

NEOTROPICAL PRIMATES



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Front cover: Aggressive stare of white-fronted capuchin (*Cebus albifrons*) in upper subtropical forest (2,515 m) in southern Ecuador.

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ARTICLES

MACRONUTRIENT PATTERNS OF 19 SPECIES OF PANAMANIAN FRUITS FROM BARRO COLORADO ISLAND

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Abstract

To attract seed dispersal agents, most Neotropical tree species produce edible fruits. Animals eat the fruits, often swallowing the seeds, which may be deposited away from the parent tree. Data show that not all frugivores in a given habitat are equally attracted to the same fruit species. Though numerous factors can influence fruit choice, the nutrient value of the pulp to the disperser is clearly of key importance. Here data are presented on the macronutrient content (total crude protein, fat and nonstructural carbohydrate) of 19 fruit species collected from a single forest site, Barro Colorado Island in central Panama. The only criterion for analyses was that each species produce fruits consumed by at least two primate species at this site. Though all fruit species contained a measurable amount of each macronutrient class, there were often striking differences in the amount contributed per class. Overall, two species (10.5% of the total sample) were highest in protein, five (26%) were highest in fats and twelve (63%) were highest in nonstructural carbohydrates. Fruit species in the same family or genus did not necessarily show the same macronutrient pattern. Similar data from a range of Neotropical sites could prove useful in formulating hypotheses related to community fruit-disperser relationships.

Key Words: Tropical forest, Panama, fruits, nutrients, protein, fats, nonstructural carbohydrates, frugivores, seed dispersal.

Resumen

Para atraer a los agentes dispersores de semillas, muchas de las especies de árboles Neotropicales producen frutos comestibles. Los animales comen los frutos, a menudo tragando las semillas, las cuales pueden ser depositadas lejos del árbol parental. Los datos muestran que no todos los frugívoros en un hábitat dado son igualmente atraídos por las mismas especies de frutos. A pesar de que numerosos factores pueden influir la selección de frutos, el valor nutricional de la pulpa para el dispersor es claramente de fundamental importancia. Aquí se presentan datos del contenido de macronutrientes (proteína cruda total, grasa y carbohidratos no estructurales) de 19 especies de frutos colectados en un solo bosque en la Isla de Barro Colorado, región central de Panamá. El único criterio para el análisis fue que cada especie produjera frutos consumidos por al menos dos especies de primates en dicho sitio. Aunque todas las especies de frutos contuvieron una cantidad apreciable de cada clase de macronutriente, hubo a menudo marcadas diferencias en la cantidad aportada por cada clase. En general, dos especies (10.5% de la muestra total) tuvieron más alta proteína, cinco (26%) más alto contenido de grasas y doce (63%) más alto contenido de carbohidratos no estructurales. Las especies de frutos de una misma familia o género no mostraron necesariamente el mismo patrón de macronutrientes. Datos similares de diferentes sitios en el neotrópico serían muy útiles para formular hipótesis acerca de las relaciones de las comunidades de dispersores de semillas.

Palabras Clave: Bosque tropical, Panamá, frutos, nutrientes, proteína, grasas, carbohidratos no estructurales, frugívoros, dispersión de semillas.

Introduction

The overwhelming majority of tropical tree species rely on animal vectors to disperse seeds to potential germination sites away from the parent (van der Pijl, 1969; Snow, 1971; Howe and Vande Kerckhove, 1979; Howe, 1993; Stiles, 1993; Herrera, 2002). To facilitate dispersal, seeds are enveloped in an edible matrix—fleshy mesocarps, pericarps, arils and the like—that serves as an attractant for potential dispersal agents. Animals enter the tree to eat the fruit, often swallowing the seeds, which may later be regurgitated or defecated some distance away. Some frugivores (*e. g.*, various bat species) carry fruits away from the parent tree to consume elsewhere, often dropping quantities of seeds below the feeding perch. Studies show that not all frugivores in a given habitat are equally attracted to the same fruit species (Snow, 1962; McDiarmid *et al.* 1977; Howe and de Stevens, 1979; Milton, 1981; Chen *et al.*, 2001; Herrera, 2002; Dew, 2005). Fruit choices at times appear deliberate in that individuals of a particular species will ignore available ripe fruits of one tree species while feed-

ing heavily on ripe fruits from another. Such behavioral disparities may influence patterns of seed distribution and thereby affect forest structure and composition (Clark *et al.* 2001).

Considerable effort has been devoted to examination of the attractant relationship between fruit species and their dispersal agents, with particular attention paid to avian dispersers. Fruit traits examined include fruit size, color, hardness, nutrient composition, seed size and number, secondary metabolites, distribution patterns in space and time, and accessibility, among others (Denslow and Moermond, 1982; Howe, 1993; Fleming *et al.*, 1993; Corlett, 1996; Alves-Costa and Lopez, 2001; Herrera, 2002). These traits must then be integrated with features of the external and internal morphology and physiology of potential dispersal agents (Milton, 1981; Witmer and Van Soest, 1989; Stiles, 1993; Alves-Costa and Lopez, 2001; Levey and Martinez del Rio, 2001; Martinez del Rio and Karasov, 1991). Due to this complex array of factors, many questions related to seed-disperser interactions remain unanswered or incompletely understood as information to address them is scarce, inconclusive or simply non-existent (Herrera, 2002).

As the edible pulp or aril is the “reward” typically offered to dispersers, its nutrient value would seem to be a critical element in plant-disperser interactions (*e. g.*, Stiles, 1993, p. 228: “Birds eat fruits to gain the nutritional rewards in fruit pulp. The preferences exhibited by birds must, in part, be influenced by the nutritional components assimilated.”) (see also Herrera, 2002). Yet to date, in spite of numerous elegant papers on aspects of fruit selection and seed dispersal by a wide range of dispersal agents, there is little comparative data on the nutrient composition of a representative array of mammal-consumed wild fruits from tropical forest sites (Howe, 1993). This absence is particularly striking for Barro Colorado Island (BCI) in the Republic of Panama, as this 1600 ha nature reserve has been the site of numerous studies of mammalian dietary ecology and there is also an unusual wealth of information on BCI forest composition and phenology and the maintenance of forest diversity (Knight, 1975; Leigh *et al.*, 1982; Hubbell and Foster, 1990; Milton, 1991).

Here I present data on the macronutrient content of 19 species of wild fruits collected on Barro Colorado Island. All species have seeds dispersed by various mammals as well as other vertebrates and/or invertebrates. Unlike many studies, fruit species analyzed were not selected because of the dietary focus of any particular species—rather they are regarded as a composite sample of macronutrient patterns of mammal-consumed fruits from the BCI forest. Results of analyses provide a quantitative basis for characterizing fruit nutrient profiles for fruits at this site. Similar information from a number of Neotropical lowland forest sites might prove useful in refining hypotheses related to fruit-disperser relationships, niche-partitioning and the predicted composition of particular disperser communities as

well as the role played by primate and other mammalian dispersers in influencing and maintaining forest composition.

Methods

Study site

Fruits were collected from adult trees, hemiepiphytes or lianas growing in the forest on Barro Colorado Island, Panama. Detailed descriptions of this moist lowland tropical forest and of climatic features characteristic of this region can be found in the literature (Allee, 1926; Croat, 1978; Leigh *et al.*, 1982; Hubbell and Foster, 1990).

Study species

The 19 fruit species analyzed were not collected according to any predetermined plan and can be regarded as an arbitrary sample of edible fruit flesh from this forest. The only criterion for acceptance was that each species produce fruit flesh of a type generally accepted as functioning to attract mammalian feeders (van der Pijl, 1969) and known to be consumed by at least two of the four non-human primate species on BCI. I typically noted a particular fruiting tree because some mammal, often a howler monkey (*Alouatta palliata*) or spider monkey (*Ateles geoffroyi*), was feeding on its fruits. If sufficient fruit could be obtained for analysis, I collected a sample. Each sample was composed of fresh, ripe, undamaged fruit dropped under the parent tree by feeding monkeys or removed by a climber with a tree pruner.

Ultimately fruits were collected from four hemiepiphytes (*Ficus bullenei*, *F. costaricana*, *F. obtusifolia*, *F. trigonata*), one liana (*Dolioscarpus major*) and 14 tree species (see Table 1 for list of all species). Four of the 14 tree species are among the 50 most abundant species in the 50-hectare survey plot of Hubbell and Foster (Hubbell and Foster, 1990; S. Lao, personal communication). Six of the fruit species analyzed are members of the genus *Ficus*; there are 17 *Ficus* species identified thus far on Barro Colorado Island and one to three species of the other genera represented in my sample (Wendeln *et al.*, 2000; S. Lao, personal communication). Wendeln *et al.* (2000) examined the nutrient content of 14 species of *Ficus* fruit from BCI, including the six species I analyzed. Their work looked at *Ficus* species only. The array of families and genera represented in my study extend their findings on *Ficus* into a broader comparative framework. Fruits analyzed ranged from ~1 cm in diameter when ripe (*F. costaricana*) to ~9 cm in diameter (*Gustavia superba*). Most species produced fruits ~2-3 cm in diameter and ~3-5 cm. in length. The *Ficus* species contained many dozens of tiny seeds; *Gustavia superba* fruit contained an average of 12 seeds per fruit, each seed ~2.5 cm in length. The rest of the species contained one to a few moderate sized (~0.5-1.5 cm long) seeds per fruit.

