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JEALOUS OF MOM? INTERACTIONS BETWEEN INFANTS AND ADULT MALES DURING THE MATING SEASON IN WILD SQUIRREL MONKEYS (*SAIMIRI COLLINSI*)

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Abstract

Squirrel monkeys (*Saimiri collinsi*) are seasonal breeders that live in large social groups in which females are dominant to males. Females have one infant per year, and the nursing period lasts six to eight months. Preliminary observations in the wild indicated that during the mating period (eight weeks: July and August in our population), the infants show agonism directed at males who approach their mothers. This directed sexual interference by infants has rarely been reported for neotropical primates. Our study reports observations in a natural population of *Saimiri collinsi* with the aim of describing the social behavior of infants during the breeding season, especially with regard to adult males in the group. Infants of both sexes were observed during three mating periods (2011, 2012, 2013), to test hypotheses about the possible function of infant harassment directed at adult males. The behavior of infants (variables: activity and nearest neighbor) was sampled by the focal animal method as well as *ad libitum* observations. We recorded 99 cases of agonism and 17 cases of tolerance between nearby males and infants via the all-occurrence method. Thus, 85% of interactions between adult males and infants involved agonism. These results suggest that infant interference can present a cost to adult males during the breeding season.

Keywords: social conflict, sexual interference, nursing

Resumen

Los monos ardilla (*Saimiri collinsi*) procrean estacionalmente y viven en grandes grupos sociales en los cuales las hembras son dominantes sobre los machos. Las hembras paren una cría por año, y el período de lactancia dura entre seis y ocho meses. Observaciones preliminares en estado silvestre indicaron que durante el periodo de apareamiento (ocho semanas: Julio y Agosto en nuestra población), los infantes muestran comportamiento agonista dirigido a los machos que se acercan a sus madres. Esta interferencia sexual dirigida por los infantes ha sido raramente reportada para primates neotropicales. Nuestro estudio reporta observaciones en una población natural de *Saimiri collinsi* con el propósito de describir el comportamiento social de los infantes durante la estación de apareamiento, especialmente con relación a los machos adultos en el grupo. Infantes de ambos sexos fueron observados durante tres períodos de apareamiento (2011, 2012, 2013), para probar la hipótesis acerca de la posible función de hostilidad de los infantes dirigida a los machos adultos. El comportamiento de los infantes (variables: actividad y vecino más cercano) fue muestreado por el método de animal focal, así como mediante observaciones *ad libitum*. Registramos 99 casos de agonismo y 17 casos de tolerancia entre machos cercanos e infantes mediante el método de registro de todos los eventos. Así, 85% de las interacciones entre machos adultos e infantes involucraron agonismo. Estos resultados sugieren que la interferencia de los infantes puede presentar un costo para los machos adultos durante la estación de apareamiento.

Palabras clave: conflicto social, interferencia sexual, lactancia

Introduction

Social conflict between adult males and unrelated infants/juveniles is often reported in primates. For example, juvenile yellow baboons (*Papio cynocephalus*) are not tolerated by adult males at feeding sites (Pereira, 1988, 1989). The most extreme form of aggression of males toward infants is evidenced by infanticide, a male reproductive strategy shown by many primates (Agoramoorthy and Rudran, 1995; Borries et al., 1999; Beehner and Bergman, 2008; Rimbach et al., 2012), when males recently immigrated to a social group attack and kill unrelated unweaned infants. However, in squirrel monkeys (*Saimiri collinsi*, formerly classified as *S. sciureus*; Lavergne et al., 2010), an inverse and seldom reported type of agonism occurs between males and infants. In this species, it is the infants who show agonism toward the adult males, usually in the presence of their mothers, and without any retaliation from the males (Stone, 2014). This behavior occurs primarily during the mating season (approximately eight weeks; Stone, 2006), and appears to consist mostly of sexual interference. Specifically a female's youngest dependent offspring (here called "infant") shows agonism toward males who approach and attempt to copulate with its mother.

"Sexual interference" is considered any disruption that other individuals direct toward a copulating pair, whether through contact or no-contact (Nishida, 1997). Usually this behavior occurs among adults in a group, and consists of behaviors by a third individual that can interrupt the pair's copulation. Intra-sexual competition among males is the most common form of sexual interference seen in primates, although female competition also results in sexual interference (Qi et al., 2011). Males also may direct aggression toward ovulating females, attempting to prevent their mating with subordinate or non-resident males (Smuts and Smuts, 1993). To our knowledge, however, sexual interference by infants (in particular, targeted agonism toward adult males) has not been reported in primates, and this phenomenon merits investigation in order to understand the context in which it occurs, and its possible ecological and adaptive function.

Squirrel monkeys are polygamous neotropical primates that live in large multi-male, multi-female groups of 25-75 individuals (Zimbler-de Lorenzo and Stone, 2011). Groups show female-biased sex ratios (Stone, 2004) and are characterized by weak male-female associations, with males remaining at the periphery of the group during most of the non-breeding periods (Izar et al., 2008). In addition, adult female *S. collinsi* are dominant to adult males (Izar et al., 2008). Squirrel monkeys are highly seasonal breeders (Di Bitetti and Janson, 2000) and males show weight gain (85 to 222 g; DuMond and Hutchison, 1967) during the brief mating period (two to eight weeks; Izar et al., 2008). The weight gain results from fat deposition and water retention, which produces a "fatted" appearance in the upper torso, arms and shoulders (Mendoza et al. 1978; Boinski, 1987;

Mitchell, 1990; Stone, 2004). Male fattening in this species appears to be related to sexual selection (Stone, 2014). Gestation in *Saimiri* lasts five months (Garber and Leigh, 1997) and lactation lasts from six to eight months in *S. collinsi*, with the end of weaning coinciding with the start of the next mating season (Stone, 2006).

This study addresses the following questions: (1) what is the possible adaptive significance of infant sexual interference/agonism toward adult males (hereby called IMA) seen in *S. collinsi*? (2) in which social and ecological contexts do these events occur? Several hypotheses (not mutually exclusive) could explain the behavior of the infants. For example, the weaning conflict (Trivers, 1974) could result in nursing infants trying to prevent pregnancy in their mothers, which would reduce investment in themselves. Alternatively, due to the pattern of female dominance in this species, female infants rather than male infants may be the main aggressors toward adult males, in order to establish dominance over them (Smale et al., 1995). Finally, the possibility exists that infants preferentially direct agonism toward certain males, either lower-quality males who try to copulate with their mothers, or males who are not their fathers. In order to shed light on these hypotheses, this study investigates: whether there is an association between IMAs and nursing bouts; the effect of sex on activity budgets and nearest neighbors of infants; and whether male robustness affects the frequency of IMAs. We also examine whether the infants are successful at blocking copulation attempts by adult males; that is, whether this infant behavior represents a cost to adult males.

Methods

Study Area
This study was conducted in near the village of Ananim (municipality of Peixe-Boi), 150 km east of Belém, state of Pará, Brazil (01°11'S, 47°19'W). The 800-hectare site consists of privately owned ranches that include primary forest and adjacent secondary forests. Rainfall is seasonal, with a wet season from January to June and a dry season from July to December. Fruit availability is highest during the wet season (Stone, 2007). Mating in this population of squirrel monkeys occurs during an 8-week period from mid-July to mid-September, and births occur in January and February of each year (Stone, 2006). Therefore, the wet season corresponds to births and lactation, and the dry season corresponds to mating and gestation. We collected the behavioral data presented here during three mating seasons (2011, 2012 and 2013).

Study Animals
We collected behavioral data on one social group of squirrel monkeys, with approximately 46 individuals (*ca.* nine adult males, 15 adult females, 12 juveniles and seven infants). Although most adult females give birth every year, infant mortality accounts for a reduction in the number of infants in the group by the next mating season (Stone, 2004). We

classified individuals as adults when over five years of age (males) and three years of age (females; Mitchell, 1990; Stone, 2004). We define individuals observed nursing on their mothers, even if sporadically, as infants (between six and eight months of age during this time period). Four individuals (two adult males and two adult females) were individually recognized, either by natural marks or by beaded identification collars. During observations involving adult males, we classified each individual into a robustness category (see Stone, 2014): Grade 1 (barely noticeable fattening response; n=2 in 2013); Grade 2 (showing the fattening response in the upper arms and torso, but neck still visible; n=4 in 2013); Grade 3 (fattening response very pronounced in the arms and torso, relative to the rest of the body which remains unfattened; neck barely visible; n=3 in 2013).

Behavioral Data Collection
Observations in the three mating seasons totaled 129 hours. We followed the group for at least 10 days per month from 06:00 until approximately 14:00 hours (2011 and 2012) and between 11:00 and 15:00 hours (2013). In all mating periods, we collected all-occurrence data on infant-adult male interactions (whether agonistic or tolerant; see Table 1) and on nursing bouts, timing the duration of the latter whenever possible. We also always attempted to sex the infant and to classify the adult male into the aforementioned robustness categories. Specifically in the 2013 mating season, we also collected 64 10-min focal-animal samples (Altmann, 1974) on infants. During the focal period, we classified the infant into male, female or unknown. At each 1-min interval, we recorded the following variables: activity of the focal animal (eat, forage, rest, travel, social) and age-sex class of the nearest neighbor (hereafter NN), within 5 m (adult male; adult female; juvenile or infant; alone). Within the focal period, we also made continuous observations of any social behaviors that took place involving the focal infant (*e.g.*, nursing, threatening adult male), noting initiation and directionality of interactions. We timed the duration of any nursing bouts observed.

Although non-identification of focal infants is a potential limitation of the study, we took steps to minimize any pseudoreplication. The order of observations of infants based on sex was not random, to avoid oversampling some of the infants. For example, if the first sample of the day was a female infant (determined randomly), we often sampled a second female infant immediately after the first in order to avoid repetition of the same infant. In addition, because the group was often spread over 50-150 m, we conducted successive samples on individuals that were distantly located.

Data Analyses
We used descriptive statistics to quantify the following variables: nursing bout duration, percent of social interactions toward adult males that were agonistic, percent occurrence of different types of IMA, percent IMA according to male robustness grade. We also conducted a Chi-squared analysis to test whether adult males differed in number of IMAs received, according to their robustness level. Instantaneous observations within each infant focal sample are not independent; therefore, we treated each sample (rather than each observation) as an independent data point. The categorical activities "activity" and "NN" were converted to quantitative variables as proportion of intervals. The effect of infant sex on each activity and on NN was then analyzed with unpaired t-tests, with the p value set at $p < 0.05$. All tests were two-tailed.

Results

General context of IMAs in S. collinsi
We observed 99 cases of IMA during the three mating periods, and 17 cases of infants tolerating adult males that were nearby. We did not observe affiliative interactions between infants and adult males. This indicates that 85% of the 116 interactions between infants and adult males involved agonism. In 76% of the 116 observations, an adult female (likely the infant's mother) was within 5 m of the infant-male pair, forming a triad (infant, mother, adult male). In 44% of these 88 observations, we were able to determine that the male was, either, sexually pursuing the

Table 1. Ethogram of social behaviors of infant *Saimiri collinsi*.

Behavior	Definition
Approach	Infant comes within less than 0.5 m of another individual, with or without physical contact
Block	Infant positions itself behind mother (without intromission) usually to block copulation by adult male
Pursuit	Infant follows mother and/or adult male, attempting to maintain physical proximity
Displacement	Infant approaches another individual and takes its place
Threat	Infant vocalizes and lunges toward another individual
Chase	Infant runs after another individual for at least 2 m, usually with threatening vocalizations
Attack	Infant jumps on, bites or scratches another individual
Tolerance	Infant is neutral in the presence of another individual (possibly maintaining physical contact), with no agonism
Play	Infant jumps on, lightly bites or wrestles with another infant or juvenile

Table 2. Number of agonistic interactions between adult males and infant *Saimiri collinsi*, over three mating seasons (2011, 2012, 2013). The first column indicates interactions initiated by infants, second column indicates interactions initiated by adult males.

Behavior	Infant→ Adult male	Adult male→ Infant
Attack	3	0
Block	3	0
Threat	52	2
Chase	35	2
Displacement	2	0
Total	95	4

Figure 1. Effect of infant sex on its activity budget, during the 2013 mating period. N=56 focal samples. RE=rest; SO=social; LO=locomotion; FO=forage

Figure 2. Effect of infant sex on its NN (within 5 m), during the 2013 mating period. N=56 focal samples. AM=adult male; AF=adult female; JV=another juvenile or infant; AL=alone.

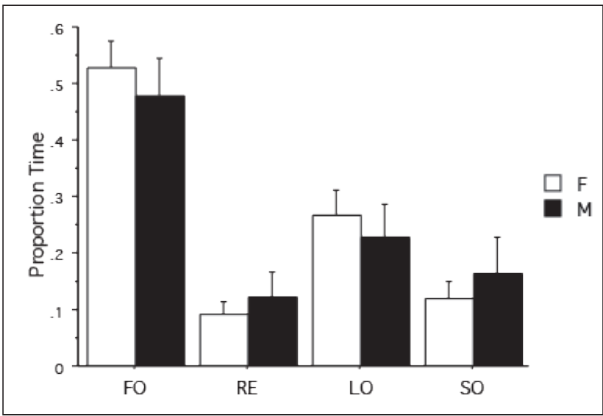adult female, conducting genital inspections or mounting the female.

As shown in Table 2, adult males directed agonism toward infants only on four occasions. IMAs consisted of vocal threats, chases and, rarely, physical aggression in the form of biting. On nine occasions, we also observed infants moving toward and chasing males that were on a nearby branch (that is, not interacting directly with an adult female). We also observed two cases in which a resting male was approached by an infant who jumped on and bit the adult male, resulting in the adult male leaving the scene. Finally, we note three cases when the infant effectively "blocked" adult males from mounting their mothers; specifically, the infant mounted his mother, blocking access by the male.

Occurrence of nursing within the mating period

We observed nursing bouts during all three mating seasons. Over the three seasons, we recorded 25 nursing events, with a mean duration of 29 ± 4 seconds (N=7 timed bouts). In 12 cases, we could not identify the sex of the infant due to its nursing position. We identified the infant as male in five cases and as female in one case. In three cases, we observed nursing bouts during a time when an adult male was pursuing the infant's mother. In one of these cases, a male infant threatened the adult male and then immediately nursed. Qualitatively, we observed an increase in weaning conflicts between mother and infant after August 15 (females forcefully removing infants from the nipple, with infants vocalizing in distress).

Effect of infant sex on its activities and nearest neighbors
Infants of both sexes spent over 50% of their time foraging independently (Fig. 1). We did not observe an effect of sex on the infants' activity budget (FO: t_{54}=0.61, NS; RE: t_{54}=-0.69, NS; LO: t_{54}=0.54, NS; SO: t_{54}=0.70, NS). Infants of both sexes also spent over 50% of their time budget near other infants/juveniles (Fig. 2). There was no effect of infant sex on proportion time spent with adult males (t_{54}=-0.97, NS), adult females (t_{54}=0.43, NS), juveniles/infants (t_{54}=0.07, NS) or alone (t_{54}=-1.52, NS). In the 99 cases of IMAs, we were only able to determine the sex of the infant in seven cases (five males and two females) because of the short duration of the IMA.
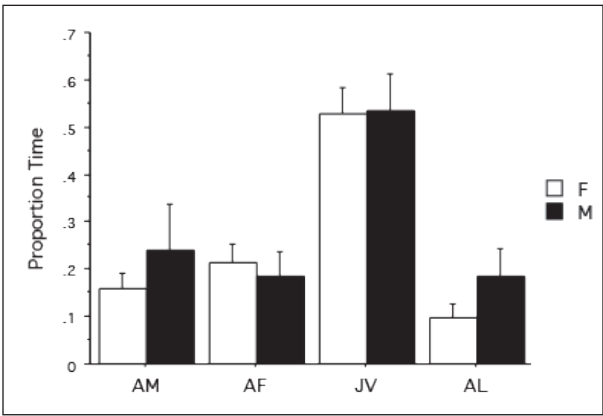
Effect of male grade on IMAs received
We were able to register male robustness level for in 18 IMAs (Table 3). The intermediate fat males received 44% of agonism cases, followed by the least fat males (39%) and the fattest males (17.6%) but this difference was not significant (χ2=1.81, df=2, p=0.40). We also highlight that only Grade 2 and 3 males were tolerated by infants when in proximity to females (n=5 cases where male grade was identifiable).

Discussion

This study confirms prior qualitative observations of the occurrence of IMAs in *Saimiri collinsi* (Stone, 2014). However, this study is the first to quantify the occurrence of this behavior in the field, confirming that most of the interactions between infants and adult males during the mating season are agonistic, and that males do not retaliate against infants, often leaving the location. Most of the interactions consist of vocal threats and chases, but they may also reach

Table 3. Number of IMAs received by adult males according to their robustness levels.

Male grade	Observed values	Expected values
Grade 1 (n=2)	7	4
Grade 2 (n=4)	8	8
Grade 3 (n=3)	3	6
Total	18	18

physical aggression. We also confirm that IMAs occur predominantly within a context of sexual interference; that is, in most cases, the infant is near its mother when the adult male approaches her for copulation or genital inspection. In coatis (*Nasua nasua*), juvenile agonism toward adults is also observed commonly. Rather than reflecting social dominance, the interactions consist of tolerated juvenile aggression, particularly during feeding contexts, so that juveniles have better access to food sources during growth and development (Hirsch, 2007). The pattern that we observed in squirrel monkeys differs in that infant intolerance toward males occurs mostly within a socio-sexual context.

We observed overlap between the copulation period and the end of the nursing period. Specifically, we observed IMAs performed by infants who are not fully weaned. This observation supports the first hypothesis that the infant's interference is an attempt to prevent its mother's pregnancy. However, data from captivity and from the field indicate that lactating squirrel monkey females are still able to get pregnant (J. Ruiz, personal communication for *S. boliviensis*; L. Kauffman, personal communication for *S. sciureus*), indicating that these primates do not undergo lactational anovulation. Therefore, a more likely, non-physiological explanation for our results then is that, nursing infants could be engaging in IMAs to prevent their mothers from spending time in mating activities, which would detract from time invested in nursing bouts. Mating activities can occupy a significant portion of a female's day; consortship pairs are common, in which males pursue adult females for several hours while conducting genital inspections, branch inspections and vocalizing to her (Stone, 2014). As such, this would still be a case of classic weaning conflict (Trivers, 1974). Our study only covered the mating season (two months in each year); therefore, we cannot affirm that IMAs occur exclusively during this season. However, we do know that adult males remain at the periphery of the group at other times of the year (Stone, 2004), reducing the chances of social contact between infants/juveniles and adult males. This suggests that IMAs probably are restricted to the mating season, which also supports the weaning conflict hypothesis.

The second hypothesis we considered was that most IMAs would be initiated by female infants, in order to establish early social dominance over adult males, a pattern similar to seen in hyaenas (*Crocuta crocuta*). Infant females in this species are highly aggressive (Smale et al., 1995) because adult females are dominant to adult males (Frank, 1986). Against this hypothesis, we did not observe sex differences in the amount of time infants spend near adult males, suggesting that female infants do not have more chances to show agonism toward adult males. We were only able to determine the sex of the infant in seven IMAs, which makes it impossible at this time to further evaluate this hypothesis. However, the prevalence of IMAs in the mating season, rather than all year round (Stone, 2014), does not lend support to the dominance hypothesis.

Although we did not find that the fattest males were targeted less for IMAs, given the small number of observations in which male grade was reliably determined, this hypothesis should be re-evaluated with additional field observations. However, given that adult females themselves spend more time in proximity to fatter males (Stone, 2014), it is possible that infants also are more tolerant of more robust males. An additional hypothesis, not tested here, is that infants may be targeting strange males (males that do not share genes with them). Otherwise, it is possible that the more robust males were also the more robust in the previous breeding season, and thereby have a higher likelihood of siring the infants. This interesting hypothesis can be examined once we collect DNA samples from infants and adult males. We hope to be able to test this hypothesis with the continuation of our trapping program, initiated in 2012.

Are infants effective in blocking the adult males who approach their mothers? This question can be addressed at several levels. Our behavioral data show that, in most cases, the male submits to the infant's threats, leaving the vicinity of the infant and adult female. Thus the male loses immediate access to the female. In this way, the behavior of the infant and the male suggests that the infants are successful in disrupting mating efforts of adult males. However, we know that most females get fertilized during the mating season. In November 2013, 10 out of 11 captured females were pregnant (Stone et al., in press). From this numeric point of view, infants are not effective in ultimately blocking adult males. However, without knowing whether the infants target specific adult males (*e.g.*, subordinate males, unrelated males, less robust males) it is not possible to quantify their efficacy. For example, it is possible that the 10 females were fertilized by one or two dominant males, while the infants blocked attempts of the remaining males. Therefore, the question becomes: who are the adult males that the infants are targeting? This is an important question that merits future investigation. A final question is whether *S. collinsi* is unique in the existence of IMAs. We argue that this behavior likely occurs in other *Saimiri* species as well, but simply has not been investigated. All squirrel monkeys show highly seasonal breeding (Di Bitteti and Janson, 2000; Zimbler-DeLorenzo and Stone, 2011) and all show the "fatted male phenomenon" (Stone, 2014). Therefore,

we suggest that these two life history traits likely contribute to the occurrence of IMAs in all squirrel monkey species.

The data collected in this study indicate that: (1) most interactions between adult males and infants during the mating season consist of harassment in the context of sexual interference and that they are mostly initiated by infants; (2) infants of both sexes avoid and harass adult males; (3) infants may be attempting to maintain maternal investment in the form of proximity and nursing, which is in conflict with time and energy expended in mating activities; (4) infant harassment may be an effective tactic in blocking approaches by specific, perhaps less robust adult males.

Acknowledgements

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RECONOCIMIENTO DE PRIMATES Y AMENAZAS PARA SU SUPERVIVENCIA EN BOSQUES PRE- MONTANO Y MONTANO DE LA REGIÓN CAJAMARCA, PERÚ

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Resumen

Llevamos a cabo un reconocimiento de corta duración de los bosques pre montano y montano de la Región Cajamarca para determinar las especies de primates que la habitan e identificar las amenazas para la supervivencia de sus poblaciones. Desde Octubre a Noviembre de 2012 se realizaron censos por transecto en nueve puntos de muestreo pertenecientes a los sectores de Huamantanga y Torohuaca y adicionalmente entrevistamos a nueve personas. En 218 km recorridos fueron registrados 20 grupos pertenecientes a *Alouatta seniculus* (6 grupos), *Cebus yuracus* (6 grupos) y *Aotus* sp. (8 grupos). El tamaño promedio de los grupos fue 3.2 para *Aotus* sp., 7.7 para *A. seniculus* y 14.0 para *C. yuracus*. La tasa de avistamiento más alta fue para *Aotus* sp. (6.6 a 7 individuos/10 km y la más baja para *A. seniculus* (1.92 a 2.54 individuos/ 10 km). En el caso de *Aotus* sp., no fue posible identificar la especie, pero podría tratarse de *A. vociferans* o una especie nueva. En el área de estudio, las principales amenazas para la supervivencia de los primates son la deforestación y quema de la vegetación.

Palabras clave: Primates, bosques de neblina, tamaño grupo, abundancia, amenazas.

Abstract

We conducted a short survey in the pre-montane and montane forests of the Región Cajamarca to record the primate species that inhabit this region and to identify threats to the survival of their populations. From October to November 2012 transect censuses were conducted in the Huamantanga and Torohuaca sectors. Additionally, interviews were realized in both sectors. During 218 km of transect walks we registered 20 primate groups: *Alouatta seniculus* (6 groups), *Cebus yuracus* (6 groups) and *Aotus* sp. (8 groups). The average group size was 3.2 for *Aotus* sp., 7.7 to 14.0 for *A. seniculus* and *C. yuracus*. Encounter rates were highest for *Aotus* sp. (6.6 - 7 individuals/10km) and lowest for *A. seniculus* (1.92 - 2.54 individuals/10 km). In the case of *Aotus,* it was not possible to identify the species, but it could be *A. vociferans* or a new species. In the study area, the main threats to primates are deforestation and vegetation burning.

Keywords: Primates, cloud forests, group size, abundance, threats.

