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Front cover: Individual of *Pithecia irrorata* observed in Chupinguaia-RO. Photo: Kurazo Matheus Okada Aguiar.

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ARTICLES

THE ECOLOGY OF TRUNK-TO-TRUNK LEAPING IN *SAGUINUS FUSCICOLLIS*: IMPLICATIONS FOR UNDERSTANDING LOCOMOTOR DIVERSITY IN CALLITRICHINES

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Abstract

Several species of callitrichines (tamarins, marmosets, and callimicos) are reported to frequently leap between vertical supports when foraging and traveling in the forest understory. In the present study, we examine trunk-to-trunk leaping in a wild group of four habituated adult saddleback tamarins (*Saguinus fuscicollis weddelli*) in northern Bolivia. From June through July, 2011 we analyzed 200 leaps in which the tamarins moved between vertical supports. On average, takeoff height was 4.1 m (±1.3 m, range 1-7.5 m). During the airborne phase of travel the monkeys lost an average of 0.5 m (±0.5 m) at contact with the landing support, and the mean distance leapt was 1.4 m (± 0.7 m). We found no correlation between the diameter at breast height (DBH) of landing and takeoff supports, and either the distance leapt or height gained/lost during leaping. Across callitrichine taxa, it appears that ecological distinctions in diet, patterns of habitat utilization, and predator avoidance strategies have played an important role in understanding the frequency and context of trunk-to-trunk leaping behavior.

Keywords: Tamarins, marmosets, positional behavior, vertical clinging and leaping, habitat utilization

Resumen

Muchas especies de callitrichinos (tamarinos, titís, y callimicos) se caracterizan por saltar frecuentemente entre substratos verticales durante el forrajeo y los desplazamientos en el sotobosque. En este estudio, examinamos los saltos de tronco a tronco en un grupo habituado de cuatro tamarinos de cabeza amarilla silvestres (*Saguinus fuscicollis weddelli*) en el norte de Bolivia. Durante junio y julio 2011 analizamos 200 saltos de los tamarinos entre substratos verticales. El promedio de la altura de despegue fue 4.1 m (±1.3 m, rango 1-7.5 m). En la fase aérea del salto, los individuos perdieron un promedio 0.5 m (±0.5 m) de altura al llegar al área de aterrizaje y la distancia promedio saltada fue 1.4 m (± 0.7 m). No encontramos ninguna correlación entre el diámetro a la altura del pecho (DAP) de los substratos de despegue y aterrizaje, y la distancia saltada o la altura ganada/perdida durante el salto. Las diferencias ecológicas en la dieta, los patrones de uso de hábitat y las estrategias para evitar la depredación, parecen haber jugado un papel importante para entender la frecuencia y el contexto del comportamiento de salto de tronco a tronco en los diferentes taxa de callitrichinos.

Palabras clave: Tamarinos, titís, comportamiento postural, salto desde y abrazarse a soportes verticales, utilización del hábitat

Introduction

Several species of primates including strepsirhines, tarsiers, *Pithecia pithecia,* and callitrichines are commonly reported to leap between vertical and/or sharply inclined supports when foraging and traveling in the forest understory (Garber 1991; Demes et al., 1995, 1999; Walker 1998; Youlatos, 1999, 2009; Garber and Leigh, 2001, Crompton et al., 2010). Traditionally, researchers have described this pattern of positional behavior as vertical clinging and leaping (Napier and Walker, 1967; Kinzey et al., 1975; Gebo, 2011). From a functional perspective, vertical clinging and leaping is composed of two component behaviors: vertical clinging in which an individual adopts a relatively stable upright posture on a trunk or other vertical support, either by grasping the support with their hands and feet or by embedding their claw-like nails into the bark, and leaping between vertical supports which requires powerful and rapid hindlimb extension and propulsion during takeoff, orientation of the body at a subvertical or inclined angle (45° represents the ballistic optimum, Crompton et al., 2010), and an ability to absorb large compressive forces when landing on a noncompliant substrate (Demes et al., 1995; Garber et al., 2009). Given that clinging to a vertical support and leaping between vertical supports represent two distinct modes of positional behavior, we refer to leaping between vertical supports as trunk-to-trunk leaping.

In this paper we present data on trunk-to-trunk leaping in Weddell's saddleback tamarin, *Saguinus fusciciollis weddelli*, in northwestern Bolivia. Field studies indicate that between 20-89% of leaping in *S. fuscicollis* involves movement to and from vertical supports (Table 1). Saddleback tamarins are the smallest tamarin species, are characterized by forelimb elongation, in particular the distal segments, and possess the highest intermembral index (IMI or the ratio of forelimb length to hindlimb length) among members of the genus *Saguinus* (Falsetti and Cole, 1992; Garber and Leigh, 2001; Davis, 2002). Among callitrichines, trunk-to-trunk leaping is reported to be a major component of the locomotor repertoire in *Callimico goeldii* (callimicos) (Garber and Leigh, 2001; Garber and Porter, 2009), *Cebuella pygmaea* (pygmy marmosets) (Kinzey et al., 1976; Youlatos (1999, 2009), *S. fuscicollis* (saddleback tamarins) (Garber, 1991; Garber and Leigh, 2001; Nyakatura and Heymann 2010) and *Saguinus tripartitus* (golden-mantled tamarins) (Youlatos, 1999) (Table 1). Given differences among these taxa in body mass (adult female body mass: *C. goeldii* - 468gm, *S. fuscicollis* - 358gm, *C. pygmaea* – 122gm, body mass data for wild *S. tripartitus* are not available; Smith and Jungars (1997), fore- and hindlimb proportions (IMI in *C. goeldii*:70.6, *S. fuscicollis*: 77.1, *C. pygmaea*: 82.3, no data are available for *S. tripartitus*; Davis, 2002), patterns of habitat utilization, and feeding ecology (e.g., bamboo fungi are a dietary staple for *C. goeldii*, trunk exudates are a dietary staple for *C. pygmaea*, and insects, ripe fruits, exudates, and floral nectar are critical components of the diet of *S. fuscicollis* and *S. tripartitus*, reviewed in Digby et al. 2011), we anticipate significant differences in the frequency and context of trunk-to-trunk leaping and the use of trunks as a foraging substrate (Garber et al. 2009).

Table 1. Frequency of trunk-to-trunk leaping during travel in callitrichine primates.

Species	Trunk-to trunk leaps (% of locomotor samples)	Trunk-to-trunk leaps (% of all leaps)	Reference
Saguinus fuscicollis nigrifrons[1]	38.4	89.2	Nyakatura and Heymann 2010
Saguinus fuscicollis nigrifrons	24.0	54.5	Norconk 1986
Saguinus fuscicollis nigrifrons	20.8	39.7	Castro 1991
Saguinus fuscicollis nigrifrons	6.1	20.7	Garber 1991
Saguinus fuscicollis weddelli	11.1	67.5	Porter 2004
Saguinus fuscicollis weddelli	6.7	20.0	Garber and Leigh 2001
Saguinus tripartitus	5.8	17.5	Youlatos 1999
Saguinus geoffroyi	1.6	3.8	Garber 1991
Saguinus midas	1.9	7.3	Youlatos unpub. data
Saguinus mystax[2]	8.2	58.9	Nyakatura and Heymann 2010
Saguinus mystax	2.7	8.8	Garber 1991
Saguinus labiatus	2.8	8.4	Garber and Leigh 2001
Saguinus labiatus	2.3	10.9	Porter 2004
Leontopithecus rosalia[3]	2.8	8.9	Stafford et al. 1996
Callimico goeldii	23.1	55.1	Garber and Leigh 2001
Callimico goeldii	47.4	88.6	Porter 2004
Callithrix jacchus[4]	0.6	2.9	Youlatos unpub. data
Cebuella pygmaea	12.9	35.1	Youlatos 1999
Cebuella pygmaea	15.3	36.7	Youlatos 2009

[1]- Data from this study of *S. fuscicollis nigrifrons* were extrapolated based on Table 1 and Figure 1 from Nyakatura and Heymann (2010). These authors do not provide quantitative data on both takeoff and landing platform orientation during leaping but state "almost all leaps were associated with vertical clinging and leaping behavior" (page 246).

[2]- Data from this study of *S. mystax* were extrapolated based on Table 1 and Figure 1 from Nyakatura and Heymann (2010). These authors do not provide quantitative data on both takeoff and landing platform orientation during leaping but state "Leaps occurred mostly on vertical inclines from trunk to trunk (vertical clinging and leaping behavior), but were also observed on other inclines, often connecting terminal branches of different trees. *S. mystax* displayed much less vertical clinging and leaping than *S. fuscicollis*" (page 246).

[3]- Data for wild *Leonopitheucs rosalia* were extrapolated from data presented in Figure 4 and Table 5 from Stafford et al. (1996) and include leaps in which trunks were used either as landing or takeoff platforms.

[4]-Data for *Callithrix jacchus* based on preliminary observations of a semi-natural group inhabiting the Botanical Gardens, Rio de Janeiro, Brazil.

Methods

During June and July, 2011, we collected behavioral and ecological data on a group of four adult saddleback tamarins (*S. fuscicollis weddelli*, three adult males and one adult female) inhabiting a mixture of primary forest, maturing secondary forest, bamboo forest, disturbed secondary forest, and stream edge forest in the Department of the Pando in northern Bolivia (Camp Callimico, 11°23'S, 69°06'W). This area of the Amazon Basin experiences pronounced dry and rainy seasons (with rainfall averaging approximately 2,000 mm per year, Porter, 2001).

On 7 of 22 full-day follows, we opportunistically recorded a total of 200 trunk-to-trunk leaps. Our study group of saddleback tamarins was fully habituated to the presence of observers, and had been the focus of previous studies in 2008 and 2009 (Porter and Garber, 2011). To ensure that our presence had a negligible effect on tamarin locomotor behavior or the distance leapt, we followed the monkeys daily for a period of two weeks prior to collecting data on leaping. For each leap the following information was collected: takeoff and landing height, the horizontal distance leapt, support type, height gained or height lost during travel, and diameter at breast height (DBH) of takeoff and landing supports. All measurements were taken immediately after we observed the tamarin to leap. Takeoff height and landing height were estimated by placing a 1.5 m tape on the substrate for scale. Height gain or height loss during a leap was calculated as takeoff height minus landing height. However to be conservative, in our analyses we consider height gains or height losses of ±0.25 m to reflect horizontal travel (no effective change in height). DBH was measured using a metric tape.

Takeoff and landing supports were scored either as tree trunk, liana, or woody bamboo. All vertical supports leapt to and from were considered in our analysis (we did not have a size threshold). The horizontal distance leapt was calculated by measuring the distance between the landing and takeoff supports using a metric tape. Finally, a support was considered compliant if we could detect it to move or be displaced during a tamarin leap. We acknowledge that this is a highly qualitative measure of support compliance. In order to examine whether the distribution of substrate type, DBH, and inter-tree distances within the study group's home range influenced tamarin support preference and leaping behavior, we walked two 100 × 2 meter transects running east-west between marked trails and measured every vertical support with a DBH >2.5 cm and a height of >2.0 m that was present inside the transect (N=406) (West, 2004). At every 20th support (N=20 target trees), we marked an area that formed a semicircle with a radius of 3 meters with the target tree at the midline of its base. We then counted the number and measured the DBH of vertical lianas, trunks, and bamboo culms that were located within the 9.42 m^2 area (total area sampled for 20 target trees was 188.4 m^2). For each vertical support present in the semicircle (total = 71) we also measured the horizontal distance from the midpoint of the base of the semicircle to each tree (distance between focal tree and sample tree). We selected a radius of 3 meters because approximately 94% of trunk-to-trunk leaps in saddleback tamarins were less than 3 meters in horizontal distance (see Results).

Given that the data were not normally distributed, comparisons between the DBH of takeoff and landing supports were made using the nonparametric Mann-Whitney U-test. Comparisons between the DBH of vertical supports in our sample transects and the DBH of supports used by the tamarins for leaping also were evaluated using a Mann-Whitney U-test. Variance in the size of takeoff and landing supports was compared using an F-Test. The effects of takeoff support DBH, landing support DBH, and the distance leapt on height gained/lost during leaping were analyzed using multiple regression analysis, as were the effects of the takeoff support DBH, landing support DBH, and height lost/gained during leaping on the horizontal distance leapt (SAS v9.3, SAS Institute, 2011). Probability values of p≤.05 are considered significant.

Results

Support type and support diameter

Saddleback tamarins commonly foraged and traveled on tree trunks in the forest understory. We did not observe the tamarins to leap between vertical branches in the middle or upper levels of the tree crown. Trunks were used as both takeoff and landing supports in approximately 90% of leaps. Areas of bamboo forest were uncommon in the study group's home range and bamboo culms accounted for less than 0.25% of vertical supports present in our sample transects. We did not observe the tamarins to leap to or from bamboo culms. Lianas accounted for 14% (57/407) of the vertical supports present in our vegetation transects, however, they were used by the tamarins as takeoff supports during only 7.5% of leaps (X^2=6.0, df=1, p<.05) and as landing supports in 10% of leaps (X^2=2.2 df=1, p>.20). We found that in 7 of 15 leaps in which lianas served as takeoff supports, the liana moved or was displaced by the leaping tamarin. In each case the liana had a DBH of ≤ 5 cm. In 7 of 20 leaps in which lianas served as a landing support, the liana also was compliant. In each of these cases the liana had a DBH of ≤ 5 cm (however, there were two instances in which the tamarins landed on a liana with a DBH ≤ 5 cm and the support was judged not to be compliant. Tree trunks were rarely compliant; 1.0% of takeoff and 2.7% of landing supports). Overall, lianas were significantly smaller in diameter than were tree trunks (lianas =5.48 ± 2.8 cm DBH; range 2.5-16.2 cm vs. tree trunks =11.3 ± 12.6 cm DBH; range 2.5-103.5 cm; Mann-Whitney U-test, Z=5.57, p<.0001), and this may have affected the tamarins' use of lianas as leaping supports. As indicated in Fig. 1, tamarins used vertical supports of less than 5 cm DBH as either takeoff (X^2=30.0, df=1, p<.001) or landing supports (X^2=25.3, df=1, p<.001) less frequently than expected based on their

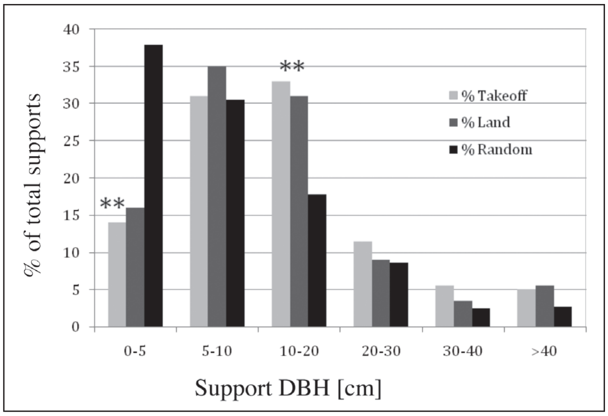

Figure 1. Diameter at breast height (DBH) of the pattern of vertical support use by saddleback tamarins compared to the availability of vertical supports in their home range. **: p<.001

availability. In contrast, the monkeys exhibited a preference for leaping to and from supports of between 10-20 cm DBH (X^2=26.4, df=1, p<.001 for takeoff support; X^2=19.9, df=1, p<.001 for landing support). Overall, we found no significant difference between the mean DBH of takeoff (15.7 cm ± 16.3) and landing supports (15.2 cm ± 17.8; Mann-Whitney U-test, Z= 1.21, p=0.22) selected by the tamarins.

Height gained/height lost

During 200 trunk-to-trunk leaps, the height of the tamarins' takeoff support ranged from 7.5m to 1m above the ground. Mean takeoff height was 4.1 m (±1.3 m). During 30% of takeoffs the tamarins were positioned at a height of between 4-5m and during 30% of the landings the tamarins were positioned at a height of between 3-4 m. (Table 2). During their airborne phase of travel, the monkeys experienced a loss in height during 121 leaps (60.5%), retained a relatively horizontal trajectory during 70 leaps (35%), and gained height during only 9 leaps (4.5%). The greatest vertical distance lost during a leap was 2.2 m and the greatest gained was 0.7 m. On average, the saddleback tamarins lost 0.5 m (±0.5 m) in height when leaping between vertical supports. During all trunk-to-trunk leaps, saddleback tamarins landed forelimbs first, a behavioral pattern which is consistent across callitrichines.

Distance leapt

The average horizontal distance leapt by the tamarins was 1.4 m (± 0.7), with the greatest number of leaps spanning a distance of 1-2m (51.5%) (Table 3). In our sample, 9.5% of leaps were <0.5m in distance and 2.0% spanned a distance of greater than 3 meters (Table 3). Given that our measure of horizontal distance leapt was identical to the way we measured the spatial distribution of vertical supports in our sample plots, we compared these data sets to determine whether the tamarins selected nearer or further vertical supports for leaping. We found that the horizontal distance leapt by the tamarins between vertical supports differed significantly from the spatial distribution of these supports in our focal transects (1.90 ± 0.84 m; N=71; Mann-Whitney U-test, Z=4.17, p<.0001). These data suggest that given the option of leaping between nearer or more distant vertical supports, especially those separated by a distance of approximately 2 meters, saddleback tamarins preferred to jump to and from nearer supports.

Table 2. Takeoff and landing height during trunk-to-trunk leaping in *Saguinus fuscicollis weddelli* (N=200 leaps)

Height (meters)	Takeoff Platform (%)	Landing Platform (%)
<1	0.5	0.5
≥1<2	2.5	7.0
≥2<3	13.0	21.5
≥3<4	21.5	30.0
≥4<5	30.5	25.0
≥5<6	21.0	10.5
≥6<7	9.5	5.0
≥7	1.5	0.5

Table 3. Distance leaped and height gain/loss in *Saguinus fuscicollis weddelli* during trunk-to-trunk leaping

Distance leaped (m)	Height change (cm)	Sample size	% Leaps with height loss[1]	% Leaps with height gain[1]
≤1	-22 ± 43	61	31.1	8.2
>1≤2	-49 ± 44	103	67.0	3.8
>2≤3	-104 ± 55	32	90.6	0.0
>3	-150 ± 46	4	100.0	0.0

1- in our analyses we consider height gains or height losses of ±0.25 m to reflect horizontal travel (no effective change in height)

Finally, using multiple regression we examined the effects of support DBH and height gained or lost on distance leapt. The multiple regression analysis for height lost during leaping (R^2=0.3802) showed a significant effect with increasing distance (t=10.921, p<0.0001). As indicated in Table 3, in 68.8% (42/61) of leaps of less than 1 meter, the tamarins either maintained (60.6.%) or gained (8.2%) height, whereas in 67% of leaps (69/103) between 1≥2 meters, 90.6% of leaps (29/32) between 2≥3 m, and 100% (4/4) of leaps > 3 meters, the tamarins lost height. In contrast, takeoff support DBH (t=0.542, p=0.5888) and landing support DBH (t=0.959, p=0.3387) did not significantly predict height loss/gain during leaping. Saddleback tamarins did not select landing supports of smaller (and potentially more compliant) DBH during longer leaps nor did they select more larger and more stable landing supports with an increase in leaping distance (Mann-Whitney U-test, Z= 0.39, p=.696; Table 4). Similarly, a multiple regression examining the effects of takeoff support DBH (t=1.34, p=0.1813) and landing support DBH (t=0.68, p=0.4961) did not significantly predict distance leapt. Thus, the DBH of takeoff and landing supports did not appear to be a critical factor influencing trunk-to-trunk leaping in saddleback tamarins.

Table 4. Support diameter, horizontal distance leapt and height gain/loss during trunk-to-trunk leaping in *Saguinus fuscicollis weddelli.*

Takeoff Platform					
DBH	**N**	**Distance leapt**	**Range**	**Height Gain/Loss**	**Range**
≤5 cm	28	1.18±0.71	0.20-2.60	-0.40±0.59	-2.25-0.5
>5≤10	62	1.47±0..74	0.48-3.37	-0.46±0.56	-1.75-0.75
>10≤20	66	1.48±0.61	0.36-3.37	-0.60±0.58	-2.0-0.5
>20≤40	34	1.61±0.81	0.38-3.68	-0.60±0.45	-1.5-0.5
>40≤80	7	0.98±0.40	0.43-1.75	-0.46±0.24	-0.75-0.0
>80	3	0.77±0.26	0.49-1.02	-0.08±0.14	-0.25-0

Landing Platform					
DBH	**N**	**Distance leapt**	**Range**	**Height Gain/Loss**	**Range**
≤5 cm	32	1.41±0.72	0.20-2.86	-0.46±0.49	-1.5-0.25
>5≤10	70	1.38±0.77	0.23-3.68	-0.47±0.61	-2.25-0.75
>10≤20	62	1.49±0.66	0.33-3.37	-0.56±0.54	-2.0-0.5
>20≤40	24	1.52±0.69	0.42-2.84	-0.61±0.56	-1.75-0.5
>40≤80	6	1.11±0.39	0.55-1.75	-0.55±0.17	-0.75-(-0.25)
>80	5	1.36±0.54	0.81-1.90	-0.55±0.41	-1.0-(-0.25)

Discussion

Leaping is a dominant form of travel in all species of tamarins, marmosets, and callimicos, and in general, three types of leaping behavior have been described for these small-bodied primates (Garber, 1991; Youlatos, 1999, 2009; Garber and Leigh, 2001; Nyakatura and Heymann, 2010). These are acrobatic leaps (also called terminal leaps by Youlatos, 2009) which begin and end on thin terminal supports in the periphery of the tree crown and between the crowns of adjacent trees, bounding leaps which are an outgrowth of rapid quadrupedal travel and occur principally on moderate and large diameter horizontal and oblique supports, and trunk-to-trunk leaps which occur on small, moderate, or large sized vertical or sharply inclined supports in the forest understory. However, there exists marked variability among callitrichine species in body mass, limb and body proportions, and the frequency of different forms of positional behavior (Table 1). An understanding of these differences offers critical insight into patterns of habitat utilization, feeding ecology, and locomotor anatomy in this primate radiation.

Among callitrichines, *C. goeldii*, *C. pygmaea*, and *S. fuscicollis* are the most frequent trunk-to-trunk leapers (Table 1). In the case of callimico, the exploitation of resources (fungi) present both in bamboo forest (which is dominated by vertical supports) and on decaying logs and fallen trunks, a behavioral pattern of crypticity and rapid escape, and anatomical adaptations associated with hindlimb elongation and ankle stability during dorsoflexion (Davis, 1996), help to explain the high frequency of long trunk-to-trunk leaps reported in this species (Garber and Porter, 2009; Porter and Garber, 2010). In contrast, the diet of pygmy marmosets is dominated by the consumption of plant exudates that are found in inundated forests along stream margins and in dense liana forest (Rylands, 1996; Youlatos, 2009). Youlatos (2009) reports that during feeding, 84.2% of locomotor behavior (principally claw climbing) and 85.7% of postural behavior (principally claw clinging) in *Cebuella* involved the exploitation of vertical trunks. In contrast to callimicos, the majority of trunk-to-trunk leaps in wild pygmy marmosets spanned a horizontal distance of less than 0.5 meters, with only 3% greater than 1 m (Youlatos pers. comm, Youlatos, 2009). This may reflect the fact that pygmy marmosets are characterized by extremely short hindlimbs, even when adjusted for body size (Davis, 2002). Moreover given that peak leaping forces scale to body mass $^{(-1/3)}$, and increase with distance leapt, smaller bodied primates are expected to engage in a series of shorter leaps in order to reduce mechanical stresses on their musculoskeletal system (Demes et al., 1999).

In the present study we analyzed 200 trunk-to-trunk leaps in Weddell's saddleback tamarins (*S. fuscicollis weddelli*). Relative to other tamarin species, *S. fuscicollis* (and possibly *S. tripartitus* and *Saguinus nigricollis*; all three of these taxa are members of the *S. nigricollis* group; Matauschek et al., 2011) travel and feed more commonly in the forest understory and use trunks as a perch to scan the ground for insect and small vertebrate prey, and to explore tree holes and bark crevices (Garber, 1992, Porter, 2001). In addition, exudates are reported to account for between 7.6-30.3% of saddleback tamarin feeding time (Table 7.2 in Digby et al., 2011). During exudate feeding, saddleback tamarins commonly cling to vertical trunks in the forest understory (Garber, 1993). We found that saddleback tamarins leapt to and from vertical supports that varied in DBH from 2.8 cm to over 110 cm, with 64% of takeoff supports and 66% of landing supports >5≤20 cm DBH. The majority of leaps occurred in the under canopy (at a height between 1 and 5m), with 30% spanning a horizontal distance of ≤1m, 51.5% ≥1<2m, and 18% ≥2 m. As distance leapt increased, the tamarins lost a greater amount of height (Table 3). Few of the takeoff or landing supports used by saddleback tamarins were compliant, and support DBH was not correlated with distance leapt or height gained or lost during leaping. This same pattern has been reported in wild *C. pygmaea* (Youlatos, 2009) and wild *C. goeldii* (Garber and Porter, 2009). Thus, it appears that among both smaller bodied and larger bodied callitrichines support DBH is not a critical factor influencing trunk-to-trunk leaping. This may reflect the mechanical advantage claw-like nails provide in maintaining support on vertical branches that otherwise are too large to be grasped by their relatively small hands and feet (Garber, 1992).

In the present study, wild saddleback tamarins were found to leap relatively longer distances between vertical supports than do wild pygmy marmosets and relatively shorter distances than wild callimicos (Youlatos, 2009, Garber and Porter, 2009). Approximately 18% of the leaps we recorded in wild saddleback tamarins spanned a horizontal distance of >2 m. However, during these longer leaps tamarins' experienced considerable height loss (average height loss of >1m when leaping a horizontal distance of greater than 2m, Table 3, compared to a height loss of 17.5 cm in callimicos leaping a distance of 2m), which is expected to result in an increase in compressive forces acting on their forelimbs during landing. This is supported by the fact that during trunk-to-trunk leaping, height loss in callitrichines is negatively correlated with takeoff velocity and positively correlated with landing velocity (Garber et al., 2009). In this regard, Garber and Leigh (2001:28) have suggested that forelimb elongation in saddleback tamarins (relative to other *Saguinus* species) may function to " increase[ing] the braking distance available for decelerating the body when landing on a rigid support" and more effectively dissipate the high forces generated on impact.

