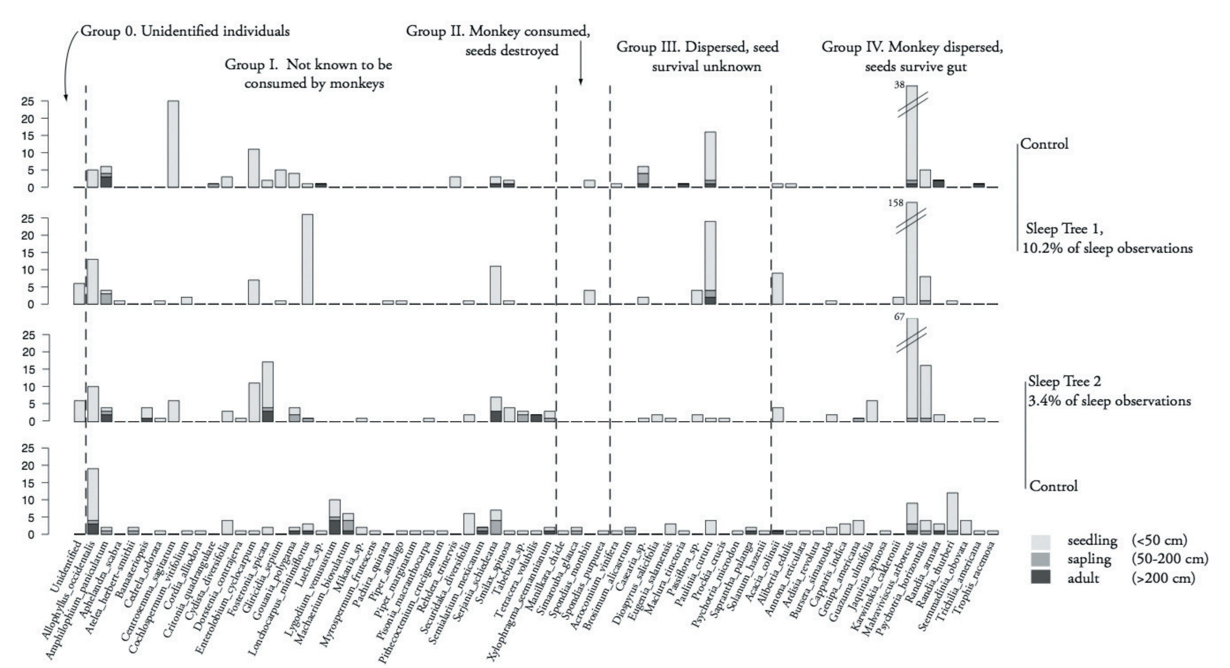

Figure 1. Relative abundance of species beneath four focal trees. Sleep trees are in the center of the diagram while control trees form the top and bottom margins. Species are arranged into dispersal types and alphabetically within those types. Where abundance values exceeded the y axis of the graph, a double score is drawn across the bar and the value appears to the left of the bar. Shadings within bars indicate whether individuals were seedlings, saplings, or adults.

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Kim Valenta, Department of Anthropology, University of Calgary, 2500 University Drive N.W. Calgary, AB, T2N-1N4, Canada. E-mail: <klvalent@ucalgary.ca>, **Jeffrey A. Klemens**, Department of Biology, University of Pennsylvania, 102 Leidy Laboratories 433 S University Avenue, Philadelphia, PA 19104 USA. E-mail: <jklemens@alumni.upenn.edu> and **Linda M. Fedigan**, Department of Anthropology, University of Calgary, 2500 University Drive N.W. Calgary, AB, T2N-1N4, Canada. E-mail: <Fedigan@ucalgary.ca>.

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POSSIBLE EVIDENCE OF MALE DISPERSAL IN COMMON WOOLLY MONKEYS (*LAGOTHRIX LAGOTRICHA*)

Angela Maldonado
Sergio Botero

Introduction

The genus *Lagothrix*, the woolly monkeys, contains four closely related species, formerly considered subspecies (Groves, 2005). *Lagothrix spp.* are known to have female-biased dispersal (Nishimura, 2003; Di Fiore and Campbell, 2007), but genetic evidence suggests that male dispersal also occurs (Di Fiore and Fleischer, 2005). Through long term field studies, female dispersal has been observed in the wild (Stevenson *et al.,* 1994; Nishimura, 2003; Di Fiore and Campbell, 2007), but to date no observations of male dispersal have been recorded. Solitary adult males of *Lagothrix poeppigii* have been observed trying to join existing groups, but have been expelled by resident males (Di Fiore and Fleischer, 2005). Here we report the acceptance of a newcomer three-year-old male into an existing group of *Lagothrix lagotricha*. This observation should be interpreted with caution since it concerns a captive raised individual reintroduced to the wild.

Observations

In 1996, a 5 to 8 month old male woolly monkey (*L. lagotricha*) that was being kept as a pet was confiscated by local authorities. The monkey's origin is not certain, but may have been the Putumayo region, Colombia. The regional environmental authorities had no adequate infrastructure to house this individual, so the infant was given to Angela Maldonado, who raised the monkey until 1998 in her household, in Bogotá, Colombia. The woolly monkey's lower lip had a scar, presumably generated during its capture from the wild. The monkey's diet consisted of fruit and vegetables, and he was taken every weekend to nearby forests in order to allow the development of normal climbing behavior.