Introducción

En el Perú, los estudios sobre primates se han llevado a cabo principalmente en bosques de la llanura amazónica del nororiente y suroriente, mientras que para los bosques pre-montano y montano la información es muy escasa. Se llevan a cabo mayormente en las regiones de San Martín y Amazonas y están orientados en particular a *Lagothrix flavicauda*, mientras que para el resto de las especies prácticamente se conoce muy poco. Los escasos estudios cercanos al área de estudio fueron conducidos entre el río Comainas y la Cordillera del Cóndor y se refieren a inventarios de mamíferos en general, entre los que mencionan a *Cebus albifrons* (Vivar y Arana-Cardó, 1994; Emmons y Pacheco, 1997a, b y Emmons et al., 1997). Aquino y Encarnación (1994) hacen referencia en sus respectivos mapas de distribución

a *Saguinus lagonotus, Saimiri sciureus* y *Callicebus discolor* hasta la margen izquierda del río Chinchipe, pero ninguna de ellas fueron confirmadas. Por su parte, Amanzo (2003) reporta para el Santuario Nacional Tabaconas-Namballe a *Alouatta seniculus, Cebus albifrons* (*yuracus*) y *Aotus* sp. Recientemente, Aquino et al. (2013) consideran que la distribución de *Ateles belzebuth* alcanza hasta el río Chinchipe, pero no mencionan la presencia de otros Atélidos, menos para los bosques pre-montano y montano presentes en el lado occidental de los ríos Chinchipe y Marañón. Dada la carencia de información sobre primates en el área antes indicada y en aras de velar por la conservación de los primates nos propusimos a explorar estos bosques para determinar la diversidad y abundancia de los primates que habitan en ellos, e identificar las amenazas para la supervivencia de sus poblaciones, puesto que en el área de estudio podrían estar

Tabla 1. Sectores y lugares de censos definidos para el inventario y evaluación de primates en los bosques pre montano y montano de la región Cajamarca.

Sectores	Lugar del censo	Código	Coordenadas	Altitud (msnm)	Tipo de bosque
Huamantanga	Nueva Jerusalén	1	729215/9367420	1,961	Montano
	San José	2	729525/9369614	2,020	Montano
	La Rinconada	3	727214/9372012	1,968	Montano
	Santa María	4	730399/9371552	2,030	Montano
	San Luis	5	729099/9374456	1,943	Montano
	Huabal	6	730705/9378956	1,523	Pre montano
Torohuaca	Torohuaca	7	702751/9403942	1,466	Pre montano
	El Valor	8	701941/9402747	1,736	Pre montano
	Bermeja	9	703849/9403197	1,320	Pre montano

habitando nuevas especies o subespecies, en particular de los géneros *Aotus* y *Alouatta*, cuyas poblaciones estarían siendo afectadas por las diversas actividades que se desarrollan, entre ellas la agricultura migratoria, ganadería tradicional, extracción de madera de valor comercial y minería informal.

Los tipos de hábitats y el nivel de perturbación influyen de manera directa en la composición de la fauna silvestre, entre ellos los primates, lo que permite un análisis comparativo en relación a la composición de especies, abundancia y las actividades que afectan a los hábitats. Para el análisis e interpretación, los datos fueron obtenidos durante los censos conducidos desde el 17 de Octubre al 15 de Noviembre del 2012. Adicionalmente se hicieron entrevistas para complementar la información acopiada durante los censos. Los resultados obtenidos se presentan en este reporte.

Métodos

Area de estudio

Ubicada en el extremo nororiental de la Amazonía peruana, cerca al límite con el Ecuador. Comprendió los bosques pre montano y montano pertenecientes a las provincias de Jaén y San Ignacio, Región Cajamarca. Según Brack (1986a, 1986b), la fauna que habita en estos bosques corresponde al dominio amazónico con especies que caracterizan a las ecoregiones de selva alta y ceja de selva. En el área, los hábitats naturales están representados por parches o manchales de bosques, los mismos que se encuentran sumamente perturbados por la extracción selectiva de árboles maderables y de plantas medicinales, mientras que las zonas abiertas que son las más extensas están conformadas por chacras, pastizales, purmas y bosque secundario. Para los trabajos de campo, los bosques aledaños de los centros poblados más representativos dentro de cada sector fueron considerados como puntos de muestreo, todos accesibles de una u otra forma a través de carreteras y/o herraduras. En total fueron definidos nueve puntos de muestreo; de ellos, tres correspondieron al sector de Huamantanga y tres a Torohuaca (Tabla 1, Fig. 1).

En el Sector de Huamantanga los bosques primarios fueron sometidos a un proceso acelerado de deforestación por la extracción de árboles de valor comercial y para dar paso a la agricultura migratoria y ganadería tradicional, por lo que actualmente los manchales de bosques remanentes están presentes únicamente en las partes accidentadas y corresponden al denominado bosque montano o de neblina. Entre la flora predominan especies de las familias Lauraceae, Rubiaceae, Podocarpaceae y Melastomataceae (Gentry, 1995), pero también están presentes varias especies de palmeras, entre ellas *Ceroxylon* sp. y *Geonoma* sp. A pesar de la fuerte alteración y reducción de los hábitats, la fauna silvestre es todavía diversa y relativamente abundante, porque salvo excepciones, los animales no son cazados para el consumo de subsistencia, de modo que en estos bosques aún se encuentran representantes de la fauna mayor, entre ellos el oso de anteojos (*Tremarctos ornatus*) y los primates como el mono aullador (*A. seniculus*) y machín blanco o choclero (*C. yuracus*). En este sector, los censos fueron conducidos en bosques remanentes circundantes a los centros poblados de Nueva Jerusalén, San José, La Rinconada, Santa María, San Luís y Huabal, todas localizadas entre 1,523 a 2,030 msnm.

En el sector de Torohuaca la deforestación alcanza niveles alarmantes, a tal punto que los bosques remanentes son afectados por la quema que es frecuente para la ampliación de la agricultura y de pastizales. Entre la vegetación sobresale el romerillo (*Nageia* sp. y *Prumnopytis* sp., Podocarpaceae) que son extraídos ilegalmente por su alta calidad como madera y las plantas de uso medicinal como la quina (*Cinchona* sp., Rubiaceae) y sangre de grado (*Croton draconoides*, Euphorbiaceae) que son igualmente derribadas para comercializarlas. A pesar de la fuerte perturbación del bosque, la fauna mayor todavía está presente y entre sus componentes figura el mono aullador (*A. seniculus*). A diferencia del sector anterior, los pobladores del centro poblado de Torohuaca son conscientes sobre la importancia de los bosques, por lo que han adoptado medidas como la prohibición de la tala de árboles en cabeceras de ríos y quebradas y en laderas empinadas. En este sector, los censos fueron
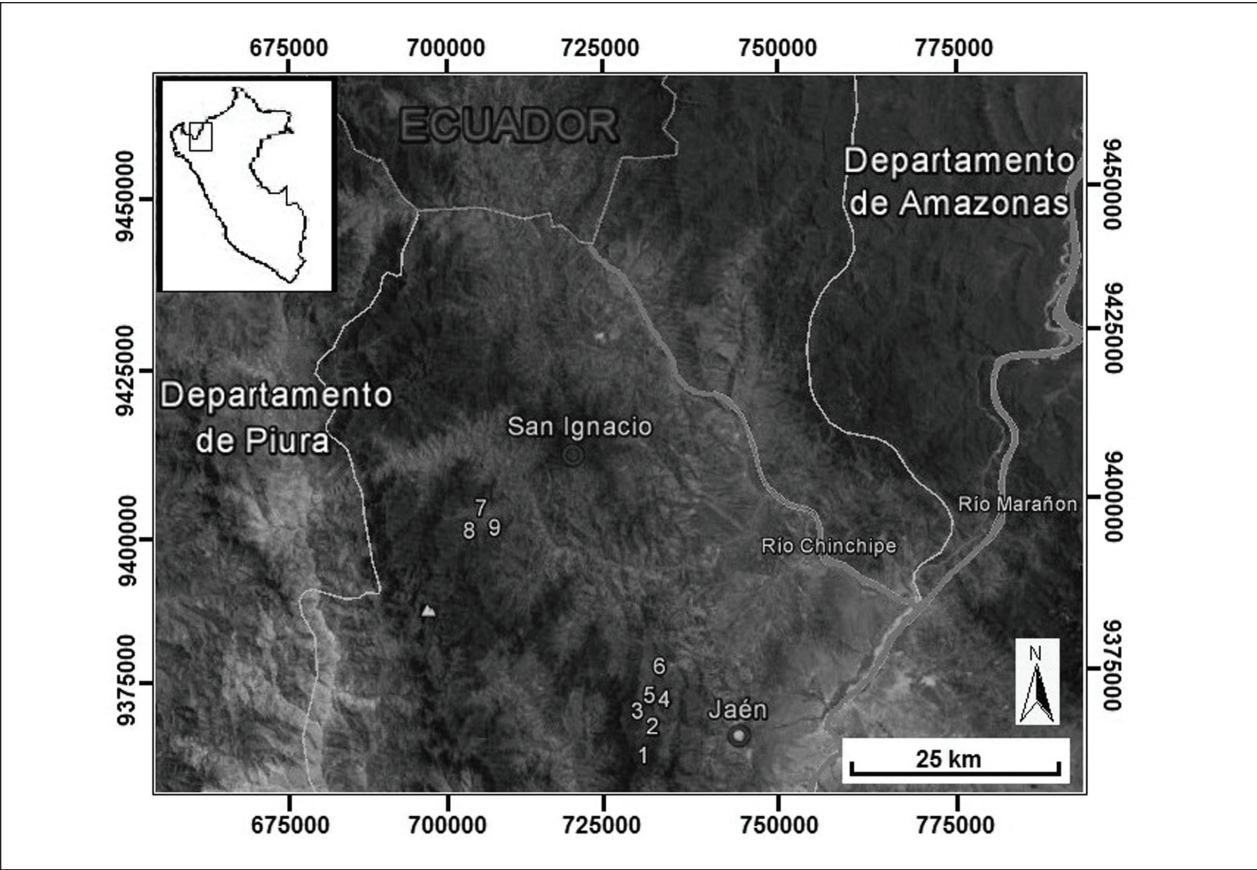
Figura 1. Mapa de ubicación geográfica de los lugares de censos en los sectores de Huamantanga (Provincia de Jaén) y Torohuaca (Provincia de San Ignacio), Región Cajamarca.

conducidos en Torohuaca, El Valor y Bermeja, localizados entre 1,320 a 1,736 msnm.

Censos por transecto

Para los censos se usaron como transectos los caminos y trochas de los pobladores, cuyas longitudes fluctuaron desde 3 a 4 km. Los censos fueron conducidos por dos grupos conformados por un investigador y un asistente de campo desde las 06:30 a 14:00 h y desde las 18:30 a 21:00 h (hora local). Durante los censos los observadores se movilizaron por los transectos a una velocidad promedio de 0.5 km/hora, con paradas de tres a cinco minutos para percibir las vocalizaciones y ruidos ocasionados por los saltos o caída de restos de frutos y ramas o bejucos secos. También se tomó en cuenta la presencia de frutos y sus restos al pie de los árboles. Cada vez que hubo avistamiento de un grupo se anotó la especie, tamaño de grupo, actividad, tipo de vegetación, distancia perpendicular del primer animal avistado al transecto y la longitud recorrida. Para determinar el tamaño fue necesario seguir a los grupos, pero no siempre tuvimos éxito debido al escarpado del terreno. En total fueron recorridos 238 km; de ellos, 200 correspondió al censo diurno y 38 al nocturno (Tabla 2).

Entrevistas

Entrevistas fueron hechas a los pobladores de los centros poblados considerados como lugares de censos y tuvieron

Tabla 2. Longitud censada (km) por sectores en el área de estudio.

Horario de censo	Sectores		Total (km)
	Huamantanga	Torohuaca	
Diurno	120	80	200
Nocturno	23	15	38
Total	143	95	238

como propósito indagar acerca de la existencia de primates. Para facilitar la identificación, algunas veces fue necesario mostrar fotografías de algunas especies de primates que se sospechaba que estarían habitando en el área de estudio. La información proporcionada fue anotada en la libreta de campo. En total fueron entrevistados nueve personas con amplio conocimiento de la fauna silvestre; de ellas, seis pertenecieron al sector de Huamantanga y tres a Torohuaca. Algunos de los entrevistados mencionaron que hace muchos años había un primate de piel negruzca y brazos largos pero que en la actualidad ya no se observan, pero no precisaron si se trataba de alguna especie de *Ateles* o de *Lagothrix*.

Identificación de amenazas

Las actividades que constituyen amenazas fueron registradas paralelo a los censos y en las entrevistas. Asimismo, durante las visitas a los centros poblados tuvimos la oportunidad de indagar acerca de la existencia de mascotas y otras evidencias (pieles, cráneos, etc.) que provienen de la caza.

Resultados y discusión

Fueron registrados 20 grupos pertenecientes a tres especies; de ellos, ocho correspondieron a *Aotus* sp. y el resto a *C. yuracus* y *A. seniculus* en igual número de grupos (Tabla 3). Para las tres especies, la mayoría de los grupos fueron observados en el sector de Huamantanga, el cual de hecho tiene relación con la mayor cobertura, tanto diurna como nocturna. Los ejemplares macho y hembra de *A. seniculus* se caracterizaron por su pelaje de color amarillo dorado desde la espalda hasta la base de la cola y mitad distal de la cola, contrastando con el resto del cuerpo que fue marrón castaño. Este patrón en la coloración del pelaje difiere de los individuos que habitan en selva baja que es de color castaño rojizo. De acuerdo con Rylands y Brandon-Jones (1999) en *A. seniculus* existe una alta variabilidad en la coloración del pelaje. Además de los ejemplares observados en Cajamarca, esta variación también ocurre en ejemplares que habitan en bosque pre montano de los ríos Bajo Urubamba y Tambo que se caracterizan por su coloración totalmente dorado tanto en machos como en hembras (Aquino et al., 2013), en tanto que en los bosques montanos del río Perené en la selva central son más bien de color rojo encendido (Aquino, obs. pers.). La variación del color en esta especie podría tener relación con el clima y los recursos alimenticios que son distintos entre uno y otro tipo de hábitat.

Tratándose de *C. yuracus*, los ejemplares observados entre uno y otro sector se caracterizaron por su pelaje largo, con la parte dorsal de color marrón difuso, excepto las extremidades anteriores y cola que fueron de color blanquecino. El patrón de coloración del pelaje de *C. yuracus* coincide con los ejemplares reportados para el bosque montano del Ecuador (Berton et al., 2008), pero contrasta con los que habitan en bosques de neblina de San Martín y Sur de Amazonas, cuya coloración es más bien de color marrón claro incluyendo las extremidades anteriores (Aquino, obs. pers.), por lo que podría corresponder a otra especie o sub especie.

Tabla 3. Especies y grupos de primates registrados por sectores durante los censos por transecto lineal.

Sectores	Especies registradas			Total
	A. seniculus	*C. yuracus*	*Aotus* sp.	
Huamantanga	4	4	5	13
Torohuaca	2	2	3	7
Total	6	6	8	20

Con respecto a *Aotus* sp., los grupos fueron observados desde 1,320 msnm (centro poblado Santa María) hasta 2030 msnm (centro poblado Bermeja). De acuerdo con las características fenotípicas descritas por Hershkovitz (1983), los ejemplares que habitan en estos bosques pertenecen al grupo denominado de "cuello gris". Podría tratarse de *A. vociferans,* puesto que algunos caracteres fenotípicos observados en una mascota juvenil en San Luís del Nuevo Retiro coinciden con los de esta especie como el pelaje de la parte ventral del cuello e interior de los antebrazos de color gris y las tres bandas oscuras de la cabeza que convergen en la base de la nuca. Sin embargo, contrasta con el pelaje en general por ser más largo y denso y porque en la cola solamente un tercio proximal es de color anteado y el resto negruzco. De confirmarse como *A. vociferans*, su distribución se ampliaría hasta los bosques montanos de la Región Cajamarca, pues anteriormente ya fue registrado en la localidad de Perico, río Chinchipe correspondiente al bosque pre montano (Hershkovitz, 1983); pero también cabe la posibilidad de que podría tratarse de una nueva especie, de modo que la colecta de especímenes para el cariotipo será decisiva para despejar esta interrogante.

De las tres especies registradas, los ejemplares de *C. yuracus* fueron los únicos que mostraron una actitud temerosa y huidiza ante la presencia del hombre, conducta que tiene mucho que ver con los disparos de armas de fuego al cual están expuestos cuando ingresan a los maizales y son repelidos para evitar pérdidas económicas.

El rango de variación del tamaño fue determinado de grupos donde fue posible el conteo completo. Los grupos más pequeños correspondieron a *Aotus* sp., que fluctuó entre 2 y 4 individuos, siendo el tamaño promedio 3.2±0.9 (N=5). Grupos más grandes fueron registrados para *C. yuracus* que variaron entre 9 y 20 individuos, promedio 14.0±4.8 (N=4) y *A. seniculus* de 4 a 12 individuos, promedio 7.7±2.9 (N=6). El tamaño de los grupos registrados para *Aotus* sp. fue muy cercano a los registrados en selva baja para *A. vociferans* (Aquino y Encarnación, 1994) y *A. nigriceps* (Aquino et al., 2013), pero difiere de *A. nancymae* (Aquino y Encarnación, 1994) y de *A. miconax* (Shanee y Shanee, 2012), puesto que para estas especies se han registrados grupos de hasta seis individuos. En *C. yuracus,* el tamaño de los grupos fue similar al reportado para las Sierras de Contamana, considerada como un área con ligera presión de cacería (Aquino et al., 2005), pero fue mayor a los registrados para los ríos Bajo Urubamba y Tambo (Aquino et al., 2013) y bosque montano del Sur del Ecuador (Berton et al., 2008), donde el único grupo observado estuvo integrado por tres individuos, aun cuando los autores hacen mención de que podría haberse tratado de un sub grupo, ya que en los *Cebus* algunas veces ocurren estas formaciones (Lynch Alfaro, 2007). Por otro lado, Defler (1982) y Terborgh (1983) hacen mención de grupos de hasta 35 individuos, lo cual parece usual en bosques de selva baja con nula o ligera presión de caza como las áreas protegidas, por lo que no descartamos la presencia de

grupos similares en el área de estudio. En referencia a *A. seniculus*, el tamaño de los grupos registrados resultó superior al reportado para los ríos Bajo Urubamba y Tambo, considerado como de alta presión de caza (Aquino et al., 2013), pero fue similar al del río Pacaya en la Reserva Nacional Pacaya Samiria (Soini, 1995) donde la caza es ocasional y al de los bosques montanos de Colombia (Gómez-Posada et al., 2007; Londoño y Gómez-Posada, 2008), con características muy similares al área de estudio.

El bajo número de observaciones obtenido durante los censos no fue suficiente para el análisis de densidad poblacional, por lo que aquí proporcionamos la tasa de avistamiento (grupos observados/10 km). Con excepción de *Aotus* sp., los resultados indican una baja tasa de avistamiento para *A. seniculus* y *C. yuracus* (Tabla 4). En el caso de *Aotus* sp., la tasa de avistamiento varió desde 6.6-7.0 individuos/10 km de longitud. La mayor tasa de avistamiento estimada para *Aotus* sp., estaría en estrecha relación con la rápida adaptación a los cambios bruscos de su hábitat tal como ocurre con *A. miconax* en la micro cuenca del río Chinchao y en Carpish, Región Huánuco (Aquino, obs. pers.). En cuanto a las otras dos especies, la relativa baja tasa de avistamientos podría estar relacionado con la escasez de recursos alimenticios debido a la reducción de sus hábitats y en otros casos fuerte alteración y fraccionamiento de los bosques, lo que estaría influyendo en la tasa reproductiva o muerte temprana de los infantes, puesto que en el área de estudio la caza es una actividad secundaria y está orientado mayormente a *C. yuracus*.

Entre las actividades desarrolladas en el área de estudio, la deforestación podría considerarse como la principal amenaza para la supervivencia de los primates y la fauna silvestre en general, pues se continua derribando árboles para la ampliación del área dedicada a la agricultura y ganadería a un ritmo acelerado, siendo ocasionado mayormente por colonos migrantes de las serranías del norte del país, quienes por desconocimiento de la selva alta en la cual ahora viven, practican una agricultura agresiva (roza, quema, siembra de pastos, entre otros) que agota rápidamente los suelos obligándolos a realizar agricultura migratoria. De continuar la tala con estos fines, es predecible que los hábitats ya fraccionados serán severamente alterados y/o destruidos con graves repercusiones para las poblaciones de primates y de otros componentes de la fauna silvestre. Actualmente ya existen grupos de *A. seniculus* que para subsistir tienen

que movilizarse de uno a otro parche de bosque residual en busca de recursos alimenticios y lo hacen cruzando los pastizales. Otros como *C. yuracus* es prácticamente obligado a invadir campos de cultivo en busca de recursos alimenticios. La deforestación también está relacionada con la extracción ilegal de madera de valor comercial, actividad que se sigue practicando pese a las prohibiciones por las autoridades locales. Uno de los impactos sería la reducción de las poblaciones de primates por escasez de recursos alimenticios y pérdida de crías por el constante estrés al cual están sometidos por la contaminación sonora que emiten las motosierras y caída de árboles para la apertura de trochas carrozables, viales y extracción de aquellos de alto valor económico.

La quema es otra de las amenazas para la supervivencia de los primates que mayormente es practicada por la gente de procedencia andina, y que justifican indicando que así mejoran la calidad del pasto y de la tierra y abaratan costos en el mantenimiento y ampliación de los pastizales. El fuego a veces resulta incontrolable y afecta no solamente los matorrales arbustivos y herbazales sino también bosques primarios que constituyen hábitats de los primates y de otros componentes de fauna mayor, entre ellos el oso de anteojos (*T. ornatus*). La quema no solamente afecta a la vegetación, sino también a los animales, en particular infantes que debido a su locomoción lenta son alcanzados por las lenguas de fuego hasta calcinarlos. Un claro ejemplo fue el reciente hallazgo por uno de los autores (R. Aquino) de un infante de *Mazama rufina* totalmente calcinado por el fuego en el Valle de los ríos Apurímac, Ene y Mantaro (VRAEM).

Finalmente, la caza podríamos considerarla entre las principales amenazas para la supervivencia de las poblaciones de primates, cuya incidencia varía de acuerdo a las costumbres de los habitantes que ocupan los sectores de muestro; es decir, andino o amazónico. En los sectores de Huamantanga y Torohuaca, la mayoría de sus habitantes proceden de la serranía norte, por lo que sus principales actividades son la ganadería y la agricultura, de modo que la caza es para repeler a los animales invasores, entre ellos *C. yuracus*. En efecto, ante la escasez de recursos alimenticios, esta especie tanto en selva baja como en selva alta tiene por costumbre ingresar a los maizales, por lo que son repelidos con disparos de armas de fuego para evitar pérdidas económicas.

Tabla 4. Tasa de avistamiento estimado para los primates observados en el área de estudio.

| Especies | Tasa de avistamiento por sectores | | | |
| | Huamantanga | | Torohuaca | |
	Grupos/10 km	Indiv./10 km	Grupos/10 km	Indiv./10 km
Alouatta seniculus	0.33	2.54	0.25	1.92
Cebus yuracus	0.33	4.62	0.25	3.5
Aotus sp.	2.2	7	2.0	6.6

Por ahora las tres especies están protegidas en el Santuario nacional Tabaconas-Namballe (Amanzo, 2003) y en el Área de Conservación Municipal "Bosques de Huamantanga" que cuenta con una extensión de 3,840.72 ha (Suclupe, 2007). Sin embargo, esta última unidad de conservación no garantiza la supervivencia a largo plazo, puesto que aparte de ser un área de pequeña extensión (3,000 has), en ella se continúa con la extracción ilegal de madera de alto valor comercial, entre ellos el romerillo (*Nageia* sp. y *Prumnopytis* sp.) que también es utilizado por *A. seniculus* para el descanso y probablemente para el "sueño nocturno".

Agradecimientos

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CENSUS OF THE BLOND TITI MONKEY *CALLICEBUS BARBARABROWNAE* (PITHECIIDAE) IN THE SEMI-DECIDUOUS ATLANTIC FOREST OF CHAPADA DIAMANTINA, BRAZIL

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Abstract

In Brazil, the destruction of the Atlantic forest and the Caatinga dry forest continues to the present, having a profound effect on the non-human primates. Here we present data on abundance of the critically endangered *Callicebus barbarabrownae* (Pitheciidae), the only primate endemic to the Caatinga, and evaluate if human presence impacts their distribution. We conducted over 152 km of line transect surveys, mostly in semi-deciduous forest near the Chapada Diamantina National Park, NE Brazil. The blond titi monkey occurred at an extremely low abundance, even when considering calls their abundance was lower than that reported for closely related species in different Atlantic forest areas surveyed previously. Although hunting pressure is high in the area, the reasons for their lower abundance are yet unclear. The presence of taller and relatively undisturbed forest seemed key factors for the presence of the species even in areas with heavy human presence. We speculate that they could prefer wetter habitats and gallery forests. Our results are the first record of blond titi monkey in protected area. The long term survival of this critically endangered species may depend on increasing the number of conservation units and stimulating conservation awareness in the local human population.

Keywords: Atlantic Forest; blond titi monkey; conservation; disturbed forest; hunting.