In conclusion, although all species of callitrichines cling to and travel on relatively large vertical supports using their claw-like nails, only a small number of taxa, most notably *C. goeldii, S. fuscicollis*, and *C. pygmaea*, are reported to commonly leap between vertical supports in the forest understory. These three species differ markedly in diet, body mass, limb proportions, and the kinematics of leaping. Detailed studies of positional behavior are needed on marmosets of the genera *Mico*, *Callithrix*, and *Callibella*, and in other *Saguinus* species, to better understand the functional and ecological implications of callitrichine postcranial anatomy on vertical clinging, patterns of leaping, and species differences in habitat utilization.

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DISTRIBUTION, HABITAT AND STATUS OF THE WHITE-COATED TITI MONKEY (*CALLICEBUS PALLESCENS*) IN THE CHACO - CHIQUITANO FORESTS OF SANTA CRUZ, BOLIVIA

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Abstract

In order to review the distribution and status of the Chacoan or white-coated titi monkey in Bolivia, I examined 60 available records of *Callicebus* and the vegetation types where they occurred in southern Santa Cruz. Based on the color pattern of photographed individuals, their location and basic ecological data, I characterized the range of *Callicebus pallescens* as extending from the Río Parapetí, across most of the Kaa Iya Park up to the Pantanal of Rio Negro, and inhabiting semiarid Chaco forests (475 mm of rainfall) with tree-like cacti, dry transitional Chaco and Chiquitano forests (<625-800 mm), up to subhumid seasonally flooded riverine forests of the Pantanal (1,000 mm). In the subhumid and humid forests North of Kaa Iya and near Santa Cruz city, *C. pallescens* is replaced by the gray titi monkey *C. donacophilus*, which can be recognized by a darker and more contrasting color pattern. However, the geographic limit between the two species is poorly known and confounded by current deforestation. Likewise, the identity of *Callicebus* from the eastern Chiquitano forest and Pantanal in the Bolivia-Brazil border is also confusing and needs to be studied.

Key Words: abundance, *Callicebus donacophilus*, dry forest, gray titi monkey, Kaa-Iya Park, Pantanal

Resumen

A fin de revisar la distribución y el estatus del sahuí, tití blanco o chaqueño en Bolivia, examiné 60 registros de ocurrencia de *Callicebus* y sus tipos de vegetación en el sur de Santa Cruz. En base al patrón de color de individuos fotografiados, su ubicación geográfica e información ecológica caractericé la distribución de *Callicebus pallescens* como extendida desde el río Parapetí, a través del Parque Kaa-Iya, hasta el pantanal del río Negro, y habitando bosques chaqueños semiáridos (475 mm de lluvia) con cactus arbóreos, bosques secos transicionales chaqueños y chiquitanos (<625-800 mm) hasta bosques ribereños subhúmedos estacionalmente inundables del pantanal (1,000 mm). En los bosques subhúmedos y húmedos cercanos a la ciudad de Santa Cruz, *C. pallescens* es reemplazado por el tití gris boliviano, *C. donacophilus*, que puede ser reconocido por su patrón de color más oscuro y contrastante. Sin embargo, el límite entre estas dos especies no está bien conocido y se enmascara por la creciente deforestación. También, la identidad de las formas de *Callicebus* del bosque chiquitano oriental y el pantanal en la frontera de Bolivia y Brasil es confusa y necesita ser aclarada.

Palabras Clave: abundancia, bosque seco, *Callicebus donacophilus*, Parque Kaa-Iya, Pantanal, sahuí boliviano

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Introduction

Titi monkeys (genus *Callicebus*) from the south of the Amazon were considered once as a single species (*Callicebus moloch*), reaching Bolivia with several subspecies of which *C. moloch donacophilus* was the southern-most (Hershkovitz, 1963). Later, these subspecies were upgraded to full species (Hershkovitz, 1990) and *Callicebus donacophilus* was recognized as having two subspecies itself, *C. d. donacophilus* in central Bolivia and *C. d. pallescens* in southern Santa Cruz department (Anderson, 1997). The southern subspecies was later considered a full species *C. pallescens* [Thomas 1907] by van Roosmalen *et al.* (2002), and its distribution was estimated as covering the full width of southern Santa Cruz into western Mato Grosso in Brazil and the Chaco in Paraguay (Veiga *et al.*, 2008a; Martínez and Wallace, 2010; Smith, 2012). Despite the advances in recognizing the white-coated titi monkey (*C. pallescens*) as an inhabitant of the Chaco and Pantanal dry forests, little is known about its ecology and habitat choice (Martínez and Wallace, 2010; Ayala, 2011). Moreover, their habitat and distribution records are often uncertain because the species is not identified as the white-coated or the Bolivian gray titi monkey (*C. donacophilus*). The Bolivian gray (or white-eared) titi monkey lives in wet but seasonal forests from southern Rondonia in Brazil through the departments of Beni, the east of Cochabamba and the north of Santa Cruz in Bolivia (Veiga *et al.*, 2008b), reaching patches of the drier Chaco-Chiquitano transitional forest around Santa Cruz city (Pyritz *et al.*, 2010). However, along the estimated range limit between these two species there is a wide expanse of dry forest habitats where the presence, absence or identity of titi monkeys is uncertain.

In order to review the distribution and status of the Chacoan or white-coated titi monkey in Bolivia, I examined the available records of *Callicebus*, new field observations, photos and vegetation types where they occur in southern Santa Cruz. Based on the color pattern of the individuals, their geographic location and available ecological data, I characterize the distribution range of *C. pallescens*, propose a range limit with *C. donacophilus* and identify uncertainties on the current knowledge of these species.

Study sites and Methods

Wildlife surveys conducted mainly by researchers from Wildlife Conservation Society (WCS) and the Museo Noel Kempff Mercado (MNKM) have produced records of titi monkeys within and around the Kaa Iya National Park during the last 15 years. This park is the largest in Bolivia and encompasses 3.5 million hectares of alluvial plains and eroded peneplains (250-450 m a.s.l.), with a few isolated sandstone hills rising 200 m or more above the plains (Cerro Cortado 600 m, Cerro San Miguel 840 m). Two Ramsar sites partially overlap the park, the Parapetí River-Isoso "Bañados" (Isoso floodplain or inland delta) in the west, and the Palmar de las Islas-Salinas de San José in the east, on the border with Paraguay. Mean temperature is 24-26° across the region but rainfall decreases sharply from 1,000 mm and 3 dry months per year in the NE of the region to 400 mm and 10 dry months in the SW corner of the park (Fig. 1). This results in semi-arid, dry, and sub-humid bioclimatic ombrotypes (Navarro and Maldonado, 2002) that affect the vegetation and fauna.

Main vegetation types of Kaa Iya park are associated with Chaco landscape systems (Navarro and Ferreira, 2008) such as the alluvial plain dry forests of the Parapetí and Grande rivers in the SW, the distinct riverine vegetation complexes along these rivers, and the transitional forests towards the Chiquitano region on alluvial plains to the N and on sandstones to the E. At the eastern border of the park, vegetation types have more affinity with the Brazilian Cerrado, and include transitional and distinct Chiquitano dry forests and scrublands that are more mesic (humid) than those of the Chaco. Further E and NE from the park, Chiquitano and Chaco forests continue as riverine strips and patches into the flooded Pantanal. A digital vegetation map of Santa Cruz (scale 1:100,000; Navarro and Ferreira, 2008) and field descriptions of at least 20 sites were used to define the forest types associated to the *Callicebus* records compiled in this study.

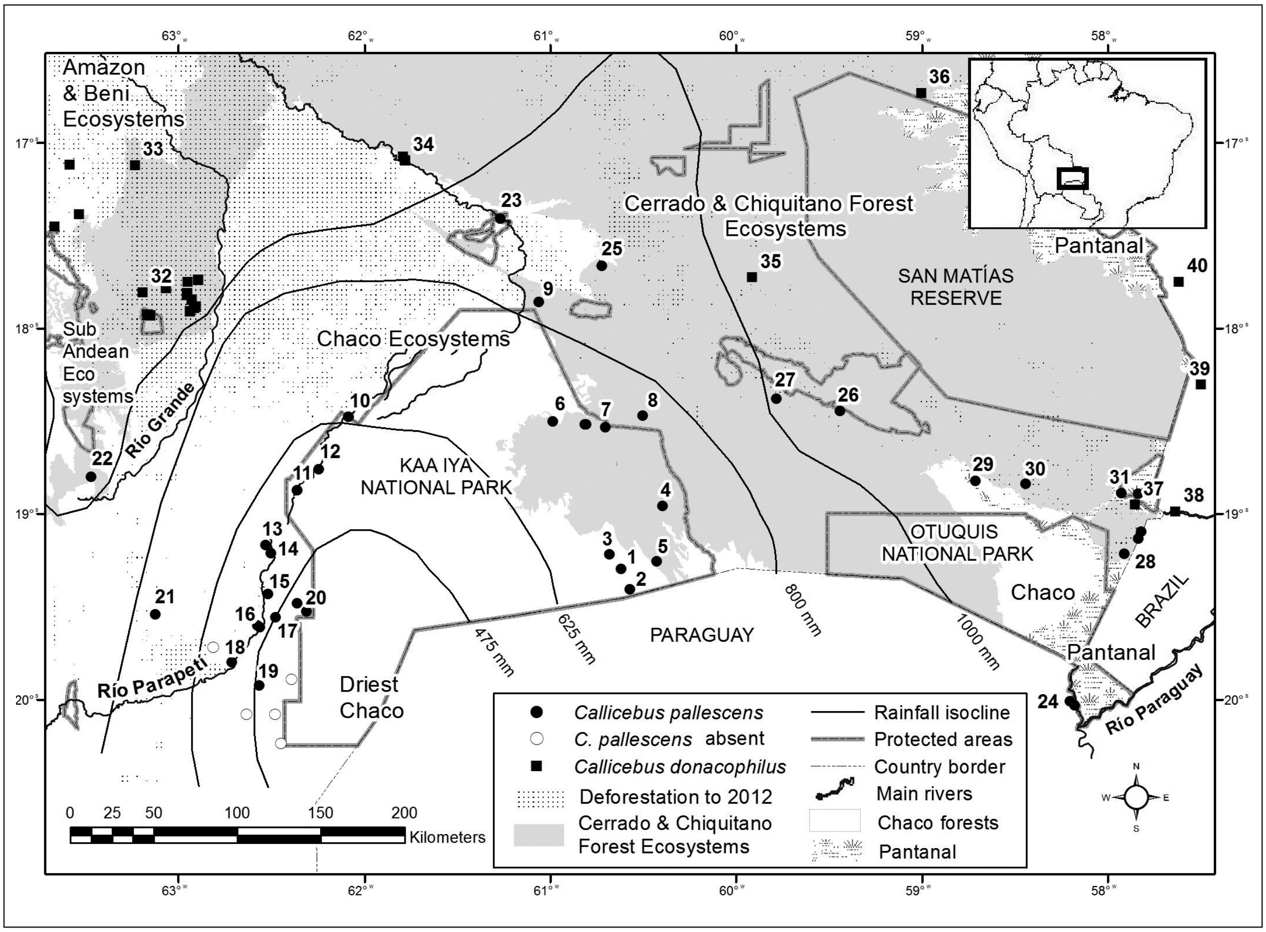

Figure 1. *Callicebus* records, protected areas, rainfall isoclines, deforestation and mayor landscape systems in southern Santa Cruz, Bolivia (ecosystems adapted from Navarro and Ferreira, 2008).

The range of *C. pallescens* was assessed by mapping 60 titi monkey localities in southern Santa Cruz and neighboring Pantanal, based on previous reviews, verification of original observations with WCS and MNKM researchers, and examination of recent images and sightings (see Table 1 for sources). However, most sources either did not identify the titi monkey species or referred it to as *C. moloch.* To become capable of identifying these species, I examined skins of *C. donacophilus* at MNKM and observed wild individuals around Santa Cruz city. I could not examine museum specimens of *C. pallescens* because there are none in Bolivia. I followed the descriptions published for these species (Hershkovitz 1990, Anderson 1997, van Roosmalen *et al.* 2002) and discussed them with observers and photographers to assess the identity of new sightings, photographs and videos. Because no specimens were collected for this study, the most reliable identifications of *C. pallescens* were those records contiguous to the collection localities of specimens identified as such by Anderson (1997). Images or sightings from these and other areas that showed *C. pallescens* with diagnostic features (uniform light color, relatively long pelage and lack of contrasting white ears) were also considered reliable identifications for this species. Undefined titi monkey observations that occurred near others identified as *C. pallescens* were assumed to be of this species, but those that were both undefined and distant from reliable records were labeled as 'suspected' *C. pallescens*. Localities marked as of *C. donacophilus* reflected their sources and were not corroborated except when stated as such in the text.

Results and discussion

Identification and distribution of Callicebus records

Forty out of the 60 titi monkey locality records were mapped in Figure 1 and listed in Table 1 after removing or grouping some points to avoid cluttering. Sources of these records included review papers (Hershkovitz, 1990; Anderson, 1997; Martínez and Wallace, 2010), broad wildlife surveys (Parker *et al.*, 1993; Cuéllar and Noss, 1997; Miserendino *et al.*, 1998; Navarro *et al.*, 1998; Ayala and Noss, 2000; Arispe and Rumiz, 2002; Brooks *et al.*, 2002; Cuéllar *et al.*, 2003; Maffei, 2005), specific primate studies (Justiniano, 2004; Thurley, 2009; Pyritz *et al.*, 2010; Ayala 2011), unpublished photos and related personal communications (Table 1). The presence of *C. pallescens* was supported by collected specimens in two sites (# 15 and 22) and by new photos and a video in nine sites (# 1, 2, 7, 8, 10, 14, 23, two in 24), while undefined observations in 21 sites and local reports in nine other sites completed the 'assumed' and 'suspected' localities for this species. *C. donacophilus* was assigned to 19 localities based on three collection sites (two near #32, one in 37), 14 direct observations as defined by their authors, and photographs that I reviewed from three sites (near #32 and 33).

Sightings assigned to *C. pallescens* with high reliability include Ravelo (#1), Palmar de las Islas (#2), Sol de Mayo, camp Tucavaca and nearby points (#6, 7, 8), and community sites along the Parapetí river (#13 through 19). From Ravelo and Palmar there are photos and a video that show the long and uniformly colored pale buff pelage of the individuals (Fig. 2), as well as in Sol de Mayo (Fig. 3) and Tucavaca (Fig. 4). The photograph from Paraboca in the Parapetí river (Fig. 5) shows the same light color of the individuals sighted in nearby riparian communities, including the locality # 15 where three specimens were collected in the 1980's and assigned then to *C. donacophilus pallescens* by Anderson (1997). Sightings and a photo from the Rio Negro in the Otuquis Pantanal (#24, Verónica Zambrana, pers. comm.) also matched *C. pallescens* descriptions, as well as the photos available from the nearby Paraguayan

Figure 2. *C. pallescens* at Ravelo (#1), Martin Thurley.

Figure 3. *C. pallescens* in #8, Rosario Arispe.

Table 1. Localities, type of evidence and source of 40 records of titi monkeys from southern Santa Cruz, Bolivia mapped in Figure 1, with the species assigned by this study or its original author in the case of *C. donacophilus*.

No.	Locality	Type of evidence and source	Coordinates	Assigned species
1	Fortín Ravelo	Photos, counts: Justiniano, 2004; Thurley, 2009	19°18'S 60°37'W	*Callicebus pallescens*
2	Palmar de las Islas	Obs.: Navarro *et al.*, 1998; Thurley, 2009; video, S. Angulo, R. Montaño, pers. comm.	19°24'S 60°34'W	*C. pallescens*
3	Salina San José	Obs.: Cuéllar *et al.*, 2003	19°13'S 60°41'W	*C. pallescens*
4	El Cruce	Obs.: Navarro *et al.*, 1998	18°57'S 60°24'W	*C. pallescens*
5	Santa Adriana	Obs.: Navarro *et al.*, 1998	19°15'S 60°26'W	*C. pallescens*
6	Camp Tucavaca	Photos, counts: Justiniano, 2004; Maffei, 2005	18°31'S 60°48'W	*C. pallescens*
7	S. Lucia pond	Photos: D. Alarcón pers. comm.	18°32'S 60°42'W	*C. pallescens*
8	Sol de Mayo	Photos, obs.: Arispe pers. comm.	18°28'S 60°30'W	*C. pallescens*
9	San Ignacito	Obs.: Navarro *et al.*, 1998	17°51'S 61°03'W	Suspected *C. pallescens*
10	Cupesí - Charata	Counts: Miserendino *et al.*, 1998 Photos: D. Alarcón, pers. comm.	18°29'S 62°05'W	Assumed *C. pallescens*
11	La Madre	Counts: Cuéllar and Noss, 1997	18°52'S 62°22'W	Assumed *C. pallescens*
12	Curuyuqui	Local report: Parker *et al.*, 1993	18°46'S 62°14'W	Assumed *C. pallescens*
13	Kuarirenda	Counts: Ayala, 2011	19°10'S 62°32'W	*C. pallescens*
14	Paraboca	Photos: L. Acosta, pers. comm.	19°13' S 62°30'W	*C. pallescens*
15	Guirapembi	Specimens: Anderson, 1997	19°26'S 62°31'W	*C. pallescens*
16	La Brecha	Counts: Ayala, 2011	19°37'S 62°34'W	*C. pallescens*
17	Isiporenda	Obs.: Noss and Cuéllar, 2000	19°33'S 62°29'W	*C. pallescens*
18	Karapari	Counts: Ayala, 2011	19°48'S 62°42'W	*C. pallescens*
19	Perforación	Local report: Parker *et al.*, 1993	19°55'S 62°34'W	Assumed *C. pallescens*
20	Cerro Cortado, Cerro Colorado	Counts: Ayala and Noss, 2000; Noss and Cuéllar, 2000	19°32'S 62°19'W	*C. pallescens*
21	Tacuarembó, Charagua	Obs.: L. Acosta and R. Strem, pers. comm.	19°32'S 63°20'W	Suspected *C. pallescens*
22	Rio Grande	Specimen: Anderson, 1997	18°48'S 63°28'W	*C. pallescens*
23	Laguna Concepción	Photo: A. Mamani and L. Acosta, pers. comm. 2011	17°25'S 61°16'W	Suspected *C. pallescens*
24	Rio Negro, Pantanal	Photos: V. Zambrana, pers. comm. 2008; Smith, 2012	20°02'S 58°10'W	*C. pallescens*
25	Quituquiña	Loc. rep.: Arispe and Rumiz, 2002	17°40'S 60°43'W	Suspected *C. pallescens*
26	Urucú	Loc. rep.: Arispe and Rumiz, 2002	18°23'S 59°47'W	Suspected *C. pallescens*
27	Quitunuquiña	Loc. rep.: Arispe and Rumiz, 2002	18°27'S 59°26'W	Suspected *C. pallescens*
28	Mutun	Local report: Parker *et al.*, 1993	19°13'S 57°54'W	Suspected *C. pallescens*
29	Guayacanes	Local report: Parker *et al.*, 1993	18°49'S 58°42'W	Suspected *C. pallescens*
30	Sunsas farm	Obs.: L. Acosta, pers. comm.	18°50'S 58°26'W	Suspected *C. pallescens*
31	Lag. Cáceres	Loc. rep.: Arispe and Rumiz, 2002	18°57'S 57°51'W	Suspected *C. pallescens*
32	Around Santa Cruz city	Specimens, photos, obs.: Anderson, 1997; Pyritz *et al.*, 2010; K. Dingess, pers. comm.	16 sites near 17°48'S 63°11'W	*Callicebus donacophilus*
33	Mineros	Photos: D. Alarcon, pers. comm.	17°07'S 63°13'W	*C. donacophilus*
34	San Miguelito	Counts: Rumiz *et al.*, 2000	17°01'S 61°31'W	Assumed *C. donacophilus*
35	San Juan de Chiquitos	Obs.: Brooks *et al.*, 2002	17°47'S 59°56'W	Assumed *C. donacophilus*
36	Candelaria	Obs.: Brooks *et al.*, 2002	16°46'S 58°56'W	Assumed *C. donacophilus*
37	Puerto Suárez	Specimen: Anderson, 1997	18°56'S 57°49'W	*C. donacophilus*
38	Corumbá	Specimens: Hershkovitz, 1990; Auricchio, 2010	19°00'S 57°38'W	*C. pallescens* or *C. donacophilus*
39	Santa Teresa	Counts: Tomas *et al.*, 2010	18°18'S 57°30'W	*C.* aff. *donacophilus*
40	Acurizal	Specimen: Hershkovitz, 1990	17°45'S 57°37'W	*C. pallescens*

Pantanal (Smith, 2012). According to all our photos, the color pattern of *C. pallescens* individuals agreed with the published descriptions of the species, although their faces were not as white as in the drawing from van Roosmalen *et al.* (2002).

Figure 4. *C. pallescens* in # 7, Daniel Alarcón.

Figure 5. *C. pallescens*, Río Parapeti #13, Luis Acosta

Records from transect censuses east of Ravelo (#4, 5), on the Isoso flood plain (#10, 11) and near the hills of Cerro Cortado and Cerro Colorado (#20) were originally identified as *Callicebus moloch,* but surely correspond to *C. pallescens* according to pictures taken in or near these sites. Recent sightings and pictures of light colored titi monkeys from the riverine forest of Laguna Concepción (#23, Ana Mamani and Luis Acosta, pers. comm.) are suspected to be this species, as well as undefined sightings (# 9, 30) and local reports of titi monkeys (# 25-31) extended further east. An old (1980) collecting site of *C. pallescens* on the lower slopes of the Andes (# 22; Anderson, 1997) could not be verified with newer data, and its closest recent record was an undefined sighting of titi monkeys in the Charagua hills (# 21; Rosa Strem, Luis Acosta, pers. comm.). Square dots near Santa Cruz city (around # 32) included two collecting sites of *C. donacophilus* (Anderson, 1997), subsequent reviews (Martínez and Wallace, 2010) and several recent sightings nearby that can be confidently assigned to the gray titi monkey (Pyritz *et al.*, 2010; Dingess, unpublished; Rumiz pers. obs.). *C. donacophilus* showed a buffy or brownish agouti pelage in the upper and outer parts of head, body and limbs, darker than in *C. pallescens*, but with the tail base noticeably paler and ear tuffs markedly whitish (Fig. 6 from #32, Fig. 7 from #33). Square dots at # 34 most probably correspond to sightings of the same form (Rumiz *et al.,* 2000) and would represent the easternmost record of the gray titi monkeys (Veiga *et al.*, 2008b; Martinez and Wallace, 2010), unless we accept that this species was also seen on the gas pipeline to Cuiabá (#35, 36; Brooks *et al.*, 2002) and may reach the Brazilian Pantanal. In fact, a specimen from Puerto Suárez on the eastern Bolivian border (# 37) was considered by Anderson (1997) to be *C. d. donacophilus*, as well as another five specimens from Corumbá (# 38) in western Brazil mentioned as *C. donacophilus* by Auricchio (2010). However, it seems that the same five specimens from Corumbá in the Museum of São Paulo, plus another specimen from Acurizal further N (#40), had been originally examined and assigned to *C. d. pallescens* by Hershkovitz (1990) in

Figure 6. *C. donacophilus* near Santa Cruz city (#32), Daniel Alarcón.

his seminal paper. A recent field transect study conducted nearby (Santa Teresa # 39; Tomas *et al.*, 2010) identified the titi monkeys as 'aff. *donacophilus.*'

Dry forest types and the occurrence of Callicebus pallescens
According to the latest classification and mapping of Santa Cruz vegetation (Navarro and Ferreira, 2008), the compiled titi monkey localities included a variety of forest types belonging to the Chaco, Chiquitano and Pantanal biogeographical provinces, belonging to semi-arid, dry, and subhumid bioclimatic ombrotypes (Figure 1). The available data on the occurrence and abundance of white coated titi monkeys were grouped in different situations according to climate, sites and forest types (Table 2). From these, three best known areas with titi monkey populations are described below in order of increasing humidity. *C. pallescens* was found living in one of the driest Chaco forests (semiarid ombrotype, <475 mm of rainfall), such as in the foothills of Cerro Cortado and Cerro Colorado (#20), but apparently only in forests patches with large trees and tree-like cacti. Encounter rates along transects run through mixed dry forests were very low since monkeys were absent in shorter stature forest (Cuéllar and Noss, 1997, Ayala and Noss, 2000; Noss and Cuéllar, 2000). Several sites in the driest SW corner of Kaa Iya had no titi monkeys (open dots in Fig. 1), and at least one of them had *Aotus* but not *Callicebus* (Justiniano, 2004). It is possible that titi monkeys occur only in the taller/denser patches of these dry Chaco forests and they may be found near other hills to the east within Kaa Iya, but they are absent in the driest Chaco of western Paraguay (Stallings *et al.*, 1989; Brooks, 1996).

The Chaco riverine, hydrophytic, and seasonally flooded forests along the Parapetí river (# 11-18) harbor abundant *C. pallescens* and three other primate species (Ayala and Noss, 2000; Ayala, 2011) despite their upper - semi-arid ombrotype (475-625 mm of rainfall). The influence of the river and a shallow water table allow the existence of dense 'algarrobo' (*Prosopis chilensis*; Fabaceae) forests, where titi monkeys were found at densities of 3.5, 6.2 and 10.4 groups/km^2. Riverine habitats extend downstream into less dry ombrotypes allowing the connectivity of *Callicebus* populations of northern Kaa Iya and the Chiquitano forests. Outside the park, however, deforestation is intense and threatens this corridor.