On April 2nd 1998 Maldonando brought the captive raised woolly monkey to the Caparú Biological Station in Vaupés, Colombia (for a more detailed description of the site refer to Defler and Defler, 1996), where a semi captive free-ranging group of primates was kept for rehabilitation and reintroduction purposes. The group consisted of eight common woolly monkeys (*Lagothrix lagotricha*: four adult females, one sub-adult female, two infant females, and one juvenile male), two white-fronted capuchins (*Cebus albifrons albifrons*: one male and one juvenile female), one sub-adult female long-haired spider monkey (*Ateles belzebuth*), and three mottled-faced tamarins (*Saguinus inustus*: two adult females and one sub-adult male). The monkeys there foraged freely in the station area and were fed once daily. On April 3, 1998, a wild group of woolly monkeys passed near the station, and in response, the captive-raised male performed an aggressive display, including branch shaking. Although an adult male stopped and observed the new male, and some other members of the group paid attention to the display, they performed no aggressive displays, and continued on their way, seemingly unperturbed. The captive-raised male followed the group until dusk and then returned to the station.

When first introduced to the primate group of the Caparú Biological Station, the captive-raised male was approximately 3 years old, and interacted normally with the other individuals of the group for his age. He was, however, rejected by one of the adult woolly females, and after this interaction all of the adult females were aggressive to him. On two occasions, this caused the captive-raised male to escape into the forest and remain alone overnight. The most aggressive female was the lowest ranking in the group, had no offspring in the group, and was also the most aggressive towards humans. On April 12, after 3 days of enforced separation by the Caparú staff, the aggressive female and the captive-raised male were allowed near each other again and the aggression continued. This time the male escaped into the forest and did not return to the station. He was observed foraging the next 2 days with a wild group. On the second day (April 14th) the male responded and approached the observer. On April 26 the same group was encountered, and the male responded when called by his pet name, but he did not approach the observer. Maldonado then left the Amazon station and returned to Bogotá. The male was observed once during the month of May by a field assistant and answered when called but did not approach the observer. It is not known if the group he joined was the same that tolerated the aggressive display on the 3rd of April, but it is likely, given the group's home range. Just over one year later, on June 26, 1999, Maldonado followed a wild group of woolly monkeys, presumably the same one the captive-raised male had joined. A male came particularly close to her during the observations and responded when called by his pet name, but because he had matured she was unable to recognize him unequivocally. She then followed the male until his identity was confirmed through the scar on his lower lip.

Discussion

The present case shows that a social mechanism exists for the acceptance of a new male into an existing group of *Lagothrix lagotricha*, and thus supports Di Fiore and Fleischer's (2005) molecular data suggesting some level of male dispersal in woolly monkeys. However, this particular male's upbringing differed significantly from wild individuals, as he remained isolated from conspecifics for an important part of his development. The fact that the introduced male was not an adult might suggest that only juvenile or sub-adults can be accepted into existing groups, but this remains to be determined. Observations of sub-adult or juvenile males dispersing from their natal groups are lacking to confirm the existence of male dispersal in *Lagothrix*.

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Angela Maldonado, Oxford Brookes University, Department of Anthropology and Geography. Gipsy Lane, OX3 0BP, Oxford, UK. E-mail: <lllugens@yahoo.co.uk> and **Sergio Botero**, Universidad de los Andes, Departamento de Ciencias Biológicas, Laboratorio de Ecología de Bosques tropicales y Primatología. Bogotá D. C., Colombia, and Rockefeller University. New York. U.S.A. E-mail: <sbotero@rockefeller.edu>

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PREDATION ON SMALL MAMMALS BY CAPUCHIN MONKEYS, *CEBUS CAY*

Marja Zattoni Milano
Emygdio Leite Araújo Monteiro-Filho

Introduction

Capuchin monkeys forage opportunistically and exploit highly diverse feeding resources that encompass a wide variety of vegetables and animal prey, including reproductive and non-reproductive plant parts, invertebrates and small vertebrates (Terborgh, 1983; Fedigan, 1990). Vertebrate prey includes birds, eggs, lizards, frogs, young coatis, bats, rodents and even other monkeys (Izawa, 1978; Newcomer and De Farcy, 1985; Fedigan, 1990; Galetti, 1990; Rose, 1997; Ferreira *et al.*, 2002; Resende *et al.,* 2003; Fragaszy *et al.*, 2004; Sampaio and Ferrari, 2005). The foraging patterns of capuchin monkeys involve strenuous and persistent activity, search for hidden prey, manual dexterity and an explorative approach (Fedigan, 1990; Janson and Boinski, 1992; Fragaszy *et al.*, 2004), but little is known regarding how they find and kill their prey. Here we report the behavior of *Cebus cay* (Illiger, 1815) (*Cebus libidinosus* sensu Groves, 2001; Rylands *et al.*, 2005) preying upon arboreal rodents (*Rhipidomys* sp.2 *sensu* Tribe, 1996) trapped during a study on small mammal population ecology.

Methods and Study Site

During a capture-mark-recapture study of small rodents and marsupials, the researchers were frequently followed by a group of capuchin monkeys. On these occasions, the monkeys' behaviors were recorded *ad libitum* (Altmann, 1974). Trapping sessions, lasting from six to ten days, were conducted every month from March to August 2006 using live-traps. The study was conducted in Cabeceira do Prata Private Reserve, state of Mato Grosso do Sul, central Brazil (21° 27' S; 56° 26' W), an area of 307.5 ha covered with seasonal forest and cerrado (Brazilian Savanna). The region has a dry season from May to September and a wet season from October to April. The Reserve is intensely visited throughout the year by tourists, who walk in small, guided groups through the forest. There is no direct interaction between the animals and the tourists. However, reserve officers keep artificial feeding sites along the trails, baited daily with corn to attract animals to facilitate wildlife watching. All observations reported here were conducted in an area of seasonal alluvial forest that is cut by a tourist trail.