Resumen

En Brasil, la destrucción del bosque Atlántico y el bosque seco de Caatinga continua actualmente, ejerciendo un profundo efecto sobre los primates no humanos. Presentamos datos de abundancia del críticamente amenazado *Callicebus barbarabrownae* (Pitheciidae), el único primate endémico de la Caatinga, y evaluamos si la presencia humana impacta su distribución. Llevamos a cabo 152 km de evaluaciones por transectos lineares, principalmente en bosque semideciduo cerca del Parque Nacional Chapada Diamantina, al nororiente de Brasil. La abundancia del mono titi rubio es extremadamente baja, aun cuando se consideraron las vocalizaciones su abundancia fue más baja que la reportada para especies cercanamente relacionadas en diferentes áreas del bosque Atlántico evaluadas previamente. Aunque la presión de caza es alta en el área, las razones para de su baja abundancia no son claras aún. La presencia de bosque más alto y relativamente no perturbado parecen ser factores clave para la presencia de la especie aún en áreas con alta presencia humana. Especulamos que la especie podría preferir habitats más húmedos y bosques de galería. Nuestros resultados son el primer registro del mono titi rubio en un área protegida. La sobrevivencia a largo plazo de esta especie críticamente amenazada puede depender de incrementar el número de unidades de conservación y de estimular en la población humana local conciencia por su conservación.

Palabras clave: Bosque Atlántico; mono titi rubio; conservación; bosque intervenido; cacería.

Introduction

Habitat loss, fragmentation and hunting are the main factors accounting for the loss of biodiversity in tropical forests (Wright, 2005; Harrison, 2011). In Brazil, the Atlantic forest and the dry forest of the Caatinga have endured the havoc wrought by forest conversion since the XVI century (Dean, 1995; Coimbra-Filho and Câmara, 1996), which has had a profound effect on the non-human primates. The Atlantic forest has 19 endemic primates and many are threatened. Research and conservation efforts have helped to create conditions for their long term survival (e.g. Kierulff et al., 2012). The only endemic primate to the Caatinga dry forest is the blond titi monkey (*Callicebus barbarabrownae*), but little is known about this species and prospects for its long-term conservation are not good (Printes et al., 2011). Hershkovitz (1990), who described the species, considered it to be a subspecies of *Callicebus personatus*, but later taxonomic reviews suggested it should be a valid species (Kobayashi and Langguth, 1999; van Roosmalen et al., 2002).

The blond titi monkey (*Callicebus barbarabrownae)* is critically endangered according to the IUCN red list. The species' range is primarily the Caatinga dry forest (deciduous forest) of Northeast Brazil, and it is evidently restricted to the state of Bahia (Marinho-Filho and Veríssimo, 1997; Printes et al., 2011) although there are anecdotal reports of its occurrence in Sergipe state (Freitas et al., 2011). Present-day populations of blond titi monkeys seem to be restricted to forest fragments and, despite their cryptic and shy habits (Dacier et al., 2011), they are hunted (Souza et al., 2008; Printes et al., 2011). Hunting is a driver of extinction in fragmented landscapes (Chiarello, 1999; Chapman and Peres, 2001; Michalski and Peres, 2005; Harrison, 2011). Non-human primates have been observed to change their behavior to avoid hunters, being more cryptic, fleeing in silence or avoiding areas used by humans (Bshary, 2001). Marinho-Filho and Veríssimo (1997) report blond titi monkeys fleeing when there were people in proximity and avoiding areas where human presence was frequent. Although local or complete extinction is a constant threat, titi monkeys can survive in fragmented landscapes and in habitats with relatively high levels of disturbance (Heiduck, 2002; Michalski and Peres, 2005; Chagas and Ferrari, 2010). Their folivory (Heiduck, 1997; Palacios, 1997; Price and Piedade, 2001) and small home ranges are probably important factors for their survival in small degraded forest fragments.

Printes et al. (2011) surveyed various areas (over 353,000 km²) in Northeast Brazil and estimated the population of blond titi monkeys to be less than 260 individuals, based on records of 65 groups. They raised concern about the long-term survival of blond titi monkeys because of their small and isolated subpopulations restricted to small forest fragments. Although Printes et al. (2011) did not record groups of blond titi monkeys in protected areas, they found evidence of their presence in fragments of semi-deciduous Atlantic Forest (highland coastal forest) on the eastern border of Chapada Diamantina. The Chapada Diamantina, of more than 60,000 km², is an important biogeographic sub-region (Tabarelli et al., 2010a). However, there are just seven conservation units which protect about 6% of the total area of the region (Pereira 2010). Semi-deciduous forests cover most of the eastern border of the Chapada Diamantina and are the largest forested areas in the region, although suffering disturbance due to forest cutting and logging (Funch et al., 2008). The Marimbus-Iraquara Environmental Protection area is an important conservation unit (about 125,400 ha) protecting these forests. Although this area is important for the long-term conservation of blond titi monkeys, there is no data on their abundance and their habitat preferences. Printes et al. (2011) elicited a response to playback calls from a group of *C. barbarabrownae* in a nearby area, but they were unable to estimate the number of groups. The aim of this study was to obtain data on the abundance of the blond titi monkey in the Chapada Diamantina and to evaluate if human presence affecting their occurrence there.

Methods

The study was carried out in the southern part of the Marimbus-Iraquara Environmental Protection area, Bahia state, NE Brazil (Fig 1), in the forest of the farms Marimbús and Bonito. The presence of human settlements is allowed (IUCN Category V) in this area. Annual rainfall is around 1,300 mm (Funch et al., 2002).

Surveys were carried out along eight trails (Fig. 1 and Table 1). Four (Grotão, Ntrail, W2 and Remanso farm) were cut exclusively for the censuses. One trail (Lençóis River) followed the gallery forest up the Lençóis River; the beginning of the trail was about 2 km from the town of Lençóis. Near to the river, there were some occasions when the water level was high due to heavy rains and only part of the trail could be surveyed. Only seven surveys were carried out as a consequence. The Grotão trail was cut in the evergreen forest found in ravines where moisture is high. Only a few censuses were carried out along this trail because access difficult and dangerous (along 2 km along a road), the path to the ravine was slippery, and we were informed that it was a breeding ground of *Bothrops* a venomous Brazilian pit viper.

We followed the standard procedures for the line transect census (Peres, 1999; Buckland et al., 2001). Censuses were carried out in the morning (from 06:00 h) and in the afternoon (from 14:00 h); the walking speed was about 1 km/h. Two observers (Moura and Corsini) surveyed the trails (Table I, Fig. 1) from June 2008 to May 2010. The total distance walked was 152.56 km. Our sampling effort was significantly higher (one sample *t* test, $t= 2.27$; $df= 9$; $p = 0.49$) compared to surveys of other closely related species of titis in the Atlantic forest (full list in Corsini 2010).
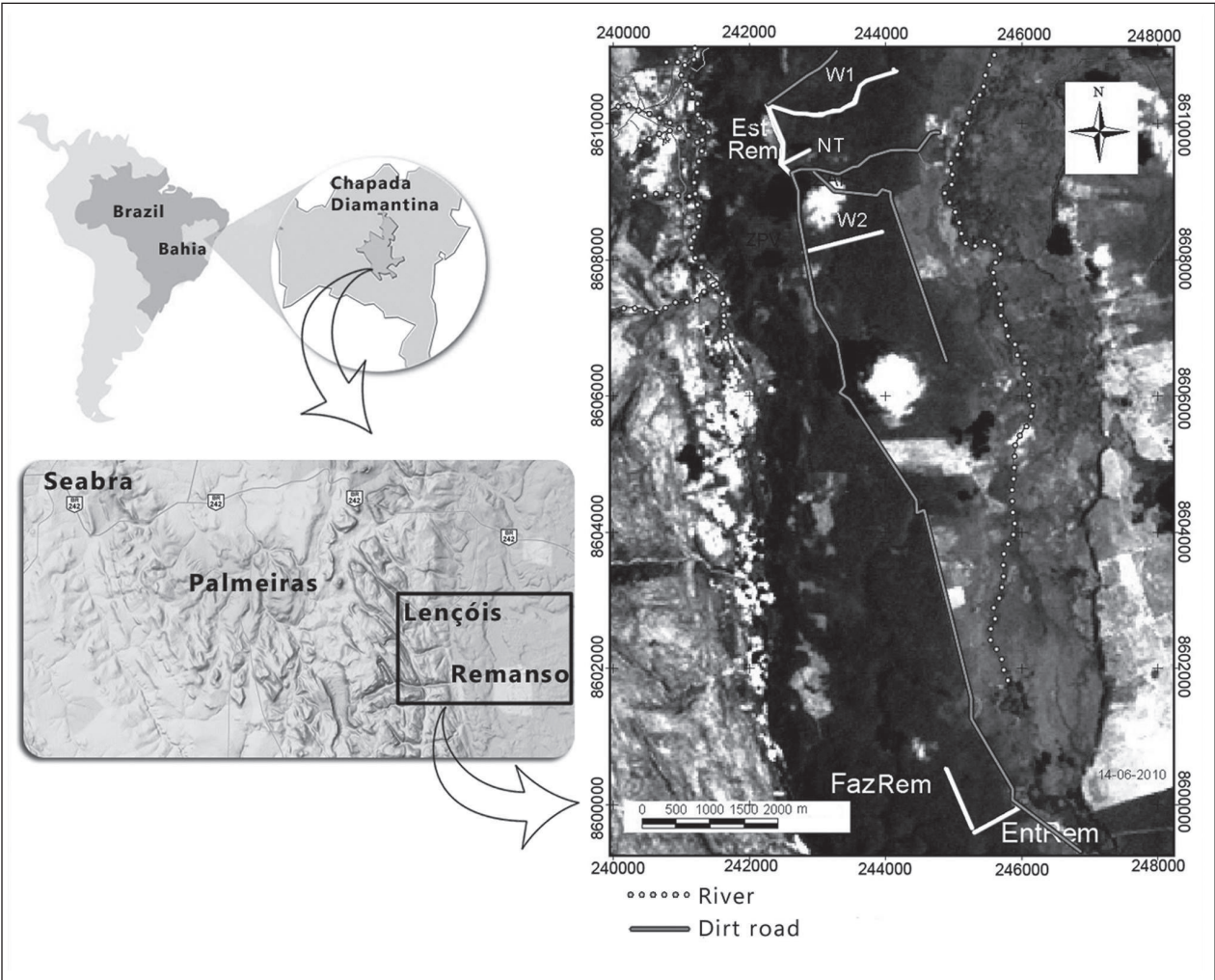
Figure 1. Location of the Chapada Diamantina region in Bahia state and the trails surveyed in the Marimbus-Iraquara protection area. Note that most of the forest near the São Jose River on the eastern side, have already been converted.

Table 1. Details of the trails surveyed and type of vegetation.

Transect	Length (km)	Vegetation type	Level human presence
Lençóis River	4	Gallery forest	Low
Grotão	0.5	Evergreen forest	Low
W1	2.05	Semi-deciduous forest (trail used by local population)	High
N trail	0.5	Semi-deciduous forest	Low
W2	1.25	Semi-deciduous forest	Low
Remanso road (Est Rem)	1.12	Semi-deciduous forest (edge forest bordering the dirt road)	High
Entrance of Remanso (Ent Rem)	0.8	Semi-deciduous forest (edge forest)	High
Remanso Farm (Faz Rem)	1.12	Semi-deciduous forest	Low

C. Corsini did about 35% of the censuses. When surveying the trail she was accompanied by a guide that followed her at a distance of about 10 m and in silence. We did not do censuses on the return walk.

We classified the trails according to the frequency of human presence and use as a shortcut by locals: a) trails with low human presence - less than four people encountered during all the census and no observable use of the trail; b) heavy human presence - encounters with humans occurred four or more times over the study and the trail was being used as shortcut. We also recorded encounters with hunters/dogs, signs of recent logging, and observed logging. We recorded group calls, which is a more effective method of detection given the cryptic and shy habits of titi monkeys in general (e.g. Aldrich et al., 2008; Dacier et al., 2011). We used sighting rates (groups/10 km walked) and calling rates (groups calling/ 10 km walked) to estimate titi monkeys abundance.

Results

Blond titi monkeys were scarce: 0.19 groups/10 km walked. We observed groups just three times (Table II). Average group size was 3.3 individuals (range = 3-4) and group spread was visually estimated at 10 m. All individuals were seen at a height of above 10 m. On 27th September 2008 an infant was observed on the back of an adult. During the censuses we encountered hunters (with guns) on eight occasions and by chance A.C.A. Moura saw a hunter carrying a dead titi monkey near Lençóis.

The number of groups registered calling (n=13, abundance of 0.85 groups/10 km, Table II) was higher than those seen. Groups were heard more often in areas where human presence was low; 1.18 groups heard/10 km walked (values based on km walked on the trails W2, Grotão, Ntrail, Lençóis River and Remanso Farm). Blond titi monkeys apparently were sensitive to human presence and activities along the trails, and abundance was low (0.68 groups heard/10 km) (W1, Remanso road and entrance Remanso). We heard and saw blond titi monkeys only in the morning; all calls were heard between 06:30 h and 10:00 h.

Discussion

The estimated abundance of blond titi monkeys in the Chapada Diamantina is lower than those of closely related species from other sites in the Atlantic forest (Corsini, 2010). Our results indicate that group calls are a more effective way to detect titi monkeys than visual encounters (see Dacier et al., 2011). However, even when using calling rate the abundance is still low. Chiarello (1999) reports an abundance of 1.66 groups/10 km in the closely related *Callicebus personatus* in a larger fragment (> 20,000 ha) of Atlantic forest which is heavily hunted. Although locals hunt monkeys and other mammals intensively throughout the area we studied, the reasons for the lower abundance of titi monkeys in our site in relation to others are yet unclear. Some studies indicate that hunting pressure and habitat loss probably lead to low densities and declines of blond titi monkeys populations throughout their range (e.g. de Freitas et al., 2011; Printes et al., 2011), but in these studies groups were found in small forest fragments.

The blond titi monkeys showed a preference for the more structured and taller forest that occurs in areas with a higher availability of water in the soil. For example, along W1 trail the forest became taller (>15 m) after the first 0.7 km, and titi monkeys were heard only after this point. We also noticed the same pattern in W2 trail and in the Remanso Farm trail, the calls of the two groups heard come from an area with more water availability. Interestingly, a group of titi monkeys was observed and heard a couple of times in the trail with the highest disturbance level (logging, vehicles and people activity), but they were found only in the area with a taller and more humid forest. These results indicate that forest condition could be a more important factor for determining titi monkey distribution than avoidance or fear of humans. The closely related *Callicebus coimbrai* and *Callicebus melanochir* prefer undisturbed forest (Heiduck, 2002; Chagas and Ferrari, 2010), which usually have higher tree diversity and probably more resources (Tabarelli et al., 2010b). It is possible that titi monkeys have a preference for habitats along rivers, where forest could be taller, with more tree species and with a more complex structure. Ferrari et al. (2007) observed that *Callicebus moloch* in Amazonia forest was absent in three sites of terra firma forest in the Tocantins-Xingu interfluvium, but they were common in sites along the Tocantins River. The authors suggested that *Callicebus moloch* may prefer riparian habitats.

We did not record blond titi monkeys along the gallery forest of Lençóis river. This was probably due to heavy hunting and low sampling effort. However, during a brief survey (about 10 km walked) in the Toalhas area about 30 km north from our main study site, the locals reported blond titi monkeys as extremely common, and larger areas of gallery forest are common there. Although Toalhas is situated in the Chapada Diamantina National Park, there are illegal human settlements in the area. When talking with locals elsewhere, we were informed that titi monkeys were common in forests along rivers and in wetter areas. The gallery forest has the highest diversity of trees among the different forests occurring in the Chapada Diamantina (Funch et al., 2008). It is possible that a high availability of resources in these areas could have a positive effect on the abundance of blond titi monkeys. Although speculative, the hypothesis that blond titi monkeys would prefer wetter

Table 2. Groups of blond titi monkeys sighted and heard during the census. Trails with two groups heard, the groups were heard at the same time, in the W1 trail this happened just once and both groups were included in analyses.

Trail	# Groups sighted	# Groups heard	Sampling effort (km)
Lençóis River			13.8
Grotão		2	1
W1		5	61.9
Ntrail		1	2.5
W2		1	21.75
Remanso road (Est Rem)	3	2	28.8
Entrance Remanso (Ent Rem)			11.2
Remanso farm (Faz Rem)		2	11.61

areas with taller and more diverse forest deserver further investigation.

Hunting, habitat fragmentation and human disturbance, such as fires and logging, increase extinction risk for the blond titi monkey (Harrison, 2011; Printes et al., 2011). We surveyed a relatively large forest (about 3,850 ha), but it is criss-crossed by hunter trails and dirt roads, and the removal of timber is frequent. The long-term survival of the species may depend on increasing the number and the area of conservation units as suggested by Printes et al. (2011) and notably on increasing conservation awareness in the local human populations. Although the abundance we observed in the Marimbus-Iraquara Protection area was low, this area should be considered as priority for conservation measures because it has larger forested areas and with an effective protection this area could be a long term survival guarantee for blond titi monkeys.

Acknowledgements

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EMERGENCE OF SEX-SEGREGATED BEHAVIOR AND ASSOCIATION PATTERNS IN JUVENILE SPIDER MONKEYS

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Abstract

Sex-segregation occurs in a number of mammals, and is typically attributed to differences in body size, reproductive energetics, or social roles. Although most primates remain in cohesive groups, spider monkeys exhibit fission-fusion dynamics and sex-segregated association patterns. Here, I present results on sex differences in behavior and subgrouping in juvenile spider monkeys. I found that the monkeys exhibit several aspects of sex-differentiated behavioral and grouping patterns that emerge despite the fact that both sexes ranged with their mothers. I conclude that juvenile spider monkeys exhibit sex-segregated behavior and association patterns earlier than previously reported for this species. Because the hypotheses regarding body size dimorphism and reproductive energetics do not apply to these juveniles, I attribute these differences to social roles.

Key Words: *Ateles,* juveniles, fission-fusion, social behavior, social play, sex-segregation

Resumen

La segregación por sexo ocurre en un número de mamíferos y es típicamente atribuida a diferencias en tamaño corporal, aspectos energéticos de la reproducción, o roles sociales. Aunque la mayoría de primates permanecen en grupos cohesivos, los monos araña exhiben dinámicas de fisión-fusión y patrones de asociación por segregación de sexos. Aquí presento resultados de diferencias de comportamiento por sexos y formación de subgrupos en monos araña juveniles. Encontré que los monos araña exhiben varios aspectos comportamentales y patrones de agrupamiento diferenciados por sexo que emergen a pesar del hecho de que ambos sexos se desplazaban con sus madres. Concluyo que los monos araña juveniles exhiben un comportamiento segregado por el sexo y patrones de asociación más tempranos que los previamente reportados para esta especie. Debido a que la hipótesis del dimorfismo por tamaño corporal y la energética de la reproducción no aplica a estos juveniles, atribuyo estas diferencias a los roles sociales.

Palabras Clave: *Ateles***,** juveniles**,** fisión-fusión, comportamiento social, juego social, segregación por sexo

Introduction

Sex segregation occurs in a number of vertebrates, and is associated with divergence in body size, social roles, reproductive energetics, or dispersal patterns (Conradt, 1999; Main, Weckerly, & Bleich, 1996; Sterck, Watts, & van Schaik, 1997)adults tend to form single-sex groups ('social segregation'. Unlike other mammals, sex segregation is rare in primates (Aureli et al., 2008; Chapman, Chapman, & Wrangham, 1995; Watts, 2005). Patterns of sexual segregation in spider monkeys are attributed to a combination of social and energetic factors. Males engage in social behaviors that optimize access to mating opportunities, including coalition building, achieving dominance, and territorial behavior, whereas females increased foraging efforts while remaining in core areas to protect offspring and reduce travel costs (Wrangham, 1980; Chapman et al., 1995; Watts, 2005).

The divergent spatial structure of spider monkey populations may pose several cognitive and social challenges to individual animals (Aureli et al., 2008; Barrett, 2003), which are likely intensified for immatures. Whereas juveniles in cohesive groups may have several opportunities to interact, in dispersed groups they may be constrained by maternal behavior (i.e., ranging and grouping patterns). Given that males and females face different social challenges as adults (Trivers, 1972; Wrangham, 1980), preparation for these challenges during the juvenile period may be important, especially if early preparation increases adult fitness. Preparation may include sex segregation during this life stage. In chimpanzees, immature males socialize with a wider variety of conspecifics, whereas immature females concentrate social interactions with their mothers, and develop social and foraging patterns that reflect these associations (Pusey, 1983, 1990). Vick (2008) reports similar social patterns for immature spider monkeys. However, these trends

are significant only when including subadults, or when specifically comparing the oldest juveniles and subadults (ages 42-60 months). Thus, it is unclear whether differences remain when only considering juveniles (ages 15-50 months –[age criteria following Van Roosmalen and Klein, 1988]).

In this study I describe the juvenile social structure of a wild population of black-handed spider monkeys (*Ateles geoffroyi*) in Costa Rican lowland rainforest. Because adults face differential energetic and social constraints, I predict female juveniles will spend more time foraging to gain ecological competence, whereas males will spend more time socializing to gain social skills. Based on the hypothesis that juvenile social behavior prepares for adult social roles, I predict that juveniles will exhibit the sex-typical patterns of social behavior reported for adults, but exhibit similar subgrouping patterns.

Methods

I conducted behavioral observations from 23 December 2005 - 5 January 2006, and from 12 May 2006 - 2 August 2006 at El Zota Biological Field Station in Costa Rica. El Zota is situated in the northeast of the country at 10°57.6 N, 83°75.9'W (Lindshield & Rodrigues, 2009; Pruetz & LaDuke, 2001)including both New and Old World monkeys. However, such reports mainly address the most prodigious tool users and frequently limit discussions of tool-using behavior to a foraging framework. Here, we present observations of novel and spontaneous tool use in wild black-handed spider monkeys (Ateles geoffroyi. This area receives approximately 4000 mm of rainfall annually and exhibits mild seasonality. Research was conducted on the Pilón group, the best-habituated of two *A. geoffroyi* populations at El Zota (Rodrigues, 2007). This population (n = 30) ranges through the southeastern portion of the property, in an area composed of secondary and swamp forest, gallery forest, and plantation (Lindshield, 2006).

Observations were made on eight juveniles, defined as individuals approximately 15-50 months old who travel independently of the mother but remain in close contact and range with her (Van Roosmalen and Klein, 1988). There were two J-1 females, two J-1 males, one J-2 female, two J-2 males, and one J-3 female. The sex of juveniles is easily distinguished by the pendulous clitoris of the females, and age was assessed visually based on Roosmalen and Klein's (1988) criteria. Focal subjects were individually identified on the basis of external characteristics, including body size, sex, facial features, and pelage.

Data collection
Two-minute instantaneous focal sampling was used to collect data on focal individuals (Altmann, 1974). Due to loss of contact with focal subjects, focal observation length varied (48.8 ±52.0 min). All individuals were observed between 0530 and 1,830 h, with 53.9% of focal

data collected in the morning and 48.1% collected in the afternoon. The following data were collected from each individual: 1) identity and activity of focal animal, 2) identity of all visible party members, 3) initiator/recipients of social interaction, and 4) type of social interaction. Activities included travel, rest, feed/forage, social interactions, and "other" behaviors (object manipulation, tool use, solitary play). Social interactions were classified into affiliative behaviors (huddle, embrace, touch, groom, play, whinny, nurse, cling, or bridge) and agonistic behaviors (avoid, displace, chase, harass, display, fight, weaning rejection, or distress vocalization). Following Ramos-Fernández (2005), party was defined as a group of individuals which associated with each other and remained within 30 meters of one another. Party sizes were calculated using individually locomoting individuals (ILI), in which dependent infants are not counted as separate individuals (Weghorst, 2007).

Data Analysis
A total of 74.5 hours of instantaneous focal data were collected (males: 36.3 hours; females: 38.20; mean±SE: 8.06±2.48 hours) and I collected all-occurrence data of focal social behavior during each focal sample (Altmann, 1974). Behaviors that were typically brief, including maternal care (nurse, cling, bridge), agonism, and whinny are reported as events/hour, and behavioral states that occurred for variable durations of time, including groom, huddle, and play, are reported as minutes/hour. Although maternal care behaviors such as nurse and cling were occasionally longer in duration and could be considered states, they were typically brief and thus treated as events. Time spent in play (min/hr) between same- and opposite-sex play partners was corrected for time spent in parties with potential partners and analyzed using Wilcoxon signed-rank tests. Activity budgets were compared using chi-square tests. All other behavioral data were compared using Mann-Whitney U tests, and statistics were run in SPSS statistical software (SPSS Inc., Chicago, IL, USA). Significance threshold was set at α = 0.05. All test results are reported as mean ± SE, with N=8 and two-tailed p-values. Following the suggestions of Nakagawa (2004), effect size *(r)* and 95% confidence intervals (C.I.) are presented for the Mann-Whitney and Wilcoxon tests. All activity variables are presented as percentage of total behavior (mean ±SE).

Results

Activity budgets
Male and female engaged in comparable amounts of each activity category (χ^2=8.0, p=0.333, df=7, for all activity categories).