Treatment of samples

Each sample was composed of the flesh or arils of various fruits collected at the same time from a single parent tree.

Ripe fruits of a given species can show notable differences in nutrient composition between trees or even when collected from the same tree on the same or different days (Howe, 1980; Wheelwright, 1993; Chapman *et al.*, 2003). Though the exact percentage of protein, fat or carbohydrate in a given ripe fruit may vary within or between trees of a particular species, the profile of the three macronutrient groups in relation to one another should generally remain consistent. In other words, one would not expect to find that ripe fruits from tree 1 of species X at a given site would predominate in protein while ripe fruits of tree 2 of species X at that same site would predominate in fats. For this reason, analytical results presented here are regarded as a composite overview of the distribution profile of the three macronutrient groups both for ripe fruits from that tree and for ripe fruits of that species on BCI. Fruits of all species except *Ficus* spp. were opened shortly after collection and the flesh or aril separated from the seeds. The *Ficus* fruits were broken apart to facilitate drying but seeds were not removed (more on this point below). Samples were dried in an oven at 55° C until a constant weight was reached. The dried flesh was then ground in a Wiley mill using a 20-mesh screen. Samples were stored in sealed plastic containers placed in a desiccator and later analyzed for crude protein, crude fat and total nonstructural carbohydrates (TNC) at the Palmer Research Laboratory, University of Alaska, using techniques described below.

Crude protein

Total nitrogen (N) in each sample was determined by the macro-Kjeldahl technique. Results were then multiplied

by the standard 6.25 conversion factor to get an estimate of crude protein present in each sample.

Crude fat

The crude fat (= all fats, oils and waxes) content of each sample was determined by the Randall extractor method (Randall 1974). In this technique each sample is immersed in hot ethyl ether for ten minutes, rinsed out of the solvent and further extracted and rinsed with solvent condensate for 20 minutes. The ethyl ether is then removed by evaporation and the residue is weighed. The difference in weight of the sample prior to and following ether extraction is used as an estimate of the crude fat content of the sample.

Total nonstructural carbohydrates

The modified Weinmann technique as described in Milton (1979) was used to determine the total nonstructural carbohydrate (TNC = sugars, starches and fructosans) content of each sample.

Results and discussion

Results of analyses are presented in Table 1. All values are expressed as percent dry weight of fruit pulp. Results are discussed first in terms of each macronutrient class and then in terms of the proportion contributed per class per species.

Protein

Protein content of the flesh or arils of the 19 species ranged from a low of 3.2% (*Tetragastris panamensis*) to a high of 15.2% (*Gustavia superba*). Mean protein content for the

Table 1. The percent dry weight of each macronutrient group (crude protein, crude fat, total nonstructural carbohydrates, TNC) in flesh or arils of 19 Panamanian fruit species.

Family	Species	Crude Protein	Crude Fat	TNC
Anacardiaceae	<i>Spondias mombin</i>	4.3	1.3	40.0
Anacardiaceae	<i>Spondias radlkofera</i>	11.7	3.9	24.6
Bombacaceae	<i>Quararibea asterolepis</i>	5.4	0.2	31.0
Burseraceae	<i>Tetragastris panamensis</i>	3.2	0.2	56.3
Dilleniaceae	<i>Dolioscarpus major</i>	4.5	3.8	21.1
Lauraceae	<i>Beilschmiedia pendula</i>	6.2	25.4	11.9
Lecythidaceae	<i>Gustavia superba</i>	15.2	42.3	5.1
Meliaceae	<i>Trichilea tuberculata</i>	7.8	38.3	15.6
Moraceae	<i>Brosimum alicastrum</i>	9.3	1.2	20.7
Moraceae	<i>Ficus bullenei</i>	7.1	3.4	3.7
Moraceae	<i>Ficus costaricana</i>	6.9	3.9	6.4
Moraceae	<i>Ficus insipida</i>	7.0	5.8	14.5
Moraceae	<i>Ficus obtusifolia</i>	4.1	3.6	8.7
Moraceae	<i>Ficus trigonata</i>	5.6	6.4	10.5
Moraceae	<i>Ficus yoponensis</i>	7.5	6.0	11.3
Myristicaceae	<i>Virola nobilis</i>	4.5	42.5	18.6
Palmae	<i>Astrocaryum standleyanum</i>	4.8	1.4	45.5
Palmae	<i>Scheelea zonenis</i>	3.6	22.3	15.1
Rubiaceae	<i>Faramea occidentalis</i>	4.1	0.1	38.8

combined samples was $6.5\% \pm 3.0\%$. This is a low protein content when compared with that of tree leaves from this same forest. On Barro Colorado Island, young tree leaves averaged $19.5\% \pm 7.2\%$ protein (Kjeldahl technique; $n = 6$ species; K. M., unpubl. data; see also Milton 1979 for estimates of leaf protein using summed amino acid technique). Data compiled by Leung (1969) show that insects (*i. e.*, flying ants, beetles, crickets, caterpillars, grasshoppers, locusts and termites) average $16.2\% \pm 8.5\%$ protein. Some insect larvae contain $\geq 42\%$ protein (Jenkins and Milton, 1993). When compared both to young leaves and insects, most ripe fruits are low in protein. The actual protein content of fruits analyzed may be even lower than estimates suggest as using nitrogen as a proxy for protein may over-estimate the protein content of fruit pulp (Levey and Martinez del Rio, 2001).

Fat

The crude fat content of the 19 species ranged from a low of 0.1% (*Faramaea occidentalis*) to a high of 54.2% (*Virola surinamensis*). Mean fat content for the combined samples was $11.8\% \pm 16.5\%$. Though most species were decidedly low in fat, five species contained a substantial ($> 22\%$ dry wt.) amount (Table 1). Leaves are generally quite low in fat. Young leaves from the Barro Colorado forest average $2.4\% \pm 2.3\%$ crude fat (Randall technique, $n = 10$ species; K. M., unpubl. data). Insects examined by Leung (1969, see list above) averaged $9.5\% \pm 9.9\%$ fat. Some insect larvae may have fat contents $> 42\%$ (Jenkins and Milton, 1993). Though most fruit species in the BCI sample were not high in fat, a few species were notably high.

Total nonstructural carbohydrates

The total nonstructural carbohydrate content (TNC) of the 19 species ranged from a low of 5.1% (*Gustavia superba*) to a high of 56.3% (*Tetragastris panamensis*). Mean TNC content for the combined samples was $21.0\% \pm 14.8\%$. Leaves are generally low in TNC. Mature leaves from the Barro Colorado forest average $3.7\% \pm 3.5\%$ TNC and young leaves $4.0\% \pm 2.2\%$ (Weinmann technique; $n = 6$ species for each category; Milton, 1979). Data from Leung (1969) show that insects average $2.7\% \pm 1.6\%$ TNC. Therefore, in contrast to both leaves and insects, many ripe fruit species contain a notable amount of nonstructural carbohydrate.

Nutrient content by species

Though all species contained some measurable proportion of each macronutrient class, there were often striking differences in the amount contributed per class per species. In terms of the three nutrient classes, two species (10.5% of the total sample) were highest in protein, five (26%) were highest in fats and twelve (63%) were highest in non-structural carbohydrates. Species predominating in TNC showed a wide range of values. In contrast, results suggest that when a given plant taxon uses fat as the principal caloric attractant, it will use a high percentage, as all five species in this category had $> 22\%$ fat. *Gustavia superba*,

with a fat content of 42.3%, is clearly in the high fat group but unlike the other four species predominating in fat, *Gustavia* had the highest protein content (15.2%) and one of the two lowest TNC contents in the entire sample. Therefore, it was an anomalous species in comparison with the other eighteen and has its own distinct pattern of nutrient allocation. The two species predominating in protein were both *Ficus* species. It is likely that the protein content of the flesh of all *Ficus* species was confounded by the protein content of the many indigestible fig seeds in each fruit and for this reason overestimated. Fig seeds are degraded by chemicals used in analyses but, if swallowed intact, (that is, not crushed by the teeth of the feeder) apparently are not degraded by the action of digestive enzymes in the guts of most fig-eating animals and are excreted intact (Hladik and Hladik, 1969; Morrison, 1980). On BCI, *Ficus* fruits are made up of approximately 50% pulp and 50% seeds dry weight and the two components show somewhat different nutrient profiles, with flesh higher in water-soluble carbohydrates than seeds and seeds higher in protein and fiber than flesh (Wendeln *et al.*, 2001).

Howler monkeys and some other fig-eating mammals crush some, but by no means all, fig seeds when eating the fruits (Hladik and Hladik, 1969; Wendeln *et al.*, 2001; K.M., pers. obs.). For this reason, it is difficult to provide an estimate of the proportion of pulp versus seed nutrient intake for many fig-eating animals. All values presented in Table 1 for *Ficus* species include both flesh and seeds; the precise nutrient contribution of one or the other component in a given animal's diet would depend on an array of factors particular to that feeder. With one exception, the TNC content of *F. insipida*, in comparison to all other species in the analyses, *Ficus* species were not outstandingly high in any nutrient group in spite of the fact that all estimates likely include augmentation from seed macronutrients.