Results and Discussion

From the first fieldwork session in March 2006, the traps attracted the attention of capuchin monkeys, who began to follow the trapping activities almost every day. The first observation involved a capuchin running after another animal in the forest canopy on the morning of March 3rd. It was not possible to identify the chased animal, which was the size of an opossum (*Didelphis albiventris* Lund, 1840) and had a long and naked tail. The outcome of this interaction was not observed. On March 21st at around 7:00 a.m., a juvenile capuchin was found vocalizing loudly, trapped inside a trap set on the ground. Other capuchins were watching nearby when it was released. On April 19th a male climbing mouse, *Rhipidomys* sp. (weight = 65 g), was captured by a capuchin just after it was released from the trap. On this occasion the group of capuchins observed the activities of the researchers from canopy branches at a distance of about 10 m. When the rodent was released a subadult capuchin quickly approached, grabbed it as it climbed a tree in the understory, and killed it using the craniocervical bite, a widespread killing strategy adopted by other primate genera (Steklis and King, 1978). The monkey remained in the understory for about 2 minutes, licking the blood from the neck of the prey and looking at the researchers, before moving to the canopy. It was not possible to observe whether it ate the prey or not. This incident took place after a 28-day interval between trapping activities, a time when the traps had remained closed.

On August 25th another male *Rhipidomys* sp. (weight = 105 g) was captured by an adult male capuchin after the rodent was released from a trap. As in the previous case, capuchins observed the researchers from a distance, and when the rodent was released, one individual quickly approached. At this time, the capuchin chased the rodent on understory branches, but the *Rhipidomys* fell to the ground and hid inside a hole in a fallen log. The capuchin descended to the forest floor, extracted the rodent from the log and took it to a branch about 3 m above the ground (Figure 1a). The rodent didn't attempt to escape. The monkey killed the prey with a craniocervical bite, licked its neck and face, ripped out a piece of flesh and ate it (Figure 1b). Then, the capuchin took it to the canopy where no further observation was possible. In both of these predation events the hunter was at a distance of at least 5 m from its group members and no interaction with the other capuchins was recorded. In addition to these events, we recorded 12 cases of attacks on the trapped rodents, with traps either on the forest floor or on branches in the understory. Seven attacks resulted in tail and ear mutilation, but these rodents survived. In the remaining five attacks the rodents were killed. Although it was not possible to identify the actors of these attacks, capuchin monkeys are the major suspects. It is intriguing that only rodents (total number of captures = 496) were attacked, although 166 captures of the small marsupial *Gracilinanus agilis* (Burmeister, 1854) were also made.

The differences in the activity rhythm of capuchins and *Rhipidomys* rodents suggest these nocturnal small mammals were opportunistically hunted by the monkeys as a side-effect of the trapping procedures. The ability to search in branch holes, though, is noteworthy and did not seem to depend on the research activity at the site. There is no food scarcity at the study site, owing to human provisioning, so it is unlikely that hunger stimulated the quick learning that allowed the exploitation of this “new” prey item. These observations are evidence of the curious and opportunistic nature of *Cebus cay,* even though it is not known how widespread this behavior was among group members.

Figure 1. Capuchin monkey (*Cebus cay*) (a) handling and (b) eating a captured rodent (*Rhipidomys* sp.) on August 25th, 2006.

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Marja Zattoni Milano, Instituto de Pesquisas Cananéia – IpeC, Rua Voluntários da Pátria, 780, Cep: 79290–000 – Vila América – Bonito-MS– Brasil, E-mail:<marjazm@yahoo.com>, **Emygdio Leite Araújo Monteiro-Filho,** Instituto de Pesquisas Cananéia – IpeC, Laboratório de Biologia e Ecologia de Vertebrados, Departamento de Zoologia, Universidade Federal do Paraná, E-mail: <elamf@ufpr.br>

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OBJECT MANIPULATION IN A CAPTIVE GROUP OF CAPUCHIN MONKEYS (*CEBUS NIGRITUS*)

David Santos de Freitas
Júlio César Bicca-Marques

Introduction

Capuchin monkeys (*Cebus* spp.) exploit embedded resources by using foraging strategies that involve several levels of object manipulation, from the simple tearing apart strips of wood to get access to invertebrates to the use of stones as tools (hammer and anvil) to break and open nuts (Ottoni & Mannu 2001; Fragaszy *et al.* 2004; Moura & Lee 2004; Waga *et al.* 2006). Tool use or the use of a detached object as an extension or functional part of the body to modify the position of another object (Beck 1980; Panger 2007) has been reported in wild, semi-captive and captive capuchins (Visalberghi 1990; Fragaszy *et al.* 2004).

Cognitively more complex than tool use, tool making involves a modification of the physical structure of the tool to improve its efficiency, a behavior that requires an understanding of cause-and-effect (Beck 1980). Among primates, tool making has only been reported for great apes (chimpanzees, orangutans and gorillas; Boesch & Boesch 1990; Fontaine *et al.* 1995; van Schaik *et al.* 2003), including humans. Recently, however, Bortolini & Bicca-Marques (2007) observed opportunistically a putative spontaneous event of tool making by a captive adult female *Cebus nigritus* in the Sapucaia do Sul Zoological Park, state of Rio Grande do Sul, Brazil. These authors state that if capuchins can make tools, the cognitive difference between them and the great apes, lineages separated for at least 30 million years, is smaller than previously thought (Bortolini & Bicca-Marques 2007). Because Bortolini & Bicca-Marques (2007) were not able to record the context prior to this event and what happened after it, therefore compromising the interpretation of its meaning, in this research we investigate object manipulation behaviors by the same study group aiming at recording additional cases of capuchin tool making.