Social behaviors
Social behavior consisted predominantly of play, grooming, huddling, and whinnying (Fig. 1). Male and female juveniles did not differ in grooming (females: 2.34±0.49 min/hr; males: 1.01±0.63 min/hr; U=3.00, p=0.146, *r*=-0.182, C.I.= -0.786 ± 0.600) or huddling (females:
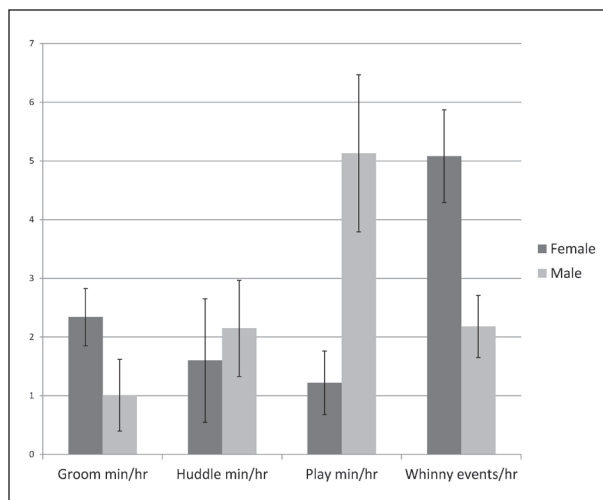
Figure 1. Sex differences in social behaviors for female and male juvenile spider monkeys.
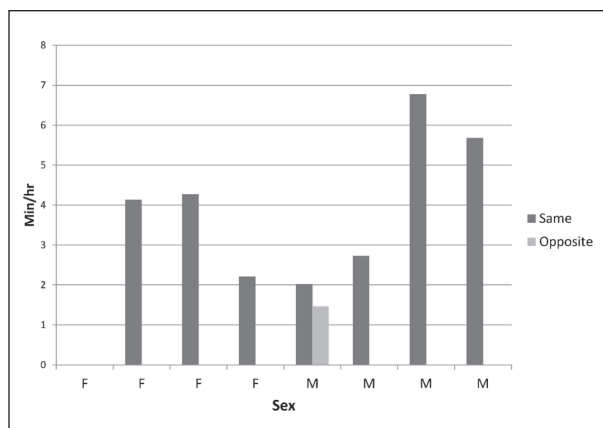
Figure 2. Same vs. opposite sex play partners for female (F) and male (M) juvenile spider monkeys.

1.60±1.05 min/hr; males: 2.15±0.82; U=12.00, p=0.248, r=0.144, C.I.= -0.624±0.770) rates. Males however tended to play more often than females (females: 1.22±0.54 min/hr; males: 5.13±1.34 min/hr; U=14.00, p=0.083, r=0.217, C.I.= -0.576± 0.799). Females whinnied more than males (females: 5.08±0.79 events/hr, males: 2.18±0.53 events/hr), and this difference was significant (U=-0.00, p=0.026, r=0.289, C.I.= -0.522± 0.825).

Juvenile males and females did not differ in their total amount of grooming. However, only the juvenile females groomed other conspecifics (females: 0.22±0.11 min/hr; males: 0.00±0.00), and this difference was significant (U=2.00, p=0.047, r=-0.248, C.I.=-0.811± 0.553). Juvenile females received more grooming than juvenile males, but this difference was not significant (females: 1.04±0.19 min/hr; males: 0.50±0.31; U=4.00, p=0.245, r=0.109, -0.6453± 0.756). Focal subjects played with juveniles of the same sex significantly more than juveniles of the opposite sex (W=0.00, p=0.018, r=-0.300, C.I.= -0.829± 0.513; Fig. 2).

Maternal Care
No difference in maternal care was observed (females: 1.54±0.75 events/hr; males=2.31±1.69 events/hr; U=-9.00, p=0.773; r=0.036, C.I.= -0.686± 0.7224). Younger juveniles (J-1: 3.46±1.39) received more maternal care than older juveniles (J-2 and J-3: 0.38±0.10), and this difference was significant (U=0.00, p=0.021, r=-0.289, C.I.= -0.522± 0.825).

Party Size and Composition
Juvenile males were in larger parties than juvenile females (females: 2.70± 0.43 ILI; males: 3.83±0.97 ILI; U=16.00, p=0.021, r=0.288, C.I.= -0.522± 0.825). Individuals of both sexes spent the majority of their time in parties with their mother (females=100.00±0.00%; males=98.25±01.75%). Moreover, juvenile males exhibited a non-significant trend spending more time in parties containing adult males (females=4.03±2.57%; males=26.47±9.44%; U=14.000, p=0.083; r=0.212, C.I.= -0.573± 0.801).

Discussion

My findings suggest that juvenile spider monkeys exhibit sex-segregation in some, but not all behavioral patterns. Juvenile males and females did not differ in activity patterns. Males tend to play more, whereas females whinnied more frequently. Although juvenile males and females engaged in comparable amounts of overall grooming, only females reciprocated this behavior. Both males and females played predominantly with same-sex play partners. Although juvenile individuals of both sexes spent most of their time in parties with their mother, juvenile males were in larger parties, and tended to be in parties with adult males more frequently. Together, these patterns suggest that sex-segregated patterns of behavior and association are initiated during the juvenile stage, despite any ranging limitations imposed upon by their mothers.

My findings provide additional support for Vick's (2008) conclusions that sex differences in spider monkey behavior emerge during juvenility. However, in Vick's (2008) study, some differences only appeared after 42 months of age. Given that all male juveniles in my study were under 36 months, these results suggest that some sex differences may emerge at earlier ages than previously documented. Patterns observed in both studies suggest that juvenile females have limited social opportunities compared to juvenile males, as is reported for other male-philopatric, fission-fusion species, including other Atelines (Stevenson, 1998; Strier, 2002), as well as chimpanzees (Pusey, 1983, 1990), and bottlenose dolphins (Gibson & Mann, 2008).

The sex differences observed here are in line with the findings of other studies of primate behavior (e.g. squirrel monkeys: Biben, 1986; rhesus macaques: Hassett, Rupp, & Wallen, 2010ranging from complete separation of habitats to social segregation within the same space, sometimes varying across seasons and lifespan development. Mechanisms

for such segregation are not well understood, though some have suggested that sex differences in preferred juvenile behaviors lead to greater behavioral compatibility within than between sexes. This within-sex behavioral compatibility may be the source of sex-segregation. As juvenile behavioral sex differences are well-documented in rhesus monkeys, we examined sex-segregation patterns of yearling rhesus monkeys engaged in three different types of behavior: rough play, parallel play, and grooming. We observed male and female rhesus yearlings from five stable long-term age-graded social groups of 67-183 animals. Behavioral observations were designed to collect equal numbers of rough play, grooming, and parallel play bouts. In addition, sex composition and proximity to adults was recorded for each bout. Across all behaviors, more all-male groups and fewer mixed sex-groups were observed than expected by chance. All-female groups occurred at the level expected by chance. Thus, males sex-segregated regardless of type of behavior, while females did not sex-segregate. Female groups were observed in proximity to adults more often than expected by chance. These results suggest that behavioral compatibility may produce sex-segregation in male yearling rhesus monkeys, possibly preparing males and females for different social roles and segregation as adults.", "author" : [{ "dropping-particle" : "", "family" : "Hassett", "given" : "Janice M", "non-dropping-particle" : "", "parse-names" : false, "suffix" : "" }, { "dropping-particle" : "", "family" : "Rupp", "given" : "Heather a", "non-dropping-particle" : "", "parse-names" : false, "suffix" : "" }, { "dropping-particle" : "", "family" : "Wallen", "given" : "Kim", "non-dropping-particle" : "", "parse-names" : false, "suffix" : "" }], "container-title" : "American journal of primatology", "id" : "ITEM-1", "issue" : "2", "issued" : { "date-parts" : [["2010", "2"]] }, "page" : "87-92", "title" : "Social segregation in male, but not female yearling rhesus macaques (Macaca mulatta; stump-tailed macaques: Lee, Mayagoitia, Mondragón-Ceballos, & Chiappa, 2010; long-tailed macaques: van Noordwijk, Hemelrijk, Herremans, & Sterck, 2002; chimpanzees: Lonsdorf et al., 2014; Murray et al., 2014; Pusey, 1983; humans: Pellegrini, 2004). For example, in my study, only juvenile females ever groomed other conspecifics, and these females had stronger grooming relationships with their mothers than juvenile males did. Grooming is the predominant form of affiliative social behavior within the primate order (Henzi & Barrett, 1999; Seyfarth, 1977), and in the majority of species females groom more frequently than males (Mitchell & Tokunaga, 1976). Additionally, in stump-tailed macaque, juveniles females groom mothers at an early age than males (Lee et al., 2010), and in chimpanzees, juvenile females maintain stronger spatial relationships with mothers than males (Pusey, 1983). Similar to the juveniles in this study, adult females spider monkeys typically use whinny vocalizations more often than males (Fedigan and Baxter 1984). Finally, sex segregation in play is one of the most common patterns in juvenile mammals (Roney & Maestripieri, 2003). Both sexes in this study concentrated their play patterns predominantly with same-sex peers. This is consistent with the sex-segregated

play patterns in other primates, including humans, macaques, and squirrel monkeys (Biben, 1986; Hassett et al., 2010; Pellegrini, 2004; van Noordwijk et al. 2002)"title" : "Spatial position and behavioral sex differences in juvenile long-tailed macaques", "type" : "chapter" }, "uris" : ["http://www.mendeley.com/documents/?uuid=3d233815-2ace-4cd0-8a3a-f27ca46b385d"] }, { "id" : "ITEM-3", "itemData" : { "DOI" : "10.1016/j.anbehav.2003.07.023", "ISSN" : "00033472", "author" : [{ "dropping-particle" : "", "family" : "Pellegrini", "given" : "AD", "non-dropping-particle" : "", "parse-names" : false, "suffix" : "" }], "container-title" : "Animal Behaviour", "id" : "ITEM-3", "issue" : "3", "issued" : { "date-parts" : [["2004", "9"]] }, "page" : "435-443", "title" : "Sexual segregation in childhood: a review of evidence for two hypotheses", "type" : "article-journal", "volume" : "68" }, "uris" : ["http://www.mendeley.com/documents/?uuid=5e432275-b795-46dd-a645-3e02a4f234a3"] }, { "id" : "ITEM-4", "itemData" : { "DOI" : "10.1002/ajp.20756", "ISSN" : "1098-2345", "PMID" : "19827140", "abstract" : "Males and females of many species sex-segregate, ranging from complete separation of habitats to social segregation within the same space, sometimes varying across seasons and lifespan development. Mechanisms for such segregation are not well understood, though some have suggested that sex differences in preferred juvenile behaviors lead to greater behavioral compatibility within than between sexes. This within-sex behavioral compatibility may be the source of sex-segregation. As juvenile behavioral sex differences are well-documented in rhesus monkeys, we examined sex-segregation patterns of yearling rhesus monkeys engaged in three different types of behavior: rough play, parallel play, and grooming. We observed male and female rhesus yearlings from five stable long-term age-graded social groups of 67-183 animals. Behavioral observations were designed to collect equal numbers of rough play, grooming, and parallel play bouts. In addition, sex composition and proximity to adults was recorded for each bout. Across all behaviors, more all-male groups and fewer mixed sex-groups were observed than expected by chance. All-female groups occurred at the level expected by chance. Thus, males sex-segregated regardless of type of behavior, while females did not sex-segregate. Female groups were observed in proximity to adults more often than expected by chance. These results suggest that behavioral compatibility may produce sex-segregation in male yearling rhesus monkeys, possibly preparing males and females for different social roles and segregation as adults.", "author" : [{ "dropping-particle" : "", "family" : "Hassett", "given" : "Janice M", "non-dropping-particle" : "", "parse-names" : false, "suffix" : "" }, { "dropping-particle" : "", "family" : "Rupp", "given" : "Heather a", "non-dropping-particle" : "", "parse-names" : false, "suffix" : "" }, { "dropping-particle" : "", "family" : "Wallen", "given" : "Kim", "non-dropping-particle" : "", "parse-names" : false, "suffix" : "" }], "container-title" : "American journal of primatology", "id" : "ITEM-4", "issue" : "2", "issued" : { "date-parts" : [["2010", "2"]] }, "page" : "87-92", "title" :

"Social segregation in male, but not female yearling rhesus macaques (Macaca mulatta.

In dispersed social structures, proximity and subgrouping patterns can provide valuable insight into social dynamics. Although sex differences in subgrouping patterns are explained through ecological and social factors (Chapman et al., 1995; Fedigan & Baxter, 1984; Wrangham, 1980), most of these factors should affect juvenile males and females similarly. Juvenile *A. geoffroyi* of both sexes have similar body sizes and growth rates (Corner & Richtsmeier, 1993). Thus an energetics-based explanation cannot account for the observed differences in juvenile behaviors. The availability of playmates (Lehmann & Boesch, 2005), and greater social opportunities (Otali & Gilchrist, 2005) for offspring, may entice mothers with juveniles to range in larger subgroups when ecological conditions permit. For male-philopatric species, these benefits are likely greater for male offspring who will remain in the community and maintain those relationships throughout life. Several mechanisms may account for the larger subgroup size of juvenile males and higher rates of grouping with adult males: 1) mothers may make subgrouping decisions to provide their male offspring with greater social opportunities, 2) other conspecifics, particularly adult males, may be more attracted to parties with juvenile males, or 3) juvenile males themselves may influence maternal subgrouping choices (e.g., Pusey 1983). More research is necessary to evaluate the relevance of these mechanisms for explaining the complex social dynamics of spider monkey populations.

The results of my study support van Noordwijk's (2002) assertion that the emergence of sex-typical behaviors occurs before these differences can be explained by immediate social or nutritional needs. While juvenile males' choice of play partners may the beginning of forming life-long bonds, juvenile females' engagement with female peers is more difficult to explain in the context of female dispersal. In spider monkeys communities, it is possible that young females may emigrate as a cohort, or encounter émigrés from their natal community after dispersal. While this phenomenon has not been documented in spider monkeys, immigration with a close peer or sibling has been reported in species characterized by male dispersal, such as squirrel monkeys (Mitchell, 1994), lemurs (Sussman, 1991), and macaques (Meikle & Vessey, 1981). Furthermore, play interactions as a juvenile may be important for learning how to negotiate amiable relationships with other females while integrating into a new social group. This may be one explanation for why female spider monkeys continue to engage in play during adulthood (Fedigan & Baxter, 1984; Pellis & Iwaniuk, 2000).

Overall, these patterns indicate that juvenile spider monkeys begin certain aspects of sex-segregated behavior earlier than previously reported. Given that they maintain equivalent body sizes through juvenility and forage at similar rates, these differences are best attributed to preparation for social roles in adulthood. However, further study is needed to determine if there are any sex differences in diet or foraging strategies, and more research is need on immigration and play patterns in adult females.

Acknowledgements

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Short Articles

TWINNING IN TITIS (*CALLICEBUS COIMBRAI*): STRETCHING THE LIMITS OF BIPARENTAL INFANT CAREGIVING?

Marina M. de Santana
João Pedro Souza-Alves
Stephen F. Ferrari

Introduction

Twinning occurs rarely in all anthropoid primates except for the marmosets and tamarins (Callitrichidae). While twin births are the norm in callitrichids, there are only a few recorded cases of twinning from field studies of other platyrrhines, such as *Alouatta* (Chapman and Chapman, 1986; Crockett and Rudran, 1987; Bicca-Marques and Calegaro-Marques, 1994), *Aotus azarae* (Huck et al., 2014), *Aotus vociferans* (Aquino et al. 1990), *Ateles belzebuth* (Link et al. 2006), and *Brachyteles hypoxanthus* (Strier, 1991).

In titis (*Callicebus*), only two twin births have been recorded in the wild (Knogge and Heymann, 1995; Lawrence, 2007). In captivity, Valeggia et al. (1999) recorded two twin births in a total of 148 events involving 32 females in a colony of *Callicebus moloch*, which is roughly equivalent to the typical twinning rate in anthropoids. In all these cases, however, one of the titi infants died or disappeared within six months of the birth. The present study reports on the events following a twin birth in a free-ranging group of *Callicebus coimbrai* in eastern Sergipe, Brazil. Only one twin survived to weaning, the typical pattern in titis, suggesting that the energetic constraints of infant carrying in these platyrrhines may limit the potential for the survival of twins in this species.

Methods

The records presented here were obtained through the systematic monitoring of a well-habituated *Callicebus coimbrai* study group between May, 2011, and March, 2013 at the Mata do Junco State Wildlife Refuge (10°32'00" S, 37°03'00" W) in the municipality of Capela. At the beginning of the study period, the group contained six members, including a breeding pair, one supernumerary adult, two subadults, and a juvenile of approximately one year of age. Following an initial period of habituation, the group was monitored continuously on four or five consecutive days each month between July 2011 and June 2012, and on most months between July 2012 and March 2013. In addition to scan sampling for the collection of basic behavioral data (Santana, 2012; Souza-Alves, 2013), important events such as social interactions were recorded in all-events fashion (Altmann, 1974).

Results

In the first month of habituation (May, 2011), the breeding pair was observed copulating on one occasion, during an interaction that lasted approximately five seconds. During subsequent months, the nonbreeding adult spent long periods in a peripheral position in relation to the study group, and usually only appeared in the vicinity of the other group members when retiring to a sleeping site together. From November onwards, this individual had apparently dispersed from the study group, and was sighted only occasionally during monitoring. On November 22nd, 2011 (mid dry season), the first observation day in this month, the male member of the breeding pair was observed carrying two infants that appeared to be only a few days old. During the subsequent monitoring period (five days), the male carried the infants continually except when they were nursing, when the female carried them, and during two rest periods, when the juvenile was observed with the infants on its back. During subsequent months, the male was invariably observed carrying both infants on its back, except when they were nursing.

On the first day of monitoring in the early rainy season month of April 2012 (April 9th), only one infant was observed being carried by the adult male. The second twin was never seen again. Considering that the infants appeared to be a few days old when first observed on November 22nd, 2011, the individual that disappeared between March 9th (the final day of monitoring in this month) and April 9th would have been between four and five months old, just a little over halfway through the weaning period (Souza-Alves, 2013). The surviving twin was still alive and present in the study group in February 2014 (M. A. Santos, pers. comm.). The cause of the infant's disappearance remains unclear, although the male was observed dropping one of the infants, which fell to the ground, on two occasions, once in January and once in February (R. R. D. Chagas, pers. comm.). A common marmoset (*Callithrix jacchus*) was attacked and killed by a viper (*Bothrops leucurus*) on the ground within the home range of the titi group during the study period (Ferrari and Beltrão-Mendes, 2011), and snakes appear to be relatively common within this area (pers. obs.), although any inference on the possibility of a snake attack would be no more than speculation.

Discussion

Twinning in the callitrichids may have evolved in the context of cooperative care-giving behavior (Dunbar, 1988). Ross (1991) concluded that this shift in reproductive output was mediated by a reduction in the relative size of the neonate, which has not occurred in titis. An additional factor here is that, whereas callitrichid groups typically contain multiple caregivers, which may contribute significantly to reproductive success (Goldizen, 1987; Snowdon, 1996; Heymann, 2000), infant carrying in titis is normally the sole responsibility of the father (Wright, 2013). Assuming

that this behavior has evolved in response to the energetic demands of reproduction on the female in these small monkeys, or alternatively, as a strategy to maintain a comparatively short birth interval (Garber and Leigh, 1997), the double burden of twins may be especially onerous for the father.

While the data are still scant, a pattern does appear to be emerging. In all three recorded cases in free-ranging titis, one of the infants disappeared within the first few months following the birth. In *C. cupreus*, the infant disappeared at 1–2 months of age (Knogge and Heymann, 1995), whereas in *C. brunneus*, the disappearance occurred at around five months (Lawrence, 2007), as in the present study. In all three cases, the remaining twin survived at least until weaning. In captivity, the two twin births observed in *C. moloch* each resulted in the loss of one of the infants shortly after birth (Valeggia et al., 1999). There is, however, one unusual case of an adoption in a *Callicebus nigritus* group (Cäsar and Young, 2008), where the breeding pair cared for, and raised two infants simultaneously, although rearing success may have been mediated by factors such as the different ages of the infants and the fact that only one of them was reared throughout the whole weaning period. A remarkably similar pattern has been recorded in Azara's owl monkey (*Aotus azarae*), a species similar to titis in body size (adult weight ca. 1 kg: Fernandez-Duque et al., 2013) and the caregiving behavior of the breeding male, which is the primary infant carrier. In the two recorded cases of twinning in a wild *A. azarae* population in northern Argentina (Huck et al., 2014), one of the infants disappeared from one set of twins at approximately three months of age, and from the other at five months. In each of these two cases, the remaining twin survived past weaning. In the much larger-bodied atelids (female body weights of over 5 kg: Rylands and Mittermeier, 2013), by contrast, the survival of both twins appears to be the norm, despite the fact that only the mother carries the infant in these species. Even so, rearing twins has high energetic costs for the mother, and retards growth and development in the infants (Chapman and Chapman, 1986; Link et al. 2006).

The sum of the evidence thus appears to indicate that energetic constraints on reproduction in the small-bodied monogamous platyrrhines (*Aotus* and *Callicebus*) limit the potential for the rearing of twin infants. This also reinforces the conclusion that twinning in the smaller-bodied callitrichids is mediated by a set of factors (Tardif, 1994), including the reduced size of the neonate and caregiving by nonbreeding group members (which in turn is mediated, in part, by the suppression of ovulation in subordinate adult females, in most cases: Digby et al., 2011). The social groups of the strictly monogamous titis and owl monkeys normally contain no supernumerary adults, and immature group members are rarely if ever seen carrying infants. In the present study, as in the other cases of both *Callicebus* and *Aotus*, the presence of twins in the group did not affect the caregiving behavior of the mother noticeably, in other words, the mother only took the infants to nurse them. In most cases one twin disappeared after a few months of life, rather than shortly after the birth, supporting the conclusion that the increasing energetic onus of infant-carrying on the father contributed to the eventual loss of one of the twins. This may imply a decreasing ability to retrieve fallen infants from the ground, for example, although there is no direct evidence for the cause of any disappearance. These conclusions also reinforce the importance of the contribution of supernumerary caregivers in the much smaller-bodied callitrichids to guarantee the survival of both twins.

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INFANTICIDES DURING PERIODS OF SOCIAL STABILITY: KINSHIP, RESUMPTION OF OVARIAN CYCLING, AND MATING ACCESS IN WHITE-FACED CAPUCHINS (*CEBUS CAPUCINUS*)

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Introduction

In non-human primates, most infanticide cases (85%) occur during periods of social instability when a change-over of the top-ranking male occurs (van Schaik, 2000). In contrast, infanticides during periods of social stability have only been reported for a few species (Valderrama *et al.*, 1990; Murray et al., 2007; Gibson et al., 2008). The sexually selected infanticide (SSI) hypothesis (Hrdy 1974, 1979), proposes that infanticide is a male reproductive strategy in that males adopting this strategy benefit by gaining mating access to females who resume ovarian cycling prematurely following the death of their unweaned offspring. According the SSI hypothesis, infanticide is a male reproductive strategy if: 1) the attacker is unrelated to the infant, 2) the mother's time to conception is shortened by the infant's death, and 3) the infanticidal male has an increased probability of siring the mother's future offspring. Though other hypotheses have been suggested to explain infanticide, most reported cases occur during or after periods of social instability and thus appear to fit the SSI hypothesis (Hrdy 1974, 1979; van Schaik, 2000).

In white-faced capuchins *(Cebus capucinus)*, infanticides are commonplace during periods of social upheaval resulting

from alpha male replacements (Fedigan, 2003; Perry *et al.*, 2012; Jack et al., 2014). Using a combination of behavioral, genetic, and hormone data, we examine whether the first confirmed infanticides during a socially stable period without immigrations or changes in the male dominance hierarchy fit the predictions of the SSI hypothesis.

Methods

The study took place from July 2008 to November 2009 in the Santa Rosa Sector of the Area de Conservación Guanacaste, in northwestern Costa Rica (see Fedigan and Jack, 2012 for full description of the field site). Both confirmed infanticides occurred during observation of GN group by VAMS. Adult and subadult group composition was stable during the entire study period (4 adult males, 4 subadult males, 10 adult females, 12 juveniles, and 3-4 infants). We recorded data on male dominance interactions and sociosexual interactions using *ad libitum* and 10-minute focal animal follows on all eight resident males (>623 hours of focal data; 2575 contact hours). *Ad libitum* behavioral data were collected at the time of each infanticide. While alpha male white-faced capuchins are easily recognizable, dominance relationships among subordinate males are difficult to discern because agonistic behaviors are rare (Schoof et al., 2014). Therefore, we used the Elo-rating method to complement qualitative assessments of dominance rank, including that of the infanticidal male (Neumann et al., 2011).

To identify maternal resumption of ovarian cycling from progesterone (P) and estradiol levels, we collected fecal samples from LV and RM once every three days, beginning immediately after the infanticide until each female was visibly pregnant (LV: Mar 17, 2009) or she disappeared/died (RM: May 19, 2009; see Carnegie et al., 2011 for detailed methods). We defined the periovulatory phase as the day of the fP (fecal Progesterone) rise ± 3 days (Schoof et al., 2014).