The nutrient patterns present in fruit species from particular locales presumably reflect a long evolutionary interplay between tree species and seed dispersal agents (Snow, 1971; McKey, 1975; Howe and Estabrook, 1977; Howe, 1993; Herrera, 2002). The manufacture of fruit flesh is costly and theoretically each parent tree is seeking to maximize returns from such investments. If we view these 19 fruit species as a type of "grab sample" of macronutrient patterns present in vertebrate-consumed fruit species in this forest, it is clear that the majority of species predominate in nonstructural carbohydrates. In terms of caloric value, TNC may not always dominate per unit mass ingested, but it predominates as a chemical constituent in terms of the three macronutrient groups. If we assume that, over evolutionary time, each plant species has been free to elaborate fruit nutrients in whatever proportions seem most expedient for seed dispersal success, it is clear that most species in this sample have "chosen" to emphasize TNC over protein or fat. A priori, there is apparently no physiological reason why all fruit flesh could not be high in protein or fat rather than TNC if either of these were more favored mode of

nutrient allocation, since there are fruit species, both on BCI and elsewhere, showing such patterns (Snow, 1962; McDiarmid *et al.*, 1977; Styles, 1993; Herrera, 2002). On a community-wide basis, soluble carbohydrates appear to be the most commonly utilized disperser attractant.

The dominance of nonstructural carbohydrates in wild fruit flesh is seen in data from other Neotropical locales. For example, in a list of 40 wild fruit species eaten by frugivores in Guatemala, 38 were highest in TNC and two in fat (Coelho *et al.*, 1976). Similarly, in most Neotropical plant communities for which data are available, lipids appear restricted to a small subset of species producing fleshy fruits. For example, only 20% of the fleshy-fruited species in a Costa Rican plant community had a lipid content > 10% dry weight (Stiles 1993). Protein content appears low for most wild fruit species, regardless of locale. A mean protein content of $8.9\% \pm 0.6\%$ was reported for 122 fruit species in the Neotropics while an overall mean protein content of $5.5\% \pm 0.4\%$ was reported for fruit species in Europe and $5.2\% \pm 0.4\%$ for species in North America (Stiles 1993). Several reasons can be suggested for the use of nonstructural carbohydrates rather than protein or fat as the predominant fruit attractant. Generally, nonstructural carbohydrates are the most rapidly and inexpensively digested of the three nutrient groups (Maynard and Loosli, 1969). This factor may be of special importance to a wide array of smaller-bodied frugivores, since they need to turn over considerable food energy each day to meet metabolic demands. In herbivorous mammals, as body size decreases, metabolic costs per unit mass increase exponentially while gut capacity increases proportionate to body mass (Parra, 1978). Thus, in general, smaller homeotherms should be greatly attracted to foods offering high and rapid energetic returns.

Flesh from six of the 19 fruit species used in these analyses, and likewise collected by KM on BCI, were analyzed for sugar composition by I. and H. Baker, using methodologies presented by Baker and colleagues (1998). In all cases (100%) fruit flesh predominated in glucose and fructose and sucrose was uniformly low (Milton, 1999). In striking contrast, data on the sugar composition of a wide range of cultivated fruits show that sucrose is generally the predominant fruit sugar (Milton, 1999). Sugar composition of flesh could have important implications for the fruit preferences of particular seed dispersal agents (Freeman and Worthington, 1989; Ko *et al.*, 1998; Martinez del Rio *et al.*, 1989; Martinez and Karasov, 1991). The digestion of the hexoses glucose and fructose does not require manufacture of a sucrase, necessary if sucrose were the principal sugar attractant. This metabolic "savings" may benefit many frugivores, particularly smaller bodied frugivores. Fats typically take considerably longer to digest than nonstructural carbohydrates and are more costly to digest in terms of their specific dynamic effect. In addition, most animals find it necessary to maintain a balance between energy and protein in the diet. The source of the energetic calories can affect the amount of protein required

to maintain this balance. Experimental data show that for each 4% of extra fat input into the diet, the protein content must go up 1% by weight to maintain a constant protein to non-protein caloric ratio (Crampton and Lloyd, 1959). A certain threshold in body size and/or digestive specializations may be required to utilize quantities of fatty foods efficiently (Stiles, 1993; Martinez del Rio and Karasov, 1990; Levey and Martinez del Rio, 2001; Dew, 2005).

As noted, there are already various sources of high quality protein available in tropical forests, including young leaves, insects and other animal matter. For this reason, tree species producing protein-rich flesh would not be offering a particularly novel attractant. As most vertebrates do not require large quantities of protein in the diet each day, smaller-bodied species in particular might rapidly become satiated on protein-rich flesh which would lower the number of fruits eaten per visit and thereby depress the number of seeds dispersed. Protein ingested in excess of what the body actually requires also tends to be wasted in so far as its specific functions are concerned, since only the most marginal amounts can be stored. And dietary protein must be catabolized, a process that is energetically expensive because of the high specific dynamic effect of protein digestion (Maynard and Loosli, 1969). The striking exception to the low protein pattern in the BCI sample was *Gustavia superba*. It was by far the largest fruit in the sample—softball-sized—and its unique nutrient profile (and large seeds) suggests that it may seek to attract large terrestrial frugivores as seed dispersal agents. Offering notable protein and energy as a reward may help ensure the specialized dispersal services required for unusually large seeds. Fruits rarely comprise the entire diet of mammals and birds, as fruit pulp provides primarily energy (Rode and Robbins, 2000). Not only do fruits generally lack a sufficiency of protein and various other nutrients animals require, a high carbohydrate-low protein intake is not desirable over the long term as it greatly elevates energy metabolism (Rode and Robbins, 2000). To obtain an optimal balance of energy and nutrients, most vertebrates must therefore move away from fruiting trees each day to seek out other types of foods. A fruit species that provided feeders with complete nutrition would likely disperse few seeds as animals would cluster around such trees until the fruit crop was exhausted. In the case of *Gustavia superba*, a high protein content might not be disadvantageous in terms of seed dispersal, as trees of this species produce only a few ripe fruits at any given time and all trees are small in size. Large frugivores would thus be forced to move about the forest each day to obtain sufficient food and in doing so would move *Gustavia* seeds away from the parent. Rodent predation on *Gustavia* seeds is high at some sites (Sork 1987) and for this reason, movement of seeds well away from parent trees may be of particular value.

In choosing to emphasize TNC in fruit flesh, species may also be seeking to maximize their possibilities for future reproductive success. As no plant can predict where a given seed will land, it seems most expedient to use the

disperser attractant with the widest appeal. If seed dispersal agents present in the parent habitat are absent in new habitats where seeds arrive and germinate, other frugivorous species should still be attracted to sugar-rich fruits. This might not happen so easily with a high protein or fat reward as most dispersal agents depend largely on other sources (leaves, insects, larvae, other vertebrates) for these nutrients. It therefore appears that on BCI, nonstructural carbohydrate is the most "popular" reward offered seed dispersal agents. By providing a source of readily assimilated energy, largely in the form of fructose and glucose, sugary flesh gives dispersal agents the fuel required for an active life style that should facilitate the movement of seeds away from the parent plant. Sugary fruits also give dispersers the energy needed to move about the forest in search of foods containing other nutrients they require. Many primates preferentially eat fruits early in the day and leaves later in the day (Chivers, 1977; Milton, 1980). This feeding pattern suggests that many frugivores actively seek out energy-rich food sources at their first opportunity and feed heavily from them in order to ensure the energy required for their other daily activities. Such a feeding pattern, in turn, should enhance seed dispersal efficiency.

As noted, the six *Ficus* species in this sample were not notably high in any nutrient group. In keeping with this finding, data suggest that most Neotropical frugivores are not attracted to fig fruits because of their high nutrient value. On BCI, spider monkeys (*Ateles geoffroyi*), for example, will ignore fruiting fig trees if other more preferred fruit species are available (Milton, pers. obs.). Neotropical *Ficus* species often produce large ripe fruit crops at times of year when many other fruit species are in short supply (Foster, 1978; Milton, 1980; Terborgh, 1983; Milton, 1993). It would appear that many Neotropical frugivores are attracted to *Ficus* fruit largely because it is the "only game in town" at some times of year (Terborgh, 1983). Various Neotropical mammals that show strong dependence on fig fruits throughout the year appear to have either an energetically inexpensive life style (e.g., howler monkeys, *Alouatta palliata*; Milton, 1980) or a technique for eating fig fruits such that nutrient returns are maximized and the intake of bulky indigestible material is kept low (e.g., fruit bats; *Artibeus jamaicensis*, Morrison, 1980; Wendeln *et al.*, 2001).