Methods

A group of five capuchin monkeys (adult females Chief and Matilda, adult male Black and juvenile males Sem-topete and Trainer) living in an enclosure (7.0 × 7.7 × 2.9 m) enriched with sand, twigs, ropes and a wood-made wheel in the Sapucaia do Sul Zoological Park, state of Rio Grande do Sul, Brazil, was observed between April and September 2008. Matilda is the individual whose tool-related behavior was reported by Bortolini & Bicca-Marques (2007). Data collection by the behavior sampling method with continuous recording (Martin & Bateson 1993) was conducted from 08:00–08:30 to 13:00–13:30 once a week. Object manipulation was classified into banging (the act of pounding an object against a surface or another object), washing (partial or total immersion of an object in water), scrubbing (the act of rubbing an object against a surface), handling (the act of just touching or holding an object) and biting (the act of biting an object). Events of food banging, washing and scrubbing were included in the analysis, whereas those of handling and biting were not included.

The study was divided into two 50-h stages. In the first stage there was no supplementation of objects to the monkeys besides those normally found in the enclosure, whereas 15 pieces of branch (30 to 40 cm in length) and five stones (6 to 7 cm in diameter) were supplemented before each observation session and removed at the end of the day in the second stage. The frequency of each type of object manipulation during each stage was compared among individuals by the chi-square test and the total individual frequency of object manipulation events was compared between stages by the Student t test considering a level of significance of 0.05 using the software BioEstat 5.0 (Ayres *et al.* 2007).

Results

Sixty two events of object manipulation (48% banging, 26% washing, 19% handling and 6% scrubbing) were recorded during the first stage, resulting in a rate of 1.2 events per hour. Most of these events involved food items ($n = 44$). Supplementation with branches and stones in the second stage produced a significant increase in the frequency of object manipulation (428 events: 68% handling, 25% biting and 8% banging; $t = 2.138$, $df = 4$, $p = 0.042$) or a rate of 8.6 events per hour, and a substantial decrease in the number of events involving food items ($n = 4$). Object manipulation differed among individuals in both stages (1st: $\chi^2 = 13.559$, $df = 4$, $p = 0.008$; 2nd: $\chi^2 = 210.570$, $df = 4$,

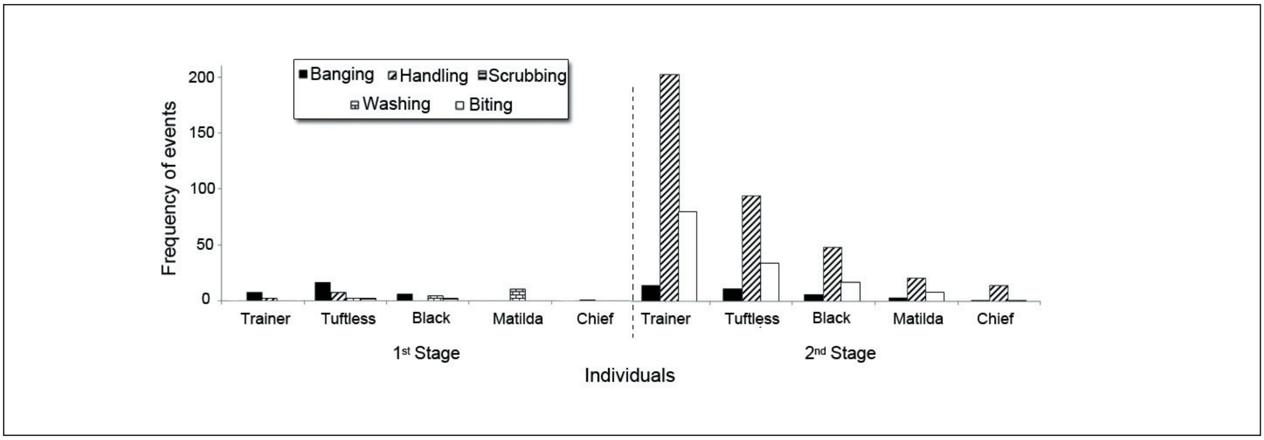

Figure 1. Distribution of events of object manipulation among group members during the first and second stages.

$p < 0.001$; Fig. 1). Whereas adult females showed the lowest frequencies of object manipulation (43 and 18 events), juvenile males Trainer (305 events) and Sem-topete (166 events) were the most manipulative group members. No case of tool use or tool making was observed during the 100 h of observation.

Discussion

Object supplementation stimulated a significant increase in manipulation events, especially by juveniles, but was not sufficient to elicit additional events of tool making. Therefore, this 100-h study failed to corroborate the observation of Bortolini & Bicca-Marques (2007) and to reject the hypothesis that capuchins despite their high cognitive abilities are not capable of making tools (Fragaszy & Visalberghi 1989; Fragaszy *et al.* 2004; Ottoni *et al.* 2005).

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David Santos de Freitas and **Júlio César Bicca-Marques**, Laboratório de Primatologia, Faculdade de Biociências, Pontifícia Universidade Católica do Rio Grande do Sul, Avenida Ipiranga 6681 Prédio 12A, Porto Alegre, RS 90619–900, Brazil, e-mail: <davids.freitas@yahoo.com.br.>

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FIELD OBSERVATION OF PREDATION OF A SLATE-COLORED HAWK, *LEUCOPTERNIS SCHISTACEA*, ON A JUVENILE SADDLE-BACK TAMARIN, *SAGUINUS FUSCICOLLIS*

Lledo-Ferrer, Y.
Hidalgo, A.
Heymann, E.W.
Peláez, F.

Due to their small body size, callithrichines are probably subject to high predation pressure; in fact, it may be an important factor shaping their cooperative social systems (Caine, 1993). However, predation events are difficult to observe, and published reports are still scarce (Hart, 2007; Ferrari, 2009). While a number of predators of tamarins have been identified (see Table 1), other potential predators may still remain unknown. Here we add an additional raptor species, the slate-colored hawk, *Leucopternis schistacea*, to the known predators of callithrichines.