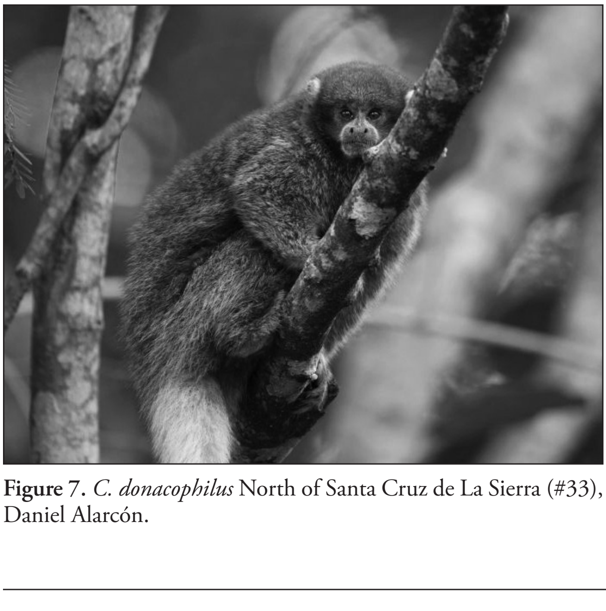

Figure 7. *C. donacophilus* North of Santa Cruz de La Sierra (#33), Daniel Alarcón.

White coated titi monkeys occur in the transitional Chaco-Chiquitano forests of Ravelo and Palmar (#1, 2, 3) under a lower-dry ombrotype (625-800 mm of rainfall), and reach a high density of 15.3 groups/km^2 at the tall foothill forest of Cerro San Miguel (Thurley, 2009). They are absent or less abundant in low stature forests nearby, but occur further north and east suggesting a continuous distribution in eastern Kaa Iya park. Within the same climate type but in the tall transitional Chiquitano forest, *C. pallescens* is common and was found at a relatively high abundance (#6; 1.8 groups encountered / 10 km walked; Justiniano, 2004; Maffei, 2005). South of Palmar de la Islas, in northern Paraguay, titi monkeys are also present at several sites (Brooks, 1996; Smith 2012) and were abundant in the tall forest of Agua Dulce (Stallings *et al.*, 1989). Further east in Bolivia and Paraguay, extending up to the Pantanal, these forests become more mesic (>800 mm), include more Chiquitano species, and also harbor titi monkeys.

The occurrence and abundance of primate species through the dry Chaco seems to depend on the relatively tall and more diverse forest patches that grow associated to well drained and richer soils (Stallings *et al.*, 1989). In Kaa Iya, *Callicebus* and other monkeys occur mainly in tall Chaco forests around the Parapetí river, old river channels, isolated hills, and in the Chiquitano transitional forest. It is likely that size of the trees, availability of tree holes and other shelters, and water-rich foods (such as succulent leaves, flowers and fruits of arboreal cacti) become the key habitat features for *C. pallescens* (and for *Aotus*). In humid Chiquitano forest patches near Santa Cruz city (Pyritz *et al.*, 2010), forest maturity, surrounding forest area and understory density have been identified as factors affecting diversity and abundance of primates, although only the high understory density seemed to have a significant and negative effect on the abundance of *C. donacophilus*. Field studies are needed to identify and conserve the main habitat features that allow these monkeys to survive in these extremely dry forests.

Subhumid forests and the range of C. pallescens and C. donacophilus
C. pallescens was confirmed to occur in the subhumid ombrotype forests (>1,000 mm) of the Otuquis Pantanal of Bolivia and Paraguay, and it is the 'suspected' form – although no good images are available – that occurs in the Chiquitano forests north and northeast of Kaa Iya under sub humid and upper-dry (800-1,000 mm) ombrotypes. This area (sites # 9, 23, 25-35) has been considered partially within the range of *C. pallescens* (Veiga *et al.*, 2008a), while further north of it there would be a hiatus in *Callicebus* distribution since the range of *C. donacophilus* (#32,

33) had not reached east of the río Grande (Veiga, *et al.*, 2008b). Points # 23, 25, 34-36, however, show that titi monkeys are present in these subhumid Chiquitano habitats, north of the accepted range of *C. pallescens*, and that they are connected westward through forests to the range of *C. donacophilus* (#32, 33). Therefore, this northeastern population may belong to *C. pallescens,* connected with the Paraguayan Pantanal and Chaco populations (Hershkovitz, 1990; van Roosmalen *et al.*, 2002; Veiga *et al.*, 2008a), or to *C. donacophilus*, according to the labeling of Pantanal specimens from Bolivia (#37: Anderson, 1997) and Brazil (#38: Aurichio, 2010). However, a current habitat connection between titi monkey populations does not prove a species' identity, furthermore if the phenotypes are not well defined and the karyotypes from these locations are unknown. *C. pallescens* from the dry Chaco looks quite different from *C. donacophilus* from the humid Amazon and Beni forests, but some photographed individuals seem 'intermediate' in their diagnostic color features. To better characterize these phenotypes it is necessary to assess the individual variation of southern *C. donacophilus* color patterns, considering age and sex differences in known groups around Santa Cruz city, and to collect specimens and more photos of potential *C. pallescens* in the subhumid transition southward into the Chaco.

The old collecting site of *C. pallescens* near the upper Rio Grande (#22) falls on a marked gradient of dry to humid forests on the Andean slopes, and it is only one hundred kilometers from *C. donacophilus* localities on the same forested slopes further north. This suggests that both species may come in contact on the sub Andean forests (around 18°20'S, 63°30'W), and also along the humid to dry lowland forest gradient of the Beni-Chaco alluvial plains near the Rio Grande, which is currently being lost to agriculture. It would be important to verify if titi monkey phenotypes in these transitions are 'intermediate' or defined for either species. The scarce data available on the karyotype of *C. donacophilus* (Minezawa and Borda, 1985) and *C. pallescens* (Dumas, 2005) suggest that differences in the number of bi-armed and acrocentric chromosomes, although both species have 2n=50, would prevent fertile interbreeding. This can only be verified by collecting geo-referenced genetic samples of these little known species and by identifying the phenotypes of the peripheral Chaco populations.

Summary and conclusions

Callicebus pallescens is the titi monkey species occurring in the Kaa Iya and Otuquis parks of Bolivia, and neighboring areas in Paraguay. It can be identified and distinguished in the field from *C. donacophilus* by its longer pelage, lighter color and little or no contrasting white ears. However, more images, new specimens and genetic samples should be analyzed to assess its phenotypic variation and relationships with *C. donacophilus*. White-coated titi monkeys occur in a variety of Chaco and Chiquitano forests, ranging from semiarid Chaco forests (475 mm of rainfall), to dry transitional Chaco and Chiquitano forests (625-800 mm), and up to subhumid Pantanal riverine forests in southeastern Santa Cruz (>1000 mm). In the subhumid and humid forests north and northwest of the Chaco, *C. pallescens* is replaced by the gray titi monkey (*C. donacophilus*), but the geographic limit between the two species is not clearly known. Moreover, additional records of titi monkeys in the Chiquitano forests fall outside the known range of both species, and likewise the Pantanal records on the Bolivia-Brazil border, their identity needs to be verified. Surveys are needed to assess remnant populations in the threatened forest north of Kaa Iya and Otuquis parks, for which park guards and biologists should be trained with visual aids to recognize the primate species in the field and to take pictures, specimens or genetic samples if opportunities arise.

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PRIMATES OF THE LOWER URUBAMBA REGION, PERU, WITH COMMENTS ON OTHER MAMMALS

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Abstract

We present data on encounter rates and group sizes of primates in the Lower Urubamba Region of Peru, an unprotected area little represented in the literature. We censused a total of 467.7km on 10 transects during two seasons and documented nine primate species in the area. Compared to nearby protected areas, group encounter rates were lower and group sizes were smaller for all species except *Saguinus fuscicollis* and *S. imperator*. Relatively high abundance of *S. imperator* and low abundance of larger bodied primates is a possible example of density compensation resulting from hunting pressure. In addition to the primates, 23 other mammal species were observed or photographed by camera traps, including *Procyon cancrivorus*, which was not previously reported in the area.

Keywords: Lower Urubamba, Peru, primate densities

Resumen

Presentamos los datos de tasas de encuentro y tamaños grupales de especies de primates en la Región del Bajo Urubamba en Perú, un área no protegida poco representada en la literatura. Censamos un total de 467.7km a lo largo de 10 transectos durante dos estaciones y documentamos la presencia de nueve especies de primates en el área. Comparando nuestros datos con los de áreas protegidas cercanas, las tasas de encuentro fueron bajas y los tamaños grupales fueron menores para todas las especies a excepción de *Saguinus fuscicollis* y *S. imperator*. La abundancia relativamente alta de *S. imperator* y la abundancia baja de las especies de mayor tamaño corporal podrían ser un ejemplo de la compensación de densidad que resulta de la presión ejercida por la caza. Adicionalmente a los registros de primates, 23 especies de otros mamíferos fueron observados o fotografiados por cámaras trampa, incluyendo a *Procyon cancrivorous*, el cuál no ha sido reportado en el área previamente.

Palabras clave: Bajo Urubamba, Perú, densidades de primates

Introduction

Peru is one of the more active South American countries in primate research (PrimateLit, 1940-2010: 678 records), yet the Lower Urubamba Region (LUR, named for the Urubamba River) in the Department of Cuzco is underrepresented in the primate literature (PrimateLit, 1940-2010: 0 records). This is likely due to the lack of protected areas in the region and the LUR's many oil concession areas (Finer and Orta-Martínez, 2010), which can limit access. Primate records therefore come primarily from environmental consulting agencies and are in the form of environmental impact assessments (EIAs; Table 1). Because these reports are often the result of rapid assessments, species lists are produced primarily with indirect evidence (e.g. scat, vocalizations), and data on encounter rates and group sizes are limited.

Because the LUR lies at the base of the Andes Mountain Range, it exhibits high precipitation and great variation in elevation and topography (Alonso *et al.*, 2001) promoting floral and faunal diversity (Gentry, 1988; Pacheco *et al.*, 2009). There is much debate regarding the geographic distributions, names, and characteristics of the primate species likely to be found in the LUR and surrounding areas (e.g., for *Callicebus* spp. see Aquino *et al.*, 2008; Defler, 2004; Hershkovitz, 1990; Heymann *et al.*, 2002; van Roosmalen *et al.*, 2002, among many others). The purpose of this paper is to document the primate species present in the LUR, report their encounter rates and group sizes, and present observations of other large mammal species encountered.

Study site

Covering approximately 60,000 ha, the LUR is bordered to the west by the Vilcabamba Mountains and to the east

Table 1. Summary of primate and mammal census data for the Lower Urubamba Region (LUR), Cordillera Vilcabamba (CV), and Manu National Park (MNP). The total number of mammal species registered in each study, both through direct (sighted or photographed) and indirect observations, are listed, as are the number of primate and other mammal species directly observed. The final column lists the primate species observed, and bold type indicates species also found at the study site. NR = not reported.

Study	Area	Loc.	Date[a]	Habitat	Effort[b] (days, hours, km diurnal monit.)	All mammals		Primates	Primate species[c]
						Total no. spp. reg.	No. spp. dir. obs.	No. spp. dir. obs.	
Present Study	LUR	Pagoreni A	D,W '11	1° lowland forest	80d; 370hrs 467.6km	27	27	9	**AC, ASA, AN, CB, CAL, CAP, PI, SF, SI**
Boddicker *et al.*, 2001	LUR	Pagoreni A	D '98	1° and 2° lowland forest	16d; 112 hrs; 80km	24	7	4	**AO, APC** (Vo), **AS, CAL**, PM
	LUR	San Martín 3	D '97	1° lowland forest with bamboo	12d; 84hrs; 42km	24	13	6	**APC, AS, CAL, CAP, SI**, SSB
	LUR	Cashiriari 2	D '97	1° lowland forest	13d; 91hrs; 65km	24	11	5	**CAL, CAP, CP, SF**, SM
	LUR	Cashiriari 3	W '97	1° lowland forest	20d; 140hrs; 100km	26	15	8	**AO, AS, CAL, CAP, CMB, LL, SI**, SSB
Emmons *et al.*, 2001	CV	Río Pomureni	D '97	Pampas	28d	4	1	0	No Primates
	CV	Río Poyeni		1° montane forest		7	3	2	**ABC** (Vo), AO (Vo), **CAL, CAP**
	CV	Río Picha	D,W '98	Mid-montane cloud forest	25d	10	8	4	**ABC** (Vo), AO, **AS** (Vo), **CAL, CAP**, LL
Rodriguez and Amanzo, 2001	CV	Llactahuaman	D '98	1° montane forest with bamboo	31d	12	5	0	No Primates
	CV	Wayrapata		Cloud forest		12	1		No Primates
ERM, 2010	LUR	Kinteroni	D,W '09, W '10	1° lowland forest with bamboo	12d; 85.5hrs; 50km	23	14	6	**AC, AL**, CA, **CAL, CAP**, **PI** (Vo), **SI**
	LUR	Mashira			12d; 87.1hrs; 59km	27	21	8	**AC, AL**, AN, CA, **CAL, CAP**, SB, **SI**
	LUR	Mapi			12d; 104.9hrs; 55km	21	14	6	**AC, AL, AN**, CA, **CAL**, LC
ERM, 2009	LUR	Kinteroni	W '09	1° lowland forest with bamboo	2d; 23.5hrs; 12.4km	20	6	3	**AN, AS** (Vo), **CAP**, CB, **SI**
ERM, 2006b	LUR	Yamihua (Coviri Alto)	W '05		6d; 34.5hrs; 37.6km	34	14	7	**AN, AS** (Vo), **CAP, CB, SA, SB, SF, SI**
ERM, 2006a	LUR	Kinteroni	W '06		5d; 15hrs; 7.5km	13	7	4	**AS** (Vo), **CAL, CAP, CB, SI**
ERM, 2005 in ERM 2006a	LUR	Miaría (Atalaya)	W '05	1° lowland forest	6d; 33.5hrs; 32.1km	22	6	2	**AN, AS** (Vo), **CAL** (Vo), **CB** (Vo), **SI**
	LUR	Sabetari (Coviri)	W '05	1° lowland forest	5d; 33hrs; 28.2km	26	10	5	**AN, AS** (Vo), **CAL, CAP** (Vo), **CB** (Vo), **SB, SI**
Leite Pitman *et al.*, 2003; Terborgh *et al.*, 1984	MNP	EBCC	D,W '73-'84; '00-'02	1° lowland and flooded forest, grassland	12 yrs	61	NR	14	AP, **AS**, AT, **CAL, CAP**, CG, CM, CP, LL, PM, **SF, SI**, SM, SS
Walsh Peru, 2010	LUR	Kinteroni, Block 57	D,W '10	1° lowland forest with bamboo	36d; 403.2hrs; 268.8km	38	NR	NR	**AC, AN, ASA**, AV, CA, **CAL, CAP, CB**, SB, **SI**

[a] D = Dry season; W = Wet season; [b] Camera and other trap time not listed; [c] **ABC = *Ateles belzebuth chamek***, **AC = *Ateles chamek***, **AL = *Alouatta* sp.**, **AN = *Aotus nigriceps***, AO = *Aotus* sp., AP = *Ateles paniscus*, APC = *Ateles paniscus chamek*, AS = *Alouatta seniculus*, **ASA = *Alouatta sara***, AT = *Aotus trivirgatus*, AV = *Aotus vociferans*, CA = *Callicebus* sp., **CAL = *Cebus albifrons***, **CAP = *Cebus apella***, **CB = *Callicebus brunneus***, CG = *Callimico goeldii*, CM = *Callicebus moloch*, **CMB = *Callicebus moloch brunneus***, CP = *Cebuella pygmaea*, **CPI = *Cebus pithecia***, LC = *Lagothrix cana*, LL = *Lagothrix lagothricha*, **PI = *Pithecia irrorata***, PM = *Pithecia monachus*, SA = *Saguinus* sp., SB = *Saimiri boliviensis*, **SF = *Saguinus fuscicollis***, **SI = *Saguinus imperator***, SM = *Saguinus mystax*, SS = *Saimiri sciureus*, SSB = *Saimiri sciureus boliviensis*

by the Urubamba Mountains. The study site is near the Pagoreni A natural gas well site, east of the confluence of the Camisea and Urubamba Rivers (11°42' S, 72°48' W; Fig. 1). Three habitat types—*terra firme*, riverine terrace, and mixed upland—have been described for the area, and Pagoreni A is in *terra firme* primary forest, dominated by *Iriartea deltoidea* (Araceae) and *Pentagonia parvifolia* (Rubiaceae) (Comiskey *et al.*, 2001). In the region, the local Matsigenka people cultivate manioc, maize, plantains, and bananas using swidden agricultural techniques (Shepard and Chicchón, 2001) along the Camisea River, and subsistence hunting is legally practiced. The study area is in traditional Matsigenka territory, within oil concession lots 56 and 58, controlled by Pluspetrol. Repsol Exploración Perú is building a second pipeline from Pagoreni A to the Malvinas processing plant. We studied a 9.2 km section of the northern part of this proposed pipeline (Fig. 1) under a collaborative agreement with Repsol, and results presented here are part of a larger study on the impacts of pipeline construction on primates.

Methods

Primates were censused along eight transect trails perpendicular to the route of the planned pipeline, between 1.2 and 1.5 km in length (opened in March-May 2011) and along two transects on the proposed pipeline route 4.0 and 5.2 km in length (Fig. 1) during the dry (28 May-3 July 2011) and wet (13 October-24 November 2011) seasons. Transects were sampled between 700-1200 and 1300-1700 h. In the dry season, perpendicular transects were walked a total of 8 times each and in the wet season 20 times each. The pipeline trail transects were sampled 20 and 18 times each during the wet season only. A total of 467.6 km (dry season: 84 km; wet season: 383.6 km) were sampled. An additional 668.2 km (dry season: 259.3 km; wet season: 408.9 km) were sampled opportunistically during transit time to, from, and between transects. There were two field teams, each consisting of a Matsigenka guide, a primatologist (TG or FCR), and a field nurse. The team members walked transects at approximately 1.25 km per hour and upon encountering a group of primates recorded the following data: species, group size, sex-age composition of the group, height of the group in the canopy, and the location with a hand-held Garmin Map CSx or Cx GPS unit. When possible, primates were photographed to confirm species identifications. Groups that were heard but not seen (particularly *Alouatta sara* and *Callicebus brunneus* groups) were not included in data analysis because their exact location and group size could not be confirmed. We used group size and composition data, combined with the spatial distribution of sightings, to estimate the total number of distinct groups observed (Table 2). Group encounter rates (# seen per 10 km walked) were calculated for each species and compared to adjacent documented localities.

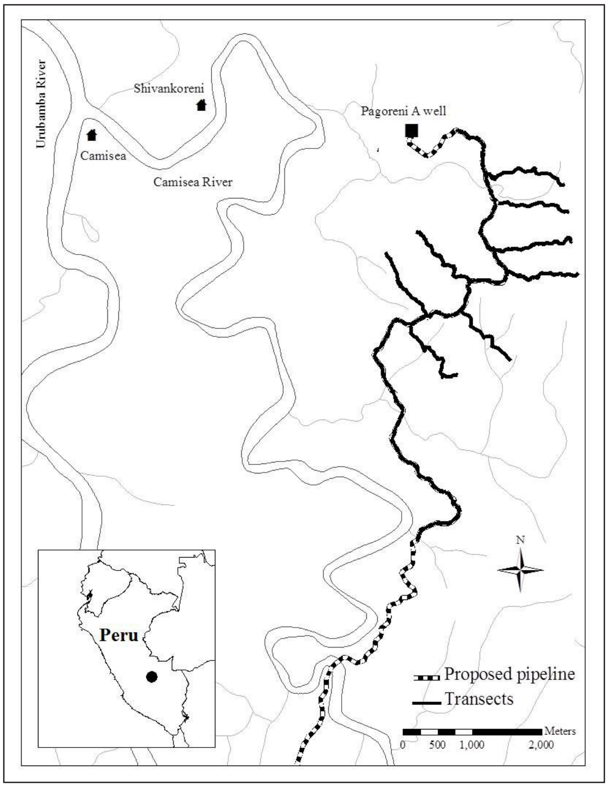

Figure 1. Map of study area. Solid black lines indicate the 9.2 km portion of the proposed pipeline that was monitored and eight perpendicular transects that are at least one kilometer in straight-line distance from the proposed pipeline.

Additionally, we placed Reconyx RC55 digital infrared trail cameras (Reconyx Inc., Holmen, Wisconsin, USA) along the pipeline route and perpendicular transects to document the presence of primates and other mammals. During the dry season, there were four cameras in five locations on the ground (87 camera trap nights) and five cameras in six locations in the canopy (89 nights). During the wet season, we placed six cameras in seven locations on the ground (157 nights).

Results and discussion

During the dry season, we documented eight species of primates. These species were also confirmed in the wet season in addition to a single subadult female *Ateles chamek* (Fig. 2; Table 2). Encounter rates were highest for the two *Saguinus* spp. and the two *Cebus* spp. *Callicebus brunneus*, *Alouatta sara*, and *Pithecia irrorata* were seen relatively infrequently. *Aotus nigriceps* was only seen on four occasions; however, this low encounter rate is likely a byproduct of strictly diurnal sampling. Group sizes were similar to those reported from other sites for both *Saguinus* spp, *C. brunneus*, and *P. irrorata*. Groups of *Cebus* spp., however, were small compared to group sizes documented in the literature (Table 2). In either or both of the seasons, infants and/or juveniles were observed in groups of all species except *C. brunneus*.

More species of primates were observed during this study than in previous studies in the area (Table 1). However, with the exception of the two *Saguinus* spp., encounter rates

Table 2. Primates observed during study period both on transect walks and during walks to reach sampling sites (total). Mean group size (with all age classes), range, and estimated number of groups observed are based on total sightings. Encounter rates (ER) are based only on transect walk sightings. References for species identifications include names of experts consulted. Group sizes and ER for nearby protected areas Manu National Park (MNP) and Los Amigos Conservation Concession (CICRA) are presented for comparison.

Species	No. of sightings on transects (total)	Mean group size (range)	Est. no. of unique groups obs.	Group ER/10km	MNP, CICRA[a]		References for species identifications
					Mean group size (range)	GroupER/ 10km	
Saguinus fuscicollis	28 (46)	4.8 (2-6)	10	0.60	5 (3-13)	0.43	Aquino and Encarnación, 1994
Saguinus imperator	34 (52)	6.0 (3-10)	9	0.73	4 (3-5)	0.37	Hershkovitz, 1977; 1979
Aotus nigriceps	2 (4)	2.8 (2-4)	4	0.04	4 (2-4)[b]	-	Fernández-Duque, 2011; Ford, 1994; Hershkovitz, 1983
Cebus albifrons	26 (41)	11.0 (8-16)	4	0.56	15 (8-16)	1.22	Silva Jr., 2001
Cebus apella	28 (36)	5.3 (3-8)	3	0.60	10 (4-12)	2.82	Aquino and Encarnación, 1994; Silva Jr., 2001
Callicebus brunneus	5 (7)	2.0 (2)	4	0.11	3 (3-4)[c]	1.04[c]	Hershkovitz, 1990; T. Defler, pers. comm.
Pithecia irrorata	5 (12)	2.4 (2-4)	9	0.11	4.7 (2-8)	-	Hershkovitz, 1987; L. Marsh and S. Palminteri, pers. comm.
Alouatta sara	7 (10)	4.2 (3-5)	6	0.15	6 (4-7)[d]	1.35[d]	Cortés-Ortiz et al., 2003; Groves, 2001; 2005; R. Cadenillas, pers. comm.
Ateles chamek	0 (1)	-	0	-	29.7 (18-44)	2.82	Quintana et al., 2009

[a] References: Gibson, 2012; Janson and Terborgh, 1980; Palminteri and Peres, 2012; Terborgh, 1983

[b] *Aotus trivirgatus*

[c] *Callicebus moloch*

[d] *Alouatta seniculus*

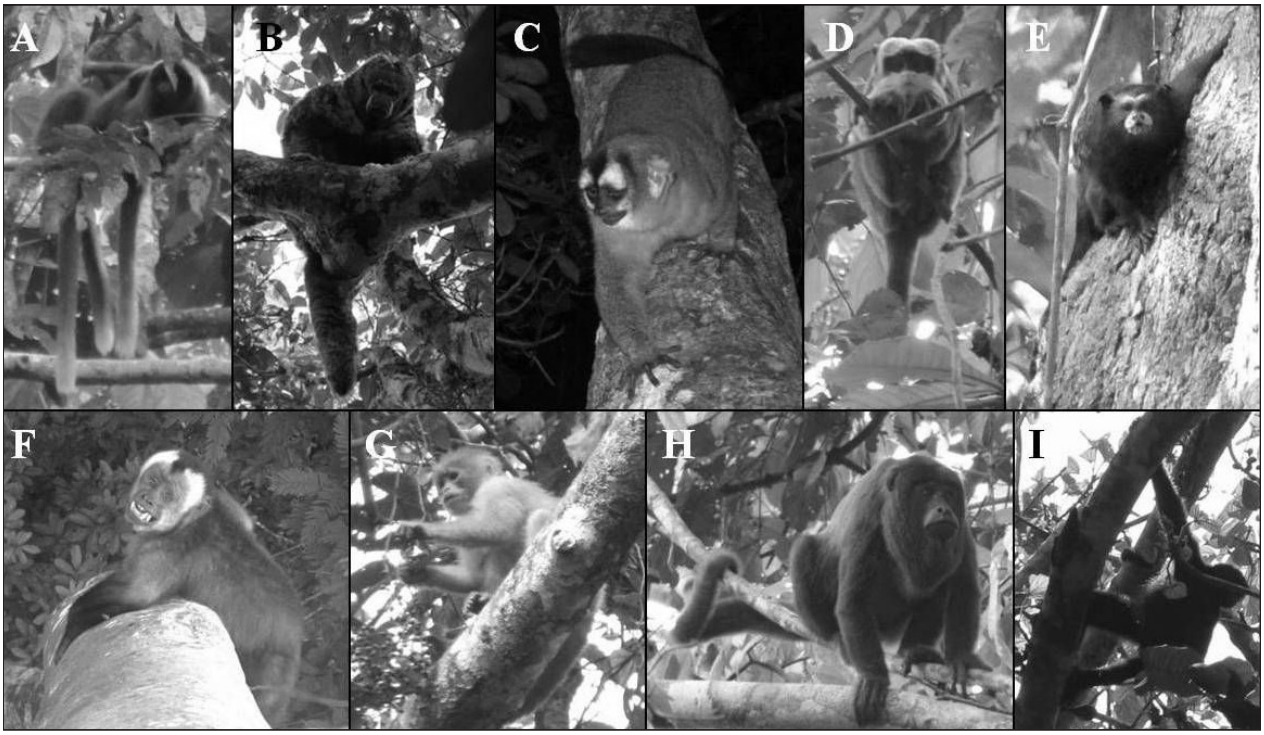

Figure 2. Images from Pagoreni A the nine species observed: A. *Callicebus brunneus* (sexes unknown), B. *Pithecia irrorata* (female?), C. *Aotus nigriceps* (sex unknown), D. *Saguinus imperator* (male?), E. *Saguinus fuscicollis* (sex unknown), F. *Cebus apella* (sub-adult male), G. *Cebus albifrons* (juvenile), H. *Alouatta sara* (male), and I. *Ateles chamek* (female). Photos: TG: A, B, D, G, H; FCR: E, I; Camera trap (taken 2013): C, F.

were low compared to nearby protected areas (Table 2). Primate species not observed but considered potential inhabitants of the area include: *Cebuella pygmaea*, *Saimiri boliviensis*, and *Lagothrix cana*. Appropriate data were not gathered during this study to determine whether these species are absent for ecological reasons. However, given that sampling intensity was relatively high and data were gathered during two seasons, it is unlikely they simply went undetected. Low encounter rates and group sizes may be attributable to various causes including ecological factors and human impact. While these factors were not specifically addressed by this study, human impact is indeed a possibility. Although construction of the original Pluspetrol pipeline from Pagoreni to Malvinas was completed in 2008, maintenance of the pipeline and well requires the continuous presence of personnel along with associated frequent helicopter traffic, resulting in a notable human presence in the area. Separate from this disturbance, legal

Table 3. Non-primate mammal species registered during the study either through direct observations or photographs from camera traps.