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References

- Allee, W. C. 1926. Measurements of environmental factors in the tropical rain forest of Panama. *Ecology* 7: 272–310.
- Alves-Costa, C. P. and Lopes, A. V. 2001. Using artificial fruits to evaluate fruit selection by birds in the field. *Biotropica* 33: 713–117.
- Baker, H. G., Baker, I., and Hodges, S. A. 1998. Sugar composition of nectars and fruits consumed by birds and bats in the tropics and subtropics. *Biotropica* 30: 559–586.
- Chen, J., Deng, X.-B., Bai, Z.-L., Yang, Q., Chen, G.-Q., Liu, Y. and Liu, Z.-Q. 2001. Fruit characteristics and *Muntiacus muntjak vaginalis* (Muntjac) visits to individual plants of *Choerospondias axillaris*. *Biotropica* 33: 718–722.
- Chivers, D. J. 1977. The feeding behaviour of siamang (*Symphalangus syndactylus*). In: *Primate ecology: studies of feeding and ranging behaviour in lemurs, monkeys and apes*, T. H. Clutton-Brock (ed.), pp.255–382. Academic Press, New York.
- Clark, C. J., Poulsen, J. R. and Parker, V. T. 2001. The role of arboreal seed dispersal groups on the seed rain of a lowland tropical forest. *Biotropica* 33:606–620.
- Corlett, R. T. 1996. Characteristics of vertebrate-dispersed fruits in Hong Kong. *J. Trop. Ecol.* 9: 501–510.
- Crampton, E. W. and L. E. Lloyd. 1959. *Fundamentals of nutrition*. W. Freeman Co., San Francisco.
- Croat, T. B. 1978. *Flora of Barro Colorado Island*. Stanford University Press, Palo Alto, California.
- Danish, L., Chapman, C. A., Hall, M. B., Rode, K. D. and Worman, C. O'D. 2006. The role of sugar in diet selection in redbellied and red colobus monkeys. In: *Feeding ecology in apes and other primates*, G. Hohmann, M. M. Robbins and C. Boesch (eds.), pp.473–488. Cambridge University Press, Cambridge.
- Denslow, J. S. and Moermond, T. C. 1982. The effect of accessibility on rates of fruit removal from tropical shrubs: an experimental study. *Oecologia* 54: 170–176.
- Dew, J. L. 2005. Foraging, food choice and food processing by sympatric ripe-fruit specialists: *Lagothrix lagothricha poeppigii* and *Ateles belzebuth belzebuth*. *Int. J. Primatol.* 26: 1107–1135.
- Fleming, T. H., Venable, D. L., and Herrera M., L. G. 1993. Opportunism vs. specialization: the evolution of dispersal strategies in fleshy-fruited plants. *Vegetatio* 107/108: 107–120.
- Foster, M. S. 1978. Total frugivory in tropical passerines: a reappraisal. *J. Trop. Ecol.* 19: 131–154.
- Freeman, C. E., Worthington, R. D. 1989. Is there a difference in the sugar composition of cultivated sweet fruits of tropical/subtropical and temperate origins? *Biotropica* 21: 219–222.
- Herrera, C. M. 2002. Seed dispersal by vertebrates. In: *Plant-animal Interactions*, C. M. Herrera and O. Pellmyr (eds.), pp.185–208. Blackwell Science Ltd., Oxford.

- Hladik, A. and Hladik, C. M. 1969. Rapports trophiques entre vegetation et primates dans la foret de Barro Colorado (Panama). *Terre et vie* 1: 25–117.
- Howe, H. F. 1993. Specialized and generalized dispersal systems: Where does the paradigm stand? *Vegetatio* 107/108: 3–14.
- Howe, H. F. 1980. Monkey dispersal and waste of a Neotropical fruit. *Ecology* 61: 944–959.
- Howe, H. F. and Estabrook, G. F. 1977. On intraspecific competition for avian dispersers in tropical trees. *Am. Nat.* 111: 817–832.
- Howe, H. F. and de Steven, D. 1979. Fruit production, migrant bird visitation, and seed dispersal of *Guarea glabra* in Panama. *Oecologica* 39: 185–186.
- Howe, H. F. and Vande Kerckhove, G. A. 1979. Fecundity and seed dispersal of a tropical tree. *Ecology* 60: 180–189.
- Hubbell, S. P. and Foster, R. B. 1990. Structure, dynamics and equilibrium status of old-growth forest on Barro Colorado Island. In: *Four Neotropical Rainforests*, A. Gentry (ed.), pp.522–541. Yale University Press, New Haven.
- Izhaki, I. and Safriel, U. N. 1989. Why are there so few exclusively frugivorous birds? Experiments on fruit digestion. *Oikos* 54: 23–32.
- Janzen, D. H. 1978. How to be a fig. *Annual review of ecology and systematics* 10: 13–51.
- Jenkins, C. and Milton, K. 1993. Diet and survival among the Hagahai of Papua New Guinea. In: *Tropical forests, people and food*, C. M. Hladik, A. Hladik, O. F. Linares, H. Pagezy, A. Semple and M. Hadley (eds.), pp.281–293. Man and the Biosphere Series, Vol. 13, pp.281–293. Parthenon Pub. Group, Pearl River, New York.
- Karasov, W. H. 1990. Digestion in birds: Chemical and physiological determinants and ecological implications. *Studies in avian biology* 13: 391–415.
- Knight, D. H. 1975. A phytosociological analysis of species-rich tropical forest on Barro Colorado Island, Panama. *Ecological monographs* 45: 259–284.
- Ko, I. W. P., Corlett, R. T. and Xu, R.-J. 1998. Sugar composition of wild fruits in Hong-Kong, China. *J. Trop. Ecol.* 14: 381–387.
- Leigh E. G., Rand, A. S. and Windsor, D. M. 1982. *Ecology of a Tropical Forest*. Smithsonian Press, Washington, DC.
- Levey, D. J. and Martinez Del Rio, C. 2001. It takes guts (and more) to eat fruit; lessons from avian nutritional ecology. *Auk* 118 : 819–831.
- Leung, W. T. W. 1969. Food composition tables for use in Africa. FAO-HEW, Public Health Service Publication. Bethesda, Maryland.
- Martinez del Rio, C., Karasov, W. H., and Levey, D. J. 1989. Physiological basis and ecological consequences of sugar preferences in cedar waxwings. *Auk* 106: 64–71.
- Martinez del Rio, C. and Karasov, W. H. 1990. Digestion strategies in nectar- and fruit-eating birds and the sugar composition of plant rewards. *Am. Nat.* 136: 618–637.
- Maynard, L. A. and Loosli, J. K. 1969. Animal nutrition. McGraw-Hill, New York.
- McDiarmid, R. W., Ricklefs, R. E., and Foster, M. S. 1977. Dispersal of *Stemmadenia donnell-smithii* (Apocynaceae) by birds. *Biotropica* 9: 9–25.
- McKey, D. 1975. The ecology of coevolved seed dispersal systems. In: *Coevolution of animals and plants*, L. E. Gilbert and P. H. Raven, (eds.), pp.159–191. University of Texas Press, Austin.
- Milton, K. 1979. Factors influencing leaf choice by howler monkeys: a test of some hypotheses of food selection by generalist herbivores. *Am. Nat.* 114: 362–378.
- Milton, K. 1980. The foraging strategy of howler monkeys: a study in primate economics. Columbia University Press, New York.
- Milton, K. 1981. Food choice and digestive strategies of two sympatric primate species. *Am. Nat.* 117: 476–495.
- Milton, K. 1991. Annual patterns of leaf and fruit production by six Neotropical Moraceae species. *J. of Ecol.* 79: 1–26.
- Milton, K. 1999. Nutritional characteristics of wild Primate foods; Do the natural diets of our closest living relatives have lessons for us? *Nutrition* 15: 488–498.
- Morrison, D. W. 1980. Efficiency of food utilization by fruit bats. *Oecologia* 45: 270–273.
- Parra. R. 1978. Comparison of foregut and hindgut fermentation in herbivores. In: *The ecology of arboreal folivores*, G. G. Montgomery (ed.), pp.205–230. Smithsonian Press, Washington, DC.
- Pijl, L. van der. 1969. Principles of dispersal in higher plants. Springer-Verlag, Berlin.
- Randall, E. L. 1974. Improved method for fat and oil analysis by a new process of extraction. *Journal of Association of Official American Chemists* 57: 1165–1168.
- Snow, D. W. 1962. The natural history of the oil-bird *Steatornis caripensis* in Trinidad W.I. Part 2. Population, breeding ecology and food. *Zoologica* 47: 199–221.
- Snow, B. K. 1971. Evolutionary aspects of fruit-eating by birds. *Ibis* 113: 194–202.
- Stiles, E. W. 1993. The influence of pulp lipids on fruit preferences by birds. *Vegetatio* 107/108: 227–235.
- Wendeln, M. C., Runkle, J. R., and Kalko, E. K. V. 2000. Nutritional value of 14 fig species and bat feeding preferences in Panama. *Biotropica* 32: 489–501.
- Witmer, M. C and Van Soest, P. J. 1998. Contrasting digestive strategies of fruit-eating birds. *Functional Ecology* 12: 728–741.
- Terborgh, J. 1983. Five new world primates: A study in comparative ecology. Princeton University Press, Princeton, N.J.
- Wheelwright, N. T. 1993. Fruit size in a tropical tree species: variation, preference by birds, and heritability. *Vegetatio* 107/108: 163–174.