The observation reported here was made at the Estación Biológica Quebrada Blanco (EBQB), north-eastern Peru (see Heymann (1995) for details of the study site). A moderately habituated mixed-species troop of 11 saddle-back tamarins, *Saguinus fuscicollis* (5 adult males, 5 adult females and 1 juvenile) and 7 moustached tamarins, *Saguinus mystax* (3 males, 4 females and 1 carried infant), was followed by the second author between 7 and 14 April 2008 to collect fecal samples from the saddle-back tamarins.

On 11 April 2008, at 1000 h, both tamarin species were feeding in a *Protium* spp. tree at about 30 m height. Suddenly, a slate-colored hawk, *Leucopternis schistacea*, flew in and caught a juvenile saddle-back tamarin that was standing without feeding on an exposed branch, lower than the rest of the group. With the prey in its talons, the hawk flew to a nearby tree where it perched at about 30 m height and started to feed on the tamarin. Both saddle-back and moustached tamarins left the *Protium* tree and surrounded the tree where the hawk perched; they vocalized intensely while climbing up and down the tree trunks between 10–20 m. After about one hour, the hawk left with the remains of its prey. The saddle-back tamarins moved c. 200 m and rested for about 2 hours in a tree at about 30 m height. The moustached tamarins travelled into a different direction before being lost by the observers. The saddle-back tamarins entered a sleeping tree at 1650 h. On the following day, 12 April, the saddle-backs left their sleeping tree at 0530 h, moved only about 20 m and then rested until 0900 h. Afterwards, they travelled for the rest of the day, were very difficult to follow, behaved nervously, giving more alarm calls as usual, and increasing their vigilance and went down to about 8 m upon hearing any of the usual noises of the forest. They did not long call until about 1400 h. At that time, they started long calling which ceased when the moustached tamarin arrived and the two tamarin species re-established their association. The group entered a sleeping tree at 1640 h.

On 13 April, the saddle-back tamarins left their sleeping tree at 0620 h. They emitted very few vocalizations and travelled very high in the trees, about 50 m apart from the moustached tamarins, feeding in the same trees but not simultaneously. They entered their sleeping tree at 1640 h. On the next day that the group was followed (16 April) and subsequently (26–29 April) the tamarins seemed to behave normally.

This is the first documented attack of a slate-coloured hawk on callithrichines or any other New World primate (Ferrari, 2009). These medium-sized hawks (bill-tip to tail-tip: 41–43 cm; (Hilty and Brown 1986)) are dietary generalists, usually feeding upon large arthropods and small vertebrates (Robinson, 1994). Thus, tamarins, at least juveniles, fall into the range of potential prey. Peres (1993) considered this species as a potential predator for tamarins and observed alarm calling by moustached tamarins in response to the related *Leucopternis kuhli* and *Leucopternis albicollis*, but did not actually observe any attacks. Our observation confirms Peres' (1993) hypothesis and expands the list of known raptorial predators of tamarins. After the attack, the tamarins followed the raptor and vocalized, as was

Table 1. Predation and predation attempts on tamarins

Predator		References
Raptors	Bicolored hawk, *Accipiter bicolor*	(Terborgh, 1983)
	Ornate hawk-eagle, *Spizaetus ornatus*	(Terborgh, 1983; Robinson, 1994)
	Barred forest-falcon, *Micrastur ruficollis*	(Izawa, 1978)
	Red-throated caracara, *Daptrius americanus*	(Ramirez, 1989)
	Crested eagle, *Morphnus guianensis*	(Oversluijs Vasquez and Heymann, 2001)
	Harpy eagle, *Harpia harpyja*	(Ney Shahuano Tello, pers. comm.)
Reptiles	Anaconda, *Eunectes murinus*	(Heymann, 1987)
	Boa constrictor	(Shahuano Tello *et al.*, 2002)
Mammals	Tayra, *Eira barbara*	(Moynihan, 1970; Goldizen, 1987b; Snowdon and Soini, 1988)
	Ocelot, *Felis pardalis*	(Moynihan, 1970; Goldizen, 1987b; Snowdon and Soini, 1988)

also observed after successful attacks by a Guianan crested eagle, *Morphnus guianensis*, on juveniles from both tamarin species (Oversluijs Vasquez and Heymann, 2001). In contrast to previous observations where the tamarins remained very low in the forest after an attack (Heymann, 1990), in the case described here, the tamarins stayed high up in the canopy, even resting there, in the hours after the attack. However, the next day the saddle-back tamarins behaved more nervously and descended in response to various noises, although they remained at higher levels than those at which saddle-back tamarins are usually most active, i.e. below 6–7 m. This may be due to the lower degree of habituation of this group in comparison to other saddle-back tamarin groups that have been under observation for longer periods at the same study site.

Even if unsuccessful (Heymann, 1990; Peres, 1993), attacks from avian predators may strongly influence the behavior of the tamarins in the days following the attack. In our observations, the group became more cryptic and alert, resting more often and for longer periods and travelling at lower strata. This is in contrast to a snake attack on moustached tamarins, in which case the group continued on with its normal activities (Shahuano Tello *et al.*, 2002). This may reflect the difference between aerial and terrestrial predators, the former being much more unpredictable, and thus representing a higher risk throughout the home range, even if previously detected. All successful predation events observed at EBQB involved non-adult tamarins of both species. This highlights the vulnerability of young tamarins that may not yet have developed the full array of anti-predator strategies of adults (vigilance, avoiding exposed positions, etc.). Successful mobbing was reported after the attack of a *Boa constrictor* at EBQB (Shahuano Tello *et al.*, 2002). In this and our own observations, both species of tamarins tried to mob the predator. Again, this strategy seems to depend on the type of predator involved. For avian predators, mobbing has no effect, as they are able to fly away for long distances, out of reach of the mobbers (Oversluijs Vasquez and Heymann, 2001), while snakes may not move away rapidly, and even can be attacked by the mobbers (Shahuano Tello *et al.*, 2002). In our case the hawk remained in the same place while consuming its prey, and mobbing had no effect on it.