Scientific name	Common name (English)	Common name (Matsigenka)	Registration type	
			Camera trap	Direct observation
Cingulata				
Dasypodidae				
Dasypus novemcinctus	Nine-banded armadillo	Étini	x	
Priodontes maximus	Giant armadillo	Kinteróni	x	
Pilosa				
Myrmecophagidae				
Tamandua tetradactyla	Amazonian tamandua	Mántani	x	
Rodentia				
Sciuridae				
Microsciurus sp.				x
Sciurus spadiceus	Southern Amazon red squirrel	Méguiri		x
Dasyproctidae				
Myoprocta pratii	Green acouchi	Chochori	x	
Cuniculidae				
Cuniculus paca	Lowland paca	Samáni	x	
Lagomorpha				
Leporidae				
Sylvilagus brasiliensis	Forest rabbit	Tsíroni	x	x
Carnivora				
Felidae				
Leopardus pardalis	Ocelot	Matsónsori, maniti	x	
Puma concolor	Puma	Matsónsori, maniti	x	
Panthera onca	Jaguar	Matsónsori, maniti	x	
Procyonidae				
Procyon cancrivorus	Crab-eating raccoon	Kovéntsiri	x	
Potos flavus	Kinkajou	Kutsáni	x	
Mustelidae				
Lontra longicaudis	Neotropical otter	Parári		x
Eira barbara	Tyra	Oáti		x
Perissodactyla				
Tapiridae				
Tapirus terrestris	Brazilian tapir	Kémari	x	
Cetartiodactyla				
Tayassuidae				
Pecari tajacu	Collared peccary	Shíntori	x	x
Cervidae				
Mazama americana	Red brocket deer	Maníro	x	x

subsistence hunting by local communities has been documented to have a significant influence on abundance and diversity of local primates in the Amazon (Naughton-Treves *et al.*, 2003) and this could be a factor in the LUR as well.

Ateles chamek and *Lagothrix cana* are the two most preferred edible primate species for the Matsigenka people in Manu National Park, followed by *Alouatta seniculus* (*sara* in the present study), *Cebus apella*, and *C. albifrons* (da Silva *et al.*, 2005; Shepard, 2002). In the present study, the absence of *L. cana* and encounter rates of the other species are consistent with this preference pattern of primate consumption. *A. chamek* and *A. sara* were seen infrequently, and while both *Cebus* spp. were among the four most frequently sighted, encounter rates and group sizes were lower than other sites, particularly for *C. apella*. In contrast to the larger bodied primates, both *Saguinus* spp. were relatively abundant and showed higher encounter rates than reported in Manu National Park (Table 2). Both small body size and high fertility (twinning every six months) likely contribute to this phenomenon. According to da Silva *et al.* (2005), Matsigenka hunters only take *Saguinus*, *Callicebus*, and *Pithecia* spp. on occasion because of their small body size. Abundances of *Saguinus* spp. may therefore be an example of density compensation, wherein abundances of smaller and medium-bodied species increase given an absence of larger-bodied species, a pattern that has been associated with hunting pressure (Barrera Zambrano *et al.*, 2008; Peres and Dolman, 2000). Alternatively, a preference among *Saguinus* spp. for disturbed and secondary habitat (Garber, 1993; Oliveira and Ferrari, 2008), such as that created by the nearby pipeline, may also explain higher numbers of these two species. Low encounter rates of *Pithecia irrorata* and *Callicebus brunneus* may be have to do with lack of habituation and a resulting cryptic anti-predator response (Gleason and Norconk, 2002; Terborgh, 1983), which likely reduced detectability for observers.

Regarding non-primates, eighteen additional large mammal species were documented in the area (Table 3). *Procyon cancrivorus* was recorded for the first time in the area, and both large felids (*Puma concolor* and *Panthera pardus*) were photographed, along with *Leopardus pardalis*. Other documented species of interest include *Priodontes maximus* and *Tapirus terrestris*, both of which are listed as vulnerable on the IUCN Red List (Naveda *et al.*, 2008; Superina *et al.*, 2010). *T. terrestris* and felid tracks were seen almost daily, and *Cuniculus paca*, *Myoprocta pratii*, *Mazama americana*, and *Pecari tajacu* were recorded frequently in the camera traps. This potentially high diversity and abundance of terrestrial large mammals, despite the low abundances of large bodied primates, requires further investigation.

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SHORT ARTICLES

INDÍCIOS DE PREDAÇÃO DE OVOS DE *CAIMAN CROCODILUS* (JACARÉ TINGA) POR *SAIMIRI* SP. (MACACO DE CHEIRO)

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José Francisco Reis da Costa
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A inundação e a predação de ovos são os principais fatores da perda ou controle populacional de crocodilianos, assim, seus ovos compõem a dieta de vários animais com hábito alimentar oportunista, incluindo répteis, aves e mamíferos (Larriera and Piña, 2000; Chen et al., 2003). No Novo Mundo já foram descritas predação de ovos de várias espécies de crocodilianos, porém, a única espécie de primata descrita como predadora de ovos de jacarés foi *Cebus apella* (macaco prego) (Tabela 1). A diferença das espécies de predadores para cada espécie de crocodiliano, descrita na tabela 1, varia de acordo com a ocorrência de cada espécie em seus habitats. O presente estudo relata, pela primeira vez na literatura, indícios de predação de ovos de jacarés por *Saimiri* sp. (macaco de cheiro).

O comportamento do primata foi evidenciado na comunidade Ilha do Carmo durante atividades de pesquisa em campo sobre a ecologia reprodutiva de crocodilianos na várzea do Baixo Rio Amazonas. A Ilha do Carmo está situada na várzea do rio Amazonas (S 02°01'27.6" W 054°45'43.6"), no município de Alenquer – PA, e está inserida no Projeto de Assentamento Agroextrativista (PAE) Salvação, próximo ao município de Santarém (Figura 1).

Um dos objetivos do projeto incluía a captura de filhotes de jacarés recém-nascidos para verificação da razão sexual nos ninhos (Allsteadt and Lang, 1995). A estratégia utilizada para captura dos filhotes foi a construção de uma cerca em volta dos ninhos. No dia 30 de janeiro de 2012 restava apenas um ninho para que seus ovos fossem eclodidos. Na manhã do dia seguinte (08:00 h) foi observado um grupo de *Saimiri* sp. acima do ninho com comportamento inquieto e muitas vocalizações. Não foi tomado nota sobre a quantidade de indivíduos nem a composição do grupo

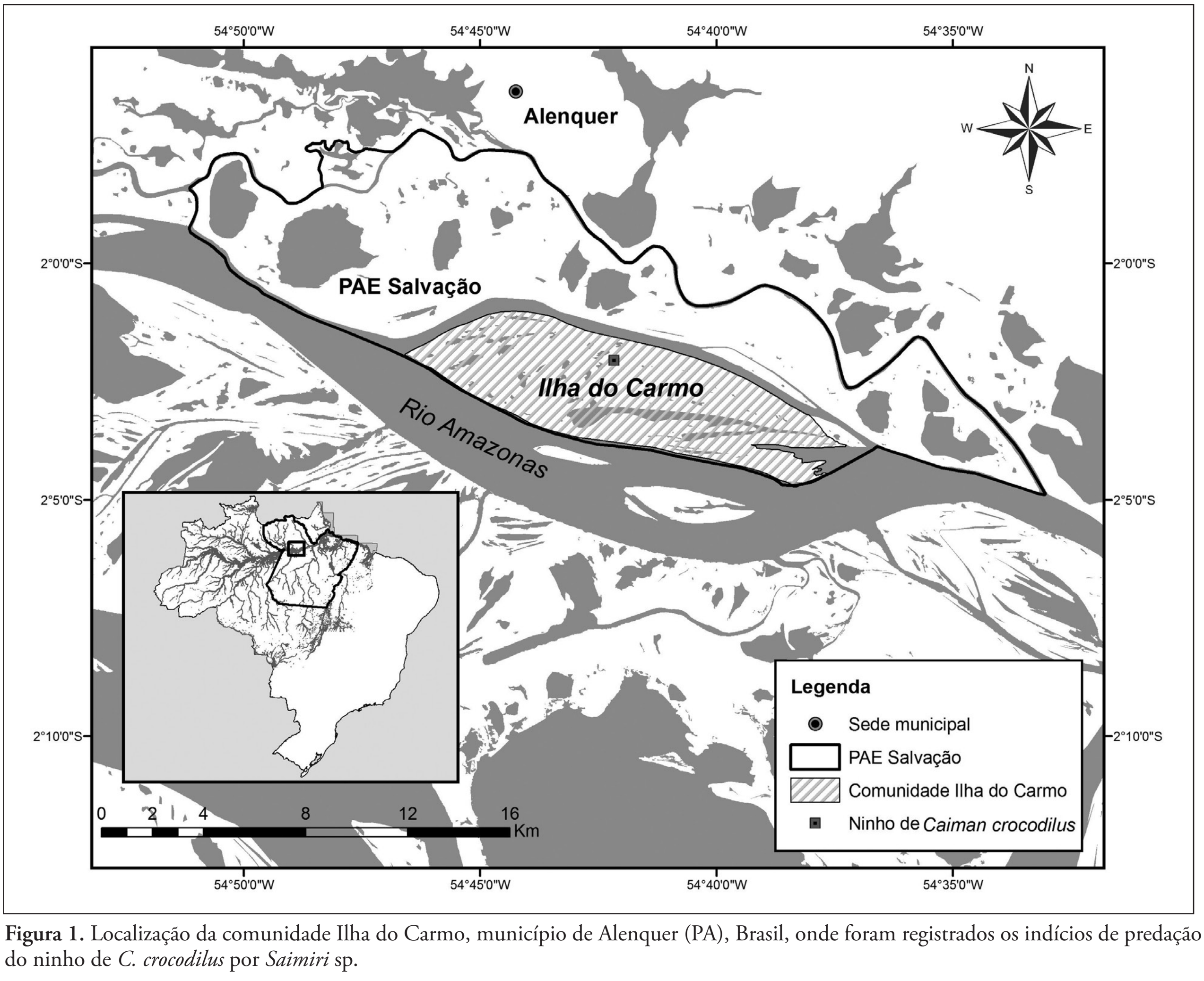

Figura 1. Localização da comunidade Ilha do Carmo, município de Alenquer (PA), Brasil, onde foram registrados os indícios de predação do ninho de *C. crocodilus* por *Saimiri* sp.

de primatas. Verificamos que havia uma casca vazia com o respectivo filhote neonato de jacaré não predado dentro da cerca que rodeava o ninho, e do lado de fora da cerca havia outra casca vazia e seu atinente filhote escondido embaixo de um tronco. O filhote encontrado fora da cerca estava ferido na região dorsal com uma perfuração, ainda sangrando, semelhante à marca de mordidas com caninos. Em uma das estacas da cerca havia indícios da quebra do ovo com marcas de sangue e pequenos fragmentos da casca do ovo, indicando tentativa de quebra do ovo para posterior consumo (Figura 2).

Tabela 1. Crocodilianos e seus predadores de ovos no Novo Mundo.

Crocodilianos	Predador de Ovos	Fonte
Alligator mississipiensis (aligator americano)	*Procyon lotor, Lutra canadensis, Oryzomis palustris, Ursus americanus.*	Joanen, 1969; Deitz and Hines, 1980; Joanen and McNease, 1989; Howard and Ogden, 1991.
Caiman yacare (jacaré do pantanal)	*Nasua nasua, Cerdocyon thous.*	Crawshaw and Schaller, 1980; Cintra, 1988; Campos, 1993.
Caiman crocodilus (jacaré tinga)	*Cebus apella, Tupinambis teguixin, Panthera onca, Homo sapiens, Cerdocyon thous, Caracara plancus.*	Rivero Blanco, 1974; Staton and Dixon, 1977; Villamarín-Jurado and Suárez, 2007; Da Silveira et al., 2010.
Caiman latirrostris (jacaré do papo amarelo)	*Sus scrofa, Polyborus plancus, Conepatus chinga.*	Larriera and Piña, 2000.
Crocodilus acutus (crocodilo americano)	*Procyon lotor, Procyon cancrivorus, Nasua narica.*	Ogden, 1978; Mazzotti, 1983; Thorbjarnarson, 1989; Abadía, 1996; Platt and Thorbjarnarson, 2000.
Melanosuchus niger (jacaré açu)	*Cebus apella, Tupinambis teguixin, Panthera onca, Homo sapiens.*	Ruffeil, 2004; Villamarín-Jurado and Suárez, 2007; Da Silveira et al., 2010; Villamarín et al., 2011.

Figura 2. Imagens do ninho de *Caiman crocodilus* possivelmente predado por *Saimiri* sp. na comunidade Ilha do Carmo, Alenquer (PA): a) ninho no dia anterior à predação; b), c) ninho com indícios de predação; d) estaca do ninho com marcas de sangue e fragmentos de casca do ovo; e) recuperação de filhote de *C. crocodilus* após alguns dias do ferimento.

A perfuração no dorso do filhote deve ter ocorrido quando ainda estava no ovo ou após eclosão. Propõem-se duas situações, onde: (1) o primata tentou consumir apenas o ovo, e o filhote fugiu após eclosão; ou (2) o primata além de tentar consumir apenas o ovo teria quebrado-o e tentado consumir o filhote mordendo-o após quebra do ovo, porém, o filhote escapou. A chegada da equipe (pesquisador e comunitário) pode ter contribuído com a fuga do filhote.

A dieta de indivíduos do gênero Saimiri inclui folhas, frutos, resinas, sementes, insetos, larvas de lepidópteros e ortópteros, néctar, flores, moluscos terrestres, caranguejos, ovos de aves, e pequenos vertebrados como lagartos, pererecas, morcegos e filhotes de aves (Janson and Boinski, 1992; de Thoisy et al., 2002; Voguel et al., 2002; Lima and Ferrari, 2003; Reis et al., 2011; Andrade, 2007). Ovos e filhotes de jacarés foram caracterizados por nós como possíveis componentes da dieta nutricional já citada para o primata, contudo, não há registros do consumo de ovos e filhotes neonatos de jacarés por *Saimiri* sp.

Outro predador de ovos de jacarés presente em áreas de várzea na Amazônia é o *Tupinambis teguixin* (jacurarú, tejú ou teiú) (Da Silveira et al., 2011). Sobretudo, dificilmente um jacurarú conseguiria levar o ovo de jacaré para fora da cerca devido à altura da mesma (70 cm) e à sua maneira de consumo, na qual o réptil não ingere o ovo inteiro com a casca em sua boca (Magnusson, 1982). E ainda, as marcas de sangue e fragmentos de casca na estaca indicam a quebra do ovo nesta estrutura, comportamento não identificado no lagarto supracitado. Os ninhos de jacarés apresentam forma de pilhas cônicas e são formados por material orgânico presente no local de nidificação como galhos e folhiços, assim, podem tornar-se facilmente visíveis para os predadores. Apesar do cuidado parental oferecido por crocodilianos, nem sempre a mãe está presente durante o período de incubação dos ovos, deixando-os vulneráveis ao ataque de predadores (Wang et al., 2011). Sobretudo, quanto mais tempo o ovo permanece incubando no ninho, maior é possibilidade de predação (Larriera, 1994; Wang et al., 2011).

Para obter informações sobre o ambiente e fauna local, foram realizadas conversas informais e aplicação de entrevistas semiestruturadas em 30 % das famílias, no ano de 2012. Foi utilizada a metodologia do tipo “bola de neve”, na qual, os próprios entrevistados indicam os informantes chave, que são os moradores reconhecidamente experientes por demonstrar conhecimento detalhado sobre a região (Biernacki and Waldorf, 1981; Viertler, 2002; Davis and Wagner, 2003; Albuquerque and Lucena, 2004; Seixas, 2005). Dessa forma, foi constatado que na Ilha do Carmo há apenas primatas pertencentes ao gênero Saimiri (denominados localmente macaco de cheiro, macaco mão amarela ou xuim) (dados não publicados). Além da informação fornecida pelos moradores locais referente à espécie de primata existente na ilha, a evidência da predação de ovos de *C. crocodilus* por *Saimiri* sp. foi sugerida pelo pescador José da Costa, membro da equipe de pesquisa participativa de jacarés, o que reforça a relevância do conhecimento tradicional para a pesquisa científica (Posey, 2000).

Mesmo sem a observação direta da coleta e quebra do ovo pelo(s) primata(s) e tentativa de consumo desse e do filhote, as evidências apresentadas indicam a tentativa de predação de ovos e neonatos de *Caiman crocodilus* por *Saimiri* sp. Este, apresenta-se como mais um predador de ovos e filhotes de *Caiman crocodilus*, e, possivelmente, os ovos do jacaré como uma fonte alimentar alternativa para *Saimiri* sp.

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IDENTIFYING AND PRIORITIZING FOREST PATCHES KEY FOR THE SURVIVAL OF THE GOLDEN-HEADED LION TAMARIN (*LEONTOPITHECUS CHRYSOMELAS*)

Sara L. Zeigler

Introduction

Through habitat loss and fragmentation, species often experience a loss in space and resources with associated changes to metapopulation dynamics and gene flow as continuous habitat is divided into small, isolated patches. The result is a decrease in survival and reproduction, ultimately reducing population abundance, range extent, and genetic diversity (reviewed in Fahrig, 2003) and leaving the species vulnerable to extinction through demographic and environmental stochasticity, genetic drift, inbreeding depression, and Alleé effects (Fischer & Lindenmayer, 2007).

Brazil's Atlantic Forest provides a prime example of how habitat loss and fragmentation can threaten native species. It is one of the world's most endangered biomes and provides habitat for a disproportionate number of species, many of which are endemic (Myers et al., 2000). Only 11.73% of the original vegetation in the Atlantic Forest remains, the majority of which is found in small fragments (< 50 ha; Ribeiro et al., 2009). Deforestation has been attributed primarily to clear cutting for timber harvest, charcoal production, cattle ranching, and monoculture plantations (Morellato & Haddad, 2000; Pinto & Wey de Brito, 2003) and has been linked to widespread extinctions and population declines for a variety of species (e.g. Chiarello, 1999; Pardini et al., 2005; Uezu et al., 2005). One species affected by the loss and fragmentation of the Atlantic Forest is the endangered golden-headed lion tamarin (GHLT; *Leontopithecus chrysomelas*), an arboreal primate endemic to a small region of southern Bahia, Brazil (Figure 1). GHLTs preferentially use lowland primary forest, secondary/regenerating forest, and shade-cocoa agroforest (Oliveira, 2010; Pinto and Rylands, 1997; Raboy and Dietz, 2004) as habitat. A survey conducted between 1991 and 1993 provides the most recent published population estimate at over 6,000 individuals covering an area of 19,462 km^2 (Pinto and Rylands, 1997). However, recent surveys suggest that the population has declined and that the total range has been reduced by 15% over the last 13 years (Raboy et al., 2010; Raboy, unpublished data).

Persistence of the GHLTs primary habitat types is uncertain. The majority of native vegetation throughout Brazil is found on private land where pressure for agricultural expansion is highest (Ferreira et al., 2012; Sparovek et al., 2010). Between 1987 and 2007, 13% of forest cover was lost within the GHLT range (Zeigler et al., 2010), and recent changes to Brazilian forestry laws are likely to increase deforestation rates country-wide by reducing levels of enforced protection of certain areas of existing forest (Calmon et al., 2011). In addition, since the early 1990's, the price of cocoa has fallen dramatically and fungal epidemics put entire plantations at risk. Thus, it is becoming increasingly more profitable for farmers to clear cut their land for timber extraction (Alger and Caldas, 1994) or for conversion to other agricultural systems like cattle ranching or management-intensive monoculture plantations that do not provide habitat for endangered species (Cassano et al., 2009; Schroth and Harvey, 2007).

Given the uncertain future of remaining habitat for GHLTs, determining which habitat patches are most valuable for GHLT populations is a conservation priority. Such knowledge is especially critical for the proactive protection of existing habitat and populations, preventing the severe population declines and limited opportunities for recovery associated with other Atlantic Forest species (e.g. Kierulff et al., 2008a; Kierulff et al., 2008b, c). The objective of this paper is to synthesize recent, published results of range-wide landscape analyses of GHLT habitat to prioritize habitat for further study and protection.

Methods

Between 2010 and 2011, three major studies were published that analyzed the spatial distribution of GHLTs and their habitat over time. Zeigler et al., (2010) created a binary forest/non-forest map of the species' range using supervised classification of Landsat 5TM remotely sensed imagery taken from 2004-2008 (the '2007 forest map'). They determined that only 5% of forest patches were greater than 36ha, the smallest recorded territory size for a group of GHLTs in primary and degraded habitat (Rylands, 1989). The authors also used the population viability analysis (PVA) program Vortex (Lacy, 2000) to calculate the minimum required area of habitat required for viable populations of GHLTs that were of sufficient size to be able to recover from threats such as disease epidemics and fire. They then located patches meeting those size requirements on the 2007 map. They found that 22 patches could support a viable population of GHLTs over 100 years (98% probability) under a baseline scenario (i.e. no additional threats), although this number decreased to 20, 9, and 6 habitat patches when they included the additional threats of disease, fire, and disease with fire, respectively. Only two patches were large enough to support a viable population that could also retain 98% of its genetic heterozygosity under the baseline, disease, and fire scenarios, and only one patch could support such a population under the disease with fire scenario.

In the second study, Zeigler et al. (2011) used a graph theoretical approach and the 2007 forest map (Zeigler et al. 2010) to determine patterns of habitat connectivity throughout the GHLT range. Assuming that the average GHLT would travel a maximum of 100m in non-forest matrix (J. Mickelberg, unpublished data), 95% of all

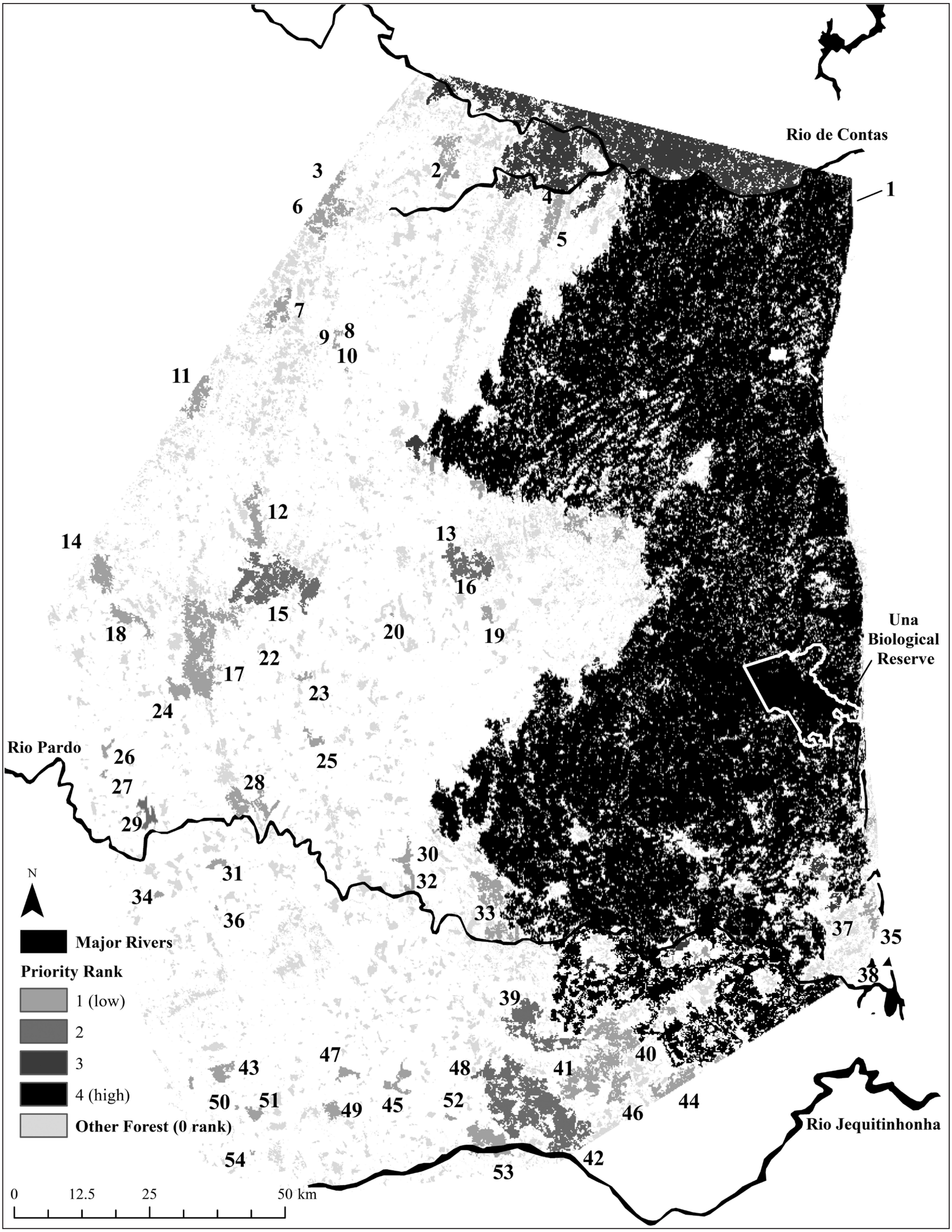

Figure 1. Priority forest patches for the conservation of golden-headed lion tamarins. Each patch was given a point if it was large enough to sustain a minimum viable population, large enough to support a genetically viable population, important for promoting functional landscape connectivity, or occupied based on positive survey results (Raboy et al., 2010). Patches meeting all of these requirements (patch ranking = 4; shown in black) may be disproportionately important for GHLTs and should be prioritized for further research and protection. All patches with at least one point (displayed in darker shades of gray) are designated with a number that corresponds to Table 1, where additional information about each patch is given (some patches are too small to be visible at this resolution).