OREONAX – NOT A GENUS

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Abstract

We summarize our re-examination and extension of the Groves (2001) parsimony analysis of Woolly monkeys, genus *Lagothrix*, which led him to conclude that the species *flavicauda* is not most closely related to *lagotricha* but to *Ateles*, the Spider monkeys. As a consequence, Groves further proposed that the Yellow-tailed woolly monkey should be assigned to a separate genus, *Oreonax*, previously erected by Oldfield Thomas (1927). Our analysis, while closely following his methods, samples a greater diversity of species and sub-species representing all the living ateline genera and makes minor revisions in Groves' data matrix of craniodental characteristics. With this broader analysis we show that Groves' cladistic results cannot be replicated except by duplicating his study using only a restricted range of taxa. A more wide ranging taxonomic sampling fails to link consistently *flavicauda* and other ateline species, in any particular cladogram topology, while the overall craniodental morphology of *flavicauda* does not separate it from *lagotricha*. Groves' cladistic conclusion is likely to be an artifact stemming from a chance combination of the particular taxa used as a study group and selection of characters that may not be appropriate in intergeneric comparison. There is thus no justification for recognizing *Oreonax* as a distinct genus, and its usage should be rejected.

Key Words: Primates, Atelidae, *Lagothrix*, *Oreonax*, *Lagothrix flavicauda*, Yellow-tailed woolly monkey, cladistics, parsimony, classification.

Resumen

Presentamos abreviadamente nuestra re-examinación y extensión del análisis de parsimonia de Groves (2001) de los monos lanudos, género *Lagothrix*, que le llevaron a concluir que la especie *flavicauda* no está más cercanamente relacionada con *lagotricha* pero sí con *Ateles*, los monos araña. En consecuencia, Groves propuso que el mono lanudo de cola amarilla debería ser asignado a un género aparte, *Oreonax*, previamente erigido por Oldfield Thomas (1927). Nuestro análisis cuidadosamente siguió sus métodos, e incluye una mayor diversidad de especies y subespecies que representan todos los géneros vivientes de Atelinos, y hace revisiones menores en la matriz de Groves de datos de características craneodentales. Con este más amplio análisis mostramos que los resultados cladísticos de Groves no pueden ser replicados excepto al duplicar su estudio utilizando solamente un rango restringido de taxa. Un muestreo taxonómico de rango mucho más amplio falla en articular consistentemente a *flavicauda* y otras especies de atelinos, en cualquier cladograma topológico en particular, mientras que la morfología craneodental general de *flavicauda* no la separa de *lagotricha*. La conclusión cladística de Groves es probablemente una idea derivada de una combinación azarosa de los taxa particulares utilizados como un grupo y la selección de caracteres que parecen no ser apropiados para las comparaciones entre géneros. Por lo tanto no hay justificación para reconocer *Oreonax* como un género distinto, y su uso debería ser rechazado.

Palabras Clave: Primates, Atelidae, *Lagothrix*, *Oreonax*, *Lagothrix flavicauda*, mono lanudo de cola amarilla, cladística, parsimonia, clasificación.

Introduction

The alpha taxonomy of living New World monkeys is experiencing an extreme makeover. The turning point behind this new perspective may be taken as the publication of Groves' (2001) book "Primate Taxonomy." After decades of consolidation and stability beginning in the late 1940s, largely based on the contributions of Philip Hershkovitz, recent treatments have promulgated quite a different pic-

ture of platyrrhine biodiversity. Contemporaries of Hershkovitz working under a similar paradigm, such as Napier and Napier (1967) and Napier (1976) who, like Groves, surveyed the systematics of all primates, recognized 64 and 67 platyrrhine species, respectively. Groves recognizes 112. The difference is remarkable, and it has large implications for systematics, evolutionary theory and conservation. The difference results largely from elevating subspecies-level taxa to full species rank. As far as we are aware, this movement

toward split taxonomies (i. e., as in the traditional distinction of “lumpers” and “splitters”) has not been scrutinized scientifically by primatologists. Groves’s platyrrhine classification (2001, and references therein) is also a departure in the number of modern platyrrhine genera recognized, three more than the authoritative and widely accepted works of the Napiers (Napier and Napier, 1967; Napier, 1976) and Hershkovitz (e.g., 1977). One of these is *Oreonax*, the genus which Groves (2001) revived for a species of Woolly monkey, *flavicauda*, that had fallen into synonymy decades ago. The purpose of this report is to explain that the analysis which led Groves (2001) to raise the rank of the species *L. flavicauda* to the genus level is flawed, making his phylogenetic interpretation and taxonomic decision unjustified.

Groves’ study was based on an algorithmic cladistic analysis of 20 craniodental characteristics involving five ateline species, one (none were identified by species name) taken from each living genus – *Alouatta*, *Lagothrix*, *Ateles*, *Brachyteles* – and a pair of species representing *Lagothrix* (explicitly *lagotricha* and *flavicauda*). In a complimentary analysis, he also added the Brazilian subfossils *Caipora* and

Protopithecus, but this aspect did not add meaningfully to the results. The character state data was analyzed under parsimony criteria using PAUP (Swofford, 1993). Groves found that the species *flavicauda* was more closely related to *Ateles* sp. than to *L. lagotricha*. Having thus discovered that *Lagothrix* is non-monophyletic, Groves elected to remove *flavicauda* to the genus *Oreonax*.

Methods

As explained more fully elsewhere (Matthews and Rosenberger, in press), we replicated Groves’ (2001) study and his results, and then extended his methodology to include more taxa belonging to the genera he studied in order to see if it produced a stable outcome that was consistent with his findings. We also made slight modifications in his dataset that are fully justified and explained in Matthews and Rosenberger. The taxonomic distribution of the original set of craniodental characters are listed in tabular form in these sources. This direct test is a more challenging one than a critique in which we would have developed an entirely independent analysis, or if we had introduced new

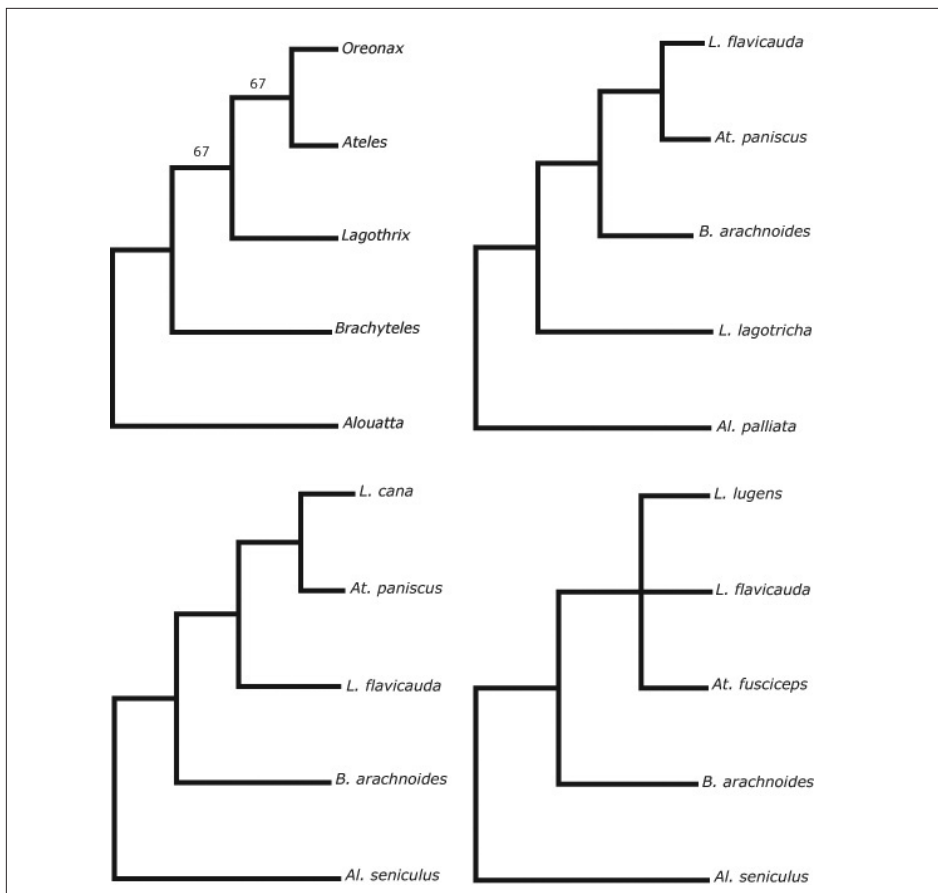


Figure 1. Four different parsimonious cladograms (from Matthews and Rosenberger, in press) based on the data and methods of Groves (2001), as explained in the text. All use five ateline species as the study group, one each from *Alouatta*, *Lagothrix* and *Ateles* and two for *Lagothrix*, *flavicauda* and one other. Fig. 1a is a tree that we generated which replicates Groves’s result, his basis for resurrecting *flavicauda* as Genus *Oreonax* Thomas. The three alternatives, and several others (Matthews and Rosenberger, in press), were obtained using different combinations of five species drawn from the four ateline genera. The absence of a stable, replicable cladistic result indicates the Groves’s tree is an artifact of taxonomic sampling.

types of data. We showed that a large variety of minimal-length, incongruent parsimonious cladograms can be generated by varying the number and taxonomic composition of species included as in-group taxa, the very ones whose interrelationships are being tested.