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Lledo-Ferrer, Y., Abteilung Verhaltensökologie & Soziobiologie, Deutsches Primatenzentrum, Göttingen, Germany, and Departamento de Psicología Biológica y de la Salud, Universidad Autónoma de Madrid, España, e-mail: <yvan.lledo@uam.es>, **Hidalgo, A.**, Caserío Diamante – 7 de Julio, Río Tahuayo, Loreto, Perú, **Heymann, E.W.**, Abteilung Verhaltensökologie & Soziobiologie, Deutsches Primatenzentrum, Göttingen, Germany, and **Peláez, F.**, Departamento de Psicología Biológica y de la Salud, Universidad Autónoma de Madrid, España.

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NEWS

PRIMATE MORPHOLOGY ONLINE (PRIMO)

The PRIMO (Primate Morphology Online) database is back online at http://primo.nycep.org. PRIMO is a resource for researchers who use metrical (including 3D) data to study aspects of primate morphology and evolution. It permits downloading of data on dentitions, crania and postcrania, mainly of cercopithecids, with nearly 8000 individuals in the database. For more information go to the web site above.

Eric Delson

THE MONKEY SANCTUARY TRUST CHANGES ITS NAME

"Wild Futures" is the new name for The Monkey Sanctuary Trust; a change which reflects its charity's growing influence in the world of conservation, education, habitat protection and primate welfare. The change in the name does not mean a move away from the work we have championed for decades, and The Monkey Sanctuary, will still exist as a flagship project of Wild Futures. By becoming Wild Futures we aim to raise our profile in national and international circles, thus increasing revenue and creating opportunities to direct funding to where it is most needed in the key areas of our work. For more information visit the new website www.wildfutures.org.

Rachel Hevesi

NUEVA MESA DIRECTIVA ASOCIACIÓN MEXICANA DE PRIMATOLOGIA

Durante el VI Congreso Mexicano de Primatología, llevado a cabo en Junio 2009, se presentó la nueva mesa directiva de la AMP para el periodo 2009–2012; conformada por Gabriel Ramos Fernández – Presidente (ramosfer@alumni.upenn.edu), Pedro Americo Dias – Secretario, Cristina Domingo Balcells – Tesorero, Victor Arroyo Rodríguez – Coord. Editorial (arroyov@correo.oikos.unam.mx). En este mismo evento, dicha mesa directiva presentó el plan de trabajo 2009–2012, con el cual se pretende colocar a la AMP como un factor de unión entre los primatólogos en México, promoviendo la excelencia académica, incidiendo sobre las políticas públicas e iniciativas de conservación del hábitat de los primates en México. Para más información visitar http://primates-amp.org.mx/index.php

SAVE THE GOLDEN LION TAMARIN

To honor Devra Kleiman, the foundation Save the Golden Lion Tamarin is creating the *Devra Kleiman Fund to Save the Golden Lion Tamarin* - the fund Devra proposed before her death April 29, 2010. *All* contributions to the fund will go to support the conservation work for golden lion Tamarins in Brazil, assuring the work Devra dedicated herself to for 40 years will continue to save golden lion tamarins in perpetuity. Contributions can be made online at www.SavetheLionTamarin.org

PUBLICACIÓN DEL SEGUNDO CAMP PARA PRIMATES MEXICANOS

El reporte final del segundo taller para la conservación análisis y manejo planificado (CAMP) para primates mexicanos se publicó el pasado 16 de abril de 2010, en la página web del Grupo Especialista en Conservación y Cría (CBSG) de la UICN. Los objetivos principales del taller fueron actualizar el estatus de cada especie y realizar las recomendaciones de conservación pertinentes, así como evaluar el impacto del primer taller, llevado a cabo en 1995, sobre la conservación de los primates a once años de su realización. Se evaluaron las cuatro subespecies presentes en el país: *Ateles geoffroyi yucatanensis, Ateles geoffroyi vellerosus, Alouatta palliata mexicana* y *Alouatta pigra* ubicándolas dentro de las categorías de riesgo de la Lista Roja de la UICN. En el reporte final del taller se incluye información relevante acerca de las principales amenazas que enfrentan estas especies, la influencia de las políticas públicas en los mecanismos de transformación del hábitat, así como el papel de las universidades y centros de investigación en la conservación de ellas. El documento completo del taller se encuentra disponible en http://www.cbsg.org/cbsg/workshopreports/display.asp?catid=24.

AMPLIANDO LAS FRONTERAS PARA LOS ESTUDIOS PRIMATOLÓGICOS EN MEXICO

El Centro de Investigaciones Tropicales (CITRO) de la Universidad Veracruzana, con el apoyo del Consejo Nacional de Ciencia y Tecnología, y del Gobierno del estado de Veracruz ha iniciado diversos estudios enfocados a primates en la región de Uxpanapa, en el sur de México. Los remanentes de selva en la región de Uxpanapa, junto con la zona de Los Chimalapas en Oaxaca, constituyen uno de los macizos de vegetación conservada más importantes en el país, en el cual habita una gran variedad de especies amenazadas, entre las que se encuentran poblaciones de mono araña (*Ateles geoffroyi*) y de mono aullador de manto (*Alouatta palliata*). Entre los distintos proyectos que se están llevando a cabo en la zona están estudios relacionados con demografía, genética, parasitología, distribución, disponibilidad de hábitat y fragmentación, entre otros. Debido a que no se cuenta con datos primatológicos para la región de Uxpanapa y a que las recomendaciones del segundo taller CAMP (http://www.cbsg.org/cbsg/workshopreports/display.asp?catid=24) para primates mexicanos señalan a esta zona como prioritaria para estudio de estos organismos, los resultados de que se obtengan aportarán información valiosa para reevaluar el estado de conservación de ambas especies de primates, y para analizar y mejorar las iniciativas y esfuerzos conservacionistas en la región, destacando la importancia de mantener la conexión con los bosques centroamericanos, mediante el establecimiento y manejo efectivo de un área natural protegida en esta región.