Using DNA extracted from infant tissue samples and adult fecal samples, we amplified nuclear DNA at 20 loci via PCR (Apm01, Ceb01, Ceb02, Ceb03, Ceb04, Ceb07, Ceb08, Ceb09, Ceb10, Ceb11, Ceb105, Ceb115, Ceb119, Ceb120, Ceb127, Ceb128, Ceb130, d3s1210, d7s794, pepl4; see Wikberg et al., 2014 for detailed methods). Infant sires were assigned in CERVUS (Marshall et al., 1998; Kalinowski et al., 2007) at the 0.95 confidence level, and we used ML-RELATE (Kalinowski et al., 2006) to calculate estimated relatedness values (*R*) and evaluate kin relationships among adults.

Results

Case 1 - HW: At 17:55 on 30 August 2008, when the monkeys normally settle down, VAMS noticed something fall to the ground where some females were vocalizing nearby. After approaching slowly, an infant was observed

Figure 1. Photograph of lethal wound observed on HW (photo by Valerie A.M. Schoof). This characteristic wound was also observed on RM08's corpse.

(HW, 69 days old) lying on the ground, still breathing. VAMS immediately moved away so as not to interfere with the monkeys' behavior. The wounding incident was not directly observed, but it was assumed that a resident male was responsible because no extra-group individuals were in the area. On two occasions, the infant's mother (LV) came to the ground and made unsuccessful attempts to carry HW. Beginning at 18:15, in the dark, a single unidentified individual emitted lost calls (long distance contact calls) on and off for 30 min and moved away slightly for approximately 10 min before approaching again and being joined by a second monkey that emitted soft contact calls. At 18:19, the infant was no longer breathing. Examination of the remains confirmed the presence of a gash (~4 cm x 1 cm) in the lumbar/sacral region of the spinal cord, which was completely severed (Fig. 1). There were no other external wounds and no bones were visibly broken. Tissue samples were collected, and infant sex was confirmed as female.

Case 2 - RM08: During the afternoon of 24 January 2009, only the group's beta male (MM), a subordinate adult male, and two subadult subordinate males were present in the group. At 16:41, screams drew the attention of VAMS towards beta male MM and female RM, who were grappling, tangled and dangling by their tails. The beta male had RM's infant (RM08, 88 days old) in his mouth and seconds later he and RM08 dropped to the ground. The attack lasted no more than 20 seconds. The beta male was chased by RM and several other monkeys, and he disappeared out of sight. RM08 presumably died quickly thereafter because she did not make any further sounds or movements.

Approximately 15 minutes after the infanticide, beta male MM was again observed with the group and rested in proximity to a female and juvenile, and later carried an unidentified infant (>10 months of age). Subordinate adult male AD then approached the beta male and repeatedly engaged him in an aggressive coalitionary display against RM. The two males engaged in mutual play, AD sucked MM's tail, and then mounted him while duck facing and vocalizing. A few minutes later, the beta male was briefly chased by

RM and several others, including male AD, although no contact aggression was observed. Two additional mounts between MM and AD occurred at 17:45, with the males taking turns. RM stayed with the dead infant long after the rest of the group moved off to a sleep tree. She tried several times to carry the corpse up into the tree with her and was eventually successful, but left the infant perched on a tree limb before heading off in the group's direction. Examination of the remains confirmed the presence of a large gash (~7 cm × 2.5 cm) at the thoracic/lumbar intersection of the spinal cord (directly below the last rib), which was completely severed. There were no other external wounds and no bones were visibly broken. Tissue samples were collected, and infant sex was confirmed as female.

Kinship
Alpha male BG was assigned as the sire to both HW and RM08. Based on demographic data and genetic analyses, alpha male BG and beta male MM were likely full-siblings (R=0.64; full-siblings versus non-kin: P<0.001; full-siblings versus half-siblings: P=0.01; full-sibling versus parent-offspring P<0.001). The beta male had relatively low R-values with both mothers (LV, HW's mother: 0.13; RM, RM08's mother: 0.03), but we could not distinguish if they were non-kin or half-siblings (P=0.19 and P=0.11 respectively). LV subsequently conceived and gave birth to an infant (HP) who was also sired by the alpha, rather than the beta male. Based on the estimated kinship between the beta male and the infants' parents, he was most likely the paternal uncle of the three infants.

Sociosexual behavior and resumption of ovarian cycling
The conceptions of both HW and RM08 occurred prior to the start of this study, likely in January and May 2008 respectively (based on a mean gestation length of 157 days; Carnegie et al., 2011), and therefore we cannot evaluate male sexual access to the females at the time of conception. Prior to HW's infanticide, LV was observed copulating only with the alpha male BG. She had two periovulatory periods (POPs) beginning 88 and 109 days after the infanticide of HW. The second POP resulted in pregnancy and successful parturition of a subsequent infant on 22 May 2009, with an interbirth interval of 0.73 years (265 days). On 20 December 2008, during LV's conception POP, she and the alpha male engaged in sociosexual behavior (BG directed a duck face and dance display, behaviors that often lead up to a mount) and both engaged in sexual vocalizations but no copulations were observed. No other males were observed engaging in sociosexual behaviors with LV during this time. During the first two months of gestation, however, four other resident males engaged in sociosexual behaviors with LV, including beta male MM.

During RM08's gestation period, RM copulated (intromission observed) with a subordinate male and directed sexual vocalizations to the alpha male and was briefly mounted by him. In the four months following the infanticide and prior to her disappearance, sociosexual interactions – including

some copulations – were observed between RM and all resident males *except* infanticidal male MM. RM had two probable POPs beginning 49 and 83 days after RM08's infanticide, and her hormone profile is consistent with the progesterone and estradiol fluctuations observed in ovulating females. RM did not conceive again before her disappearance in late May 2009 (she was presumed dead at 26 years of age).

Discussion

Predictions generated from the SSI hypothesis were only partially supported by the infanticides reported here. According the SSI hypothesis, the attacker should be unrelated to the infant. Genetic data confirm that both infanticide victims were sired by the alpha male BG, rather than by beta male MM who was the known attacker of infant RM08. However, the alpha and beta male are likely full-siblings who transferred between groups together at least twice (Wikberg et al., 2014). To our knowledge no studies have reported paternal kin bias between males and their sibling's offspring, and males may occasionally kill related infants (Gibson et al., 2008; Clarke et al,. 1994) if they have limited means to assess their relatedness to potential victims (Murray *et al.*, 2007; Widdig, 2007). Instead, males may rely on their mating history with the mothers to assess kinship (Sugiyama, 1965; Hrdy, 1974; van Schaik, 2000). However, the killing of close kin's offspring suggests that if cognitive links between mating history and paternity probability exist, these are not transferable to the mating behavior of others.

The SSI prediction that the mother's time to conception would be shortened by the infant's death was generally supported. Capuchin infants are not fully weaned until 12 months (Carnegie et al., 2011; Fedigan and Jack, 2012). Given that both infants were under three months of age, the mothers were likely experiencing lactational amenorrhea at the time of the infanticides. Both mothers resumed ovarian cycling soon after the infanticide, and LV's interbirth interval was a mere 0.73 years, compared to the mean interval of 2.25 years for females whose infants survived to one year (Fedigan and Jack, 2012). The SSI hypothesis also predicts that the infanticidal male has an increased probability of siring the mother's future offspring. Following RM08's death, RM was observed engaging in sociosexual behavior with all resident males except the attacker MM. In the case of HW, the attacker was not identified, but the mother LV was observed copulating only with the alpha male during her conception period, and he sired the resulting offspring. Therefore, unless BG attacked his own infant (HW), the infanticidal male did not sire LV's subsequent infant. The probability of siring future offspring can also increase via an imminent or temporary increase in dominance rank, as was proposed for an observed infanticide in wedge-capped capuchins (Valderrama et al., 1990). We cannot discount this possibility since at the time of RM08's infanticide, the alpha male had been away for several hours.

The beta male may have committed infanticide despite a limited chance of siring the subsequent infant because the alpha male's absence may have minimized the risk of major repercussions. Alpha males and potential sires likely play an important role in infant defense as many infanticides occur after resident males, especially sires, disappear or die (van Schaik, 2000). While the role of protector male(s) is generally proposed as a response to threats from predators and non-resident conspecifics (van Schaik, 2000), potential sires may nonetheless protect infants from threats posed by co-resident males (Borries et al., 1999, Broom et al., 2004). Capuchin alpha males engage in infant defense during takeover attempts and intergroup encounters (Fedigan and Jack, 2013), and our analysis of long-term data shows that infanticide is just as likely to occur following rank reversals (where formerly subordinate males become alpha) as they are following takeovers by extragroup males (Jack et al., 2014). Although male vigilance is primarily directed towards predators and extragroup conspecifics (Rose and Fedigan, 1995), social vigilance appears to be related to the number of same-sex competitors (Jack, 2001). Thus, it is possible that alpha male absence, even if temporary, increases infanticide risk even in socially stable groups.

Conclusions

Few studies have included the genetic and hormone data necessary to evaluate if the SSI hypothesis can explain infanticides by male primates during periods of social instability (e.g. Borries et al., 1999; Harris and Monfort 2003; Murray et al., 2007). The current study includes unique observations of infanticides combined with genetic and hormonal data, allowing us to evaluate whether the SSI hypothesis might also explain infanticides during a period of apparent social stability. The hormonal data supported the rapid resumption of ovarian cycling and a shortened interbirth interval as predicted by the SSI hypothesis. In contrast, behavioral data did not support increased reproductive access to females. Finally, the genetic data provided mixed support for the predictions of the SSI hypothesis; although the attacker did not sire the infant(s), he was likely closely related to their sire, and he did not sire the mother's subsequent infant. Taken together, the SSI hypothesis was not well supported by these infanticides during a socially stable period.

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PREDATION OF BIRDS BY AN ENDANGERED PRIMATE SPECIES, *CALLICEBUS COIMBRAI*, IN THE BRAZILIAN ATLANTIC FOREST

Luana Vinhas
João Pedro Souza-Alves

The world faces a significant environmental crisis, in which continuous natural environments are being reduced to disturbed fragments (Ladle and Whittaker, 2011). Some species can take advantage of this process, but the majority of biodiversity is threatened by human activities (IUCN 2012). Ecological plasticity is regarded as a characteristic that favors species' survival when habitat becomes degraded (McKinney, 1997). Most primates have generalist diets and show some behavioral plasticity (Garber, 1987); however, current knowledge is concentrated on some well-studied species, while there is a lack of information for other primates.

Titi monkeys (*Callicebus* spp.) are regarded as primarily frugivorous primates, which complement their diets with invertebrate prey and other plant parts, such as leaves, seeds and flowers (Bicca-Marques and Heymann, 2013; DeLuycker, 2012; Heymann and Nadjafzadeh, 2013). These primates tolerate disturbed habitat (Heiduck, 2002; Jerusalinsky et al., 2006; Souza-Alves et al. 2011a) and it has already been suggested that titi monkeys might show some dietary plasticity. For example, Santos et al. (2012) report that *C. nigrifrons* can take advantage of temporarily available items, such as masting bamboos. Neri (1997) describes a male *C. personatus* driving a dove away from its nest and allowing the female to eat its egg. Souza-Alves et al. (2011) verified a high consumption of insects (i.e., caterpillar) during the dry season by *C. coimbrai*. However, up to now, there are no reports of titis preying on vertebrates.

Here, the predation of birds by one subadult *C. coimbrai* in a large fragment of Atlantic forest in the northeastern Brazil is reported. The observation appears to be the first record of predation of birds by *C. coimbrai* and by titis in general. The events were recorded at the largest fragment of the Mata do Junco Wildlife Refuge - MJWR (10°32'S, 37°03'W), which encompasses 522 ha of Atlantic Forest in the Northeastern Brazilian state of Sergipe, municipality of Capela, Brazil. Systematic monitoring of the *C. coimbrai* study group has occurred since 2011 until the present time (Chagas et al., 2013). Between January and March 2014

– when the event was recorded – quantitative behavioral data were collected in scan samples at 5-min intervals. On March 2014, when the event was observed, the study group was composed of a breeding pair, one subadult/adult, two juveniles and one infant.

On March 5th 2014, at approximately 14:50 h, one subadult *Callicebus coimbrai* was observed preying on a nestling Pale-breasted Thrush (*Turdus leucomelas*, Turdidae). The nest was localized among the branches and foliage at 3 m of height and fixed on a branch of a Guapira opposita tree. The titi monkey grabbed its prey with the right hand and started eating it one meter away from the nest. Two other individuals of *T. leucomelas* - probably the nestling parents - were observed vocalizing intensively nearby. Afterwards, one of the birds tried to mob unsuccessfully the titi away from its nest by attacking the titi's head. The birds continued vocalizing near the nest for approximately four minutes. The titi monkey seemed distressed with the approach of one MJWR employee and moved away from the area after dropping the rest of the nestling body to the ground (Fig. 1).

One day later, at approximately 10:30 h, the same individual was observed preying on another *T. leucomelas* nestling in the same nest. Once again, the titi held its prey with the right hand and ate it at the exact same place. The consumption of the prey lasted for approximately six minutes; meanwhile two *T. leucomelas* individuals flew and vocalized some eight meters away, without approaching the titi. After eating the nestling, the titi moved away from the area together with other group members. Curiously, one adult male of the same *C. coimbrai* group was also observed destroying abandoned nests on two occasions at Mata do Junco (JP Souza-Alves, pers. comm.) and during the monitoring in March 2014, the same individual of the records above was observed preying on eggs in the nest of an unidentified bird species (pers. obs.).

The predation of birds by primate species has been widely recorded in the literature. Marmosets (*Callithrix* spp.) were observed preying on bird eggs and nestlings of at least 15 species, including *T. leucomelas* (Mendes Pontes and Soares, 2005; Lyra-Neves et al., 2007; Begoti and Landsemann, 2008; Gomes and Lima-Gomes, 2011; Alexandrino et al., 2012). In addition, capuchins (*Cebus* spp.) were also observed preying on *Harpiprion caerulescens* and *Ictinia plumbea* (Olmos, 1990). Other birds, such as hawks, kites, toucans, and jays; arboreal snakes; and mammals, such as coatis, opossums, and primates are among the potential predators of bird eggs and nestlings in forest fragments (Morre and Robinson, 2004).

In the literature, titi monkeys have been commonly regarded as prey of other vertebrates. For example, there are records of predation of *Callicebus* spp. by crested eagles (*Morphnus guianensis*, Terborgh, 1983), capuchin monkeys (*Cebus* spp., Sampaio and Ferrari, 2005; Lawrence, 2003), ocellot (*Leopardus weidii*, Bianchi, 2001; Bianchi and Mendes, 2007), *Boa constrictor* (Cisneros-Heredia et al., 2005), margays (Defler, 2004) and harpy eagles (*Harpya harpyja*, de Luna et al., 2010). Nest predation can negatively impact bird richness and diversity (Argel de Oliveira, 1995); however, given its rarity, predation of birds by titis seems likely to have little effect on bird populations.

The study group have a diet based mainly on fruits and vegetative plant parts (Chagas et al., 2013), which is typical for the genus (Bicca-Marques and Heymann, 2013). However, there are two possible explanations for the absence of other reports of bird predation by titis. Firstly, other titi groups may also prey opportunistically on birds, but this may not have been observed by other researchers given the rarity of these events. Secondly, bird predation may be a response of the study group to habitat degradation. Both potential explanations highlight the possible plasticity and opportunism of titis monkeys, and help our understanding of the persistence of these monkeys in highly degraded landscapes, such as the Atlantic Forest of Northeastern Brazil.

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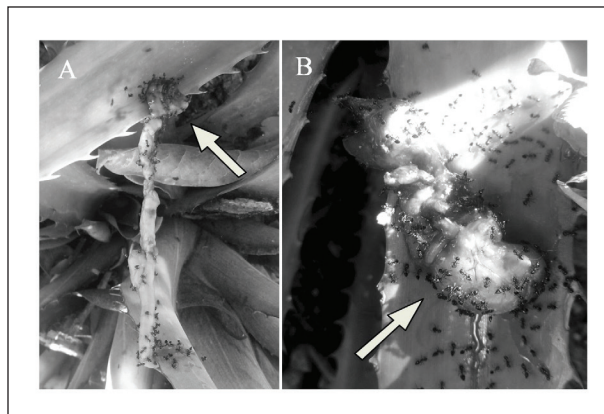
Figure 1. Photograph of the remains of two individuals of *Turdus leucomelas* preyed by *Callicebus coimbrai* at the Mata do Junco Wildlife Refuge.

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OBSERVATION OF WEAPON USE IN A GROUP OF SEMI-FREE TUFTED CAPUCHINS (*SAPAJUS* SPP)

Claire Hamilton
Dorothy M. Fragaszy

Introduction

There have been many studies about the use of tools by capuchins (*Cebus* and *Sapajus* spp.) particularly during the last two decades of the 20th century including experiments in captive settings and to a lesser degree in semi-free and wild conditions (Fragaszy et. al., 2004; Ottoni and Izar, 2008; Visalberghi and Fragaszy, 2012). Capuchins have been observed manipulating objects either out of curiosity or as a means to extract food (Fragaszy et al., 2004). There is very limited documentation, however, as to the use of objects as weapons either in response to a threat or as an aggressor. Wild capuchins have been reported to flail branches or drop objects on intruders (Chevalier-Skolnikoff, 1990; Fragaszy et al., 2004) and Boinski observed a male white-faced capuchin (*C. capucinus*) use a branch to strike a boa constrictor pinned to the ground beneath a fallen branch (Boinski, 1988). Cooper & Harlow (1961) reported a tufted capuchin (*C. a. fatuellus*) in a laboratory struck a white-fronted capuchin (*C. albifrons*) with a stick in defense of food and the same tufted capuchin used a stick to defend himself when surrounded by a group of rhesus monkeys (*Macaca mulatta*) although he failed to hit any of them.

Throwing objects is less often reported. Vitale et al. (1991) reported observing a group-living tufted capuchin throw (unspecified) light objects a short distance towards a model snake as part of a mobbing event. Westergaard and Suomi (1994) showed that captive tufted capuchins could throw stones with good aim 20 cm away into a bucket following practice, but in this case the outcome was receipt of a reward. More recently Falotico & Ottoni (2013) reported observing female bearded capuchins (*Sapajus libidinosus*) throwing stones at males during their proceptive phase, seemingly to gain the males' attention. Here we report the use of a large stick and a stone by a female *Sapajus* spp. in a seemingly unprovoked attack on a tortoise in a semi-free environment.

Study Site

The study site is a primate sanctuary situated in Plettenberg Bay, Western Cape, South Africa named Monkeyland, created in 1998 as a sanctuary for captive primates where they could live semi-free in a more natural environment.

The sanctuary encompasses an area of 12 hectares of natural indigenous forest surrounded by a 6 meter fence, and is now home to 10 species of primates including capuchins (*Sapajus* spp.), squirrel monkeys (*Saimiri boliviensis*), black howler monkeys (*Alouatta caraya*), sakis (*Chiropotes chiropotes*), vervet monkeys (*Chlorocebus pygerythrus*), langurs (*Trachypithecus obscurus*, *Semnopithecus entellus*), lar gibbons (*Hylobates lar*), ring-tailed lemurs (*Lemur catta*) and black and white ruffed lemurs (*Varecia variegata variegata*). Along with unwanted pets, some of the primates are retired from laboratories or zoos and many more were born here. There are now approximately 450 free-ranging primates living sympatrically in the forest. Together with the primates are approximately 30 Mountain (or Leopard) tortoises (*Stigmochelys pardalis*), native to South Africa, as well as some other native South African fauna.

Monkeyland is open to the public for guided tours of the forest. Although the monkeys and apes are habituated to humans, there is no interaction between humans and the other primates. All primates go through a period of rehabilitation prior to their release into the forest in order to wean them off of human dependency. There are 15 feeding stations throughout the forest and the primates are fed twice daily a variety of fruits, vegetables, proteins and carbohydrates. Aside from eating provisioned foods, the primates feed on leaves, flowers, fruits, insects, invertebrates and birds that they obtain by foraging in the natural forest. Food is abundant.

Conflicts occasionally occur between the different species; however, these rarely result in serious injury. Apart from the occasional snake (puff adder (*Bitis arietans*), night adder (*Causus rhombeatus*) and boomslang (*Dispholidus typus*) there are no natural predators. Small raptors reside in the area but are rarely seen above the Monkeyland forest. A series of natural paths of varying widths link the feeding stations, and tourists are restricted to these paths. Currently there are approximately 100 capuchins divided into three groups, each with an alpha male. Conflicts between the groups are minor and are generally limited to vocal and visual displays when the groups meet. The observer, Claire Hamilton, worked at Monkeyland for two years prior to this event and previously spent a year in Bolivia working with and amongst wild, semi-free and captive capuchins where wild tortoises were also present.

Observations

On 7th November 2012 Claire Hamilton was on a routine walk through the Monkeyland forest. Shortly after entering the forest she heard something rushing through the undergrowth and she observed two capuchins (*Sapajus* spp.) heading out from the forest onto a wide path. Both were making the 'open mouthed threat face' and giving alarm vocalizations. Apart from another capuchin resting in a tree and a few squirrel monkeys (*Saimiri boliviensis*) foraging on the forest floor, no other monkeys could be seen and the

Figure 1. In chronological order from left to right.
a)   14:51:49 The female capuchin showing her bared teeth. She is following the male who has crossed the path and is out of sight.
b)   14:51:49 Just prior to her picking up a branch.
c)   14:51:53 The branch just as it was making contact with the tortoise.
d)   14:51:55 The branch is visible to the left of the tortoise and the female is (presumably) searching for another weapon.
e)   14:52:00 The female has thrown the rock which can now be seen mid-air.
f)   14:52:00 The rock is landing to the right of the tortoise who is still retracted into its shell.
g)   14:52:04 The tortoise makes a hasty retreat and the rock can be seen on the ground to the right of the tortoise.

only other animal visible was a medium sized mountain tortoise (approximately 35 cm long x 23 cm wide) which was making its way along the path towards Hamilton. The male capuchin crossed the path, followed by the female, making threat faces and vocalizations. It became apparent that the object of their alarm was the tortoise. While the male remained to the side of the path, the female took hold of a broken branch measuring approximately 59 cm long x 4 cm diameter and whilst holding this she struck the tortoise across its shell once before dropping the branch. The tortoise reacted by retracting into its shell. The female capuchin then took up a rock measuring approximately 8 x 5 x 4 cm and threw it with such precision and force that it bounced off the tortoise's back and landed over a meter in front and to the side of it. She stood bipedally erect and watched the tortoise make a hasty departure, heading towards Hamilton. She then resumed normal quadrupedal posture and watched until the tortoise was at least 3m away. The male remained in the forest to the side of the path and his reaction was not observed. The tortoise suffered a slight chip to its shell. The whole incident lasted approximately 15 seconds. Hamilton obtained a series of photos of the incident, shown in Figure 1.

Discussion

All the primates in the forest are familiar with Hamilton's presence but have never associated her with the provision of food or other favors and there is no apparent explanation for the capuchins' behavior toward the tortoise during this

incident. The female was not in estrus, nor was she showing any outward signs of pregnancy. Following the incident the male was identified as 'Joey', a high ranking male subordinate to and an ally of the alpha male of this group. The female was identified as 'Lindy' (aged 12), the alpha female of the group who spends the majority of her time with the alpha male and Joey. Both Joey and Lindy were born at Monkeyland and have lived in the forest all (Lindy) or most (Joey; from 7 months) of their lives. Neither Joey nor Lindy had shown particularly aggressive tendencies prior to this incident although Lindy had displayed resourceful behavior, such as using a long stick to 'fish' out pieces of apple which were out of reach behind a fence.

The Mountain tortoises are the largest (30-60 cm, 8-20 kg) of the South Africa tortoises and the most widely distributed. They are often (illegally) taken as pets and many get injured on the roads. These tortoises are confiscated by 'Cape Nature' and generally passed to sanctuaries as they cannot be released back into their natural habitat for fear of unknown pathogens which may seriously affect the wild tortoises. Monkeyland has been home to rescued mountain tortoises for many years. The primates have always co-existed peacefully with the tortoises, which roam freely through the forest and regularly feed off fallen food from the feeding platforms. They are on occasion the object of curiosity by capuchins and Hamilton has observed the capuchins sniffing, poking and slapping sleeping tortoises. Since Monkeyland opened in 1998 there have been no other observed instances of threatening or defensive behaviour directed by

monkeys towards a tortoise. The capuchins do, however, steal and eat the tortoises' eggs.

The incident shows that capuchin monkeys will spontaneously throw a stone hard enough to cause a potential competitor or threatening animal to move away. It also provides a new case of a capuchin using a stick to strike another animal in an aggressive/defensive context. Once again, we are reminded that capuchins use objects effectively and creatively to achieve a goal.

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TWO CASE STUDIES USING PLAYBACKS TO CENSUS NEOTROPICAL PRIMATES: *CALLICEBUS DISCOLOR* AND *ALOUATTA PALLIATA AEQUATORIALIS*.