Results

There is no solid evidence that *Lagothrix*, as classically constituted, is paraphyletic; there is no solid evidence that *flavicauda* is closer cladistically to Spider monkeys than to the Common woolly monkey. Figure 1 shows a sample of cladograms that we generated by analyzing the Groves (2001) characters with a more recent version of PAUP* (Swofford, 2002); additional examples appear in Matthews and Rosenberger (in press). Several points need to be made: 1) when replicating Groves' protocols as precisely as possible, we obtain the same tree (Fig. 1A), 2) when adding new ateline taxa to the sample, but still maintaining his 5 species / 20 character matrix, the results diverge from Groves' result and the monophyly and interrelationships of the ateline genera begin to vary in unstable ways (Fig. 1B-1D), 3) the driving force behind these variations appears to be the taxonomic composition of the five species defined as the in-group, or study group. Cladograms resembling the outcome Groves found occurred only under specific conditions, when they included *L. lagotricha* and *Alouatta seniculus* in the study group. For example, when we substituted *L. lagotricha* with another Woolly monkey taxon (*poepigii*, *cana* or *lugens*) in combination with *flavicauda*, the monophyly of *flavicauda* and *Ateles* sp., the crux of Groves' new findings, was broken.

Discussion and Conclusion

These results reflect an underappreciated shortcoming of algorithmic parsimony analysis and possibly of cladistic analyses in general (including likelihood and Bayesian approaches), that topologies generated from some character sets are highly sensitive to the taxonomic composition of the study sample. Collins (2003) found essentially the same thing in his molecular study of ateline intergeneric relationships. The outcomes varied as he sampled more and different species within the genera. Similar results were also obtained by Sargis (2007) and Silcox (2007) using morphological data in studies involving the relationships of primates to other orders of mammals. Thus the constraints that drive taxonomic sampling to skew cladistic analyses with programs like PAUP appear to occur irrespective of data type and taxonomic level.

Regarding *Oreonax*, we offer some additional thoughts on why Groves' (2001) study may have been problematic from the outset. First there is a practical issue in the nature of the craniodental material Groves used that raises some questions. *Lagothrix flavicauda* is poorly represented in museum collections (Mittermeier et al., 1977). Groves' samples of skulls were the only two specimens in the col-

lections of the American Museum of Natural History (AMNH) and in the United States. They are curiously different in morphology from the holotype and others in the Natural History Museum (British Museum of Natural History, London), a young adult male and female (Fig. 2) plus a juvenile. The AMNH individuals are aged, with very heavily worn teeth and some anatomical peculiarities in jaw and cranial shape. Skins, with the typical *flavicauda* yellow proximal tail, are associated with these and the London specimens, so the species identifications are probably correct. However, unlike the AMNH material, the London skulls do not differ much from samples of *lagotricha* in craniodental anatomy. After consulting with Groves (pers. comm.) some years ago regarding the morphology of the AMNH specimens, we believed it would be wise to split *Lagothrix* into two subgenera (see Hartwig et al., 1996). Groves went a step further as a consequence of his parsimony analysis. We can only offer that genus *Lagothrix* may be somewhat variable craniodentally (as is *Ateles*, but neither case is well documented). While this is not a satisfactory status report on research materials or intrageneric variation, we hope it encourages a more comprehensive reinvestigation of the systematics of *Lagothrix* and study of the full sample of cranial material, including the skulls in Lima, Peru (Mittermeier et al., 1977).

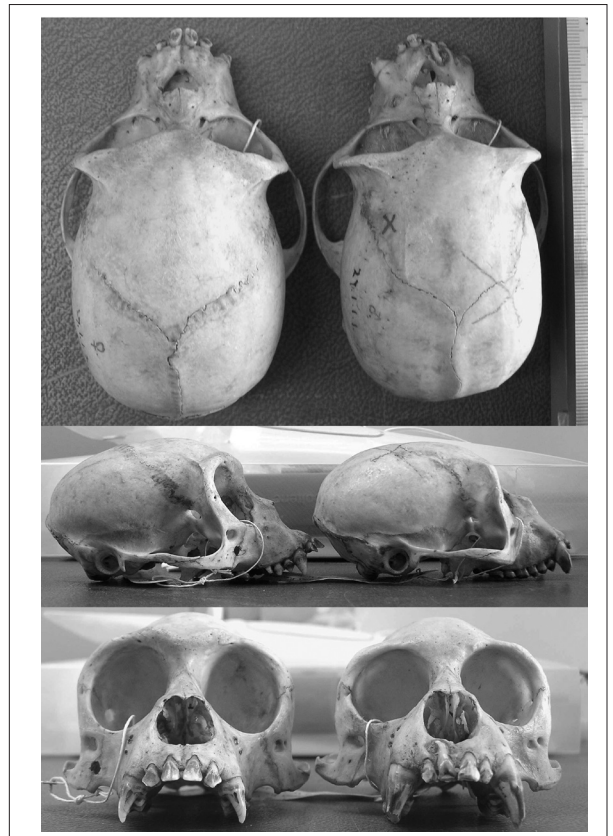


Figure 2. Craniodental morphology of the (right) adult male, the holotype, and (left) female specimen of *Lagothrix flavicauda* in the Natural History Museum (BMNH). The morphology is basically indistinguishable from *L. lagotricha*.

A second point relates to the data Groves (2001) employed. As we discuss to some extent in Matthews and Rosenberger (in press), several of his anatomical characters were problematic, or were coded in ambiguous ways. We tested this by asking three other primate morphologists to score a sample of ateline skulls using Groves' system, and used their determinations in separate PAUP runs. All three produced different cladograms. At another level, some of the features Groves employed, whether or not they are well defined or the characters states easily verified by others, would appear to be low-level population variations that we think would not be reliable as cladistic indicators at the generic level (Matthews and Rosenberger, in press). Finally, we raise a philosophical question. Systematists understand that naming a genus – unlike identifying and naming a species, which has a biological reality – is an artful practice, though it is not without mutually agreed guidelines. We do not believe Groves' (2001) decision to recognize *Oreonax* followed standard practice, irrespective of the difficulties of his parsimony analysis. Conventionally, living primate genera are "defined" by morphology (implicitly or explicitly involving functional/adaptive uniqueness), often with an emphasis on the skull and dentition (even if the taxon is first identified by molecular means and cladistics). Differential diagnoses of ateline genera are not plentiful, as these formalistic descriptions are usually published only as a part of broadly based, synthetic taxonomic revisions. Napier (1976) and Groves (2001), for example, offer such diagnoses and provide at least a brief paragraph of details that allow for identification and diagnosis of each genus by the skull and teeth. Napier (1976) also presents generically distinctive features pertaining to body shape, limbs, hands and feet, and external genitalia. It is worth noting that although she had access to the type series Oldfield Thomas (1927) used in naming *Oreonax flavicauda* when writing her catalogue of primates in the Natural History Museum, Napier retained this species in genus *Lagothrix*, citing the authority of Fooden's (1963) revision.

Groves (2001) also provides apt craniodental and somatic descriptions of *Alouatta*, *Ateles*, *Brachyteles* and *Lagothrix*. However, he offers no similar differentia for *Oreonax*, no anatomical description or list of features that either characterizes *Oreonax* or distinguishes it from any other platyrrhines. In fact, we would argue that the description he gives for his concept of *Lagothrix* perfectly encompasses *flavicauda* as well as *lagotricha*. Instead of an explicit morphological diagnosis, Groves (2001:194) presents the cladistic analysis of traits and concludes:

...the yellow-tailed woolly monkey should be separated generically from *Lagothrix*, because there are no derived character states that appear to unite them; and from all other atelines, because the bootstrap value for the clade uniting it with *Ateles*, its putative closest relative, is not high. Its taxonomic position is isolated.

In other words, Groves' (2001) decision to separate *flavicauda* from *Lagothrix* is based on his inability to establish

the monophyly of Woolly monkey species on the basis of his characters and method. However, by the same logic, because his study was so limited in scope, it could also be argued that the one unidentified species of *Ateles* that grouped with *flavicauda* should also thus be a candidate for generic status, either monotypically or grouped with *flavicauda*. Applying Groves' logic to our complimentary multi-species study would suggest that numerous new genera ought to be erected, since in many cases the cladograms (Fig. 1) yielded novel clusters and irresolute branching sequences. Also, the "isolated" status of the *flavicauda* linkage, which Groves evidences by low PAUP bootstrap values, has no biological or phylogenetic meaning. The low numerical value means that the characters analyzed do not consistently link *flavicauda* with *Ateles* sp., more probably because the linkage is wrong or the evidence for it is weak; not because it is sending a biological signal of uniqueness that has classificatory relevance. Essentially, *flavicauda* has been misclassified because a heuristic measure of statistical support has been misconstrued as a biological and phylogenetic characteristic.