RECENT PUBLICATIONS

BOOKS

Primate Parasite Ecology: The dynamics and study of host-parasite relationships, edited by M.F- Huffman and C.A. Chapman. 2009. Cambridge University Press. 548pp. ISBN: 978–0521872461. Monkeys and apes often share parasites with humans, so understanding the ecology of infectious diseases in non-human primates is of paramount importance. Furthermore, there is accumulating evidence that environmental change may promote contact between humans and non-human primates and increase the possibility of sharing infectious disease. This book provides up-to-date information on the methods of study, natural history and ecology/theory of the exciting field of primate parasite ecology. *Contents:* 1. Collection methods and diagnostic procedures for primate parasitology – E.C.Greiner & A. McIntosh; 2. Methods for collection and identification of minute nematodes from the feces of primates – H. Hasegawa; 3. The utility of molecular methods for elucidating primate/pathogen relationships – R.B. Gasser, J.M. de Gruijter & A.M. Polderman; 4. The application of endocrine measures in primate parasite ecology – M.P. Muehlenbein; 5. Using agent based models to investigate primate disease ecology – C.L. Nunn; 6. What does a parasite see when it looks at a chimpanzee? – M.V.K. Sukhdeo & S.C. Sukhdeo; 7. Primate malarias – A. DiFiore, T. Disotell, P. Gagneux & F.J. Ayala; 8. Disease avoidance and the evolution of primate social connectivity – P.D.Walsh, M. Bermejo & J.D. Rodriguez; 9. Primate/parasitic zoonoses and anthropozoonoses – T. Kaur & J. Singh; 10. Lice and other parasites as markers of primate evolution history – D.L. Reed, M.A. Toups, J.E. Light, J.M. Allen & S. Flannigan; 11. Cryptic species and biodiversity of lice from primates – N.P. Leo; 12. Prevalence of *Clostridium perfringens* in intestinal microflora of non-human primates – S. Fujita, A. Ogasawara & T. Kageyama; 13. Intestinal bacteria of chimpanzees in the wild and in captivity – K. Ushida; 14. Gastrointestinal parasites of bonobos in the Lomako Forest – J. Dupain, C. Nell, K.J. Petrzelkova, P. Garcia, D. Modry & F. Ponce; 15. Habitat disturbance and seasonal fluctuations of lemur parasites – P.C. Wright, S.J. Arrigo, K.L. Hogg, B. Bannon, T.L. Morelli, J. Wyatt, A.L. Harivelo & F. Ratelolahy; 16. Chimpanzee/parasite ecology – M.A. Huffman, P. Pebsworth, C. Bahuneeta, S. Goto & M. Bardi; 17. Primate exposure and the emergence of novel retroviruses – N.D-Wolfe & W.M. Switzer; 18. Overview of parasites infecting howler monkeys and potential consequences of human-howler interactions – S.K. Vitakova; 19. Primate/parasite ecology – A.D. Hernández, A.J. MacIntosh & M.A. Huffman; 20. Crop raiding – A.H. Weyher; 21. Can parasite infections de selective force influencing primate group size? – C.A. Chapman, J.M. Rothman & S.A.M. Hodder; 22. How does diet affect the parasite ecology of mountain gorillas? – J.M. Rothman, A.N. Pell & D.D. Bowman; 23. Connecting primate field data to theory – C.A. Champan, S.A.M. Hodder & J.M. Rothman; 24.Ways forward in the study of primate parasite ecology – C.A. Chapman, M.A. Huffman, S.J. Ryan, R. Sengupta & T.L. Goldberg; 25. Useful diagnostic references and images of protozoans, helminths and nematodes commonly found in wild primates – H. Hasegawa, C.A. Chapman & M.A. Huffman.

Nature unbound: Conservation, capitalism and the future of protected areas, by J. Igoe, D. Brockington and R. Duffy. 2008. Earthscan Publications. 240pp. ISBN: 978–1844074402. This volume is the first comprehensive examination of the rise of protected areas and their current social and economic position in our world. It examines the social impacts of protected areas, the conflicts that surround them, the alternatives to them and the conceptual categories they impose. It also explores key debates on devolution, participation and democracy; the role and uniqueness of indigenous peoples and other local communities; institutions and resource management; hegemony, myth and symbolic power in conservation success stories; tourism, poverty and conservation; and the transformation of social and material relations which community conservation entails. *Contents:*

1. Nature unbound; 2. Histories and geographies of protected areas; 3. The imperatives for conservation; 4. The power of parks; 5. Local management of natural resources; 6. Conservation and indigenous peoples; 7. The spread of tourist habitat; 8. International conservation; 9. Conservation and capitalism.

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Svensson MS, Bearder SK. Assessing the distribution and abundance of owl monkeys (*Aotus zonalis*) in Chagres National Park, Panama.

Tiddi B, Polizzi di Sorrentino E, Aureli F, Janson CH, Shino G. Grooming for tolerance? Behavioural interchange in wild tufted capuchin monkeys (*Cebus apella nigritus*).

Toole A. Contribution to new forest growth by *A. palliata* in a fragment of dry tropical forest.

Valenta K, Fedigan LM. Spatial correlates of capuchin-dispersed seed and seedling survival, germination and growth.