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Manuel Mejia
Katie Slocombe
Sarah Papworth

A solid understanding of wild population status is needed to monitor biodiversity for conservation (Milner-Gulland & Rowcliffe, 2007), but as time and money are seriously limited in conservation projects, investigators should try to get accurate results whilst minimizing costs. The minimum number of observations required for accurate census results are often difficult to obtain (Marsden, 1999): species may behave cryptically and so are less audible and visible to those conducting surveys, or habitats can be densely vegetated with low visibility, increasing the effort required to achieve minimum number of observations. In order to increase detection in these circumstances, playbacks of conspecific calls have been used for a variety of Neotropical primate species. Playbacks have been used to determine the presence of primates (e.g. *Ateles fusciceps* Peck et al., 2011) and to estimate primate density using a combination of playbacks and distance sampling (e.g. *Callicebus discolor* Dacier et al., 2011), or strip transects (e.g. *Saguinus oedipus* Savage et al., 2010). Here we focus on the use of playbacks to estimate population densities, though some of the content will be of interest for those using playbacks to survey primate presence. We review the requirements to conduct playbacks censuses with Neotropical primates and present assessments of the utility of this method for two Ecuadorian species: red titi monkeys (*Callicebus discolor*) and Ecuadorian mantled howler monkeys (*Alouatta palliata aequatorialis*). We review the utility of playbacks for Ecuadorian mantled howler monkeys and compare the cost and time for three different census methods for red titi monkeys; line transects, passive point transects; and playback point transects.

Using playbacks in combination with distance sampling methods is relatively common in birds (e.g. Alba-Zúñiga et al., 2009), but has been slow to be adopted in primates. Distance sampling is the most widely used method to determine abundance and density of animal populations (Buckland et al., 2001), and is a popular method for sampling primates (Buckland et al., 2010). Censusing primates using distance sampling has been reviewed by Buckland et al. (2010) so will not be repeated here. Instead, we discuss the pre-census checks before using playbacks to determine which if any method, can be used to census a particular species.

Any survey using playbacks needs at least one recording (and ideally multiple recordings) of a spontaneous call by a local group. The ease of recording this call will depend on both species and population density, but could require a few days of pre-census fieldwork and therefore increase the total project cost. However, these recordings need be made only once and can be used for multiple surveys in the area. Even once calls have been recorded, it should be verified that the species responds to playbacks of a conspecific's call before conducting a widespread survey (Figure 1). Some species, such as the buffy headed capuchin (*Cebus xanthosternos*), have been reported not to respond to playbacks (Martins Kierulff et al. 2004). In species with a diverse call repertoire, it is also necessary to determine which call types conspecifics will respond to with vocalizations. For example, individuals may always respond to contact calls, but less frequently respond to predator alarm calls.

The accuracy of distance sampling depends on several assumptions, the first being that animals on the line or point are always detected. Thus to combine playbacks with distance sampling, it is imperative to demonstrate that a species always responds when located at the playback location. This information may already be present in the published literature for some species, reducing pre-census demands. Otherwise, confirming the responses of the species to playbacks will of course raise the cost of the initial survey, but need not be repeated if the census is repeated in future years nor for new surveys with the same species in new areas. The assumption of certain detection is also true for strip transects, though the area of certain detection is expanded to a strip within a certain distance of the census line (Buckland et al., 2001). Determining the probability of response to playbacks of conspecifics is therefore a key factor when using playbacks to estimate density.

A second assumption of distance sampling is that animals are detected at their initial location. It must therefore be checked whether the species is repelled or attracted by conspecific calls (Figure 1). Buckland et al. (2001) caution readers about combining playbacks with distance sampling

Figure 1. Flowchart showing information needed about a species response to playback before using playbacks to aid detection for density estimations.

methods, as species may be attracted to, or repelled by the playback, biasing estimates upwards or downwards respectively. If a species responds to a playback by calling before moving, this movement will not be a problem for estimating density, but movement before calling is a problem. Spatial responses to conspecific calls may be available for some well-studied species. For example, Whitehead (1987) showed that mantled howler monkeys (*A. palliata*) had a high response rate to a "withdrawing" bark sequence, and also responded to this sequence before moving. Although distance sampling requires that individuals do not move in response to playbacks, other methods can still be used. For example, Savage et al., (2010) found that cotton-top tamarins (*Saguinus oedipus*) are attracted to playbacks of conspecific calls from 150-200m, and so used strip transects and lured individuals to the census line with playbacks.

In addition to the above, the survey design must have random and replicated census locations so density results are accurate and can be extrapolated (non-random locations may not represent the wider landscape). When designing a playback study, the impact of repeated playbacks on resident groups should be considered. Repeated playbacks at the same location may displace groups as they respond to what appears to be an aggressive intruder. Sampling a greater number of points spread over a large area will increase the accuracy of the density estimate and minimize potential stress to the sampled population.

Callicebus discolor
C. discolor is small cryptic primate that lives in small sized groups of adults and their offspring. The adults produce loud and regular calls, which are audible for about 500m, and occur in the early morning (Dacier et al., 2011). Groups do not chorus every morning (Papworth, 2012). Dacier et al, (2011) have previously shown that the responses of *C. discolor* to playback point transects does not violate the assumptions of distance sampling, and can also provide accurate estimates. Thus here we compare the cost and time for three different census methods for this species in Yasuní National Park, Ecuador (S 0°41, W 76°24); line transects, passive point transects, and playback point transects.

Derby (2008) performed a census of 10 monkey species using line transects. Data were collected two to three days per month over 11 months, between 0600 and 1400 hours. Eighty kilometers of transect were walked, and just 13 *C. discolor* were observed. Unpublished data collected in 2010 by ASR and SP was used to determine the efficiency of passive point censuses of loud calls. Spontaneous calls of *C. discolor* between 0700 and 0730 were recorded. Seventeen calls were heard during seven days of sampling at each of six different points, thus a total of 21 hours of observation. A playback point transect census was also conducted in 2010 (Papworth, 2012) following the methods of Dacier et
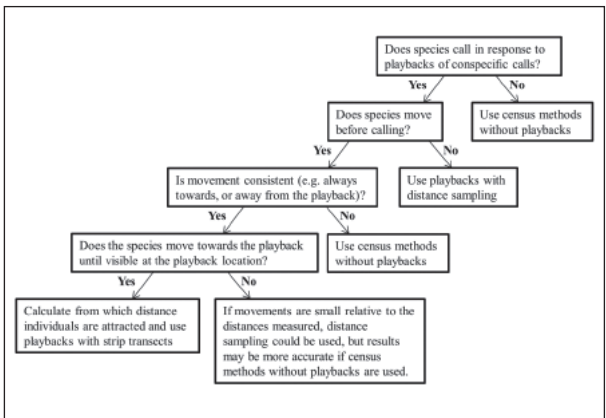
al., (2011). The playback was recorded from a group living within the sampled area and consisted of four repeats of a two minute duet call with each repeat separated by two minutes of silence. The census sampled 68 points spaced 250-400 m apart over 14 days and recorded 60 responses to the playback.

For each method, the time (in both days and hours) which would be required to reach the minimum number of observations was calculated. The relative cost of equipment used for each method was calculated using current (March 2013) market prices (Table 1). In this case, perhaps because of the cryptic behaviour of *C. discolor*, a census using call playbacks is the fastest way to achieve the minimum sample size (Table 1), and could also be the cheapest if multiple surveys are conducted, reducing equipment costs per survey. Using a point transect with observations of spontaneous calls was predicted to take the most time, so is not considered further. Although the comparative cost of line transects and playback point transects depend on accommodation costs at a particular site and how many surveys the equipment will be used for, the minimum number of observations would be achieved far faster using playback point transects. As no method achieved the minimum sample size for an accurate density estimate it is not possible to compare the precision of each method. However, Dacier et al. (2011) found playback point transects of *Callicebus* gave accurate density estimates, and as this method offers faster detection of this cryptic genus, it is a viable alternative to traditional line transects.

Alouatta palliata aequatorialis
A. palliata aequatorialis is a larger cryptic primate which also lives in small groups of adults and offspring, though these groups are less spatially cohesive and can be very large (up to 21 individuals, SP, unpublished data). Adults produce loud calls, which can be audible for up to 1 km, and can occur at any time of day (SP, unpublished data). Although playbacks of conspecific calls can illicit responses in various *Alouatta* species (e.g. *A. palliata*, Whitehead, 1987;

A. pigra Kitchen, 2006), we wanted to assess whether these responses violated the assumptions of distance sampling methods. Six groups of Ecuadorian mantled howler monkeys were located in Cerro Blanco Protected Forest (S 2°10, W 80°04) and the loud calls of individuals in these groups were recorded and used to create playback stimuli. Playback stimuli were two minutes long and played at 100dB, which was audible up to 200-300m (depending on habitat type). Recorded calls were only played to groups located more than 1km from where the call was originally recorded, to ensure individuals did not hear playbacks of their own calls or the calls of neighboring groups. Six playback trials were conducted.

In two trials, the groups were silent and did not respond. In another two trials, the monkeys silently fled from the playback, even though they had not been moving before. One of these groups then called continuously for 2 hours and continued calling during the night. In just two trials, *A. palliata aequatorialis* called without moving, but the response was not immediate (a delay of more than 12 minutes for both playbacks). Thus calling responses consistent with the assumptions of distance sampling were recorded to just two of the six trials, and the fleeing responses suggested a possible negative impact of playbacks. Furthermore, for the two trials were the groups did respond, these responses were not immediate. Immediate responses to playbacks are important as they ensure that individuals are not counted twice if they call, move and then call again. Overall, after six playbacks, there was no evidence to suggest that the playback method would work to assess the density of howler monkeys. The silent flight of two groups suggested the activity had a negative impact on howler monkey groups, thus trials were halted.

For *A. palliata aequatorialis* therefore, playback point censuses do not seem an effective method. As mentioned above, the lack of response to the playback may be due to the type of call used. Whitehead (1987) showed that mantled howler monkeys responses to playbacks differed

Table 1. Time needed for each method and equipment costs. The number of days and hours needed is obtained by calculating the time that each study would have to gain the minimum observations recommended by Buckland et al. (2001). These costs may be lower if different brands are used. Accommodation costs are not displayed, as these vary from site to site, but for this species, if accommodation is more than USD40 per night, then the high equipment costs for the playback method will be compensated by the reduced accommodation costs.

Method	Minimum observations	Days needed	Hours needed	Equipment needed	Approximate equipment cost (USD)
Line Transect	60*	63	504	Handheld GPS Sighting compass	200
Passive point transect	75	262	131	Handheld GPS Sighting compass	200
Playback point transect	75	14	95	Handheld GPS Sighting compass Microphone Sound recorder Speaker Sound player	2,113

with call type. In our trials, three of the playbacks used "howl" calls and three used "bark" calls, but no pattern in response was observed to these different types. Alternately, information about the caller may have been encoded in the call, and individuals may respond differently to more or less dominant individuals (Hopkins, 2013). Although it is possible that different playback stimuli or a greater understanding of *A. palliata aequatorialis* behaviour at Cerro Blanco Protected Forest could elicit responses to playbacks which are consistent with the assumptions of distance sampling, we did not continue trials as the negative response to playback was so strong.

A number of *Callicebus* species have been shown to respond to playbacks of conspecific calls (e.g. *C. coimbrai*, Ferrari et al., 2010; *C. nigrifrons*, Cäsar et al., 2012), and it may be that genus specific behavioural responses to conspecific calls make playback point censuses particularly appropriate for this genus. In contrast, the responses of *A. palliata aequatorialis* violated the assumptions of distance sampling, thus passive sampling methods which rely on spontaneously given calls (cue counting, see Buckland et al., 2010) may be more appropriate for *Alouatta* if these responses are typical of the genus. When contrasting playbacks responses of just two species, it is difficult to draw conclusions about which species or genus characteristics are associated with successful or unsuccessful use of playbacks. One hypothesis is that these differences are related to the different grouping patterns and roles of calls in these species. For example, loud calls in *Callicebus* are thought to function in mate or territory defense, and groups of *Callicebus* hold relatively stable territories (Dacier et al. 2011). Therefore loud calls by novel groups within or close to a territory may frequently elicit vocal responses. In contrast, the grouping and social behaviors of *Alouatta* is more varied, with single and multi-male groups, overlapping territories and intra-group dominance hierarchies (Whitehead, 1987; Kitchen, 2006; Hopkins, 2013), thus responses to playbacks simulating the presence of an unknown individual may also be more varied.

In other Neotropical species, investigating behavioral responses to playbacks is necessary before the suitability of playbacks to assess population density can be determined. Playbacks have been used to determine the presence of a variety of Neotropical species (e.g. *Saguinus* spp. Urbani, 2006; *Cacajao melanocephalus*, Bezerra et al. 2010; *Ateles fusciceps*, Peck et al., 2011), thus for these species the first hurdle of demonstrating responses to playbacks have been demonstrated, and it only remains to be investigated whether the behavioral responses to conspecific calls are consistent with the assumptions of density estimation methods.

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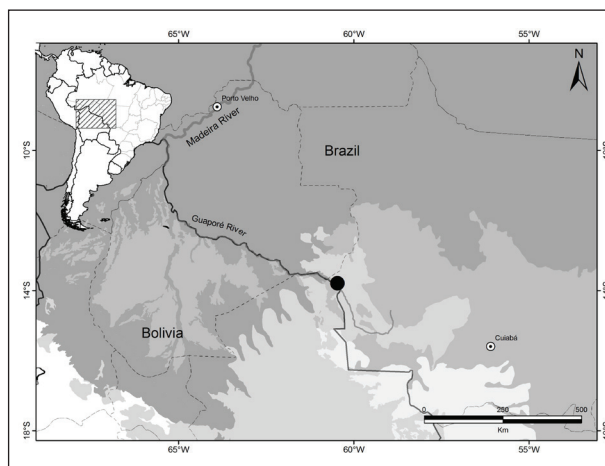## REPORT OF A BLACK SPIDER MONKEY (*ATELES CHAMEK*) SWIMMING IN A LARGE RIVER IN CENTRAL-WESTERN BRAZIL

André Valle Nunes

Rivers are considered to influence the current patterns of ecological and genetic variation of Amazonian species and communities (Gascon *et al.*, 2000). Rivers are impenetrable barriers to the dispersal of several vertebrate species, and, in some cases, they interrupt the expansion of species from their origin centers and gene flow between populations of sister species from opposite margins (Sick, 1967; Hershkovitz, 1977; Ayres and Clutton-Brock, 1992; Gascon *et al.*, 2000). Hence, rivers drive, inter and intraspecific differentiation patterns in the distribution of Amazonian primates (Ayres and Clutton-Brock, 1992).

There are few records of New World primate species swimming (Parnell and Buchanan-Smith, 2001). Some platyrrhines, such as *Cebus*, *Cacajao*, *Aotus*, and *Saimiri*, can inhabit or use swamps and seasonally flooded areas, but they do not swim between habitat patches (Socoloske and Kymberley, 2010; Bezerra *et al.*, 2010). The only reports of swimming refer to large primates, such as *Alouatta palliata*, *Cacajao melanocephulus*, as well as large species of Old

World cercopithecoids: *Macaca radiata* (bonnet macaque), *Nasalis larvatus* (proboscis monkeys), *Papio anubis* (olive baboon), *Macaca fuscata* (japanese macaques), *Pan troglodytes* (chimpazee), and *Pongo pygmaeus* (bornean orangutan) (Wata, 1981; Yeager, 1991; Forthman, 2000; Agormoorthy *et al.*, 2000; Gonzalez-Socoloske and Snarr, 2010; Bezerra *et al.*, 2010; Bender and Bender, 2013). Among the largest platyrrhines are the atelids, such as the black spider monkey (*Ateles chamek*), which may weight up to 10 kg and has two common characteristics of the subfamily Atelinae: immigration and movement through semibrachiation (Chapman and Chapman, 1989; Chapman and Chapman, 1990; Campbell *et al.* 2005). *Ateles chamek* occurs in lowlands from northeastern Peru, northern and central Bolivia in the Noel Kempf Mercado National Park, and western Brazil in the state of Mato Grosso on the left margins of the rivers Teles Pires and Tapajós (Wallace *et al.*, 1996; Iwanaga and Ferrari, 2002). There are reports of black spider monkeys using the ground to socialize, collect food, and cross open areas (Di Fiore, 2002; Campbell *et al.*, 2005). However, there is no information on swimming. Therefore, we report a rare case of swimming by a female *A. chamek* in an Amazonian River.

On November 28th, 2012, in the municipality of Comodoro (13°47'54"S, 60°27'53"W), in the Amazon of Mato Grosso, we observed a female *A. chamek* crossing the Guaporé River by swimming. Approximately at 16:30 h, the female began moving on the ground of the river's beach, which is located within the Noel Kempff Mercado National Park in the municipality of Santa Cruz, Bolivia (Fig. 1). Next, the specimen began to swim towards the opposite margin, located in the state of Mato Grosso, Brazil. The swimming activity lasted ca. 15 min, and the specimen crossed 38 meters from one margin to the other. The specimen had the body completely submerged, leaving only the

Figure 1. Location of the swimming of black spider monkey (*Ateles chamek*) in Guaporé River, border between Bolivia and Brazil in South America. Tropical and subtropical moist forests; Tropical and subtropical savannas; Floodplains; Tropical and subtropical dry forests; Moutain grasslands. Habitat types follow Olson *et al.* (2001).

Figure 2. Photography of the adult female black spider monkey (*Ateles chamek*) swimming towards the shore of the state of Mato Grosso, Brazil. Photo Credit: Antônio Linares

Figure 3. Locomotion of the adult female black spider monkey (*Ateles chamek*) on a submerged branch prior to climbing to tree crowns in the riparian forest of the Guaporé River in the state of Mato Groso, Brazil.

head out of the water (Fig. 2), and moved its arms and legs. It was panting and was not scared by our boat; on the contrary, it even climbed onto the boat and walked around the boat's edge before immersing back into the water. Then, the specimen managed to climb onto a submerged branch and began a fast movement between tree crowns in the riparian forest of the Guaporé River, on the Brazilian side (Fig. 3).

The present report is consistent with the meta-analysis by Ayres and Clutton-Brock (1992), which assessed the relationship between the width of Amazonian rivers and the body weight of primates. This meta-analysis assumes that larger species are less affected by ecological barriers, which means that speciation and interspecific differences between primate communities in the Amazon may be correlated with the ability of the species to cross ecological barriers. Another factor that could have favored swimming by the female *A. chamek* is the morphodynamics of the Guaporé River. According to Souza-Filho *et al.* (1999) the Guaporé River has a fluvial meandering channel with the formation

of beaches in the dry season. Rivers with sinuous conformation and sand banks on their margins allow animals to cross them, which lead to possibility of crossing of terrestrial vertebrates between opposite margins (Ayres and Clutton-Brock, 1992). In this scenario, the breaking of a physical barrier may favor gene flow between sister species of primates that evolved in opposite margins of Amazonian rivers and help us understand species distributions.

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YELLOW-TAILED WOOLLY MONKEY (*OREONAX FLAVICAUDA*: HUMBOLDT 1812) ALTITUDINAL RANGE EXTENSION, UCHIZA, PERÚ

Néstor Allgas
Sam Shanee
Ana Peralta
Noga Shanee

The yellow-tailed woolly monkey (*Oreonax flavicauda*) is endemic to a small area of montane cloud forest dominated by *Ficus* spp. in the Peruvian departments of Amazonas and San Martin (Leo Luna 1980) and neighboring areas of the departments of Huánuco and La Libertad (Graves &
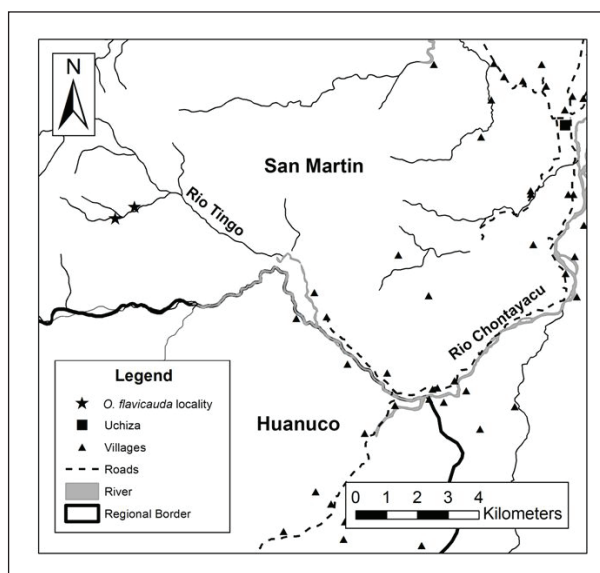
O'Neil, 1980; Parker & Barkley, 1981; Shanee, 2011). This species is listed as Critically Endangered on the IUCN Red List of Threatened Species (2008, A4c) and Endangered on Appendix 1 of CITES (2005). The main threats to *O. flavicauda* are massive deforestation for agriculture, subsistence hunting, logging and mining (deLuycker, 2007; Leo Luna, 1980; Shanee, 2011). In many areas habitat loss has forced this species into small forest fragments (Shanee et al., 2007; Shanee, 2011).

On the 25th and 26th of January 2013, while carrying out distribution surveys of the Andean night monkey (*Aotus miconax*), we encountered a group of *O. flavicauda* 14.5 km west of the city of Uchiza in San Martín department in an area known locally as Tingo de Uchiza (S 8°28'47.04", W 76°35'24.90"), just north of the border with Huánuco (Fig 1.). The group was found along an existing 1.1 km trail at altitudes between 1,084 and 1,373 m. a.s.l., just under 500 m lower than previous observations (Table 1). We observed the group feeding on fruiting figs (*Ficus* spp.) for 25 minutes before they crossed a small stream which feeds the Rio Trisneja where we were unable to follow. The group consisted of 12 individuals, including two females with infants.

The habitat was similar to that described by previous researchers (Shanee, 2011; Shanee & Shanee, 2011) with high humidity (up to 99% relative humidity at 14.7°C). Forests in this area are dominated by Moraceae (*Ficus* spp.) and Cecropiaceae (*Cecropia* spp.) as well as Fabaceae (*Inga* spp. and *Erythrina* spp.), Icacinaceae (*Citronella* spp. and *Styloceras* spp.) with a high density of epiphytes. Our observations were made in a long thin canyon with steep sides that culminated in the 400 m high *Velo de Plata* waterfall. It is possible that the extremely humid and cool microclimate created by the local topography and the effect of the waterfall have allowed the higher altitude forest type, which

Figure 1. Map of observation locality.

Table 1. Minimum altitudes where *O. flavicauda* has been observed in previous studies.

Altitude (m a.s.l.)	Study sites	Source
1,084	Tingo de Uchiza, San Martín	This study
1,560	Shunte, San Martín	Shanee (2011)
> 1,600	Pucatambo, Amazonas	Leo Luna (1980)
1,505	Bosque de Protección Alto Mayo	DeLukyer (2007)
2,400	Ongón, La Libertad	Parker & Barkley (1981)
1,670	Abra Patricia, Amazonas	Graves and O'Neil (1980)
1,550	Pucatambo, Amazonas	Thomas (1927)
2,220	Cordillera de Colán, Amazonas	Butchart et al (1995)

is home to *O. flavicauda*, to establish itself at these lower altitudes.

Local villagers stated that *O. flavicauda* is common in the area, which they had mistakenly identified as howler monkeys (*Alouatta* sp.). When informed about the species endemism and Critically Endangered status they showed a lot of interest in conserving the species. The Municipality of Uchiza is currently working with the San Martin Regional Government to create a new Regional Conservation Area (*Area de Conservación Regional*) which covers the area where our observations were made. More time will need to be spent in this area to see how much lower the species distribution reaches in this and other similar areas. With the current high rates of habitat loss throughout this species distribution area, any additional areas of habitat suitable for them are of importance for its conservation.

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PRIMATAS DA RESERVA PARTICULAR DO PATRIMÔNIO NATURAL ÁGUA BOA, CACOAL, RONDÔNIA, BRASIL

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O conhecimento da fauna de primatas do Estado de Rondônia, o qual está inserido no "arco do desmatamento" (Ferreira et al., 2005), é escasso (Ferrari et al, 1996; van Roosmalen et al., 2002). Segundo van Roosmalen et al. (2002), os fragmentos florestais da região podem abrigar até nove espécies. Neste estudo realizamos um levantamento dos primatas habitantes de um fragmento de floresta de terra firme, a Reserva Particular do Patrimônio Natural Água Boa.

A RPPN Água Boa (11°29'17,14"S, 61°26'20,23"O; 210 m a.n.m.m) está situada na linha "E", Setor Prosperidade, Lote 65 do município de Cacoal, Rondônia, Brasil (Fig. 1). Ela possui 96 ha cobertos predominantemente por Floresta Ombrófila Aberta (RADAMBRASIL, 1978) no interior de uma propriedade particular de uso agropecuário, agroflorestal e florestal com 343 ha, dos quais 178 ha são cobertos por floresta e 165 ha por pastagens. O entorno da RPPN possui pequenos fragmentos florestais isolados imersos em uma matriz de pastagem. O clima da região, segundo a classificação de Köppen (1948), é equatorial quente e úmido. A precipitação pluviométrica média anual excede 2,000 mm.