The reality is that among all the modern platyrrhines there is no mistaking the dense, woolly brownish coat, stocky body build, thick-looking limbs and tail, and naked helmeted face of a Woolly Monkey from any other platyrrhine. These same characteristics make it hard to tell apart *flavicauda* from *lagotricha* unless one examines the underside of the tail and pubic region, which tends to be a light golden brown in *flavicauda*. It has yet to be proven that *flavicauda* differs in biologically meaningful ways from *lagotricha* that would justify separating it at the genus level. We also wonder if the small allopatric population of Yellow-tailed woolly monkeys can even be shown convincingly to be a different species from its congeners using modern morphological and molecular approaches. We submit that there is no rationale for dividing Woolly monkeys into two genera, *Lagothrix* and *Oreonax*, and the notion should be rejected.

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References

- Collins, A. C. 2003. Atelinae phylogenetic relationships: The trichotomy revived? *Am. J. Phys. Anthropol.* 124: 285–296.
- Fooden, J. 1963. A revision of the woolly monkeys (genus *Lagothrix*). *J. Mammal.* 44: 213–247.
- Groves, C. 2001. *Primate Taxonomy*. Smithsonian Institution Press, Washington DC.

- Hartwig, W. C., Rosenberger, A. L., Garber, P. A. and Norconk, M. A. 1996. On atelines. In: *Adaptive Radiations of Neotropical Primates*, M. A. Norconk, A. L. Rosenberger and P. A. Garber (eds.), pp.427–431. Plenum Press, New York.
- Hershkovitz, P. 1977. *Living New World Monkeys (Platyrrhini), with an Introduction to Primates. Vol. 1.* University of Chicago Press, Chicago.
- Matthews, L. J. and Rosenberger, A. L. (in press). An object lesson for primate systematics: parsimony analysis (PAUP*) and the taxonomy of the yellow-tailed woolly monkey, *Lagothrix flavicauda*. *Am. J. Phys. Anthropol.*
- Mittermeier, R. A., de Macedo-Ruiz, H., Luscombe, B. A. and Cassidy, J. 1977. Rediscovery and conservation of the Peruvian yellow-tailed woolly monkey (*Lagothrix flavicauda*). In: *Primate Conservation*, Prince Rainier III and G. H. Bourne (eds.), pp.95–116. Academic Press, New York.
- Napier, J. R. and Napier, P. H. 1967. *A Handbook of Living Primates*. Academic Press, London.
- Napier, P. H. 1976. *Catalogue of Primates in the British Museum (Natural History). Part I: Families Callitrichidae and Cebidae*. British Museum (Natural History), London.
- Sargis, E. J. 2007. The postcranial morphology of *Ptilocercus lowii* (Scandenti, Tupaiidae) and its implications for primate supraordinal relationships. In: *Primate Origins*, M. J. Ravosa and M. Dagosto (eds.), pp.51–82. Springer, New York.
- Silcox, M. T. 2007. Primate taxonomy, Plesiadapiformes, and approaches to primate origins. In: *Primate Origins*, M. J. Ravosa and M. Dagosto (eds.), pp.143–178. Springer, New York.
- Swofford, D. L. 1993. *PAUP: Phylogenetic analysis using parsimony. Version 3.1.1.* Smithsonian Institution Press, Washington DC.
- Swofford, D. L. 2002. *PAUP*: Phylogenetic analysis using parsimony (*and other methods). Version 4.0 10b.* Sinauer Associates, Sunderland MA.
- Thomas, O. 1927. A remarkable new monkey from Peru. *Ann. Mag. Nat. Hist.* 19: 156–157.

ECOLOGÍA DE ATELES CHAMEK HUMBOLDT EN UN BOSQUE HÚMEDO MONTANO DE LOS YUNGAS BOLIVIANOS

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Resumen

Desde enero de 2000 a marzo de 2001 evaluamos aspectos de la variación temporal del comportamiento, dieta y tamaño de grupo de una población de *Ateles chamek* en un bosque húmedo montano de los Yungas Bolivianos (Estación Biológica de Tunquini - EBT), así como la disponibilidad de frutos consumidos por este primate (desde abril de 2000). Encontramos correlaciones negativas entre las combinaciones del porcentaje de tiempo dedicado a actividades de descanso y desplazamiento y entre alimentación y desplazamiento, pero ninguna correlación entre las combinaciones de los porcentajes de tiempo dedicado a otras actividades. La dieta de este primate fue altamente frugívora con un bajo consumo de hojas y otras partes vegetales. Las especies más consumidas fueron *Protium montanum*, *Casearia mariquitensis*, *Podocarpus* sp., *Anomospermum* sp., especies del género *Ficus*, una especie indeterminada (nombre vernacular "canelón") y especies de la familia Lauraceae. La mediana mensual del número de individuos por grupo no presentó un pico evidente pero sí una tendencia a una relación positiva con la disponibilidad de frutos distintos al género *Ficus* (agrupados como no-*Ficus*). En cuanto a la disponibilidad de frutos, se observó un incremento en la oferta de frutos no-*Ficus* hacia el inicio de la época húmeda, mientras que la oferta de *Ficus* se dió en todos los meses aunque de manera irregular. Finalmente, encontramos una relación negativa entre la disponibilidad de frutos no-*Ficus* y el tiempo invertido en el desplazamiento.

Palabras Clave: *Ateles chamek*, dieta, disponibilidad de frutos, Estación Biológica de Tunquini.

Abstract

From January 2000 to March 2001 we evaluated aspects of temporal variation of activities, diet, and group size of an *Ateles chamek* population in an area of humid mountain forest (Estación Biológica Tunquini - EBT) in the Bolivian Yungas. We also evaluated (from April 2000) the availability of fruit species consumed by these primates. We found negative correlations between the proportion of time dedicated to resting and traveling, as well as between feeding and traveling, but no correlations were found between other combinations. The diet of these primates was highly frugivorous with a low consumption of leaves and others items. The species most consumed were *Protium montanum*, *Casearia mariquitensis*, *Podocarpus* sp., *Anomospermum* sp., various species of the genus *Ficus*, an undetermined species (known by the common name "canelón"), and various species of the family Lauraceae. The monthly median of the number of individuals per group did not present an evident peak, but did present a tendency towards a positive relation with non-*Ficus* fruits. Regarding fruit availability, we observed an increase of non-*Ficus* species around the beginning of the wet season, whereas *Ficus* species had fruits available during all months of the study. Finally, we found a negative relationship between the fruit availability of non-*Ficus* species and the time spent in traveling.

Key Words: *Ateles chamek*, diet, fruit availability, Estación Biológica de Tunquini.

Introducción

Ateles chamek Humboldt se distribuye en bosques altos amazónicos no perturbados de Brasil, Perú y Bolivia (Anderson, 1997). *Ateles* tiene una dieta especializada en frutos carnosos maduros y muchos aspectos de su ecología se relacionan con la disponibilidad de los frutos como recurso alimentario (Wallace, 1998). En Bolivia, la mayoría de los estudios sobre *Ateles chamek* han sido desarrollados en bosques amazónicos y de pie de monte (Pacheco y Simonetti, 1998, 2000; Wallace, 1998; Wallace *et al.*, 1998; Mendez, 1999; Tarifa, 2000; Palomeque, 2001; Aguilar, 2002). Estos estudios reportan una dieta basada principalmente en un gran número de frutos (Mendez, 1999; Palomeque, 2001; Aguilar, 2002) y una fuerte dominancia de aquellos frutos que se encontraron en mayor disponibilidad en su ambiente (Aguilar, 2002; Wallace, 2005). En relación a la asignación de tiempo a diferentes actividades del comportamiento de este primate, Wallace (2005) encuentra variaciones estacionales en las actividades de movimiento, descanso y alimentación, estando esta última relacionada positivamente con el peso de los frutos de las especies más dominantes. También se indica que el tamaño de grupo en algunas poblaciones de *A. chamek* tiende a disminuir o la observación de los grupos tiende a ser menos frecuente durante la época seca (Mendez 1999; Aguilar 2002). Esto posiblemente esté relacionado con la disponibilidad de frutos como reportan otros estudios para el género en Surinam y Perú (van Roosmalen, 1985; Chapman, 1990).

En Bolivia *A. chamek* también habita bosques húmedos montanos y bosques nublados de Yungas, entre 1000 y 2700 msnm (Ribera, 1995; Rios, 1999); sin embargo no conocemos estudios anteriores sobre su ecología en estos ambientes. Los bosques húmedos montanos se encuentran entre los menos conocidos y más amenazados del Neotrópico (Carrizosa, 1990; Dodson y Gentry, 1991; Henderson *et al.*, 1991) y están siendo altamente fragmentados debido a la expansión de actividades agrícolas (Ribera, 1995), constituyendo ello una seria amenaza para las poblaciones de *A. chamek* ya que esta especie no suele habitar ambientes perturbados (Johns y Skorupa, 1987; Wallace, 1998). Por otra parte, *Ateles* es considerado un buen dispersor de semillas debido a su dieta y fisiología alimentaria y podría estar cumpliendo un rol importante en la dinámica de regeneración de estos bosques, como ocurre en otros hábitats (Klein y Klein, 1977; van Roosmalen, 1985; White, 1986; van Roosmalen y Klein, 1988; Pacheco y Simonetti, 1998, 2000; Wallace, 1998; Aguilar, 2002).