Table 1. Priority forest patches for the conservation of golden-headed lion tamarins (GHLTs). Each patch was given a point if it was large enough to sustain a minimum viable population, large enough to support a genetically viable population, important for promoting functional landscape connectivity, or occupied based on positive survey results (Raboy et al., 2010). Descriptions of patches meeting at least one of these criteria are listed here (Rank = 1-4), and patches meeting all criteria (Rank = 4) may be especially important for protection and research in the future. See Figure 1 for the locations of these priority forest patches.

Patch Number	Patch Area (ha)	Occupied by GHLTS?*[a]	Genetically Viable Population?*[b]	Viable Population?*[c]	Forest Connectivity?*[d]	Total Rank
1	741973.30	1	1	1	1	4
2	1929.87	0	0	1	0	1
3	1555.83	0	0	1	0	1
4	4.50	1	0	0	0	1
5	1731.06	0	0	1	0	1
6	1467.54	0	0	1	0	1
7	1347.39	0	0	1	0	1
8	109.71	0	0	0	1	1
9	7.92	0	0	0	1	1
10	126.18	0	0	0	1	1
11	1492.02	0	0	1	0	1
12	1985.49	0	0	1	0	1
13	3054.60	1	0	1	0	2
14	1809.45	0	0	1	0	1
15	7149.96	1	0	1	0	2
16	4.50	1	0	0	0	1
17	8004.69	0	0	1	0	1
18	1140.03	0	0	1	0	1
19	432.99	1	0	0	0	1
20	35.64	1	0	0	0	1
21	1.80	1	0	0	0	1
22	9.72	1	0	0	0	1
23	243.72	1	0	0	0	1
24	956.97	1	0	0	0	1
25	477.99	1	0	0	0	1
26	231.84	0	0	0	1	1
27	85.68	0	0	0	1	1
28	2080.71	0	0	1	0	1
29	896.31	1	0	0	1	2
30	532.89	1	0	0	0	1
31	393.75	1	0	0	0	1
32	702.99	0	0	0	1	1
33	2026.44	0	0	1	0	1
34	160.65	0	0	0	1	1
35	806.58	1	0	0	0	1
36	44.55	0	0	0	1	1
37	59.76	1	0	0	0	1
38	4.41	1	0	0	0	1
39	4006.98	1	0	1	0	2
40	2662.92	0	0	1	0	1

Patch Number	Patch Area (ha)	Occupied by GHLTS?*[a]	Genetically Viable Population?*[b]	Viable Population?*[c]	Forest Connectivity?*[d]	Total Rank
41	4003.65	0	0	1	0	1
42	13734.72	0	1	1	0	2
43	928.44	0	0	0	1	1
44	1531.08	0	0	1	0	1
45	924.03	1	0	0	0	1
46	1189.35	0	0	1	0	1
47	501.21	0	0	0	1	1
48	21.60	0	0	0	1	1
49	720.18	0	0	0	1	1
50	53.73	0	0	0	1	1
51	497.70	0	0	0	1	1
52	134.28	1	0	0	0	1
53	2621.97	0	0	1	0	1
54	37.44	0	0	0	1	1

[*] In these columns, “1” denotes that the patch met this requirement, and “0” denotes that it did not.

[a] Researchers found evidence of GHLTs in these patches during surveys of the landscape (Raboy et al. 2010).

[b] Patches meeting this requirement are large enough to support a population of GHLTs that has at least a 98% probability of surviving for 100 years and is able to maintain at least 98% of its original genetic heterozygosity (Zeigler et al. 2010).

[c] Patches meeting this requirement are large enough to support a population of GHLTs that has at least a 98% probability of surviving for 100 years under baseline conditions (i.e. no added threats from disease, fire, etc; Zeigler et al. 2010).

[d] Patches meeting this requirement were found to be disproportionately more important for maintaining functional habitat connectivity throughout the landscape (Zeigler et al 2011, Zeigler et al unpublished data).

habitat patches had no neighboring patches within this distance, and the median component size (i.e. forested area of a group of patches less than 100m apart) was 80ha. In general, they determined that habitat connectivity for this species was low and that 15 habitat patches were disproportionately important for maintaining habitat connectivity in the landscape (Zeigler, unpublished data). Finally, Raboy et al. (2010) conducted a range-wide survey to establish the location of possible GHLT populations using play-back studies and interviews with local people. By overlaying positive points that established the presence of GHLTs from this survey with the 2007 forest map, it was determined that 21 patches in the landscape were probably occupied by GHLTs (Zeigler et al., 2010).

Using the results of these three studies, I calculated a simple ranking scheme to prioritize forest patches throughout the range of the species. I created four separate geographical information system (GIS) layers in the program ArcGIS ver. 9.3 (ESRI). In the first layer, I gave each forest patch a point if it was large enough to support a minimum viable population under baseline conditions according to Zeigler et al. (2010; 22 patches). In the second layer, I gave forest patches a point if they were large enough to support a genetically viable population under baseline conditions, also according to Zeigler et al. (2010; 2 patches). The third layer contained forest patches, all given a point, if they were considered important for maintaining functional connectivity based on the results of Zeigler et al. (2011; 15 patches). Finally, I gave forest patches a point in the fourth layer if they were known to be occupied based on positive survey results according to Raboy et al. (2010; 21 patches). I then added the four GIS layers together in the raster calculator in ArcGIS to produce a single map in which forest patches could have a value ranging from zero (not meeting any of the above conditions) to four (meeting all of the above conditions).

Results

Within the GHLT historical distribution, only one forest patch had a ranking of ‘4’ while 5 and 48 patches had rankings of ‘2’ and ‘1’, respectively (Table 1; Figure 1). All other remaining forest patches were too small to support viable or genetically viable populations of GHLTs, were not important for maintaining connectivity between patches, and were not occupied by GHLTs according to recent surveys.

Discussion

The ranking scheme described here offers a simple first step for prioritizing habitat patches for the conservation of GHLTs. An ideal next step would be to conduct additional surveys on forest patches highlighted here to understand land ownership, likely plans for substantial changes to forest patches by landowners, habitat quality, and the size and condition of any GHLT groups on these patches. They can then be further prioritized, based on the best available science, for protection or as reintroduction sites.

As described in the Introduction, habitat throughout the GHLT range is vulnerable to deforestation for a variety of reasons. Ultimately, the survival of GHLTs and other Atlantic Forest species will depend on the creation of federally mandated protected areas, the promotion of private reserves, and the implementation of positive incentives for farmers to continue biodiversity-friendly agroforestry practices (reviews in Alger and Caldas, 1994; Cassano et al., 2009; Langholz and Lassoie, 2001; Rambaldi et al., 2005; Tabarelli et al., 2005). In addition, it will be critical to protect forested areas throughout the species' range in an effort to preserve redundant populations and the species' full complement of genetic variability. Currently, protected areas within the GHLT range are exclusively found in the eastern half of the region (Schroth et al., 2011) despite the fact that deforestation has historically been heaviest in the west (Zeigler et al., 2010). Further research and protection of western forest patches highlighted here may be especially pertinent.

Forest patches of high quality that meet one or more of the four criteria could also be prioritized as potential reintroduction sites for captive-bred GHLT populations. A large and well-managed captive breeding program currently exists for GHLTs (Ballou et al., 2002), yet these populations have rarely contributed to wild populations. Reintroductions of captive golden lion tamarins (*Leontopithecus rosalia*) have significantly improved the status of the wild population, contributing to the species' nearly unprecedented downlisting from Critically Endangered to Endangered in recent years (Ballou et al., 2002; Kierulff et al., 2008a). A similar program for GHLTs, where captive individuals are reintroduced into ranked forest patches highlighted in Figure 1 (particularly in the western portion of the species' range), could also provide substantial conservation benefits for this species.

Finally, only one forest patch (area: 741973 ha), which contains Una Biological Reserve (Figure 1), meets all four criteria in my ranking scheme (Table 1) and, therefore, may be especially important for the long-term survival of GHLTs. Although I do not advocate strict protection of this entire forest patch, efforts to minimize its fragmentation are critical. This patch was primarily composed of shade-cocoa agroforests as of 1995 (Landau et al., 2003) and is vulnerable to forest loss and fragmentation as small yields, low cocoa prices, and fungal epidemics make landcover conversion more profitable (Alger and Caldas, 1994; Cassano et al., 2009; Schroth and Harvey, 2007). Government subsidies, price premiums for "shade" or "fair-trade" cocoa production, and other incentives for maintaining biodiversity-friendly cshade-cocoa/forest mosaics over cattle pastures and management intensive monoculture plantations will be critical for the persistence of GHLTs (and other Atlantic Forest species) and should be encouraged (Cassano et al., 2009; Schroth et al., 2011). Such mechanisms would allow farmers to be profitable while supporting biodiversity conservation.

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CORREÇÃO DA DISTRIBUIÇÃO GEOGRÁFICA DO PARAUACU-CINZA (*PITHECIA IRRORATA* GRAY 1842) NO LIMITE SUDOESTE DA AMAZÔNIA BRASILEIRA

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Adriana Akemi Kuniy
José de Sousa e Silva Jr

Introdução

Pithecia irrorata (Primates: Pitheciidae) é uma espécie de primata amazônico conhecido pelo nome comum de parauacu ou macaco-velho. Esta espécie foi descrita por Gray (1842) e, de acordo com Hershkovitz (1987), sua localidade tipo é a margem esquerda do rio Tapajós, no interior do Parque Nacional do Amazônia, Estado do Pará, Brasil. A distribuição geográfica de *Pithecia irrorata* foi atualizada por Hershkovitz (1987). Na Figura 1(p. 390), Hershkovitz (1987) representou a distribuição da espécie em forma de polígono, indicando que esta distribuição estaria restrita à região situada ao sul do rio Solimões-Amazonas, oeste dos rios Tapajós e Juruena, norte dos rios Guaporé e Madre de Dios, e leste do rio Juruá, nos estados brasileiros do Pará, Amazonas, Acre e Rondônia, e também no sudoeste do Peru (Departamento de Madre de Dios) e noroeste da Bolívia (Província de Pando). O mapa da Figura 1 de Hershkovitz (1987) serviu como base para a construção do mais recente polígono de distribuição geográfica de *P. irrorata* (Patterson *et al.*, 2007; Veiga, 2009; Fig. 1).

Na mesma obra, Hershkovitz (1987) apresentou outro mapa (Figura 2; p. 392), indicando os locais de coleta das amostras utilizadas no trabalho. Comparando-se os dois mapas, foi possível verificar uma incongruência entre os mesmos. Duas localidades (sítio # 114 [15°01'S; 59°57'W] e sítio # 117 [14°51'S; 57°45'W]) indicadas na Figura 2 estão situadas fora do polígono apresentado na Figura 1. Baseado em fontes bibliográficas (Miranda Ribeiro, 1914; Wagner, 1848), Hershkovitz (1987) indicou que o espécime oriundo do sítio # 114 havia sido obtido por J. Natterer no ano de 1826, nas florestas de Cravari, estado de Mato Grosso (Wagner, 1848), e o espécime proveniente do sítio # 117 havia sido coletado por F. Hoehne em Tapirapuá, rio Cipotuba, estado de Mato Grosso (Miranda Ribeiro, 1914). O objetivo do presente estudo é esclarecer o equívoco ocasionado pela incongruência observada nas figuras de Hershkovitz (1987). A confirmação da presença de *P. irrorata* na região em questão é reforçada por dados de campo, estabelecendo-se novos registros para a espécie.

Metodologia

Os registros apresentados no presente estudo foram obtidos em dois inventários independentes de primatas no estado de Mato Grosso (Fig. 1). Nesta região, a vegetação natural é composta por florestas tropicais úmidas, florestas de transição e manchas de cerrado nas porções mais meridionais (RADAMBRASIL, 1978; Daly e Prance, 1989). Contudo, as atividades humanas alteraram significativamente esta paisagem nas últimas décadas (Fearnside, 2005). O primeiro sítio de amostragem está localizado no município de Brasnorte (Sítio # 1: 12°32'S, 57°52'W). Dezenove incursões foram realizadas durante todos os finais de semana, no período de fevereiro a junho de 2009, em três fragmentos florestais situados em torno da Pequena Central Hidrelétrica Bocaiúva, com extensões de 306, 450 e 600 hectares. Caminhadas aleatórias em trilhas já existentes, bem como em bordas de mata e estradas de terra no interior dos fragmentos foram realizadas. O período de amostragem de campo/final de semana foi de 24 horas. O esforço total de amostragem

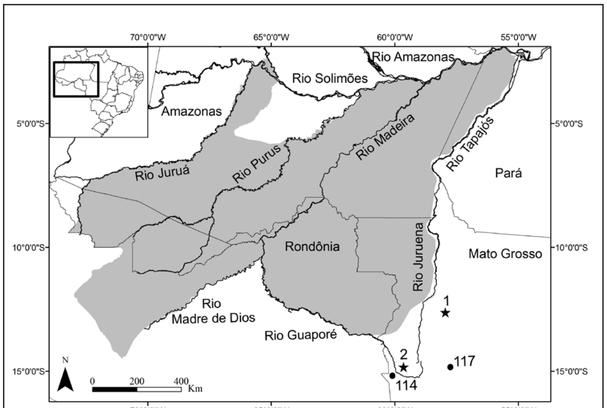

Figura 1. Distribuição geográfica de *Pithecia irrorata* (em cinza), de acordo com Hershkovitz (1987), Patterson *et al.*, (2007) e Veiga *et al.*, (2008). Os círculos (# 114 e # 117) correspondem aos sítios apresentados por Hershkovitz (1987). As estrelas representam os novos registros de *Pithecia irrorata*, numerados de acordo com o texto.

Figura 2. Indivíduo de *Pithecia irrorata* observado em Chupinguaia-RO. Foto: Kurazo Matheus Okada Aguiar.

foi de 456 km. Um chamariz (*playback*) com vocalizações do táxon identificado por Emmons *et al.* (1997) como *Pithecia monachus* foi utilizado para facilitar as buscas.

O segundo sítio está localizado entre as cidades de Vila Bela da Santíssima Trindade e Pontes e Lacerda (Sítio # 2: 59°37'W, 15°01'S). Os registros foram feitos em uma transecção de 5 km através da metodologia Rapeld (Magnusson *et al.*, 2005), em novembro de 2009. O esforço de amostragem foi de 40 km. As identificações de *Pithecia irrorata* foram baseadas na chave de identificação de Hershkovitz (1987). Além disso, fotografias feitas nos dois sítios foram posteriormente utilizadas para confirmação da identificação dos animais (Fig. 2), por comparação direta com os exemplares de *Pithecia irrorata* pertencentes ao acervo do Museu Paraense Emílio Goeldi.

Resultados

No Sítio # 1, *Pithecia irrorata* foi registrada em apenas um fragmento florestal de 306 ha, na margem direita do rio Cravari, um afluente de segunda ordem do rio Juruena. Somente uma observação (dois indivíduos adultos) foi realizada. No Sítio # 2, os registros foram feitos em um fragmento de floresta sazonal semi-descídua de 400 ha. Neste sítio, ocorreram cinco observações de *Pithecia irrorata*. Na primeira, observou-se um grupo composto por três indivíduos. Na segunda, foi possível visualizar quatro animais. As demais observações foram de indivíduos aparentemente sozinhos.

Discussão e conclusão

Os resultados sugerem que os registros #114 e 117 de Hershkovitz (1987) são fidedignos, uma vez que estão situados na mesma região inventariada no presente estudo. Assim, o limite sudeste da distribuição geográfica de *Pithecia irrorata* é estendido para além da margem direita do rio Guaporé e da margem esquerda do rio Juruena (Figura 1). É possível que o limite natural da distribuição da espécie coincida, nesta região, com os limites entre a vegetação de floresta e a de cerrado. O refinamento deste conhecimento carece de mais investigações de campo, uma vez que os dados sobre a distribuição de *P. irrorata* nesta região ainda são escassos. De acordo com Sampaio *et al.* (2012), existem grandes fragmentos de floresta situados próximo às áreas investigadas no presente estudo. Tais fragmentos são representados por Terras Indígenas (TI), tais como as TI de Enawenê Nawê, Nambiquara e o complexo de TI Paresi-Utlariti-Tlrecatinga (Mato Grosso), e também TI menores, tais como as TIs Vale do Rio Guaporé, Sararé e Irantxe/Manoki (Mato Grosso), as quais podem abrigar populações viáveis e apresentam um grande valor de conservação para esta espécie e demais primatas da região.

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PREDATION ATTEMPT ON A ROAD-KILLED BROWN-EARED WOOLLY OPOSSUM (*CALUROMYS LANATUS*) BY A BLACK-HORNED CAPUCHIN (*SAPAJUS NIGRITUS*)

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Camila Camara Pianca

Hunting and scavenging of vertebrates by nonhuman primates has been recorded widely across the world (Butynski, 1982). Researchers have observed predation of small amphibians, reptiles, birds and mammals by several different primate species (Boinski and Timm, 1985; Wrangham and Riss, 1990; Heymann et al., 2000; Poulsen and Clark, 2001; Begotti and Landesmann 2008; Silva et al., 2008). However, capuchins, chimpanzees and baboons are the only non-human primates known to prey systematically upon relatively large vertebrates (Rose, 1997). Capuchin monkeys have consumed a variety of vertebrate prey such as frogs (Izawa, 1978); lizards, birds, bats (Fedigan, 1990; Rose, 1997; Rose et al., 2003); opossums (*Didelphis* sp.), rats (*Rattus rattus*) (Resende et al., 2003); mice (*Rhipidomys* sp.) (Milano and Monteiro-Filho, 2009); squirrels (*Sciurus aestuans*, *S. variegatoides*) (Galletti, 1990; Cunha et al., 2006); coati pups (*Nasua narica*) (Newcomer and Fancy, 1985; Fedigan, 1990; Perry and Rose, 1994; Rose et al., 2003); anteater juveniles (*Tamandua mexicana*) (Rose et al., 2003); and even other primates, such as titi monkeys, *Callicebus moloch* (Sampaio and Ferrari, 2005), and owl monkeys*, Aotus brumbacki* (Carretero-Pinzon et al., 2008). Here we describe an opportunistic attack attempt on a road-killed brown-eared woolly opossum (*Caluromys lanatus*) by a black-horned capuchin monkey (*Sapajus nigritus*) during a fortuitous encounter in a disturbed fragment in the Brazilian Atlantic Forest.

On November, 30th, 2003, at around 1000 h, we collected *ad libitum* data on a black-horned capuchin attacking a brown-eared woolly opossum that had been hit by a car, in the Ecological Station of Ribeirão Preto, Mata Santa Tereza (21°12’57” S; 47°50’52” W), a semi-urban area of 154.16 ha in Ribeirão Preto, in the northeast of São Paulo state, Brazil. Mata Santa Tereza is an isolated forest fragment and has a large population of these capuchin monkeys (Amaral et al., 2005). Although the group has been well studied (Siemers, 2000; Amaral et al., 2005; Machado et al., 2012), this is the first report of this particular behavior. The brown-eared woolly opossum was still alive on the ground, with its organs exposed (Fig. 1a), when an adult male black-horned capuchin monkey, that was standing on the ground (Fig. 1b), approached the fatally injured woolly opossum and started to attack the animal viscera while the rest of the capuchin group watched at the edge of the road. There was high traffic volume on the road that day, and the predation attempt was interrupted by the approach of a car, which caused the capuchin to run away towards the forest adjacent to the road.

Perhaps, Mata Santa Tereza does not have enough feeding resources to support this large monkey population and food shortage is a common situation faced by the group. It may also be important that, especially on weekends and holidays, local people feed these capuchins a variety of foods such as bananas, eggs, peanuts, bread and other snacks. In most cases, individuals descend to the ground to get the food from the visitors’ hands. So, these monkeys may have learned to patrol the road for people’s food and also are aware of other opportunities such as road-killed animals, which could serve as alternative food source available in this area. Siemers (2000) observed that the capuchins of

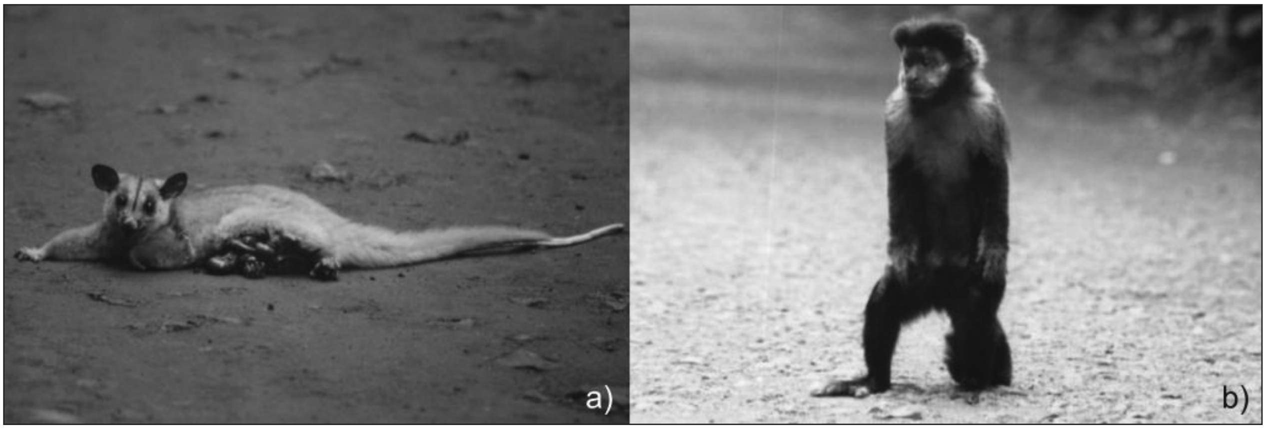

Figure 1. (a) Road-killed Brown-eared woolly opossum (*Caluromys lanatus*) and (b) Black-horned capuchin (*Sapajus nigritus*) in the Ecological Station of Ribeirão Preto, northeastern of São Paulo state, Brazil (Photos: Camila Camara Pianca).

Mata Santa Tereza remained on the forest floor and did not flee to higher strata when humans passed. They often foraged for food voluntarily or accidentally dropped by humans on the ground. Also, the monkeys predominantly traveled in low forest strata and spent more time close to the ground than in the canopy.

In general, predation of mammals or other vertebrates by monkeys is usually performed during a period of food shortage or through intraspecific social learning (Resende et al., 2004). Apparently, seasonality is not an important factor in the occurrence of vertebrate predation by capuchins. Different surveys on predation by capuchins have been recorded during the dry season which is also the birthing season of most prey species (Fedigan, 1990), but also in the wet season (Rose, 1997) or even with the same frequency in dry and wet seasons (Ferreira et al., 2002). Apparently, there is a sex difference in frequency of predation by capuchins, since adult males tend to catch more prey than females (Fedigan, 1990; Rose, 1997; Ferreira et al., 2002). In addition, capuchins tend to select prey items by size and age; for example, they preferentially search for infants or juveniles of large mammals, such as for coatis, anteaters and other primates (Rose, 1997; Rose et al., 2003; Sampaio and Ferrari, 2005). However, injured or killed animals could be consumed opportunistically by capuchins regardless of their age or size (Carretero-Pinzón et al., 2008). Therefore, further detailed surveys are needed to determine the conditions under which predation of large mammals by capuchin monkeys can occur.

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PARASITOS GASTROINTESTINALES EN EL MONO CHORO COLA AMARILLA (*OREONAX FLAVICAUDA*) Y EL MONO NOCTURNO ANDINO (*AOTUS MICONAX*) EN AMAZONAS, PERU

Jéssica Sánchez Larrañaga
Sam Shanee

Introducción

El parasitismo es un fenómeno ecológico de asociación simbiótica donde solo uno de los organismos de dicha asociación se beneficia y el otro la tolera (Campillo, 1999). Existe así una estrecha relación entre el parásito y el huésped la cual actúa como una fuerza para la selección natural, afectando por ende los patrones de densidad y la distribución de las especies (Stoner et al, 2005; Gillespie et al, 2005). Dentro de los factores que influyen en el parasitismo de los primates están la densidad poblacional, factores climáticos, comportamientos, factores reproductivos y, lo más importante, su dieta y la fragmentación del hábitat (Scott, 1988; Serrano, 1998; Stoner et al, 2005).