O levantamento dos primatas foi realizado pelo método da transecção linear (Peres, 1999; Buckland et al., 2001) no período de fevereiro a novembro de 2009 em intervalos de 10 dias. Duas trilhas perpendiculares com 1,950 m e 700 m de comprimento, marcadas a cada 50 m, foram percorridas 26 vezes pela manhã (início das atividades às 06:00) a uma velocidade média de 1,5 km/h (esforço de amostragem: *ca.* 69 km). Um total de 111 avistamentos distribuídos entre seis espécies foi obtido: *Saguinus weddelli*, *Sapajus apella*, *Callicebus* cf. *moloch*, *Pithecia irrorata*, *Alouatta puruensis* e *Ateles chamek*. Além dessas espécies, *Aotus nigriceps* foi observado em três ocasiões extracenso. A ausência de *Saimiri ustus* e *Chiropotes albinasus* na RPPN pode estar relacionada, respectivamente, à inexistência de cursos d'água na área, tendo em vista que os macacos-de-cheiro preferem ambientes úmidos (Baldwin, 1985; Silva Jr., 2007), e à baixa tolerância dos cuxiús à perda e fragmentação do habitat (Gordo et al., 2008; Veiga e Pinto, 2008).

O tamanho dos grupos variou de um indivíduo solitário a 12 indivíduos e a abundância das espécies variou de 0,7 (*Alouatta puruensis*) a 7,8 grupos/10 km (*Sapajus apella*; Tabela 1). A maior abundância (16,1 grupos/10 km) observada na RPPN em comparação com outras áreas em Rondônia (Tabela 2) sugere um adensamento de fauna (Ferrari et al., 2001).

Em suma, apesar de possuir uma pequena área, a RPPN Água Boa abriga a maioria das espécies de primatas da região de Cacoal. Entretanto, a sobrevivência dessas espécies em longo-prazo na área pode depender de estratégias de manejo que facilitem o fluxo gênico entre as populações da RPPN e as populações dos fragmentos vizinhos.
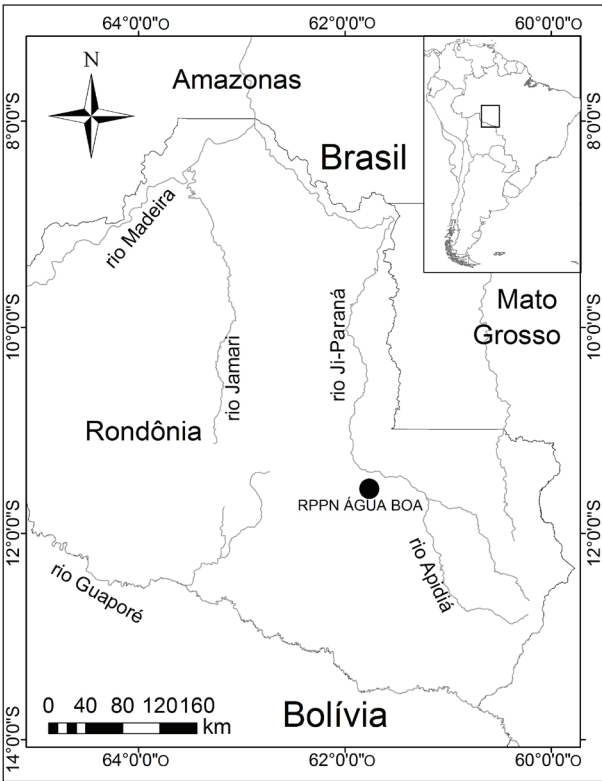

Figura 1. Mapa do Estado de Rondônia em destaque mostrando a localização da RPPN Água Boa (círculo preto).

Tabela 1. Tamanho dos grupos, abundância e tipo de registro (C=censo; E=extracenso; V=vocalização) das espécies da RPPN Água Boa (Cacoal, Rondônia, Brasil).

Família	Especie	Tamanho do grupo (nº de avistamentos)	Abundância (grupos/10 km)	Tipo de registro
Cebidae	*Sapajus apella*	min.-máx.=1-12 x̄ ± d.p.=3,3 ± 2,3 (N=54)	7,8	C, E, V
Callitrichidae	*Saguinus weddelli*	min.-máx.=1-5 x̄ ± d.p.=3,1 ± 1,4 (N=14)	2,0	C, E, V
Aotidae	*Aotus nigriceps*	-	-	FC
Pitheciidae	*Callicebus* cf. *moloch*	min.-máx.=1-7 x̄ ± d.p.=3,5 ± 1,8 (N=14)	2,0	C, E, V
	Pithecia irrorata	min.-máx.=1-6 x̄ ± d.p.=3,1 ± 1,6 (N=6)	0,9	C, E, V
Atelidae	*Alouatta puruensis*	min.-máx.=2-9 x̄ ± d.p.=5,4 ± 2,5 (N=5)	0,7	C, E, V
	Ateles chamek	min.-máx.=1-11 x̄ ± d.p.=3,7 ± 2,5 (N=18)	2,6	C, E, V

Tabela 2. Riqueza de espécies de primatas, esforço amostral, número de avistamentos e taxa de avistamento em sete áreas de estudo no Estado de Rondônia.

Local	Área (ha)	Riqueza (nº spp.)	Esforço (km)	Nº de avistamentos	Abundância (grupos/10 km)	Fonte
Ouro Preto	201.334	7	493	177	3,5	Messias, 1999
Traçadal	22.540	6	170	69	4,1	Ferrari *et al.*, 2001
Serra da Cutia	283.501	7	199	84	4,2	Messias, 2003
Manoa	73.079	8	496	308	6,4	Ferronato, 2006
Samuel	71.061	7	317	236	7,4	Bonavigo, 2005
Nava	18.281	8	79	65	8,2	Messias, 2002
Água Boa (RPPN+ área adjacente)	**178**	**6**	**69**	**111**	**16,1**	**Presente estudo**

* Atlas Geoambiental de Rondônia (Rondônia, 2007). Legenda: Ouro Preto=Reserva Biológica Rio Ouro Preto; Traçadal=Reserva Biológica Traçadal; Serra da Cutia=Parque Nacional Serra da Cutia; Manoa=Fazenda Manoa; Samuel=Estação Ecológica Samuel; Nava=Estação Ecológica Antônio Mujica Nava; Água Boa=Reserva Particular do Patrimônio Natural Água Boa.

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REGISTRO DE *CALLICEBUS CINERASCENS* (SPIX, 1823) NO MÉDIO VALE DO GUAPORÉ, RONDÔNIA, BRASIL

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Na compilação de dados realizada por van Roosmalen et al. (2002), a distribuição geográfica de *Callicebus cinerascens* (Spix, 1823) era restrita ao interflúvio Tapajós-Juruena e Aripuanã-Roosevelt-Madeira, ignorando o registro de Miranda-Ribeiro (1914) para o sul do estado de Rondônia. Recentemente, Sampaio et al. (2012) registraram esta espécie em Vila Bela da Santíssima Trindade e Pontes e Lacerda no estado de Mato Grosso, e em Vilhena no estado de Rondônia. Esses registros ampliaram consideravelmente a extensão da distribuição geográfica da espécie, à qual alcança a margem direita do rio Guaporé. Souza et al. (2013) observaram um grupo com dois indivíduos na floresta do Campus de Colorado D'Oeste do Instituto Federal de Ciências e Tecnologia de Rondônia – IFRO, estendendo a distribuição da espécie mais ao sul do estado de Rondônia.

Callicebus cinerascens é um primata neotropical muito pouco estudado (Sampaio et al., 2012). As informações recentes descritas por Sampaio et al. (2012) e Souza et al. (2013) demonstram que a espécie carece de informações básicas. Este trabalho relata a ampliação da área de ocorrência da espécie na porção mais ocidental de sua distribuição geográfica, o vale do Guaporé Rondoniense.

A área de registro de *C. cinerascens* é caracterizada por floresta de terra firme do tipo Amazônica, Ombrófila Aberta (RadamBrasil, 1978), em paisagem altamente fragmentada principalmente pela substituição da floresta por plantações de soja e pastagens. A observação foi realizada de forma oportunista durante visita à região com um esforço amostral de 26 h. A identificação da espécie foi realizada com base na diagnose e fotografias publicadas por van Roosmalen et al. (2002) e Sampaio et al. (2012).

Um grupo com três indivíduos adultos foi observado na borda de um fragmento florestal contíguo à Área de Proteção Permanente (APP) do Sítio do Renato na margem direita do rio Guaporé (13°29'26,5"S, 61°55'43,5"O,
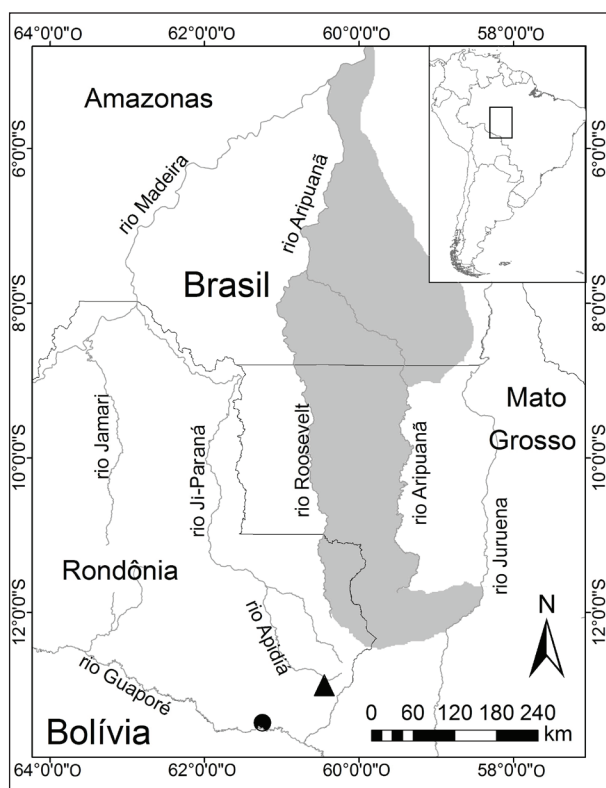
Figura 1. Mapa da distribuição geográfica de *C. cinerascens*; a área cinza representa a distribuição proposta por van Roosmalen et al. (2002), triângulo mostra o registro da espécie em Rondônia apresentado por Sampaio et al. (2012) e o círculo representa o novo registro no Vale do Guaporé, Pimenteiras, RO.

altitude 183,1 m a.n.m.m.), município de Pimenteiras do Oeste, médio Vale do Guaporé Rondoniense (Fig. 1), por volta das 16:00 do dia 2 de julho de 2013. É possível que este seja o limite ocidental de distribuição de *C. cinerascens*, pois não há registro da espécie para além dos extensos campos alagados do Parque Estadual Corumbiara (Gusmão e Aguiar, 2013).

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PREDAÇÃO OU NECROFAGIA DE *ALOUATTA GUARIBA CLAMITANS* POR *LEOPARDUS PARDALIS*?

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Theany Biavatti
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Relatos de predação de primatas são escassos na literatura primatológica em decorrência, principalmente, das dificuldades de registrar eventos rápidos e raros (Urbani, 2005) e por que muitas observações ocorrem durante estudos com enfoque nos predadores ao invés das presas (Ferrari, 2009). Dentre os animais que consomem primatas podemos destacar os rapinantes, carnívoros de médio e grande porte, outros primatas e répteis (Ford e Boinski, 2007; Ferrari, 2009; Bianchi et al., 2010; Quintino e Bicca-Marques, 2013). A predação de primatas por felinos selvagens tem sido amplamente reportada (Calleia et al., 2009). *Leopardus pardalis* Linnaeus, 1758 é o felino que apresenta o maior número de estudos relacionado à sua dieta, embora dados oriundos de populações da Mata Atlântica brasileira sejam escassos (Bianchi et al., 2010). Estudos têm sugerido uma relação entre o tamanho do corpo da presa e o do predador (Calleia et al., 2009). Para *L. pardalis* tem sido reportado principalmente o consumo de pequenos mamíferos (até 2 kg), cuja frequência varia em resposta à abundância local das presas (Bisbal, 1986; Emmons, 1987). Contudo, este felino pode se alimentar esporadicamente de presas de

maior porte (Konecny, 1989; Meza et al., 2002), como os bugios (*Alouatta* sp.) (Peetz et al., 1992; Miranda et al., 2006; Bianchi et al., 2010), seja via predação ou necrofagia (Crawshaw, 1995; Meza et al., 2002).

O presente estudo reporta o consumo de *A. guariba clamitans* por *L. pardalis* na Área de Relevante Interesse Ecológico (ARIE) Floresta da Cicuta (*ca.* 131 ha, 22°24'-22°38'S, 44°09'- 44°20'O, 300 - 500 m a.n.m.m.; Monsores et al., 1982), uma Unidade de Conservação de Uso Sustentável localizada nos municípios de Barra Mansa e Volta Redonda, Estado do Rio de Janeiro, Brasil. A região possui clima mesotérmico (Cwa), com inverno seco e verão quente e chuvoso, com elevados índices de umidade relativa do ar (Monsores et al., 1982). A ARIE está inserida na Floresta Estacional Semidecidual Submontana (IBGE, 1992) e é circundada por matas em estágio inicial ou médio de sucessão, antigos plantios de *Eucalyptus* spp. e pastagens (Alves e Zaú, 2005). A ARIE é habitada por cerca de 26 grupos de bugios-ruivos e uma população estimada em cerca de 150 indivíduos, sendo considerada uma das últimas populações do Vale do Paraíba do Estado do Rio de Janeiro (Alves e Zaú, 2005).

No dia 12/12/2012 foram encontradas fezes frescas de carnívoro (Fig. 1) em uma trilha permanente da ARIE. As fezes foram coletadas, acondicionadas em saco plástico e triadas para a realização de microscopia dos pelos-guarda em laboratório seguindo o protocolo de Quadros et al. (2006). Foram identificados pelos dos mamíferos *Leopardus pardalis*, *Alouatta guariba clamitans* e *Akodon cursor* Winge, 1887 (Fig. 2) com base em chaves dicotômicas de pelos (Ingberman e Monteiro-Filho, 2006; Vanstreels et al., 2010; Silveira et al., 2013).

Bianchi e Mendes (2007) reportam uma grande importância de *A. guariba clamitans* na dieta de *L. pardalis* na Estação Biológica de Caratinga (EBC; atualmente, Reserva Particular do Patrimônio Natural Feliciano Miguel Abdala) no Estado de Minas Gerais, Brasil. Segundo Bianchi et al. (2010), a elevada taxa de predação de bugios na EBC pode estar relacionada à sua alta densidade. A grande abundância em florestas alteradas pelo homem é uma característica populacional conhecida de *Alouatta* spp. (Ferrari, 2009), cenário este compatível com o encontrado na EBC por Bianchi e Mendes (2007) e na área do presente estudo. Crawshaw (1995) e Meza et al. (2002) reportaram o consumo de carniça por jaguatiricas por considerarem que espécies de mamíferos de maior porte são consumidas apenas ocasionalmente (*e. g.*, quando atropeladas). A distinção entre predação e necrofagia tem sido realizada com base na presença/ausência de larvas e pupas de moscas nas amostras fecais. Sua presença tem sido relacionada ao fato de as moscas poderem ovipositar poucos minutos após a morte do animal, embora a colonização das larvas dependa das condições climáticas (Smith, 1986). A confiabilidade desta evidência, no entanto, é comprometida quando o predador consome a carcaça logo após a morte do indivíduo e

Figura 1. Amostra fecal de *Leopardus pardalis* encontrada em dezembro de 2012 na **Área de Relevante Interesse Ecológico Floresta da Cicuta.**
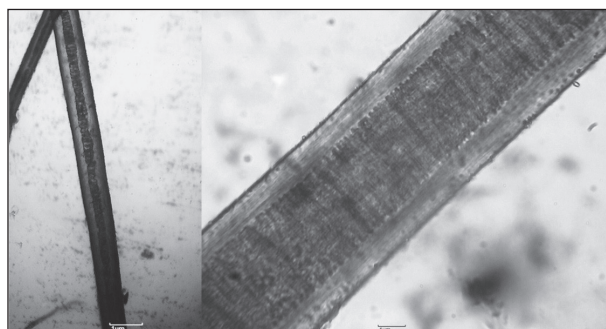
Figura 2. Imagens de pelos de *Alouatta guariba clamitans* e *Leopardus pardalis* encontrados nas fezes de *L. pardalis* vistas em microscópio óptico comum. (A) Medula do pelo de *A. guariba clamitans* [células da medula unisseriadas isoladas e semi-escalariformes – Ingberman e Monteiro-Filho, 2006]. (B) Medula do pelo de *L. pardalis* [células da medula em formato trabecular com margens fimbriadas e largura medular com mais de 2/3 da largura do pelo – Vanstreels et al., 2010].

quando as fezes do predador contêm larvas e pupas de dípteros coprófagos (*e.g.*, McAlpine et al., 1987; Francesconi e Lupi, 2012). A amostra fecal analisada no presente estudo estava fresca e continha muco, além de sinais de urina nas suas imediações (Fig. 1). À semelhança do registrado por Miranda et al. (2006), não foram observadas larvas ou pupas de moscas.

O consumo de *A. guariba clamitans* do presente relato pode estar relacionado a uma combinação de quatro fatores: (i) pequeno tamanho e (ii) isolamento da Unidade de Conservação, (iii) alta densidade de *A. guariba clamitans* e (iv) plasticidade alimentar de *L. pardalis*. Os dados disponíveis, no entanto, não permitem descartar a hipótese de se tratar de um caso de predação oportunística (Miranda et al., 2006), cujo impacto na população de bugios-ruivos seria, provavelmente, insignificante. Por fim, o uso experimental de armadilhas fotográficas para monitorar o destino e os consumidores de carniça de primatas (*e.g.*, Huang et al., 2014), aliado a análises dos pelos encontrados nas fezes de predadores, possui grande potencial para elucidar a relação entre os primatas e seus potenciais predadores.

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OCORRÊNCIA DE *SAPAJUS FLAVIUS* E *ALOUATTA BELZEBUL* NO CENTRO DE ENDEMISMO PERNAMBUCO

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Introdução

O primeiro registro de *S. flavius* foi realizado por Marcgrave (1648). Posteriormente, Schreber (1774) denominou o táxon como *Simia flavia*. Hershkovitz (1949) sugeriu que *S. flavia* era inidentificável e, mais tarde, o considerou sinônimo de *Cebus* (*Sapajus*) *libidinosus* (Hershkovitz, 1987). Entretanto, Oliveira e Langguth (2006), determinaram que *Simia flavia* era um táxon válido, atualmente reconhecido como *Sapajus flavius* (Lynch Alfaro et al., 2012). Igualmente citado por Marcgrave (1648), *Alouatta belzebul* apresenta distribuição disjunta, com uma população amazônica e outra restrita ao norte da Mata Atlântica (Bonvicino et al., 1989; Gregorin, 2006). Estas espécies compartilham grande parte de sua distribuição na região que corresponde ao Centro de Endemismo Pernambuco (CEP), o qual inclui todas as florestas entre os estados do Rio Grande do Norte e Alagoas e que, comparado a outros setores da Mata Atlântica, é o mais desmatado e o menos conhecido e protegido em unidades de conservação (Silva e Tabarelli, 2001). O primeiro levantamento da situação dos primatas na Paraíba, com destaque para *A. belzebul*, foi realizado há cerca de 20 anos (Oliveira e Oliveira, 1993). Recentemente, Feijó e Langguth (2013) compilaram os registros de coleções científicas.

Sapajus flavius é categorizado como Criticamente Em Perigo na Lista Vermelha da IUCN de 2010 (Oliveira et al., 2008), enquanto *Alouatta belzebul* consta como Vulnerável (Veiga et al., 2008). Embora não constem na Lista Oficial das Espécies da Fauna Brasileira Ameaçadas de Extinção (MMA, 2003), considerando a fragmentação e a perda de 93% da cobertura original da Mata Atlântica ao norte do Rio São Francisco (Tabarelli et al., 2005), torna-se plausível especular sobre um alto risco de extinção para *S. flavius* e para as populações de *A. belzebul* desta área de sua distribuição. Desta forma, este trabalho visou revisar as áreas de ocorrência dessas espécies no CEP.

Material e Métodos

Três espécies de primatas autóctones são encontradas no CEP: *S. flavius*, *A. belzebul* e *Callithrix jacchus*. A última está amplamente distribuída na região, com ocorrência, inclusive, em áreas urbanas. Para as duas primeiras foram compilados os registros de presença disponíveis na literatura e em material não-publicado de colaboradores (*e.g.*, fotografias) e de levantamentos realizados entre 2006 e 2009 em fragmentos florestais na área entre os paralelos 5°20' e 10°10'S. Equipes compostas por dois a três pesquisadores realizaram oito expedições, totalizando 30 dias de amostragem, a fim de vistoriar as localidades com ocorrência de *S. flavius* e *A. belzebul* descritas na literatura e obter registros de novas áreas. Informantes (especialmente agricultores, caçadores, indígenas e funcionários de usinas sucroenergéticas e de fazendas e, eventualmente, técnicos agrícolas e extensionistas) foram selecionados nas vizinhanças dos fragmentos florestais identificados em mapas cartográficos e imagens de satélite. Entrevistas informais, baseadas em um questionário semi-estruturado que visava averiguar o nível de conhecimento do entrevistado sobre as espécies de interesse e a indicação de áreas com presença atual ou pretérita das mesmas, foram realizadas com todos os informantes. Pranchas pictóricas de várias espécies de primatas foram empregadas, quando necessário, para auxiliar na entrevista e permitir o descarte de informantes contraditórios, à semelhança do realizado por Jerusalinsky (2007).

Os fragmentos com indicação de ocorrência de, pelo menos, uma espécie-alvo, foram visitados à procura de indícios diretos (avistamentos) ou indiretos (*e.g.*, fezes, carcaças, vocalizações e pedaços de cana-de-açúcar sobre as árvores). Os fragmentos com confirmação ou indicação confiável da presença dos primatas foram georreferenciados com auxílio de receptor GPS (*Global Position System*). Estimativas da área desses fragmentos foram obtidas nas entrevistas e confirmadas com auxílio do programa Spring (Câmara et al., 1996) por Silva e Fialho (2013), sempre que possível.

Resultados

Quarenta localidades com presença de *Sapajus flavius* e/ou *Alouatta belzebul* (22 somente com *S. flavius*, 11 somente com *A. belzebul* e sete com ambas as espécies) foram citadas em 247 entrevistas válidas. A ocorrência das espécies foi confirmada em 28% destas localidades por meio de indícios diretos e indiretos (*S. flavius*=8/29, *A. belzebul*=5/18; Fig. 1 e Tabela 1).

O estado do Rio Grande do Norte possui uma única área de Mata Atlântica com a presença de *S. flavius* e *A. belzebul*, a RPPN Senador Antônio Farias (06°26'14"S, 34°58'47"O), a qual atualmente representa o limite setentrional para ambos os táxons no bioma. O estado da Paraíba, por outro lado, concentra o maior número de registros e indicações de presença para ambas as espécies (19 para *S. flavius* e 10 para *A. belzebul*).

Os fragmentos ocupados ou com indicação de ocorrência possuem entre 10 e 3,000 ha, cerca de 1/4 dos quais possuem >1,000 ha. A soma de todas as áreas com indicação ou presença confirmada totalizou quase 32,000 ha. A área de ocupação de *S. flavius* foi estimada em 23.500 ha e a de *A. belzebul* em 15,600 ha. As espécies ocorrem em sintopia em 4,600 ha. De modo geral, os fragmentos visitados parecem apresentar um risco muito baixo de serem totalmente suprimidos, apesar de serem frequentemente usados como fonte de lenha, subprodutos florestais (*e.g.*, lenha e mel) e/ou local de caça pela população circundante.

Em relação à proteção legal destas áreas, quatro fragmentos habitados por *S. flavius* estão localizados em unidades de conservação (UC) e quatro estão inseridos em terras indígenas. Por sua vez, seis fragmentos habitados por *A. belzebul* estão em unidades de conservação e um se encontra em terra indígena (Tabela 1).

Discussão

A situação das populações de ambas as espécies no Centro de Endemismo Pernambuco parece bastante crítica. Suas populações estão restritas a poucos fragmentos, em sua maioria, relativamente isolados. *Alouatta belzebul* pode estar em uma situação mais crítica, pois é a espécie de primata mais caçada na região e parece ocorrer em um número menor de fragmentos florestais. Embora *S. flavius* ocorra em um maior número de fragmentos, apenas sete deles (24%) apresentam área superior ao mínimo necessário (952 ha), segundo Montenegro (2011), para suportar populações demográfica e geneticamente viáveis em longo prazo. Oliveira e Oliveira (1993) identificaram nove áreas com macacos-prego (*S. flavius*) na Mata Atlântica da Paraíba, duas das quais (mata do Grotão e mata do Silva, esta última em terras indígenas potiguaras) desapareceram em decorrência de desmatamento para implantação de "roças". Em relação a *A. belzebul* foi possível detectar pelo menos uma extinção local em Alagoas (mata da Usina Sinimbu; 9°55'S, 36°08'O; Langguth et al., 1987). Contudo, embora imprecisos no espaço e no tempo, relatos de ocorrência pretérita das duas espécies foram recorrentes. Remetiam, em especial, às décadas de 1970 e 1980, quando da

Tabela 1. Localidades com indicação ou confirmação de presença de *Sapajus flavius* e *Alouatta belzebul* no Centro de Endemismo Pernambuco.