Van Belle S, Ziegler TE, Estrada A, Strier KB. Social and hormonal mechanisms underlying male reproductive strategies in black howler monkeys (*Alouatta pigra*).

Walz JT. The context of spider monkey whinnies: party composition and activity.

Wheeler BC. The monkey who cried wolf: tufted capuchin monkeys use anti-predator calls to usurp resources from conspecifics.

Wilbanks KL. Sex differences in mantled howler monkey (*Alouatta palliata*) feeding diversity in two dry tropical forest fragments.

MEETINGS

International Conference on Diseases of Zoo and Wild Animals

The international conference on diseases of Zoo and wild animals will be held at the Zoo Aquarium of Madrid, Spain between May 12 – 15, 2010. The main topics will include Conservation and reproduction: pathologies, stress; In situ conservation projects in South America among others. For more information visit the web site http://www.zoovet-conference.org/

33rd Meeting of the American Society of Primatologists

The 33rd Meeting of the American Society of Primatologists will be held at the historic Seelbach Hilton Hotel in downtown Louisville, Kentucky June 16–19, 2010. They encourage preparation of proposals for symposia and abstracts for paper and poster sessions. In addition to the usual schedule; there will be opportunities to visit the Louisville Zoo and observe training sessions with several species of primates. Deadline dates: January 8, 2010 for a symposium or workshop, January 29, 2010 for abstracts for oral and poster presenters. For more information go to http://www.asp.org/meetings/index.html

47th Annual Meeting of the Animal Behavior Society

The annual meeting of the Animal Behavior Society will be held on the historic campus of the College of William and Mary, in Williamsburg, Virginia, USA, from July 25 to 29, 2010. Abstract deadline: May 14th, 2010. For more information and registration visit the web site http://animalbehaviorsociety.org/absmeetings/47th-animal-behavior-meeting

International Primatological Society XXIII Congress

The 23rd congress of the International Primatological Society will take place at Kyoto University, Japan on September 12–18, 2010. The theme of the conference will be *Quest for Coexistence with Nonhuman Primates*. In line with IPS policy, the committee welcomes suggestions for symposia on any of the disciplines of primatology. The Symposium submission deadline is October 15th, 2009. The presentation submission deadline is January 15th, 2010. For more information go to: www.ips2010.jp/

XIV Congreso de la Sociedad Mesoamericana Para la Biología y la Conservación

El XIV congreso de la SMBC tendrá lugar en la ciudad de San José, Costa Rica, los días 8–12 Noviembre, 2010. El tema principal del congreso será *conservación y desarrollo, una propuesta mesoamericana frente al cambio global*; en el que se incluyen los retos relacionados con la conservación de la biodiversidad, los servicios ecosistémicos y el desarrollo sostenible, frente a amenazas globales, como lo son la pérdida de hábitat y el cambio climático. La fecha límite para el envío de resúmenes es el 01 de Mayo, 2010. Para más información visita la página http://www.sociedadmesoamericana.org/congresos/proximo-congreso.php

Association of Primate Veterinarians Workshop

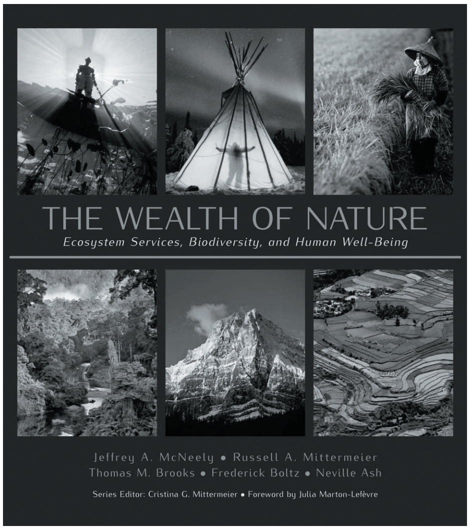
The 2010 Association of primate veterinarians workshop will be held October 6–9, 2010 in Atlanta, GA at the Emory Conference Center Hotel/Emory Inn. Early registration ends September 1. For more information visit http://www.primatevets.org

III Congreso Colombiano de Zoologia

La Asociación Colombiana de Zoología organiza el III Congreso Colombiano de Zoología *Creando un clima para el cambio: la biodiversidad, servicios para la humanidad,* el cual se llevará a cabo en la ciudad de Medellín, Colombia del 21 al 26 de Noviembre, 2010. Para más información consulte: http://iiicongresocolombianozoologia.org

American Anthropological Association Annual Meeting

In 2010, the AAA will conduct the 109th Annual Meeting in New Orleans, Louisiana, November 17–21, 2010. This year's theme is "Circulation", and it's meant to encourage us to consider what triggers, facilitates, constrains, disrupts or stops flows; what is at stake in these processes, and for whom; and what their consequences might be for humans and for the environment; and also to think about boundaries. For more information and registration go to http://www.aaanet.org/meetings/index.cfm.



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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. (Resolution: 300 dpi. Column widths: one-column = 8-cm wide; two-columns = 17-cm wide). Please keep these to a minimum. We stress the importance of providing maps that are publishable.

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

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

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

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

Journal article

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

Chapter in book

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

Book

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

Thesis/Dissertation

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

Report

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

Website

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

For references in Portuguese and Spanish:

"and" changes to "e" and "y" for articles in Portuguese and Spanish respectively.

"In" changes to "Em" and "En" for articles in Portuguese and Spanish respectively.

"Doctoral thesis" changes to "Tese de Doutoramento" and "Tesis de Doctorado" for articles in Portuguese and Spanish respectively.

"MSc Thesis" changes to "Dissertação de Mestrado" and "Tesis de Maestría" for articles in Portuguese and Spanish respectively.

"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. 16(2), December 2009

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