En el bosque de El Toro se puede observar la presencia humana y de animales domésticos por algunas zonas ya que se ha iniciado la fragmentación del bosque, y esto influye en el aumento de la carga parasitaria. El mono choro cola amarilla (*Oreonax flavicauda*) es endémico del Perú (Macedo Ruiz y Mittermeier, 1979; Leo Luna, 1987), habita los bosques nublados de la vertiente nororiental de los Andes a una altitud de 1,500 – 2,700 msnm, encontrándolos en los departamentos de Amazonas y San Martín (Leo Luna, 1980; Shanee, 2011) así como en pequeñas áreas de las regiones de Huánuco y La Libertad (Shanee, 2011; Graves y O'Neil, 1976). El mono nocturno Andino (*Aotus miconax*) también es endémico del Perú y comparte mucha de su distribución con el mono choro cola amarilla (Shanee, 2011). Su extensión es un tanto más amplia latitudinalmente, hasta los 3,000 msnm., y llega más al sur en el departamento de Huánuco. Su distribución actual no es del todo conocida y falta muchos datos para evaluar su estado de conservación.

El hábitat de ambas especies se caracteriza por ser zonas de empinados desfiladeros y barrancos. La extensión original del hábitat de *Oreonax flavicauda* se estima en alrededor de 11,000 km² (Leo Luna, 1982). Estudios actuales reportan que el hábitat de esta especie ha decrecido quedando entre 6,000 y 7,000 km² (Buckingham y Shanee, 2009). *Oreonax flavicauda* se encuentra reportado por la UICN como especie en peligro crítico de extinción (lista Roja A4c). *Aotus miconax* se encuentra en UICN como especie vulnerable a la extinción (Lista Roja A2c). En La Esperanza ambos especies están presentes en varios tipos de hábitat y niveles de disturbio antropogénico. Las densidades poblacionales de las especies son medio altas y se encuentran fácilmente (Shanee y Shanee, 2011; en prensa). El objetivo de la presente investigación fue determinar la presencia de parásitos en estas especies endémicas de primates, ya que éste puede ser uno de los factores que pone en riesgo el bienestar de sus poblaciones.

Materiales y métodos

Area de estudio

El presente estudio se realizó en La Esperanza, un pueblo situado en la comunidad campesina Yambrasbamba, Provincia de Bongará, Región Amazonas, Perú. Las muestras se tomaron en un bosque primario localmente llamado El Toro. La temperatura media en el área es de entre 15 y 25 °C, con precipitación fuerte durante todo el año con una pequeña sequía entre Mayo y Setiembre. El bosque primario está a una altitud de 1,920 msnm Esta área se forma al extremo sur de un bosque continuo hasta el Río Marañón en el Norte (~115 km).

Recolección de muestras y procesamiento

Durante los meses de Marzo y Mayo del 2011 se recolectó un total de 33 muestras de heces procedentes de *Oreonax flavicauda* y *Aotus miconax*. Las muestras se tomaron mediante una técnica no invasiva que consistió en la recolección manual de estas inmediatamente después de la defecación, la cual se realizó con mayor frecuencia después de los periodos de descanso y antes de iniciar su desplazamiento, principalmente en el caso de *O. flavicauda*. Para la recolección de las muestras de *A. miconax*, primero se identificaron los nidos, y se tomaron las muestras principalmente antes de que los animales iniciaran su desplazamiento y durante esta actividad pero en menor proporción. Se tomaron muestras de dos grupos diferentes de *O. flavicauda* con un tamaño de grupo cada uno de 18 y 15 miembros, donde recogieron 12 y 13 muestras individuales respectivamente. En el caso de *A. miconax* se encontró un solo grupo sin poder determinar el tamaño, tomando del mismo nido por 3 días consecutivos un total de 8 muestras.

Las muestras se colocaron en un envase plástico con tapa rosca, posteriormente se le adicionó formol al 10% y luego fueron refrigeradas para su conservación hasta el traslado al laboratorio de biología-microbiología de la Universidad nacional Toribio Rodríguez de Mendoza en la ciudad de Chachapoyas donde fueron analizadas por los autores. Las muestras de heces fueron procesadas mediante la técnica de flotación con solución sobresaturada de cloruro de sodio, solución shater y la técnica de sedimentación. Así mismo se procedió a realizar un pool cada 02 o 03 muestras realizando sedimentación en mallas metálicas; y se examinó a través de un microscopio electrónico determinando la presencia de trofozoitos o quistes de protozoarios, así como huevos, larvas o adultos de nemátodos gastrointestinales, mediante las características morfológicas correspondientes a cada una.

Resultados

De las 33 muestras estudiadas 21 (64%) resultaron ser positivas al menos a una forma parasitaria; en las muestras de *Aotus miconax y Oreonax flavicauda* se pudo hallar infecciones múltiples de protozoarios y nemátodes. (Tabla 1). Los resultados fueron diferentes para las dos especies en estudio. En el caso de *Oreonax flavicauda* se encontraron dos clases de nemátodos; *Strongydoides spp.* y *Trichuris spp.*, y protozoarios como *Iospora spp*, *Endolimax spp;* se encontró además un mayor número de casos de infección por *Eimerias spp.* En *Aotus miconax* se encontró un caso de *Strongylodes spp.* y de protozoarios solo se halló *Eimeria spp.* (Tabla 2).

Discusión

Este es el primer estudio parasitológico realizado en mono choro cola amarilla (*Oreonax flavicauda)* y mono nocturno Andino *(Aotus miconax)*. Tanto en *O. flavicauda y A. miconax* se registró la presencia de parásitos. Debe considerarse que las muestras fueron tomadas del mismo bosque, y el primer grupo de individuos muestreados comparten el mismo areal de distribución con los *A. miconax.* Se aprecia

Tabla 1. Porcentaje de frecuencia de parásitos gastrointestinales en *Oreonax flavicauda* y *Aotus miconax*

Especie		**Resultados**			
	N° muestras	**Nemátodes**		**Protozoarios**	
	N°	**N°**	**%**	**N°**	**%**
Aotus miconax	8	1	13%	2	25%
Oreonax flavicauda					
Grupo N°1 (n:18 individos)	12	3	25%	10	83%
Grupo N°2 (n:15 individuos)	13	2	15%	6	46%
Total	25	5	20%	16	64%

Tabla 2. Porcentaje de grupos de parásitos encontrados en *Aotus miconax* y *Oreonax flavicauda* de acuerdo a la zona de estudio.

Parásitos encontrados	***A. miconax***		***O. flavicauda***	
Nemátodes	**Muestras positivas**	**% total de muestras**	**Muestras positivas**	**% total de muestras**
Strongyloides spp	1	13%	3	12%
Trichuris spp.			3	12%
Protozoos				
Eimeria spp.	2	25%	12	46%
Iospora spp.			5	19%
Endolimax spp.			2	8%
Total	3	38%	25	100%

la relación existente entre parásito-hospedero ya que factores como la composición de la dieta afecta considerablemente esta relación. Existen compuestos secundarios presentes en algunas plantas que pueden tener efecto adverso en los organismos (Freeland, 1983); cualquiera de los mecanismos del huésped relacionado con la resistencia general y específicamente el parasitismo tiene una importante relación con la dieta (Stoner et al, 2005). Estudios demuestran que existen ciertas partes de las plantas, entre ellas los frutos, que tienen efecto antiparasitario y que los animales de forma instintiva pueden usarlas en aquellos momentos que se sienten en mal estado, probablemente por un aumento en su carga parasitaria (Stoner et al, 2005; Huffman, 1997; Martínez Esquivel, 2010).

En investigaciones de *Aotus spp.* se han reportado con anterioridad casos de *Strongyloides spp.* (Perea-Rodriguez et al, 2010; Tantalean y Gonsalo, 1994). En el presente estudio se puede apreciar que existen diferencias en los resultados entre las dos especies de primates, a pesar de que ambas comparten el mismo hábitat. Puede ser que *Aotus miconax* tiene una alimentación diversa y/o selectiva en comparación con *O. flavicauda*; de igual manera debe considerarse que en el caso de los primates en vida silvestre muchas veces estos hacen inmunidad a los parásitos así como también que los parásitos en especial los protozoarios son parte de la compleja biología de sus hospederos (Campillo, 1999) y necesitan una carga parasitaria elevada para causar signos clínicos.

Finalmente, hay que mencionar que pudimos tomar algunas muestras de *A. miconax* (t= 03) en un parche cercano al poblado de La Esperanza, donde hallamos que el 100% son positivas a infección parasitaria (datos sin publicar). Estos resultados son un punto de partida para futuras investigaciones, en las cuales se pueda considerar el tomar muestras de otros grupos de *O. Flavicauda* y *A. miconax,* tanto en bosques primarios continuos como en parches, y aportar al entendimiento de la dinámica de la parasitosis en estos primates.

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TWINS AND INFANTICIDE IN RED HOWLER MONKEYS INHABITING A FRAGMENT IN WESTERN ORINOQUIA

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Twinning is rare in anthropoid primates, but it occurs in a variety of species, including New World atelid monkeys (Link et al., 2006). This reproductive strategy is common in some small primates (e.g., Callithrichinae), but it does not seem to be appropriate for larger species, for which the cost of simultaneously rising two infants is quite high (Chapman and Chapman, 1986; Link et al., 2006). Similarly, infanticide (the killing of an infant) is an uncommon primate behavior. This occurs particularly when a mature male wins alpha status and kills unrelated infants. The loss of the infant allows the mother to become receptive sooner and to mate with the new, infanticidal male, likely increasing his reproductive success (i.e. sexual selection hypothesis; van Shaik 2000). Infanticide has been documented in several populations of howler monkeys (Crockett, 2003). In this note we report an unusual case of twinning and infanticide in red howler monkeys (*Alouatta seniculus*).

The observation took place during a socio-ecological study in Santa Rosa Farm, located in San Martín (Meta, Colombia) (3°36'52.10"N, 73°38'34.20"W, 373 m a.s.l). The study group, composed of two adult males, two adult females, one juvenile male, and one infant male, ranged over 12 ha within a forest fragment of 32 ha. Changes in alpha male status were observed three times during a period of six months (February-August 2004). On July 18th we were following the subordinate adult male ("Tamarindo") and the alpha male ("Die") was not observed that day. Both males showed injuries and we suspected a recent change in alpha male status, since Die did not rejoin the group. In the morning we noted that one of the adult females ("Juana") was giving birth. The infant's tail was first observed and then its hind limbs. Five minutes later (8:15 h), half of the infant's body was outside, but the mother was unable to completely pull it out. The infant's head was still inside after 45 minutes of delivery. More than two hours later (11:28 h) the female finally took out the infant, but it was dead. The mother held it for about 10 min. and, then, dropped it at 11:40 h. Our inspection of the infant suggested that it died asphyxiated by the umbilical cord. Surprisingly, there was another infant attached alive to the cord, but about one third the size of the dead one. We placed the second infant on the forest floor closer to the mother. She went down to the ground after hearing the infant screaming, but probably because of its small size and its attachment to the placenta, it was unable to grab the mother's fur. She took the infant and went to the canopy, where the adult male approached her and took the infant. The male quickly bit the infant's head and dropped it in the creek, where it died.

We suggest that twinning may incur mechanical complications during delivery. Although the resident males fought the day before the infanticide (as expected by the sexual selection hypothesis), we do not know which male had sired the infants. Therefore, it is not possible to confirm the attack completely fits the sexual selection hypothesis.

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MORPHOMETRIC DATA FROM A WILD FEMALE TITI MONKEY, *CALLICEBUS CUPREUS*

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Body size and the size of organs and other body structures are intimately related to the life history and ecology of a species (Temerin et al. 1984). Comparative analyses of data from different taxa can reveal allometric relationships and the adaptive value of different body or organ size (Martin 1990, Terborgh 1983). E.g., Terborgh (1992) showed the

Table 1. Morphometric measurements from the *Callicebus cupreus* female and comparative data from the literature

	This report	Hill 1960	Hershkovitz 1990	Bicca-Marques et al. 2002	Peres 1993	Ferrari & Lopes 1995
External measurements						
Body mass [g]	720		1106 (1000-1175)[*]	750, 900	860, 970[*]	880[#], 1020[§]
Head-body length [mm]	285	325, 310	337 (270-410)	280, 310	302, 358[‡]	
Tail length [mm]	475	440, 420	439 (405-470)	340, 440	412, 414[*]	
Hind foot length [mm]	89	100, 95	92 (85-100)		89, 91[*]	
Skull length [mm]	67.7	65[†]	63.9 (60.0-66.8)			
Zygomatic breadth [mm]	42.2	41.25	39.0 (36.0-42.0)			
Orbital breadth [mm]	37.2					
Braincase width [mm]	39.8					
Postorbital restriction [mm]	31.4					
Across molars [mm]	19.9					
C^1 - C^1 [mm]	12.0		13.7 (12.9-15.0)			
C1 - C1 [mm]	8.7					
P^2 - M^3 [mm]	15.1	15.4				
M^1 (right) breadth [mm]	4.4					
M^2 (right) breadth [mm]	4.1					
M^3 (right) breadth [mm]	3.3					
Mandibular height [mm]	35.4					
Orbita height [mm]	1.7					
Orbita breadth [mm]	1.4					
Internal organs						
Liver mass [g]	25.5					
Kidney mass [g], right left	3.5 4.8					
Adrenal length [mm], right left	5 7					
Spleen mass [g]	3.25					
Small intestine length [mm]	950					944[#], 1056[§]
Caecum length [mm]	100					
Large intestine length [mm]	435					324[#], 521[§]
Pluck (lung, heart, trachea, tongue) [g]	9.75					

[*] Data for male C. cupreus only; [#] Callicebus caligatus; [§] Callicebus moloch; [†] Hill (1960) provides a mean of two males and three females; [‡] Peres (1993) gives 716 and 770 mm, but this is likely to be head-body-tail length, values listed here are therefore the value given by Peres minus tail length

relationship between primate body size and dietary strategies. Ferrari et al. (1993) compared gut proportions of a specialized and an opportunistic gum feeder and showed the former to have a comparatively larger caecum, as an adaptation to the fermentation of gums. Morphometric data from skulls and skeletons can be obtained from museum material, but data on fresh body mass and on organ size or mass are generally not available from museum specimen. Given ethical implications and the increasing threat to wild primates, collecting wild primates for the purpose of obtaining organ size data is prohibitive. It is therefore imperative to exploit opportunities for taking morphometric data without collection, e.g. when a fresh carcass is found.

In this paper, we report morphometric data from a wild female red titi monkey, *Callicebus cupreus*, at the Estación Biológica Quebrada Blanco (EBQB) in north-eastern Peruvian Amazonia. This female was a member of one study group and found in a comatose state below the sleeping tree on early morning of 29 September 2002. It died a few hours later and was subjected to a field necropsy by the senior author, a trained veterinarian. For a detailed case report and the pathological findings see Müller et al. (2010). We measured body mass, head-body length, tail length and hind foot length on the fresh carcass with Pesola spring balances and a Vernon calliper, respectively. Skull length was measured before the braincase was opened for brain inspection and removal. After necropsy, skull and skeletal material were buried, to allow for decomposition of flesh, and recovered later. Unfortunately, part of the material was taken by scavengers. The remaining material was stored at EBQB and measured with a Mitutoyo CD-20DCX digital calliper by the first author in October 2012. Each variable was measured three times with and values were averaged.

Morphometric data collected before and during necropsy, and from the skull and skeletal material are provided in Table 1, together with data compiled from the literature. For many measurements taken here, actually no comparative data are available from the literature. Most skeletal and dental measurements are within or close to the range of values reported in the literature. The comparatively low body mass is likely due to the diseased condition. It should be note that data for liver, spleen and adrenal, perhaps also for kidney may also represent pathological conditions (Müller et al. 2010).

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ALOUATTA CARAYA: NUEVO SITIO DE ESTUDIO EN ARGENTINA

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Marta D. Mudry

Introducción

Dentro de la familia Atelidae, los monos aulladores (género *Alouatta*) tienen una de las distribuciones geográficas más amplias, extendiéndose desde el sur de México hasta el norte de Argentina (Crockett y Eisenberg, 1987; Zunino et al., 2001). Groves (2001; 2005) reconoce 10 especies para el género. De éstas especies dos llegan a la República Argentina: *Alouatta guariba clamitans* y A*louatta caraya* Humboldt, 1812 (Cabrera, 1939). *Alouatta caraya* posee una amplia distribución en Sudamérica, en Argentina, el límite sur de su distribución, se encuentra al Este de Formosa y Chaco, NE de Santa Fe, el centro de Corrientes y Misiones (Brown y Zunino, 1994).

A finales del 2008 se realizaron salidas de campo a un nuevo sitio de estudio conocido como: "Las Lomas", (27° 23' S; 58° 22' O), campo privado de 623 ha en la localidad de San Cosme, Provincia de Corrientes, Argentina (Fig. 1). La temperatura media anual es 21°C y las precipitaciones medias anuales son de 1,200 mm. Allí se constató la presencia de varias tropas de aulladores. Según Cabrera (1976) y Carnevali (1994) forma parte del Distrito Oriental Chaqueño, Sub-distritos: "Correntino", a su vez dividido en "Parque Chaqueño Correntino" (sector Noroeste). El Chaco Oriental está compuesto por un mosaico de bosques, palmares, pastizales, pajonales y esteros. Las especies más características de estos bosques los quebrachos (*Schinopsis spp*), el urunday (*Astronium balansae*), y el viraró (*Ruprechtia laxiflora*). En las zonas más bajas se desarrollan bosques de algarrobos (*Prosopis spp*) acompañados de talas (*Celtis spinosa*) y palmeras caranday (*Trithrinax* sp). En forma de isletas de monte aparecen especies vegetales típicas como el alecrín (*Holocalyx balansae*), la palmera pindó (*Syagrus romanzoffiana*), el timbó (*Canthormion sp*) y el laurel (*Nectandra spp*) (Burkart *et al*, 1999).

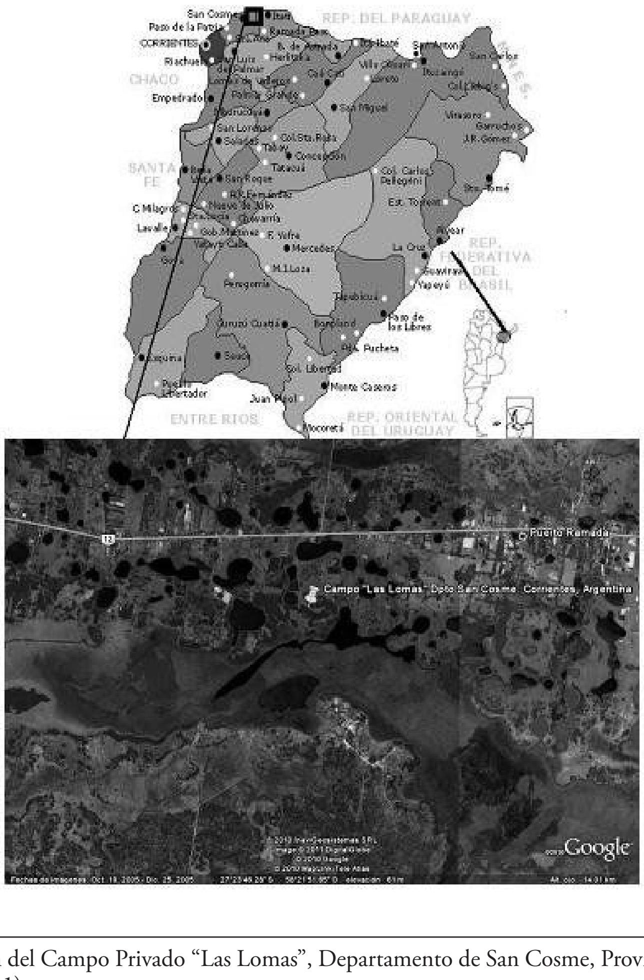

Figura 1. Mapa de Ubicación del Campo Privado "Las Lomas", Departamento de San Cosme, Provincia de Corrientes, Republica Argentina. (Tomada de Bruno, 2011)

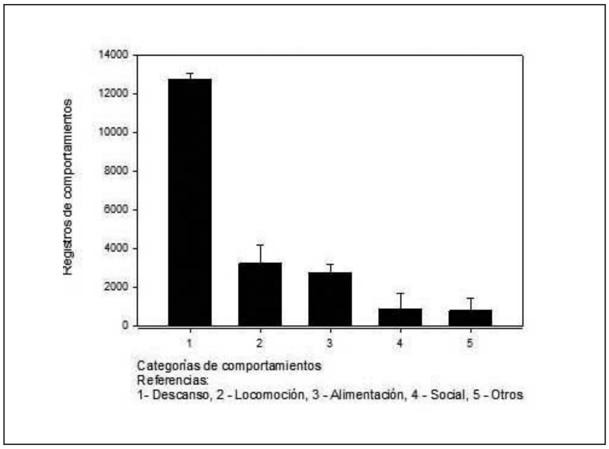

Figura 2. Patrón diario de actividades de dos tropas de *A. caraya* en el campo ¨Las Lomas¨Corrientes, Argentina (Tomada de Bruno, 2011)

En este sitio se realizaron registros de reconocimiento de individuos y composición sexo etárea las tropas de aulladores y área de acción dentro los parches de bosque nativo. Para ello se aplicaron las técnicas de barrido y registro de todas las acciones (Altmann, 1974; Martin & Batenson, 1991). A partir de este procedimiento se obtuvieron datos para caracterizar patrón de actividad. También se tomaron muestras frescas seriadas de materia fecal (n=74) para caracterizar los endoparásitos presentes en esas tropas que eran objeto de observación. Las muestras se conservaron en formol al 10 % y se analizaron en el CEPAVE-UNLP- Argentina, aplicando las técnicas de Ritchie y de Willis.

Resultados Preliminares

Se realizó el seguimiento de 2 tropas; una formada por 11 individuos (4 machos adultos, 4 hembras adultas, 2 machos juveniles y 1 hembra juvenil), y otra formada por 12 individuos (1 macho adulto, 3 hembras adultas, 3 machos juveniles, 2 hembras juveniles y 3 infantes). En la figura 2 se muestra el patrón de actividad de estas tropas de aulladores con base en un total de 40,841 registros de comportamiento. De los análisis parasitológicos, el 56,75 % de las muestras analizadas mostraron presencia de endoparásitos. La prevalencia de infección fue 77,5 %. Las especies más frecuentemente encontradas fueron: *Blastocystis sp., Giardia sp.; y Entamoeba coli.* (Milozzi, et al 2010). En el presente año se continúan los análisis estacionales de comportamiento y de prevalencia de parasitosis.

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A RECORD OF THE VARIEGATED SPIDER MONKEY (*ATELES HYBRIDUS BRUNNEUS*) IN SELVA DE FLORENCIA NATIONAL PARK, COLOMBIA

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Ateles hybridus brunneus is a subspecies endemic to Colombia. Its distribution has been estimated at 49,000 km^2, assuming its distribution extends up to 2,000 meters above sea level (Defler, 2010). However, a new model predicts an even smaller potential distribution and habitat available, between 5,000 and 13,000 km^2 (Roncancio *et al.*, in press). Several characteristics of the variegated spider monkey make it extremely vulnerable to the loss, reduction and fragmentation of its habitat: these include its low population density, which ranges from 0.24 to 43 ind/km^2 (Roncancio *et al.*, 2010a, b) and features such as its large body mass (7-9 kg), frugivorous diet (up to 85% of the diet is composed of ripe fruit), long birth intervals (one offspring every 3-4 years), wide-ranging activity patterns (1.5-3.5 km traveled per day) and large home range (60-350 ha) (Chapman and Onderdonk, 1998; Stevenson *et al.,* 2002; Defler *et al.,* 2003; Link and Di Fiore, 2006; Takahashi, 2008; Urbani *et al.,* 2008; Palacios *et al.,* 2009; Defler, 2010).

A. hybridus is categorized as Critically Endangered (CR) (Urbani *et al.,* 2008) and is considered one of the 25 most threatened primates in the world (Mittermeier *et al.,* 2009). In particular, *A. h. brunneus* is most at risk of extinction because in addition to other threats common to all subspecies, the area of distribution for this subspecies is smaller and no national protected area contains a confirmed population of the taxon. Only the recently declared National Natural Park, Selva de Florencia, on the southern limit of the historical distribution of this subspecies (Defler, 2010), may house a population, but has never been an official record of its presence there. The nearest confirmed population is 61 km away from this area (Roncancio *et al.,* 2010a).

In order to plan effective strategies for wildlife conservation, it is necessary to assess conservation status by measuring indicators that, compared over time, will enable the evaluation of any implemented interventions. Two of these indicators are species distribution and available habitat. Following a random sampling design, several points in the historical distribution of *A. h. brunneus* were visited in order to gather occurrence records to model its current distribution. Additionally, some places that could be important conservation areas for the taxon were visited (Roncanio *et al,* in prep).

Selva de Florencia National Natural Park is the only protected area in the historical distribution of this taxon. Ten years ago, the presence of this primate was reported near the area of the park (Castaño, 2001), but the individual recorded was in captivity and its "owner" said that the primate was captured in the park´s area. Nevertheless, there was no official record of the species in the park. In order to confirm a natural population of the variegated spider monkey in Selva de Florencia National Natural Park, the staff of the park interviewed local inhabitants in the area. In November 2011 an individual living on the western zone of the park provided information about the species' presence in the protected area.

On December 8, this zone was visited by a staff from the park and individuals living in the area, and two individuals of *A. h. brunneus* were recorded. They were seen moving and foraging at 1,780 meters a.s.l. (5°29'43"N, -75°06'56"W). The Selva de Florencia National Natural Park is now confirmed as the only national park that protects this taxon and its southernmost population. Another important aspect lies in the fact that this park has an altitudinal distribution from 850 to 2,200 meters a.s.l. and only a limited area (10% of the park) is below 1,000 m. The fact that this remnant population is at the limit of the distribution makes this population more vulnerable. Additionally, *Ateles hybridus* prefers habitat from 0 to 800 meters a.s.l. (Defler, 2010), and thus suitable habitat available inside the protected area is also relatively small. The lowland section of the park is also highly affected by extractive and productive human activities and some of the lands are still under private ownership. In consequence, this park might only offer marginal habitat to this spider monkey, but, due to the loss of its preferred habitat, is a very important refuge for a population. It is necessary to acquire land adjacent to the park and restore the habitat to generate better quality habitat for this taxon.