Localidade	Município/UF	*Sapajus flavius*	*Alouatta belzebul*	Coordenadas	Área (ha)
RPPN Senador Antônio Farias (Mata Estrela)*	Baía Formosa/RN	1, E, F	1, E, F	06°26'14.0"S 34°58'46.6"O	620
Millennium	Mataraca/PB	E		06°33'28.6"S 34°58'16.2"O	500
Estação Experimental de Camaratuba (Asplan) e Fazenda Jaçanã	Mamanguape/PB	2, C (UFPB5100, 5104), E, V		06°34'12.5"S 35°07'53.5"O	110
Estação Ecológica Estadual do Pau Brasil*	Mamanguape/PB	E, I		06°36'37.9"S 35°07'59.0"O	90
Jardim (parcialmente Terra Indígena Potiguara)	Rio Tinto/PB	3, E		06°38'15.6"S 35°03'41.5"O	100
Cajarana/Águas Claras (parcialmente Terra Indígena Potiguara)	Rio Tinto/PB	3, E	3, E	06°38'47.8"S 35°05'04.5"O	40
Grupiúna (Terra Indígena Jacaré de São Domingos)	Rio Tinto/PB	E		06°43'54.8"S 35°06'21.5"O	140
Rio Vermelho (Terras indígenas Jacaré de São Domingos e Monte Mor)	Rio Tinto/PB	3, E		06°45'30.4"S 35°06'29.8"O	1.000
SEMA 2 (Reserva Biológica Guaribas)*	Mamanguape/PB		R	06°43'33.8"S 35°10'56.9"O	2.350
Italiana	Rio Tinto/PB	E		06°55'50.5"S 35°04'44.7"O	~1.400
Capitão/Sucupira/Pau Brasil	Santa Rita/PB	E		06°57'36.2"S 35°04'26.2"O	650
Barra do rio Miriri (Área de Proteção Ambiental Mamanguape)*	Mamanguape/PB	E		06°51'37.0"S 34°54'37.0"O	515
Dois Rios	Santa Rita/PB	3, E	3, E	06°57'44.1"S 35°06'10.2"O	520
Sucupira/São João/Jacuípe	Santa Rita/PB	3, E	3, E	07°00'54.4"S 35°05'27.7"O	1.230
RPPN Pacatuba*	Sapé/PB		4, C (UFPB414, 415, 416, 2761) V	07°02'34.2"S 35°09'15.9"O	170
Assentamento Santa Helena	Santa Rita/PB		E	07°02'39.4"S 35°07'59.3"O	260
Bruxaxá	Santa Rita/PB	E		07°03'29.7"S 35°05'19.8"O	720
Paú de Zé Bedias/Oiteiro	Santa Rita/PB	3, E		07°04'40.3"S 35°00'42.7"O	450
Açude dos Reis	Santa Rita, Cruz do Espírito Santo/PB		3, E, V	07°09'09.9"S 35°01'19.9"O	1.280
Cafundó	Santa Rita/PB		3, E	07°11'34.1"S 35°05'17.7"O	165
Buraquinho (Jardim Botânico)	João Pessoa/PB	R		07°08'44.7"S 34°51'38.7"O	390
RPPN Engenho Gargaú*	Santa Rita/PB	3, C, E, V	3, E, V	07°01'30.6"S 34°57'28.2"O	1.615
Fazenda Pau Brasil 1	Santa Rita/PB	E, I	E	06°59'38.8"S 34°55'16.8"O	380
Fazenda Pau Brasil 2 (corredor-mangue)	Santa Rita/PB	E, I		07°00'24.6"S 34°54'56.9"O	100
Córrego do Inferno	Caaporã/PB Goiana/PE	2, C (UFPB5091), E, V		07°30'47.7"S 34°58'33.2"O	215
Bujari (Usina Santa Teresa)	Goiana/PE	E, F		07°36'3.1"S 34°59'32.8"O	1.065

Tabela 1., cont.

Localidade	Município/UF	*Sapajus flavius*	*Alouatta belzebul*	Coordenadas	Área (ha)
Oito Porcos (Serra dos Mascarenhas)	São Vicente Férrer/PE	E, V		07°36'29.1"S 35°28'05.9"O	300
Água Azul (Usina Cruanji, Serra dos Mascarenhas)	Timbaúba/PE	E, V		07°36'33.0"S 35°23'31.0"O	~3.000
Mata dos Macacos (Usina São José)	Igarassu/PE	E		07°46'39.4"S 35°00'46.8"O	180
Usina Salgado	Ipojuca/PE	5, E		08°31'32.8"S 35°03'09.4"O	40
Engenho Sacramento	Água Preta/PE		6, E, F	08°42'45.6"S 35°24'14.1"O	80
Estação Ecológica Murici*	Murici/AL		4, C (MN25671, 25672, 25905)	09°15'45.4"S 35°50'10.9"O	~3.000
Santa Justina (Usina Santo Antônio)	Passo de Camaragibe, Matriz de Camaragibe/AL	C (MN26625), E		09°13'38.7"S 35°30'02.6"O	~2.000
Junco (Usina Caeté)	Jequiá da Praia/AL	E	E	09°52'55.1"S 36°03'50.3"O	~2.000
Mata dos Macacos (Usina Coruripe)	Coruripe/AL	E		10°06'46.8"S 36°18'28.7"O	130
Usina Porto Rico	Campo Alegre/AL	E		09°45'26.7"S 36°14'07.3"O	660
RPPN Santa Tereza*	Atalaia/AL		E	09°31'00.4"S 35°58'55.8"O	430
Usina Coruripe 1	Coruripe/AL		E	10°00'57.3"S 36°13'39.3"O	520
Usina Coruripe 2	Coruripe/AL		E	10°02'06.3"S 36°10'56.0"O	10
Usina Coruripe 3	Coruripe/AL		E	10°00'28.5"S 36°17'43.2"O	950

* = Unidades de Conservação. RPPN = Reserva Particular do Patrimônio Natural. Referências: 1 = Gabriel et al. (2005); 2 = Oliveira e Langguth (2006); 3 = Oliveira e Oliveira (1993); 4 = Langguth et al. (1987); 5 = Pontes et al. (2006); 6 = Souza e Monteiro da Cruz (2005). C=coleta (número de coleta do indivíduo ou material biológico), E=entrevista, F=fotos, I=indícios, R=reintrodução, V=visualização.

implantação do programa governamental Pró-Álcool que visava o estímulo à produção deste biocombustível.

Embora *S. flavius* esteja presente em uma UC de Proteção Integral, cabe destacar que a mesma não possui isolamento do entorno, sinalização, infraestrutura e fiscalização. Além disso, residentes vizinhos à UC relatam a eventual captura de animais para uso como animais de estimação ou consumo. *Alouatta belzebul*, entretanto, dispõe de uma situação ligeiramente melhor em relação à sua presença em unidades de conservação, embora tenha sido registrada em um número menor de fragmentos. Cabe destacar que a população da REBIO Guaribas é, em sua totalidade, produto da liberação de animais translocados e apreendidos (Garcia et al., 2011). Apesar de ambas as espécies estarem presentes em terras indígenas potiguaras, a situação demográfica destas populações é desconhecida.

O presente estudo constitui um marco referencial para proposição de ações para a conservação das espécies, embora não elimine a possibilidade de existirem outras áreas habitadas por estes primatas no CEP. Entre as medidas prioritárias para a conservação de *S. flavius* e *A. belzebul* nesta região destacam-se a formação de corredores entre os fragmentos remanescentes, a translocação de indivíduos, a reintrodução e/ou o reforço populacional. Estas ações visariam atenuar os efeitos negativos da endogamia e aumentar a probabilidade de persistência em longo prazo das metapopulações (ICMBio, 2011).
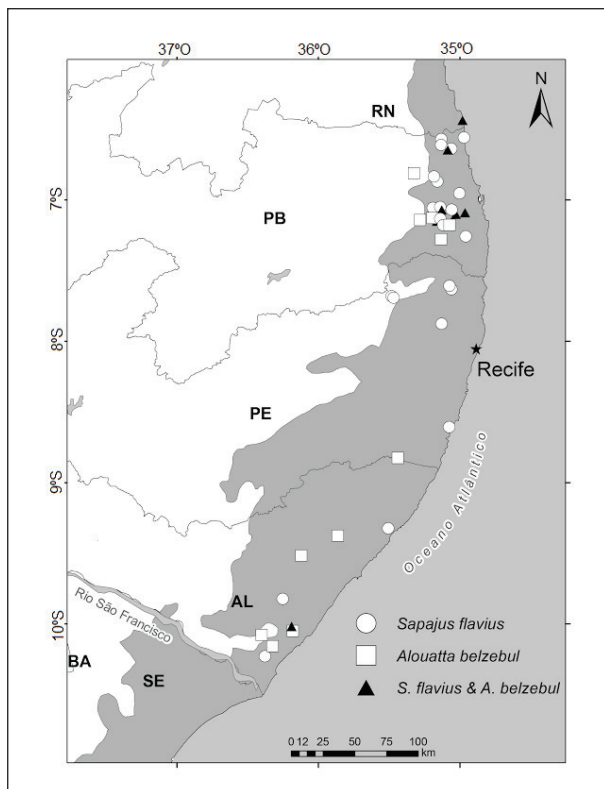
Agradecimentos

Figura 1. Áreas com indicação ou confirmação de presença de *Sapajus flavius* e *Alouatta belzebul* no Centro de Endemismo Pernambuco, Brasil.

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CAPTURE OF A COMMON MARMOSET (*CALLITHRIX JACCHUS*) BY A CAPUCHIN MONKEY (*SAPAJUS* SP.) IN THE IBURA NATIONAL FOREST, SERGIPE (BRAZIL)

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Introduction

Together with chimpanzees and baboons, capuchins (*Cebus* and *Sapajus* spp.) are the most carnivorous – rather than insectivorous – nonhuman primates (Freese and Oppenheimer, 1981; Rose, 1997). Capuchins are known to feed on a wide range of vertebrate prey, including mammals (Resende et al., 2003; Rose et al., 2003; Cunha et al., 2006; Milano and Monteiro-Filho, 2009; Palmeira and Pianca, 2012; Rodrigues, 2013), and other monkeys (Sampaio and Ferrari, 2005; Carretero-Pinzón et al., 2008). However, while marmosets and tamarins (Callitrichidae) are found throughout most of the geographic range of the capuchins, and are of similar size to the mammalian prey typically captured by these larger monkeys, no predation events involving callitrichids have ever been recorded. The present study reports on the capture of a common marmoset (*Callithrix jacchus*) by an adult male capuchin at a site in northeastern Brazil. The observed sequence of events indicates concerted group foraging behavior and an ambush type of strategy on the part of the adult male that captured the marmoset.

Methods

The event reported here was observed during fieldwork at the 144 hectare Ibura National Forest (10°51' S, 37°07' W) in Nossa Senhora do Socorro, Sergipe, northeastern Brazil, on February 23rd, 2013. The local forest is inhabited by at least eight marmoset (*C. jacchus*) groups, and a group of capuchins, with five members at the time of the present observation. As a number of confiscated capuchins have been released into the forest in recent years, it is unclear which species are represented in the local population, especially as many of the individuals present pelage more characteristic of *Sapajus nigritus* or *Sapajus libidinosus* than *Sapajus xanthosternos*, the native local species (Rylands *et al.*, 2013). Given this, the members of the capuchin group were classified as *Sapajus* sp. for the purposes of the present study.

Results

At 06:20 h on February 23rd, 2013, a number of animals – both capuchins and marmosets – were observed moving

Figure 1. Adult male tufted capuchin (*Sapajus* sp.) responsible for the attack on a marmoset in the Ibura National Forest, Sergipe (Brazil), showing its distinctive tail. Photo: Natasha

rapidly within the dense crowns of fruit-bearing mango (*Mangifera indica*) trees at heights of 10–13 m. Members of both species were emitting intense vocalizations, and eight marmosets were observed moving rapidly on horizontal branches, more dispersed in the lower strata in at least three trees, followed by at least three capuchins, more closely grouped together, with the adult (alpha) male at the front and a female carrying an infant behind. The distribution and movements of the animals indicated that the capuchins were chasing the marmosets.

As the animals approached each other, the alpha male (*Sapajus libidinosus* morphotype), easily distinguished by its amputated tail (Fig. 1), was observed resting in dense foliage close to the branches along which the marmosets were moving. The capuchin then snatched at an adult marmoset as it passed and captured the monkey in its right hand. As soon as it caught the marmoset, the alpha male moved rapidly out of sight, followed by the other capuchins, which now ignored the marmosets. Although no predation was observed directly, the sequence of events indicates clearly that the capuchin killed and presumably ingested the marmoset. The remaining marmosets continued moving rapidly and vocalizing excitedly for approximately one minute and then also moved away into the forest. The whole sequence of events lasted around 10 minutes.

The sequence of events observed here indicates that the alpha male capuchin had been waiting in anticipation of an opportunity to ambush a passing marmoset. This contrasts with the behavior of the other capuchins, which were chasing the marmosets actively, although it is unclear whether this represented a purposeful attempt to capture one of these monkeys or to displace them from a food source (mango tree) in a form of interference competition. The alpha male was observed actively attempting to capture marmosets on

two other occasions, in April 2013. During each of these events, however, the capuchin pursued the marmosets and attempted to snatch them using both hands, rather than waiting in ambush. While the marmosets often reacted to the presence of the capuchin group with alarm and mobbing vocalizations, and evasive behavior, they were also observed frequently in the vicinity of the capuchins without reacting to their presence, even in feeding trees.

Discussion

The events reported here are not totally unexpected, given the predatory potential of capuchins (Sampaio and Ferrari, 2005; Carretero-Pinzón *et al.*, 2008), although in most cases, it seems likely that the small size and agility of the marmosets may ensure that they avoid predation by other mammals (Ferrari, 2009). Given this, a surprise attack or ambush, as observed in the present study, may normally be the only viable approach for the capture of a marmoset. In the event observed here, even if the behavior of the capuchins did represent a concerted attempted to capture marmoset prey, as proposed by Rose (1997) for *Cebus capucinus*, it seems unlikely that this represented a coordinated hunting strategy, such as that observed in chimpanzees (Nishida, 1992; Boesch, 1994).

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Recent Publications

BOOKS

Distributions and Phylogeography of Neotropical Primates: A Pictorial Guide to All Known New-World Monkeys, by Marc G. M. van Roosmalen, Stephen D. Nash and Piero Gozzaglio. 2014. CreateSpace Independent Publishing Platform. 72 pp. ISBN: 978-1494852535. This is the first complete pictorial field guide to all the known Neotropical Primates. All taxa are depicted in full color according to their phylogeography. Included are also a number of recently identified but not yet published taxa new to science.

The Evolution of Social Communication in Primates: A Multidisciplinary Approach, edited by Marco Pina and Nathalie Gontier. 2014. Springer. 326pp. ISBN: 978-3319026688. In this volume the evolutionary origins of social communication in primates is analyzed. Epistemological frameworks associated with primate communication and language evolution are addressed. Chapters highlight cross-fostering and language experiments with primates, primate mother-infant communication, the display of emotions and expressions, manual gestures and vocal signals, joint attention, intentionality and theory of mind. *Contents:* 1) Studing social communication in Primates – Gontier, N. & Pina, M.; 2) Lord Monboddo's *Ourang-Outang* and the origins and progress of language – Blancke, S.; 3) Ferality and morality: the politics of the "forbidden experiment" in the twentieth century – Swart, A.; 4) Experimental conversations: sing language studies with chimpanzees – Jensvold, M. L.; 5) How primate mothers and infants communicate – Botero, M.; 6) On prototypical facial expressions versus variation in facial behavior – Gaspar, A., Esteves, F. & Arriaga, P.; 7) The evolution of joint attention: a review and critique – Racine, T. P., Wereha, T. J., Vasileva, O., Tafreshi, D. & Thompson, J. J.; 8) Describing mental states: From brain science to a science of mind reading – Nagataki, S.; 9) Bodily mimesis and the transition to speech – Zlatev, J.; 10) From grasping to grooming to gossip: innovative use of chimpanzees signals in novel environments supports both vocal and gestural theories of language origins – Leavens, D. A., Taglialatela, J. P., & Hopkins, W.; 11) Reevaluating chimpanzee vocal signals: toward a multimodal account of the origins of human communication – See, A.; 12) Communication and human uniqueness – Tattersall, I.; 13) How did humans become behaviorally modern? Revisiting the "art first" hypothesis – Nolan, R.; 14) Experiments and simulations can inform evolutionary theories of the cultural evolution of language – Tamariz, M.; 15) The emergence of modern communication in primates: a computational approach; 16) What can an extended synthesis do for biolinguistics: on the needsand benefits of Eco-Evo-Devo program – Boeckx, C.

The Woolly Monkey: Behavior, Ecology, Systematics, and Captive Research, edited by Thomas Defler and Pablo R. Stevenson. 2014. Springer. 302pp. ISBN: 978-1493906963. This book placed together a number of recent woolly monkey studies from three Amazonian countries, including five taxa of woolly monkeys, four of which have recently been reclassified without using new biological criteria as species rather than subspecies. *Contents:* 1) Introduction: studying woolly monkeys – Stevenson, P. R. & Defler, T. R.; 2) Coat color is not an indicator of subspecies identity in Colombian woolly monkeys – Botero, S. & Stevenson, P. R.; 3) Colombian *Lagothrix:* analysis of their phenotypes and taxonomy – Defler, T. R.; 4) Behavior and husbandry of a captive group of woolly monkeys: a case study – White, B. C. & Zirkelbach, S.; 5) Clinical experience and diseases of the woolly monkey (*Lagothrix lagothticha*) at the Louisville zoo- Burns, R.; 6) Recent advances in woolly monkey nutrition – Ange-van Heugten, K. D.; 7) Effect of housing conditions and diet on the behavior of captive woolly monkeys (*Lagothrix*) – Guzmán-Caro, D. C. & Stevenson, P. R.; 8) Life history, behavior and development of wild immature lowland woolly monkey (*Lagothrix poeppigii*) in Amazonian Ecuador – Schmitt, C. A. & Di Fiore, A.; 9) Seed dispersal by woolly monkeys (*Lagothrix lagothricha*) at Caparú biological station (Colombia): quantitative description and qualitative analysis – Gonzalez, M. & Stevenson, P. R.; 10) Ranging behavior, daily path lengths, diet and habitat use of yellow-tailed woolly monkeys (*Lagothrix flavicauda*) at La Esperanza, Peru – Shanee, S.; 11) Vocal communication in woolly monkeys (*Lagothrix lagothricha lugens*) in Cueva de los Guacharos National Park, Colombia –Leon, J., Vargas, S. A., Ramírez, M. A., Galvis, N. F., Cifuentes, E. F. & Stevenson, P. R.; 12) Potential determinants of the abundance of woolly monkeys in Neotropical forests – Stevenson, P. R.; 13) Behavioral ecology and interindividual distance of woolly monkeys (*Lagothrix lagothricha*) ina rainforest fragment in Colombia – Zárate, D. A. & Stevenson, P. R.; 14) Notes on the behavior of captive and released woolly monkeys (*Lagothrix lagothricha*): reintroduction as a conservation strategy in Colombian Southern Amazon – Millán, J. F., Bennett, S. E. & Stevenson, P. R.; 15) Population viability analysis of woolly monkeys in Western Amazonia – Lizcano, D. J., Ahumada, J. A., Nishimura, A. & Stevenson, P. R.; 16) Yellow tailed woolly monkey(*Lagothrix flavicauda*): conservation status, anthropogenic threats, and conservation initiatives – Shanee, N. & Shanee, S.

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Meetings

2015

SPRING MEETING OF THE PRIMATE SOCIETY OF GREAT BRITAIN

The spring meeting of the Primate Society of Great Britain, will be held in Roehampton University, London, UK from 9-10 April, 2015. For more details contact Dr. Todd Rae, t.rae@roehampton.ac.uk or see the website www.psgb.org/meetings.php

38TH MEETING OF THE AMERICAN SOCIETY OF PRIMATOLOGISTS

The 38th meeting of the American Society of Primatologists (ASP) will be held at the Riverhouse Hotel and Convention Center in Bend, Oregon, USA from June 17 - 20, 2015. For more information please visit www.asp.org/meetings/conference.cfm

6TH CONGRESS OF THE EUROPEAN FEDERATION FOR PRIMATOLOGY (EFP)

The 6th Congress of the European Federation for Primatology (EFP) is scheduled to take place at the Science Department of Roma Tre University, Rome, Italy from 25-28 August, 2015. In the same place and in the same dates is scheduled also the 22' API Congress. For more information please visit www-3.unipv.it/webbio/api/api.htm

114 ANNUAL MEETING OF THE AMERICAN ANTHROPOLOGICAL ASSOCIATION

The 114 annual meeting of the American Anthropological Association will be held in Denver, Colorado, USA from November 18-22, 2015. Familiar – Strange. Casting common sense in new light by making the familiar seem strange and the strange seem familiar is a venerable strategy used across anthropology's subfields. It can denaturalize taken-for-granted frames and expand the horizons of students and public alike. But useful as this process of estrangement and familiarization can be, it can lapse into exoticism through "us/them" comparisons that veil historical and contemporary relations of power and powerlessness within and across societies, begging the question of the normative templates (of the "West," of "whiteness") that lurk behind. As an orienting theme for the 2015 Denver meeting the AAA invite proposals for Executive Program Committee sponsorship (sessions, forums, special events, installations or media submissions) that press us to grapple with how and why this strategy proves both productive and obstructive, considering what it simultaneously opens up and 'nails down. For more information please visit www.aaanet.com/meetings/index.cfm

THE 2015 ASSOCIATION OF PRIMATE VETERINARIANS WORKSHOP

The Association of Primate Veterinarians and the National Research Council's ILAR Roundtable invites to join this free workshop where experts from around the world will discuss established performance standards and how they might be improved to conform with today's experimental environment. The 2015 workshop will be held in Phoenix, Arizona, USA from October 28-31. More information will be available in the coming months. April 20-21, 2015

2016

JOINT MEETING OF THE INTERNATIONAL PRIMATOLOGICAL SOCIETY AND THE AMERICAN SOCIETY OF PRIMATOLOGISTS

Hosted by Lincoln Park Zoo's Lester Fisher Center for the Study and Conservation of Apes, will be held in Chicago, Illinois, USA from August 21-27, 2016. For more information please visit www.ipschicago.org

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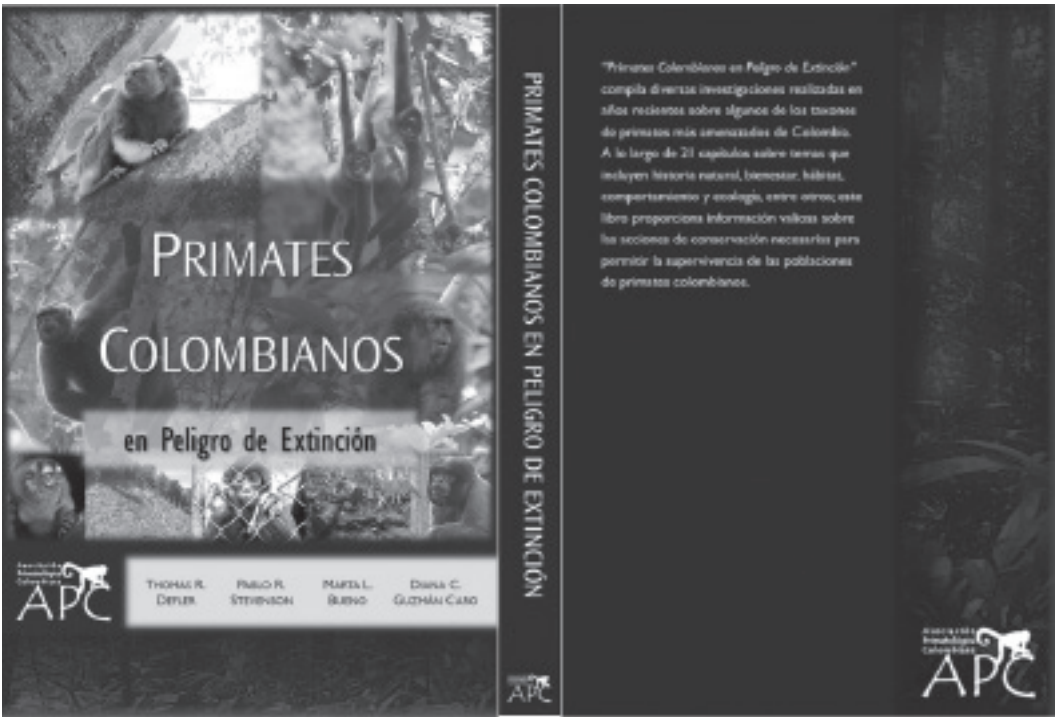
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Notes to Contributors

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), Bioge-ography, 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 descrip-tions, 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.

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