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REGISTROS DE JUVENIS PERDIDOS DE *ALOUATTA FUSCA* (GEOFFROY SAINT-HILAIRE, 1812) (PRIMATES: ATELIDAE) NO PARQUE NACIONAL DA SERRA DOS ÓRGÃOS

Bruna Maia
Pedro Henrique dos Santos Dias

Dentre os primatas neotropicais, o gênero *Alouatta* Lacépède, 1799 é o que apresenta a mais ampla distribuição geográfica, ocorrendo desde o Estado de Vera Cruz, no México, até o Estado do Rio Grande do Sul, no Brasil e Corrientes, na Argentina (Hill, 1962; Gregorin, 2006). *Alouatta fusca* (Geoffroy Saint-Hilaire, 1812) é uma espécie endêmica do Brasil e restrita à Mata Atlântica (Gregorin, 2006). Em comparação com outros mamíferos, filhotes de primatas necessitam de um longo período de cuidado parental e aprendizagem com suas mães (Vochteloo *et al.*, 1993). Em espécies monogâmicas, muitas vezes as fêmeas recebem alguma espécie de colaboração por parte dos machos, seja ela direta ou indireta (Tardif, 1984; Wright, 1984, 1986; Van Schaik e Dumbar, 1990; Runcie, 2000; Sommer, 2000).

No gênero *Alouatta* a necessidade da mãe é muito grande, e mesmo quando já são capazes de se deslocarem sozinhos (Miranda *et al.*, 2005), juvenis podem passar até 86% do tempo com as mães (Podgaiski e Jardim, 2009), e em muitas das ocasiões podem passar longos períodos de tempo sob os cuidados de outros indivíduos do grupo, inclusive machos adultos (Bolin, 1981). Alomatria foi registrada para *A. caraya* (Calegaro-Marques and Bicca-Marques, 1993; Bravo e Sallenave, 2003), *A. clamitans* (Miranda *et al.*, 2005), *A. palliata* (Clarke *et al.*, 1998) e *A. seniculus* (Mack, 1979), de tal modo que é muito raro o avistamento de indivíduos de pequeno porte perdidos do grupo. Os relatos apresentados aqui são referentes a trabalhos de campo realizados em outubro de 2010 no Parque Nacional da Serra dos Órgãos (PARNASO), município de Teresópolis, estado do Rio de Janeiro, Brasil. O PARNASO é uma Unidade de Conservação que abriga uma área de 20.024 hectares de Mata Atlântica.

Em duas ocasiões foram observados indivíduos perdidos de seus grupos. Na primeira delas (15 de outubro de 2010), dois juvenis I de sexo indeterminado (*sensu* Mendes, 1989) foram observados atravessando de uma árvore para outra (22°27'22.6"S, 42°59'49.7"W) às 15:20. Os mesmos permaneceram um curto período de tempo na mesma árvore. Durante esse período não foi observada a presença de nenhum indivíduo adulto nas proximidades. Na segunda ocasião (27 de outubro de 2010) um juvenil II, novamente sem sexo determinado, foi observado sozinho em uma árvore (22°27'16.0"S, 43°59'59.1"W) por volta das 16:40. O mesmo estava bastante agitado, balançando galhos e rasgando bromélias (Bromeliaceae). Após cerca de 15 minutos exibindo esse comportamento, o indivíduo subiu para o ponto mais elevado da árvore e lá permaneceu. Mesmo com a chuva e o anoitecer, não se deslocou e não foram observados indivíduos adultos ao redor. O juvenil foi observado até aproximadamente ás 19:00, e presume-se que tenha passado a noite no local. Todas as observações foram feitas seguindo o método *ad libitum* (Altmann, 1974) sem limite de tempo.

É sabido, sobretudo em primatas neotropicais, que as fêmeas com filhotes reduzem suas áreas de atividade e tendem concentrar seus esforços nos mesmos. Chapman (1988) demonstrou tal fato para duas espécies de atelídeos (*Alouatta palliata* e *Ateles geoffroyi*) e um cebídeo (*Cebus capucinus*), de modo que é bastante incomum encontrar juvenis e infantes longe de membros de seu grupo. Apesar do fato de que juvenis perdidos constituam um fenômeno raro, já foram relatados casos em que durante o forrageio, indivíduos de um mesmo grupo de bugios apresentavam-se mais dispersos, podendo ocorrer eventualmente uma separação (Steinmetz, 2005). Quando isso acontecia os indivíduos perdidos ficavam se deslocando a procura dos outros e em alguns casos vocalizavam. Embora tenha sido levantada a hipótese de ser uma peculiaridade dos grupos estudados, o mesmo foi observado no presente estudo.

Os registros descritos no presente estudo corroboram a hipótese de que indivíduos de *Alouatta fusca* possam eventualmente se perder de seus grupos por longos períodos de tempo, uma vez que é o primeiro registro para esta população. A ocorrência de indivíduos perdidos em populações geograficamente isoladas dá indícios de que este comportamento não é uma peculiaridade regional, e sim algo recorrente nestes animais.

Outra informação importante que pode ser extraída de nossas observações diz respeito às questões demográficas de *Alouatta fusca* na Serra dos Órgãos. Treves (2001) hipotetizou que as fêmeas das espécies de *Alouatta* podem maximizar a taxa de sobrevivência da prole ao se reproduzirem em grupos que apresentam uma alta proporção de machos adultos e subadultos em relação ao número de fêmeas. Mudanças de dominância ou subdivisão de grandes grupos em grupos menores podem estar relacionados aos avistamentos de indivíduos perdidos, no entanto, maiores conclusões não podem ser extraídas devido à ausência de estudos populacionais com bugios nessa região.

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OBITUARY

Liza Maria Veiga (1963 - 2012)

Liza Maria Veiga was born on October 31st, 1963, in London, England. She graduated in Business Economics at Cardiff University in Wales, in 1994, and took her masters in Environment and International Development at the University of East Anglia (UEA), in England, in 1995. In 1996, Liza became a researcher for the Overseas Development Group at UEA, where she developed studies on the traditional knowledge and subsistence systems of rural populations for DFID, the British government body for International Cooperation and Development. In 1997, as a member of the socio-economic team of the Environment and Natural Resources Program, Liza embarked on her first research in the tropics; in Tanzania and other African countries.

In 1999, Liza was involved in her first professional activities in Brazil, where she participated in a study of human activities in the Amazon estuary, analyzing the evolution of local practices for the management of the environment and natural resources—continuing the activities she had begun in Africa some three years previously. This first Brazilian project was coordinated by Dr. Edna Castro of the *Núcleo de Altos Estudos Amazônicos – NAEA*. Environmental questions, which Liza had previously considered to be no more than one aspect of the life of rural populations, began to take on an increasingly important role in her approach to this research, and eventually became her principal focus. This shift in focus probably inspired Liza to seek new research horizons more directly linked to the environment, biodiversity, and a unique group of mammals. Amazonian primates and their conservation began to dominate Liza's intellectual interests and her professional activities at around this time (2000), firstly as a DTI assistant at NAEA, and then through her graduate research in the Behavior Theory and Research Program of the Department of Experimental Psychology at the Federal University of Pará (UFPA). Between 2001 and 2004, Liza was involved in research projects on primate ecology and conservation, as well as surveys of mammal populations, which had now become her principal study subjects. Her main study during this period was a project entitled "Management of the Populations of *Chiropotes satanas* in the Area of the Tucuruí Reservoir," coordinated by Dr. Stephen Ferrari; a project which later became the embryo of her doctoral research. In 2004, as a graduate student at the UFPA Experimental Psychology Department, Liza began to teach undergraduate courses. Her doctorate was supervised by Dr. Stephen Ferrari, and co-supervised by Dr. Olavo Galvão.

In 2005, Liza became a scientific consultant to the Center for the Protection of Brazilian Primates (CPB-ICMBio) and a member of the International Committee for the Conservation and Management of Amazonian Primates. This period was marked by the increasing intensification of her involvement in all fields of Primatology.

Liza defended her doctoral dissertation, entitled "Ecology and Behavior of the Black Cuxiú (*Chiropotes satanas*) in the Fragmented Landscape of eastern Amazonia" at UFPA in 2006. In her dissertation, Liza demonstrated not only her profound interest in the ecology and behavior of the cuxiús, but also her preoccupation with the conservation and protection of these animals, which would become the primary focus of her professional activities in subsequent years.

In 2007, Liza became a member of the Primate Specialist Group (PSG) of the Species Survival Commission of the International Union for the Conservation of Nature (IUCN), and played an important role in the Global Mammal Assessment (GMA), participating in the production of the Red List for Neotropical primates (Pitheciidae) as part of the Biodiversity Assessment Initiative of IUCN/SSC and the Center for Applied Biodiversity Science (CABS), based at Conservation International in Washington, DC. She was also a collaborator on the IUCN Species Survival Commission (SSC), and participated in the development of the Pitheciine Action Group (PAG) of the PSG (Neotropical Section), as well as being active on the subcommittee for the integrated development of research of the International Committee for the Conservation and Management of Amazonian Primates (IBAMA).

Liza became a member of the Brazilian Primatological Society (SBPr), was part of its executive council, and participated in the scientific committee of the Society's 13th congress. In 2007, she began to intensify her relationship with the Goeldi Museum (MPEG) in Belém, first by becoming a DTI grantee in the Professional Training Program until the middle of 2008, and then, at the end of the year, by becoming a postdoc in the joint UFPA/MPEG Graduate Program in Zoology (PPGZool). As a postdoc, Liza had a grant from the CAPES National Post-doctoral Program (PNPD), and in 2007 and 2008, she coordinated the project entitled "Ecology, Social Organization, and Conservation of the Black Cuxiú (*Chiropotes satanas*)." In 2007, she joined the TEAM ("Ecology, Evaluation, and Monitoring of Tropical Forests") project, collaborating with Conservation International (Brazil), first as project manager, then as vice-coordinator, and finally as coordinator, between 2008 and 2010.

As a postdoc and an associate researcher at the Goeldi Museum, Liza was a graduate supervisor, and contributed to the teaching of a number of courses, including "Behavioral Ecology," "Conservation Biology," "Primatology," and "Special Topics in Primatology," in which she administered the topic "Reproductive Behavior and Ecology." Between 2008 and 2010, Liza participated in a number of surveys of medium-sized and large mammals, and worked as a private environmental consultant. However, it was as a postdoc at the Goeldi Museum that Liza advanced even further as a professional. She participated in the ongoing project "Ecology and Conservation of the Endangered Primates of the Brazilian state of Pará," coordinated by Dr. José de Sousa e Silva Júnior. This project aims to provide a database on the ecology, distribution, and extinction risk of the threatened primates of the Brazilian state of Pará (*Cebus kaapori*, *Chiropotes satanas*, *Chiropotes utahickae*, and *Ateles marginatus*), one of Liza's main concerns. Between 2008 and 2010, she participated in the project "Endangered Species and Critical Areas for the Biodiversity of the Brazilian state of Pará," coordinated by Dr. Teresa Cristina Ávila Pires, during which she contributed to the development of a database of the information available on the species included in the state list of endangered taxa.

Between 2009 and 2011, Liza coordinated the project "Conservation of the primates *Cebus kaapori* and *Chiropotes satanas*," during which she conducted field studies of both species, as well as a population viability analysis of *Chiropotes satanas*. This project sought to develop guidelines for the conservation and management of these species. During the same period, she coordinated the project entitled "Survey of Medium- and Large-bodied Mammals and the Use of Camera Traps in the Tucuruí Environmental Protection Area," and began participating in the project "Biodiversity in the state of Pará: Development of the first Atlas of Priority Areas for Conservation" coordinated by Dr. Ana Luisa Albernaz, and during which she contributed to the definition of the priority areas for the conservation of the state's biodiversity.

In 2012, Liza initiated a project entitled "Distribution and Conservation of the Remnant Populations of the Ka'apor capuchin (*Cebus kaapori*), a Critically Endangered Species," undertaking a survey of the remaining populations of this species in the remaining habitat, with the ultimate aim of capturing and translocating a vulnerable group of these primates in the area surrounding the Tucuruí reservoir. This project also involved the National Primate Center and the CPB.

In 2009 and 2010, as a member of the IUCN Primate Specialist Group (PSG-SSC), Liza participated in the evaluation of the conservation status of Brazilian primates, an initiative of the CPB and the Brazilian Environment Ministry (MMA), contributing to the production of the lists of Brazilian endangered animal species and the "Action Plan for the Mammals of Southeastern Brazil." As a private consultant, Liza also participated in a Rapid Ecological Assessment (RAPELD) in Guyana. In 2011, she joined the Neotropical Section of the PSG, providing the focus for the development of the primate Red List for the Amazon region. As a member of a joint task-force between the Species Survival Commission (SSC) and the World Protected Areas Commission (WPC), Liza contributed to the evaluation of the impact of protected areas on biodiversity, and the identification of new key areas for conservation. She also became a member of the Strategic Assessment Group of the National Action Plan for the Conservation of Endemic Endangered Species of the Middle and Lower Xingu River, an initiative of the Coordination for the Development and Implementation of Action Plans (COPAN), part of the Chico Mendes Biodiversity Institute (ICMBio).

Liza was especially active as an educator, and supervised or co-supervised a number of undergraduate projects and dissertations, and masters theses. She co-supervised a study of tufted capuchins, and supervised studies of the ecology and behavior of *Chiropotes satanas* and *Cebus kaapori*. The thesis on *Cebus kaapori* is the only systematic study of the ecology and behavior of this Critically Endangered species. Liza accepted three new masters students in 2011 and 2012, developing ecological studies of the primates and felines of the region of Alta Floresta (Mato Grosso). She was also supervising a number of undergraduate students who were researching the behavior and ecology of primates in the Tucuruí region. Liza's students were always profoundly involved in the research projects that she developed with such dedication.

Liza was a member of the editorial board of *Neotropical Primates* and the *Pitheciine Action Group Newsletter*, and a reviewer for the *American Journal of Primatology*, *Folia Primatologica*, the *International Journal of Primatology*, and the *International Zoo Yearbook*. She attended many scientific events, such as conferences and workshops, where she presented papers and participated in scientific committees, and was the principal editor of the book *Evolutionary Biology and Conservation of Titis, Sakis and Uacaris*, just recently published by the Cambridge University Press. She published numerous papers, including articles in journals, book chapters, texts in newspapers and magazines, as well as congress abstracts. Liza Maria Veiga passed away prematurely on October 28th, 2012.

José de Sousa e Silva Júnior, Helder Lima de Queiroz and Maria Aparecida Lopes
Museu Paraense Emílio-Goeldi; Universidade Federal do Pará

Being an editor can be a lonely job, with most of one's time spent alone in front of the computer. It is made much more interesting at *Neotropical Primates* by the lively international e-mail exchanges among the editors, on topics that range from the fate of particular articles, to our opinions on primatological controversies, to more personal conversations as we have gotten to know each other better and have become friends. The best part is the few occasions, usually at international meetings, when the editors actually get to spend time with each other in person. Here, we acknowledge the tremendous loss of one of our editorial team members, Liza Veiga, and make a tribute to her work for the understanding and conservation of primates, and in appreciation of her persistent efforts to improve *Neotropical Primates*.

The first time I met Liza Veiga was at the Congress of the International Primatological Society at Edinburgh, Scotland, in 2008, about a year after I started work at *NP*. I had assumed she was Brazilian until then, and I left the meetings still unsure—perfect Brazilian Portuguese, perfect British English, thick black silky hair, Asian eyes, stylish modern blouse, old jeans, Amazonian jewelry. She defied simple categorization. What I noticed about her then was her intensity, her focus, and her seriousness. She was ready with several ideas of how to improve the journal, and after the meetings she was the first to contact others and implement the changes.

I saw Liza again briefly at the Brazilian Primatology Meetings in Curitiba, Brazil, in 2011. She spoke as part of a roundtable discussion on "Amazonian Primates." She was ill at the meetings, had nearly lost her voice, and she admitted she was feeling dizzy and might faint. Nevertheless,

Neotropical Primates editorial team, August 2008. IPS meetings in Edinburgh, Scotland. From left to right, Brenda Solórzano, Erwin Palacios, Liza Maria Veiga, Liliana Cortés-Ortiz, Jessica Lynch Alfaro, Eckhard Heymann, Anthony B. Rylands, Júlio César Bicca-Marques.

she soldiered on with her presentation. She delivered her words slowly, precisely and quietly. It was, without doubt, the most moving and devastating talk I have ever seen. Up until that moment I had harbored the illusion that the vastness of the Amazon Basin remained relatively safe, relatively pristine. Liza demonstrated, in careful detail, the arc of deforestation that has denuded most of eastern Pará, and she went on to explore other threats—the impact of hydroelectric dams, the new rise in soybean plantations, the ever-expanding cattle ranches—that are devouring the Amazon rainforest from all sides, from the outside in. There never was such a convincing advocate as Liza for the desperate need for research and conservation work on Amazonian primates. I left that roundtable with a new worldview after hearing Liza's message.

The last time I spent time with Liza was in the summer of 2012, at the Assessment Workshop for the Conservation Status of Brazilian Primates, at Iperó, São Paulo, Brazil. It was a workshop she had helped to organize, and I was grateful for the invitation to participate. We ended up as roommates there, and this is where I really got to see the personal side of Liza. She was hilarious, charming and brimming with ideas about everything. She could hold a room enthralled with her stories from the field. She loved to imitate everyone and everything: the park guards who sat around all day scratching themselves; the Indians around Tucuruí who would stick a lower lip out farther and farther to show how truly far away something was; her students circling back to her with more and more questions; the field guide who fell out of the boat with the motor still running; the bearded saki males huddled together in a greeting; the capuchin monkey that threatened her from the doorway so she couldn't enter her own house at the field station...

Liza loved to laugh. She lived and breathed Brazil, the Amazon, the animals. She was the Amazon's biggest champion, with so much determination to solve the gargantuan problem of habitat loss against all odds. She was tireless in her fight. She also embodied a huge wealth of knowledge about Brazilian fauna. A tiny example: We had heard that the lake near the workshop in Iperó had capybara, a species I'd never seen in the wild. As she was leaving the workshop and we said our goodbyes, Liza told me if I walked up slowly enough, capybaras don't get scared. The next morning at dawn I followed her advice at the lake, creeping nearer until I could sit right next to that giant rodent at the water's edge.

What Liza had inside of her was unique, particular, and can't be recreated. She saw things in the forest that no one else has seen, and that perhaps may never be seen again. But also, she desperately wanted to share her experiences. She was so very excited about the upcoming publication of her book on the pitheciines, after ten years of hard work and waiting. Liza was so very alive, so in the middle of things, she had so much that she still wanted to accomplish; but she was also deeply tired from so much desire, so much passion, and so much struggle. I am grateful for the time I had with her, as co-editor, collaborator and friend. We will all miss her terribly at *Neotropical Primates*, and we thank her wholeheartedly for all of her contributions, that have accomplished so much in promoting the research and conservation of Brazilian primates.

Jessica Lynch Alfaro, Editor of Neotropical Primates
University of California, Los Angeles

The 2008 IPS meetings in Edinburgh gave me the opportunity to meet Liza Veiga in person for first time. I only saw her again a few other times, but regularly heard from her due to her enthusiastic and efficient participation in *Neotropical Primates* and her devoted actions towards the conservation of Amazonian primates. Liza always showed a great passion for research, a strong commitment to share her knowledge with colleagues and students, and a tremendous devotion to truth in her actions.

Liliana Cortés-Ortiz, Editor of Neotropical Primates
University of Michigan

I met Liza for the first and only time at the 2008 IPS meetings in Edinburgh. From the first moment on, it was inspiring to talk to Liza, and I appreciated her collegiality and friendliness. Her ambitious and conservationist spirit will be missed.

Eckhard W. Heymann, Editor of Neotropical Primates
Deutsches Primatenzentrum GmbH (DPZ), Leibniz-Institut für Primatenforschung

Liza was truly a special, a kind and trustworthy person and an excellent researcher, editor and student advisor. Sadly, our great new and growing friendship and colleagueship ended quite prematurely. Brazilian primatology and the Amazonian biodiversity will miss her. Hopefully her warrior spirit will continue inspiring us all.

Júlio César Bicca-Marques, Editor of Neotropical Primates
Pontifícia Universidade Católica do Rio Grande do Sul

Liza was always ready to devote time to give advice, no matter the time of the day or the size of her workload; she was a fantastic friend and teammate. I will miss her.

Erwin Palacios, Chief Editor of Neotropical Primates
Conservation International Colombia

I first met Liza at the Brazilian Primate Congress in Porto Alegre and immediately appreciated a certain specialness about her. Her calm, elegance, and sweet nature combined with a remarkable courage, energy and determination in her work. Liza's pioneer research on the black saki was outstanding, and she rapidly became an important contact and reference for teaching, research and the general business of primate conservation and ecology in Brazil; and most particularly for the pitheciines. She played a fundamental role in the IUCN SSC Primate Specialist Group as a member of the Executive Committee, as the PSG liaison with the Brazilian government on the assessment of the conservation status of the Brazilian primates, and as a member of the editorial board for the PSG newsletter and journal *Neotropical Primates*. Her distinguished academic achievements are well represented in her book, recently published, *Evolutionary Biology and Conservation of Titis, Sakis and Uacaris*. She was dedicated and brilliant, and adored and respected by all her colleagues and those who had the privilege to work with her.

Anthony B. Rylands, Deputy Chair
IUCN SSC Primate Specialist Group

Liza was a wonderful person, and a very active member of our IUCN/SSC Primate Specialist Group. And of course I followed her work very closely because she studied the pitheciines, probably my favorite primates in the world, and especially *Chiropotes*, a genus to which I have a particularly close attachment. She was at the peak of her career, which makes her loss even more tragic. We will all miss her, and remember her outstanding contributions for the rest of our lives. I am especially saddened by the fact that she did not see her book on the evolutionary biology and conservation of the pitheciines finally published, but it is a fitting memorial to all that she achieved in her career.

Russell A. Mittermeier, President
Conservation International, and Chair, IUCN SSC
Primate Specialist Group

Brazilian Primatology owes a lot to scholars who weren't born in Brazil, but adopted this country as their own. Many great individuals in our history didn't grow up in Brazil. Liza is proof of this. No one would say that Liza wasn't Brazilian. Her love of primates, of the Amazon, and for all she did in her work is revealed in the articles she wrote. We know much more about the pitheciines now, thanks to Liza's particular dedication to this group. At the time that she left us, Liza was on the directorial board of the Brazilian Primatological Society (SBPr). Her willingness and readiness to share information was essential to SBPr running smoothly. We will always have Liza as an example—of love and complete dedication to the study of Brazilian primates. SBPr will never let this example be forgotten. Thank you for so very much, Liza.

Maria Adélia Borstelmann de Oliveira, President
Brazilian Primatological Society

Brazilian Primatology has lost an excellent researcher and a wonderful spokesperson, and primatologists have lost a dear friend. The members of the Centro Nacional de Pesquisa e Conservacao de Primatas Brasileiros (CPB/ICMBio) offer their tribute to Liza Maria Veiga with heavy hearts.

Liza's work highlighted black bearded saki (*Chiropotes satanas*) conservation in both Brazilian and international primatology. She promoted conservation action for the family Pitheciidae in general, and worked in favor of Brazilian primate conservation even more broadly, with a focus on the Amazon. Her technical abilities and her great willingness to collaborate are shown through her work as the coordinator of both the IUCN (International Union for the Conservation of Nature) Pitheciine Action Group and the IUCN Primate Specialist Group.

CPB honors Liza as a valuable researcher and a great friend, and thanks her for the generous help and participation in several Center projects, most recently for her role as Taxon Coordinator in the Evaluation Process for the Conservation Status for Brazilian Primates in 2012, where her efforts were essential in facilitating the interactions with and among the scientific community. As always, she made use of her collaborative nature for which we were so grateful.

Our tribute goes beyond just the research accomplishments and professional partnerships; what we most want to celebrate is Liza as a dear and special friend. She will always be remembered for her important work fighting for the conservation of Brazilian primates, and for the sum of her intelligent and ethical personality.

Centro Nacional de Pesquisa e Conservacao de Primatas Brasileiros (CPB/ICMBio)

I first met Liza Veiga at the Primate Society of Brazil's conference in Belém in 2000. A little lost in a city I didn't know at all, in a language in which I was only half-competent, I was ever so impressed when a rather Chinese-looking person with a very Brazilian name (Liza *Maria* Veiga, after all) suddenly started speaking to me in fluent English—especially as she had just concluded a conversation in rapid fire and apparently perfect Portuguese (she also spoke fluent French; languages being one of Liza's many talents). By sheer happenstance, we were both starting PhDs; I was in flooded forests, she was in flood-created islands. And we were both working on one of the least-known of the Neotropical primate groups, the pitheciines; she was studying *Chiropotes,* I was studying *Cacajao.* I remember tea (real tea!) in a garden somewhere in Belém and the conversation evolving into one that decided that ''something must be done."

Fast forward six years and we are in another conference, this time in Entebbe, Uganda, and we are about to see the fruition of about 18 months of hard work—the first-ever symposium dedicated solely to pitheciines, their ecology and conservation. Like the Pitheciine Action Group and the soon-to-be-published book on Pitheciine ecology and conservation, my initial idea for the symposium was seized upon by Liza with what can only be described as zeal and glee. Things first expanded and then fell into place, both with a remarkable speed as Liza's training in business logistics swung into action.

That is one of the many remarkable things about Liza Veiga, that for fully three-quarters of her all-to-brief life, she didn't do biology at all. With a degree in Economics and a Master's in International Development Studies, Liza only came to monkeys via a strange set of steps that Stephen Ferrari has already described so well. A curious course from which primatology benefitted greatly.

The Liza I first met was brisk, charming, funny and breathtakingly efficient. To-do lists had a habit of rapidly vaporizing into nothing in her presence. Finishing her PhD on a Friday in 2006, she had a job by the following Monday—possibly a record for post-grad unemployment. And how she networked, and how hard she worked, and how much she helped others. And she took on students and she took on projects with Conservation International and IUCN and the SSC and became member of various committees and commissions and spread herself thinner and thinner so that gradually the phone calls and e-mails stopped being bouncy and full of vim, and slowly depression clouded the life of our dear friend and colleague.

And now she's gone, and I still can't quite adapt to the fact. It's not true that I'll never get another e-mail from her, or have another crackly skype call, never see her again at conferences—juggling students and presentations, talks to see and committees to attend, all with a smile and a busy busy cell phone. We will publish those papers we were always just about to be going to get round to—Liza's out in the field, she'll be back …

A book on pitheciines—her first and foremost primatological love—was published in April 2013 by Cambridge University Press. It's dedicated to her, but I just wish it didn't have to be. I wish it were a celebration of her still-present competency and drive, rather than a memorial of much-missed abilities.

Primatology has lost a great colleague, and a person of remarkable vision, ability and drive. Many students have lost a magnificent and insightful mentor, I have lost a dear friend, and primates in general have lost a small, bustling and much-loved champion.

Liza Maria Veiga, remembered-in-primates.

Adrian Barnett
Roehampton University, London

The trajectory of Liza Maria Veiga shows us that a successful career must be constructed through hard work and dedication, but also with intense love for the chosen work. The field of primatology was lucky to have Liza fall in love with it, and Liza dedicated herself not only to the study of primates, but also to the mentoring and professional development of several students. She loved to work collaboratively, and she was always sharing her experiences.

Liza was a great friend, and she participated in many important moments of my professional life, always with much generosity. It was my privilege to have her on my doctoral thesis committee, and I greatly benefited from her rich knowledge of *Chiropotes* and her experience as someone who had gone through similar difficulties during long and arduous fieldwork. She was the author of one of the most thorough studies of *Chiropotes* ever conducted. Her work with the black bearded saki, *C. satanas*, in the Tucuruí region in Brazil, caused admiration among primatologists for the seriousness and effort that she put into it.

From the beginning of her career as a primatologist, she showed commitment, collaboration and tireless dedication to primate conservation in Brazil. She came to Brazil in 1999 with a dream of exploring new worlds and dedicating herself to new causes, both of which happened in her short and intense career. Those with the luck of sharing in her life can give testimony that her genuine happiness and admirable disposition, in addition to her ethics and her commitment, made Liza a captivating researcher. An example was her participation in the symposium "Pitheciines: Ecology and Conservation," organized by her and Adrian Barnett for the XXI International Primatological Society Meetings, in 2006 in Uganda. An outcome of this symposium was the book *Evolutionary Biology and Conservation of Titis, Sakis, and Uakaris* that demonstrates the full force of the combined qualities Liza possessed. Liza also acted on her passion for primatology through her collaboration in the evaluation of threatened species for IUCN, as the primary person responsible for data collection to support the evaluation of the Pitheciidae in 2008. She also played an important role in the Evaluation Workshop of the Conservation Status of Brazilian Primates, held by the Centro Nacional de Pesquisa e Conservação de Primatas Brasileiros/ICMBio in 2012. Liza was remarkable and courageous in her position in the post-doctoral program at the Museu Paraense Emílio Goeldi, where she advised students, lectured, and collaborated in diverse lines of research.

Besides her dedication, her ethics, her efficiency, and her joy, Liza Maria Veiga added love in her particular way of acting and living. Her death has transformed her trajectory into a legacy and has consolidated what I already knew before her untimely departure: everyone loved her, and she deeply deserved our love.

Liliam Patricia Pinto
Centro Nacional de Pesquisa e Conservação da Biodiversidade Amazônica – CEPAM/ICMBio

The recent loss of Liza Veiga is a painful fact that saddens us all profoundly... not only is the sudden death shocking in itself, but so is the loss of such a pivotal researcher with a brilliant, flawless and aspiring career. We are forced to realize that we cannot turn to her anymore for her much-needed help in our unending shared fight for a world that takes responsibility in protecting the environment. We have lost a great friend who was loving, caring, attentive, genuine, and extremely fair. It is unnecessary to describe her competence and seriousness, to try to enumerate all the virtues that Liza possessed as a professional—we all know these and can attest to them. In truth there is no way to express the pain of losing someone as special as her, and all we can do now is try, with our best efforts and sacrifice, to make up for, at least partially, her loss... In life she waged an enduring struggle to fight against the imminent threat of extinction for our Brazilian primates... We will continue this mission in her absence, though now it seems even more impossible, and without Liza, more arduous, lonely, and sad!

Fabiano Rodrigues de Melo
Universidade Federal de Goiás
University of Wisconsin, Madison

Teaching is an extremely rewarding profession, and it is hard not to get involved with one's students, especially at the graduate level, when a somewhat intimate relationship inevitably arises from the long hours spent together discussing projects and data, and worrying over analyses and deadlines. In Liza Veiga's case, the sense of a familial bond was especially strong, for a number of reasons. While I think neither of us felt an especially strong link with our home country, the fact that we were both English was perhaps the most important factor, possibly for no better reason than being able to share the odd moment of typically British humor to the blank-faced consternation of the Brazilians around us. It was nice to have someone to chat to in English now and again, although we would more often than not talk to each other in Portuguese.

There were other, minor coincidences. We both had mixed backgrounds—Liza's father was Chinese and mine was Italian—so in some ways, we were both quirky, atypical Britons who shared a slightly distinctive viewpoint on the world. We were both also late starters, following unusual, roundabout paths to finally become primatologists. But Liza beat me hands down for originality, having graduated in Business Economics and taken a masters degree in International Development. In fact, when she walked into my office at the Federal University of Pará, in the Amazon city of Belém, and told me she was an economist, one of the last things I imagined her doing was a doctorate in experimental psychology based on a study of primate ecology. But a few short years later, she was defending her thesis, and nobody would ever imagine she had ever been anything but a career primatologist.

During the intervening years, Liza taught me, her academic mentor, many important lessons, beginning with the old adage that "anything is possible." As far as she was concerned, in fact, "nothing is impossible" would have been a more appropriate motto. In addition to her incorrigible enthusiasm and dedication to her work, studies, and research, she was endowed with an impressive ability to organize things, which represented probably the major difference between us. I would often feel almost embarrassed, in fact, whenever she was in my office, because I'm sure she found the absolute chaos of my typical absent-minded academic's workplace at the very least a little annoying, if not totally frustrating or infuriating. She never criticized, although she would sometimes say something like "my goodness, this place could do with a good spring cleaning," and all I could do would be to agree wholeheartedly. But she did once clear it all out, repaint the walls, and rearrange everything to her satisfaction, which was nice, even though I subsequently spent weeks trying to find all my important stuff.

While she was meticulous in the extreme—which I can only see as being a positive trait in a scientist—Liza was far from being a fuddy-duddy, cloistered away in ivory towers. She was always full of energy, always good for a joke and a laugh, and only very rarely would she refuse an invitation for a happy hour (or two or more) after a long day's hard work. In addition to brightening up the laboratory environment with her invariably good humor, Liza was always ready to lend a hand too, whether it was helping me to make a deadline, finding a reference for one of her colleagues, or just chipping in around the department in general.

Liza's dedication and attention to detail, not to mention her eagerness to learn, more than compensated for any lack of formal training in biological sciences, and she was an exemplary doctoral student, going to extremes to guarantee the collection of her data. She had her fair share of mishaps in the field, including a "shipwreck," when the boat she was travelling in to her field site hit a submerged log at a fairly high speed and threw her and the boatman into the water.

Liza took this and other minor disasters in her stride, with typically British stoicism, but about halfway through her fieldwork, she hit an unexpected barrier. She always took pretty good care of herself, and was a regular in the gym (when she was in town), but she pushed herself to the limit and the long, hard days in the field finally took their toll on her health. However, the problem was not so much her blistered feet, bad back, and almost clinical exhaustion, but the fact that she was determined not to miss any of her planned fieldwork time. She was monitoring two groups of cuxiús (*Chiropotes satanas*) simultaneously, and was worried that any interruption of her schedule would jeopardize the quality of her data. I had my work cut out to convince her that she could more than compensate by obtaining comparative data in consecutive years, but in the end, she realized that her health issues were a little more serious than she wanted to believe, and she took a much-needed two month sabbatical.

Liza needn't have worried, because her study was excellent. It bore all the characteristics of her trademark dedication and efficiency. Her dissertation transformed her from a novice economist-cum-monkey-watcher into a fully-fledged primatologist, more than ready to go on to higher things. Most people tend to relax after finishing their degrees, but Liza wasn't like that. In fact, she seemed to thrive on hard work and new challenges, and almost before the ink had dried on her diploma, she was off managing projects, working as an environmental consultant, and then taking up a postdoctoral position at the Goeldi Museum, where she dedicated herself to new research initiatives, and in particular, teaching.

I had moved away from Belém by this time, and sadly, we saw each other only very rarely over the past few years, although we continued to work together on many new projects and publications, and would still chat regularly through long e-mails. While Liza had become a proficient primatologist, her administrative skills also showed through, and she was active in many different capacities, perhaps most importantly, the IUCN Red List and the Pitheciine Action Group, as well as being an editor of *Neotropical Primates*.

My memories of Liza Veiga are as a cheerful, hard-working, and dedicated student, colleague, and friend. I am proud to have been able to help her achieve her dream of studying the monkeys of the Amazon forest, and even prouder to know that she did so much to share her knowledge and experience with the rest of us, and in particular her students. As a teacher, there are few more satisfying things than seeing an ex-student carrying on the tradition, and while she was with us for such a painfully short time, Liza's contribution to primatology will stand proud for many generations to come.

Stephen F. Ferrari
Universidade Federal de Sergipe

Liza Maria Veiga's publications

Articles in journals and newsletters

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Furthermore, Liza Veiga is author or co-author of 38 species accounts in the latest version (2012.2) of the IUCN Red List of Threatened Species (see http://www.iucnredlist.org)

NEWS

2013 CONSERVATION AWARDS

The Conservation Leadership Programme is currently soliciting applications for 2013 Conservation Awards. These awards are aimed at early-career conservationists (no more than 5 years professional experience in the conservation sector). Awards that will be offered in three categories: 1) Future conservationist, 2) Conservation follow-up, and 3) Conservation leadership. The application deadline for all awards is 9th November 2012. For more information go to www.conservationleadershipprogramme.org

PRIMATE ECOLOGY AND ANIMAL BEHAVIOR

The "Primate Ecology and Animal Behavior" course will be offered in Panama from December 20th, 2012 to January 9th, 2013. The course is given at Bocas del Toro Biological Station is located on the north end of Isla Colón. The purpose of this course is to give the student a foundation in primate ecology, primate behaviour, field techniques and analytical tools in a tropical setting. The material covered is equivalent to a university upper level course in primate ecology. For more information go to www.itec-edu.org/info.html#course

SOCIEDAD LATINOAMERICANA DE PRIMATOLOGÍA (SLAPRIM)

Durante el XXIV Congreso IPS 2012, llevado a cabo del 12 al 17 de Agosto de 2012 en Cancún, México, nos reunimos un numeroso grupo de primatólogos latinoamericanos con la intención de revivir a la SLAPrim (Sociedad Latinoamericana de Primatología). La SLAP (ahora SLAPrim) tuvo su origen en 1986 durante el XII Congreso IPS en Alemania, y fue alentada principalmente por el Dr. Milton Thiago de Mello, ilustre primatólogo brasileño quien fungió como su primer presidente. La SLAP sobrevivió hasta los inicios de los años noventa, siendo su último presidente el Dr. Ernesto Rodríguez Luna, primatólogo de origen mexicano. Desde entonces, a pesar de algunos intentos, no se había logrado reactivar ésta sociedad, que representó por varios años los esfuerzos por mantener la unidad entre primatólogos de Latinoamérica. Por esta razón es que, en esta última la reunión se decidió dar inicio a una serie de acciones que deberán culminar durante el Congreso Brasileño de Primatología y Segundo Congreso Latinoamericano de Primatología que se llevarán a cabo en Recife, Pernambuco, Brasil, del 4 al 9 de Agosto de 2013. Los puntos que se acordaron fueron: a)Realizar el II Congreso Latinoamericano de Primatología dentro del XV Congreso Brasileño de Primatología; b) Se eligió a Domingo Canales Espinosa (México) como Presidente Honorario, debiéndose elegir un Presidente formal para la SLAPrim en la Asamblea General de la asociación durante el Congreso Brasileño de Primatología; c) Se eligió a Martin Kowalewski como representante de la región Cono Sur (Argentina, Paraguay, Chile, y Uruguay), Andres Link como representante de la región Andina (Bolivia, Peru, Ecuador y Colombia), Bernardo Urbani como representante de la región Amazonia) Venezuela, Guyanas, Surinam y Caribe), Domingo Canales como representante de la región Mesoamerica (Mexico y Centroamérica), Leandro Jerusalinsky y Mauricio Talebi como representantes de Brasil; d) El Presidente Honorario deberá presentar en Recife la propuesta de estatutos que regirán a la SLAP, así como una propuesta de organización para la asociación; e) Se invitará a participar de SLAPrim a todos los primatólogos que trabajan en hábitats de primates del Nuevo Mundo, sin importar su nacionalidad. Esta es una primera invitación dirigida a todos los investigadores, estudiantes e interesados en el estudio, manejo y conservación de los primates del Nuevo Mundo, a que participen en la SLAPrim. Esperamos con ello, dar la cara a los nuevos paradigmas que debemos enfrentar desde la Primatología Latinoamericana.

Atentamente
Domingo Canales Espinosa
Presidente Honorario SLAPrim

RECENT PUBLICATIONS

BOOKS

Long-Term Field Studies of Primates, edited by Peter M. Kappeler & David P. Watts. 2012. Springer. 479pp. ISBN: 978-3642225130. In this volume, leading field workers report on the history and infrastructure of their projects in Madagascar, Africa, Asia and South America. They provide summaries of their long-term research efforts on primate behaviour, ecology and life history, highlighting insights that were only possible because of the long-term nature of the study. *Contents:* 1. The values and challenges of long-term field studies – Kappeler PM, *et.al*; 2. Berenty Reserve, Madagascar: A long time in a small space – Jolly A: 3. Beza Mahafaly Special Reserve: Long-term research on lemurs in southwestern Madagascar – Sussman RW, *et.al*; 4. Long-term lemur research at Center Valbio, Ranomafana National Park, Madagascar – Wright PC, *et.al;* 5. A 15-year perspective on the social organization and life history of sifaka in Kirindy Forest – Kappeler PM & Fichtel C; 6. The northern muriqui (*Brachyteles hypoxanthus*): Lessons on behavioral plasticity and population dynamics from critically endangered species – Strier KB & Mendes SL; 7. The Lomas Barbudal Monkey Project: Two decades of research on *Cebus capucinus* – Perry S, *et.al.;* 8. Tracking Neotropical monkeys in Santa Rosa: Lessons from a regenerating Costa Rican dry forest – Fedigan LM & Jack KM; 9. The group life cycle and demography of brown capuchin monkeys (*Cebus apella nigritus*) in Iguazú National Park, Argentina – Janson C, *et.al;* 10. Social organization and male residence pattern in Phayre´s Leaf monkeys – Koengi A & Borries C; 11. White handed gibbons of Khao Yai: social flexibility, complex reproductive strategies, and slow life history – Reichard UH, *et.al;* 12. The Amboseli baboon research project: 40 years of continuity and change – Alberts SC & Atlmann J; 13. The 30 year blues: what we know and don't know about life history, group size, and group fission of blue monkeys in the Kakamega Forest, Kenya – Cords M; 15. Long-term field studies of chimpanzees at Mahale Mountains National Park, Tanzania; 16. Long-term studies of the chimpanzees of Gombe National Park, Tanzania – Wilson ML; 17. Long-term research on Grauer's gorillas in Kahuzi-Biega National Park, DRC: life history, foraging strategies, and ecological differentiation from sympatric chimpanzees – Yamagiwa J, *et.al;* 18. Long-term studies on wild bonobos at Wamba, Luo Scientific Reserve, D.R. Congo: towards the understanding of female life history in a male-philopatric species – Furuichi T, *et.al;* 19. Long-term, individual-based field studies – Clutton-Brock T.

Building Babies: Primate Development in Proximate and Ultimate Perspective, edited by Kathryn B.H. Clancy, Katie Hinde & Julienne N. Rutherford. 2012. Springer. 575pp. ISBN: 978-1461440598. This book features multi- and trans-disciplinary research approaches to primate developmental trajectories. It is organized thematically along the developmental trajectory: conception, pregnancy, lactation, the mother-infant dyad, broader social relationships, and transitions to independence. *Contents:* 1. Inflammation, reproduction, and the Goldilocks Principle; 2. The primate placenta as an agent of developmental and health trajectories across the lifecourse; 3. Placental development, evolution, and epigenetics of primate pregnancies; 4. Nutritional ecology and reproductive output in female chimpanzees: variation among and within populations; 5. Prenatal androgens affect development and behavior in primates; 6. Navigating transitions in HPA function from pregnancy through lactation: implications for maternal health and infant brain development; 7. Genome-environment coordination in neurobehavioral development; 8. Building marmoset babies: Trade-offs and cutting bait; 9. Lactational programming: mother's milk predicts infant behavior and temperament; 10. Do bigger brains mean better milk?; 11. Infant gut microbiota: developmental influences and health outcomes;12. Maternal influences on social and neural development in rhesus monkeys; 13. Behavioral response of mothers and infants to variation in maternal condition: adaptation, compensation and resilience; 14. The role of mothers in the development of tool-use in chimpanzees;15. Reproductive strategies and infant care in the Malagasy primates; 16. When dads help: male behavioral care during primate infant development; 17. Ontogeny of social behavior in the genus *Cebus* and the application of an integrative framework for examining plasticity and complexity in evolution; 18. Identifying proximate and ultimate causation in the development of primate sex-typed social behavior; 19. Future adults or old children? Integrating life history frameworks for understanding primate positional patterns; 20. Quantitative genetic perspectives female macaque life histories: heritability, plasticity, and trade-offs; 21. Cultural evolution and human reproductive behavior; 22. The ontogeny of investigating primate ontogeny.

Transfrontier Conservation Areas: People Living on the Edge, edited by Jens A. Andersson, Michel de Garine-Wichatitsky, David H.M. Cumming, Vupenyu Dzingirai, & Ken E. Giller. 2012. Routledge. 256pp. ISBN: 978-1849712088. This book focuses on the forgotten people displaced by, or living on the edge of protected wildlife areas. It moves beyond the grand 'enchanting promise' of conservation and development across frontiers, and unfounded notions of transfrontier conservation areas as integrated social-ecological systems. Peoples' dependency on natural resources varies enormously along the conservation frontier, as does their reliance on resources on the other side of the conservation boundary. Hence, the studies in this book move from the dream of ecotourism-fuelled development supporting nature conservation and people, towards the local realities facing marginalized people, living adjacent to protected areas in environments often poorly suited to agriculture.

Tropical rainforests - Compared in a nutshell
Review of: *Tropical Rain Forests. An Ecological and Biogeographical Comparison*, 2nd edition, by Richard T. Corlett and Richard B. Primack, 2011. Chichester: John Wiley. ISBN paperback: 978-1-4443-3255-1, ISBN hardcover: 978-1-4443-3254-4. x+326 pp., numerous colour figures. Price: US-$ 79.95 (paperback), US-$ 149.95 (hardcover). <www.wiley.com/WileyCDA/WileyTitle/productCd-1444332554.html>

Eckhard W. Heymann
In order to understand their research organisms, primatologists – at least those focussing on the ecology and natural behaviour of primates – need to understand the ecological context in which primates live. Furthermore, a comparative perspective, both between different primate radiations and between primates and non-primate animals, can help to better understand the specific adaptations of primates. However, in a scientific world with an ever increasing amount of information, obtaining concise and accurate updates that provide the broader picture becomes increasingly demanding. Therefore, books like the one that is reviewed here are highly welcome.

The authors of this book are renowned tropical ecologists, and the first author has also worked in the field of primate ecology (e.g. Corlett & Lucas 1990; Lucas & Corlett 1992). This book is the second edition, but it is not only updated but also augmented in scope. It is divided into nine chapters, one of which is focusing on primates (chapter 3: "Primate communities: a key to understanding biogeography and ecology"). The first chapter deals with a general introduction and highlights the similarities and differences among tropical rainforests. Chapter 2 describes the "Building blocks of the rain forest", i.e. the distribution and taxonomic and structural diversity of tropical plant communities. While chapter 4 focuses on carnivores and plant-eaters (other than primates), chapters 5-7 are dedicated to the comparison of bird, bat and gliding animal, and insect communities in the different tropical regions. The final two chapters deal with rainforests on tropical islands, and with the future of tropical rain forests. Each chapter ends with conclusions and suggestions for further research directions.

This book is not (and certainly was never intended as) an exhaustive treatment of all aspects of tropical ecology and biogeography. But its comparative approach, the strong emphasis given to biotic interactions (e.g. seed dispersal, herbivory) and the exemplary treatment of ecological phenomena with examples from organisms that are best suited for highlighting the respective phenomenon make it a highly instructive reading. The book is generally well edited (despite a few disturbing spelling errors, e.g. *Tarsium* instead of *Tarsius*, p. 78). The writing style is very accessible, and the quality of figures (many of which are in colours) is excellent. Twenty pages with references (many of them quite recent) provide fodder for more detailed reading.

I enjoyed reading this book and recommend it to every primatologist who wants to look beyond the primatological horizon and update his/her knowledge in comparative tropical ecology and biogeography.

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A new novel highlights a landmark conservation success story

Thirteen Gold Monkeys, by noted conservationist Benjamin B. Beck, is a story of hope, love, and unspeakable death in a disappearing Brazilian rainforest. A team of dogged conservationists tries to save a beautiful monkey species, the golden lion tamarin, from certain extinction by reinforcing their numbers with tamarins born in zoos. Will these immigrants learn to find enough to eat, find secure places to sleep, avoid predators, and survive attacks by wild tamarins? Will they find mates and make babies? The technique, known as reintroduction, is new, and the conservationists struggle to find the best method. Can they train the tamarins in zoos to meet the challenges of the wild? Once the monkeys are released in the forest, should the people give them food, shoo away predators, rescue them if they get lost, and treat them if they are injured? Or should they be hands-off, letting the monkeys fend for themselves and become wild as quickly as possible? Beck describes the reintroduction of the first 13 tamarins, capturing their fierce determination to survive, their loves and conflicts, their nurturant families, adorable babies, hidden language, sometimes comical attempts to solve the problems of adapting, and the agonizing deaths of those who don't make it. He describes the power and beauty of the rainforest, and the loves, loyalties, conflicts, and sometimes comical bumbling by their human caretakers. Challenging their better-known bosses, two women, a zookeeper and a Brazilian field assistant, discover the right way to reintroduce the monkeys. But a well-known Rio citizen almost destroys the program in a callous act of vanity. The story is vivid and authentic; Beck was there and has studied animal thinking and monkey and ape conservation for more than 40 years.

Thirteen Gold Monkeys is available from Amazon (including a Kindle edition), Barnes and Noble (including a Nook edition), and www.outskirtpress.com/bookstore. It should be orderable from any bookseller. There will soon be an iTunes version for iPhone/iPad. Fifty percent of any profits from the sale of the book will be donated to the Devra G. Kleiman endowment for the support of ongoing conservation efforts with golden lion tamarins (see www.savetheliontamarin.org).

Our website is www.outskirtpress.com/thirteengoldmonkeys.

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ABSTRACTS

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Meetings

PRIMER CONGRESO ARGENTINO DE BIOLOGIA DEL COMPORTAMIENTO

El primer congreso Argentino de Biología del Comportamiento se llevará a cabo del 15-17 de abril, 2013, en Mar del Plata, Argentina. Este será un espacio para la presentación, discusión y síntesis del conocimiento científico sobre biología y ecología del comportamiento. Se promoverá la comparación de resultados obtenidos a través de distintos sistemas de estudio y en relación al conocimiento generado en otros lugares del mundo. Fecha límite para envío de resúmenes: 10 de diciembre de 2012. Para mayores informes visitar: www.grieta.org.ar/comporta/index.htm

36TH MEETING OF THE AMERICAN SOCIETY OF PRIMATOLOGISTS

The 36th meeting of the American Society of Primatologists will be held in San Juan, Puerto Rico, with tentative dates of June 18-22, 2013, in conjunction with the Caribbean Primate Research Center's 75th anniversary. Our annual meetings allow primatologists worldwide to meet and discuss their latest research. Each meeting includes a mix of invited addresses by eminent primatologists, themed symposia, and the presentation of contributed papers. For more information go to www.asp.org/meetings/

II CONGRESSO LATINOAMERICANO DE PRIMATOLOGIA E XV CONGRESSO BRASILEIRO DE PRIMATOLOGIA

Agosto 4, 2013 - Agosto 9, 2013, Recife, Pernambuco, Brasil. Organizado pela Sociedade Brasileira de Primatologia. Para mais informações visite o seguinte link: http://www.cbprimatologia.com.br/

5TH CONGRESS OF THE EUROPEAN FEDERATION FOR PRIMATOLOGY

We are pleased to invite you to the 5th Congress of the European Federation for Primatology, which will take place in Antwerp, Belgium from 10th – 13th September 2013. The general theme of the conference 'Primates in our hands' refers to fact that, to date, survival of many primate species lies in the hands of mankind. Therefore, sharing and exchanging scientific knowledge on all aspects of primate biology is our duty. A broad range of topics will be addressed ranging from conservation biology, behaviour and cognition, physiology, ecology to functional morphology. More details will be posted on the website www.efp2013.org

Notes to Contributors

Scope

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

Submissions

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

Contributions

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

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

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

Figures and maps. Articles may include small black-and-white photographs, high-quality figures, and high-quality maps. (Resolution: 300 dpi. Column widths: one-column = 8-cm wide; two-columns = 17-cm wide). Please keep these to a minimum. We stress the importance of providing maps that are publishable.

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

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

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

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

Journal article

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

Chapter in book

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

Book

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

Thesis/Dissertation

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

Report

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

Website

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

For references in Portuguese and Spanish:

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

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

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

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

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

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Contents

Articles

Short Articles

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