El presente estudio da a conocer aspectos sobre la variación mensual en 1) las actividades desarrolladas por *A. chamek*, 2) la composición de su dieta, 3) el tamaño de sus grupos, y 4) la disponibilidad de frutos consumidos por *Ateles*, en un bosque húmedo montano de Yungas. Estos bosques abarcan serranías de gran relieve topográfico y características climáticas diferentes de otros bosques, por lo cual es

interesante evaluar aspectos básicos de la ecología de *Ateles* en estos ambientes, de forma que puedan ser comparados con estudios en tierras más bajas.

Área de Estudio

El área de estudio abarcó aproximadamente 200 ha del cerro Hornuni, entre 1,600 y 1,960 msnm, en los alrededores de la Estación Biológica Tunquini (EBT), Parque Nacional y Área Natural de Manejo Integrado Cotapata (PNANMI Cotapata), Bolivia (67°43'– 68°62'W, 16°10'– 16°20'S). La topografía del lugar es muy abrupta con pendientes de por lo menos 60° en algunas laderas. Los datos climáticos de la EBT, registrados a 1,840 msnm indican una precipitación anual de 2,500 mm y un promedio de temperatura mensual de 17.2 °C (Bach *et al.*, 2003). La precipitación es mayor durante los meses de noviembre a abril, aunque se presenta durante todos los meses del año. La altura promedio del dosel del bosque es de 25 m, con emergentes como *Ficus* spp. y *Aniba* spp. que alcanzan hasta 30 m. Algunas especies representativas son: *Hyeronima alchorneoides*, *Morus insignis*, *Licania trianda*, *Meriania axinaeoides*, *Spondias mombin*, *Hedyosmum angustifolium*, *Virola* spp., *Inga* spp., *Ladenbergia* spp. y *Bathysa* spp. El sotobosque es dominado por la familia Rubiaceae, destacándose *Condaminea corymbosa*, *Faramea* cf. *multiflora*, *Ladenbergia* cf. *multiflora* y *Palicourea* aff. *semirasa*, además de especies de otras familias como *Piper* spp., *Allophylus punctatus*, *Trichilia clauseni*, *Morus insignis*, *Miconia* spp. También en el sotobosque son abundantes dos especies hemiepífitas: *Blechnum ensiforme* y *Philodendron ornatam* (Ribera, 1995; Bach *et al.*, 2003; Paniagua *et al.*, 2003).

Métodos

El registro de actividades se llevó a cabo durante 10 días por mes desde enero de 2000 hasta marzo de 2001 (excepto marzo y mayo de 2000). La disponibilidad de frutos se registró entre abril de 2000 y marzo de 2001. Para detectar grupos de *Ateles* se establecieron tres sendas perpendiculares a la pendiente a 1,600, 1,700 y 1,900 msnm. Cada senda tenía una longitud aproximada de 2 km y fue atravesada por tres sendas de aproximadamente 300 m en el sentido de la pendiente. La detección de los grupos se realizó mediante contacto visual, auditivo (vocalizaciones) y por movimientos de las ramas durante recorridos diarios de búsqueda intensiva (desde las 7:30 a las 18:30) a lo largo de las sendas. Consideramos como "grupo" a aquellos individuos observados en conjunto en cada encuentro; nuestras observaciones sugieren que todos los "grupos" probablemente pertenecían a una sola unidad social. En ese sentido, nuestros "grupos" no representan unidades sociales independientes y corresponderían a los subgrupos de otros estudios de estructura social de *Ateles* (Izawa *et al.*, 1979; Chapman, 1990; Wallace, 1998; Mendez, 1999).

Cada encuentro con un grupo de *A. chamek* constituyó un periodo de observación. Para el muestreo de compor-

tamiento se utilizó la técnica de barrido (*scan sampling*, Martin y Bateson, 1986), registrando en cada barrido el número de individuos observados realizando cada actividad. Se hicieron barridos cada 5 minutos y cada período de observación fue mantenido mientras al menos un individuo de *Ateles* permanecía a la vista. Las actividades muestreadas fueron (modificado de Wallace, 1998): **Movimiento:** cuando el animal se desliza, balancea, salta, sube, desciende o trepa en las ramas de un mismo árbol o árboles contiguos al árbol donde se realizó el primer registro de un periodo de observación; **Alimentación:** cuando el animal es observado ingiriendo cualquier recurso alimenticio; **Descanso:** cuando el animal está sentado o recostado y no se mueve entre las ramas; **Desplazamiento:** cuando el animal se mueve hacia y entre árboles lejanos al árbol donde se realizó el primer registro de un periodo de observación y generalmente el desplazamiento es rápido, y **Otros:** cuando el animal realiza cualquier actividad fuera de las anteriormente mencionadas, tales como: acicalamiento, juego, vocalizaciones, defecar, etc. Durante los registros de "alimentación" se anotó también el recurso consumido (flor, fruto, hoja, brote y otros), nombre común de la especie y, siempre que fuera posible, se obtuvieron muestras botánicas para su correspondiente identificación en el Herbario Nacional de Bolivia (LPB).

Para establecer la composición de la dieta se calculó el porcentaje mensual de registros de alimentación para dos categorías: frutos y no-frutos (cualquier otra parte vegetal distinta de fruto). La categoría frutos incluyó tres grupos de especies: 1) *Ficus*, 2) especies 1, (especies con un mínimo de 10 registros) y 3) especies 2 (especies con menos de 10 registros). Para el registro mensual de disponibilidad de frutos se establecieron diez parcelas de 0,1 ha (10 x 100 m) cada una, en áreas donde fueron observados los primeros grupos de *A. chamek*, pero distribuidas de manera dispersa en el área de estudio. En cada parcela se marcaron los árboles con DAP \geq 10 cm y mediante el método de estimación de abundancia visual del dosel (Chapman *et al.*, 1992) se realizó un seguimiento mensual de la fenología de frutos maduros de cada individuo. Para esta estimación se asignó una categoría de abundancia de frutos maduros en la copa de cada árbol según la siguiente escala: 0 = 0%, 1 = 1 – 25%, 2 = 26 – 50%, 3 = 51 – 75%, 4 = 76% - 100%. Finalmente se calculó la disponibilidad mensual de frutos maduros por especie (*D*) mediante el índice propuesto por Wallace (1998). Así, para una especie dada:

$$D = \sum_{i=1}^n (DAP \times \text{categoria fenológica})$$

Para el análisis de disponibilidad de frutos solamente se utilizaron datos de especies que estuvieron presentes en los registros de la dieta de *A. chamek*, excluyendo aquellas reportadas por los guías locales pero sin evidencia en campo, y sólo se consideraron los árboles con DAP \geq al menor DAP que presentó actividad reproductiva dentro de cada especie y durante el muestreo fenológico. *Ficus*

presenta una fenología irregular a lo largo del año y valores muy altos de disponibilidad de frutos debido a la enorme cantidad que produce en relación a las otras especies, lo cual podría determinar el comportamiento fenológico de la muestra en un análisis conjunto con las demás especies, enmascarando así el comportamiento de estas últimas. Por tal razón se consideró conveniente analizar la disponibilidad mensual de frutos en dos grupos de especies: a) especies que pertenecen al género *Ficus* y b) especies no-*Ficus*, que incluyen al resto de las especies.

Para expresar la variación temporal mensual del comportamiento de *A. chamek* se obtuvo el porcentaje de tiempo dedicado a cada actividad en un mes dado así:

$$\% \text{Actividad} = \frac{(\text{registros actividad } i)}{(\text{registros todas las actividades})} \times 100$$

Donde:

i = movimiento, alimentación, descanso, desplazamiento y otros.

Con los datos mensuales para cada actividad se realizaron correlaciones de Spearman entre pares de variables de actividad para determinar posibles relaciones entre ellas (Zar, 1996).

La variación en el tamaño de los grupos de *A. chamek* fue reportada como la mediana y los cuartiles del número de individuos observados por grupo en cada mes. Para evaluar la relación entre la disponibilidad de frutos, la variación temporal del comportamiento y el tamaño de grupo se realizaron correlaciones de Spearman (Zar, 1996) entre disponibilidad de frutos no-*Ficus* y el tiempo asignado a cada actividad, así como con el tamaño de grupo desde abril/2000. Se excluyó de este análisis al grupo *Ficus* porque presenta una fenología poco sincrónica a nivel poblacional (Milton *et al.*, 1982; van Schaik, 1986; Ragusa-Netto, 2002), y por tanto, una ausencia de un pico fenológico padrón. Así, un análisis de correlación con nuestros datos en esta variable, no produciría una correlación o produciría una correlación ficticia.

Resultados

Durante el estudio se obtuvieron 78 encuentros (períodos de observación) con grupos de *Ateles*, resultando en 1,068 barridos y 3,775 registros de organización temporal, para un total de 89 horas con 45 minutos de observación directa (Fig. 1). Se encontró una correlación negativa entre los porcentajes de tiempo asignados a alimentación y a desplazamiento ($R_s = -0.7$, $n = 13$, $p = 0.02$), así como para la combinación entre desplazamiento y descanso ($R_s = -0.65$, $n = 13$, $p = 0.03$). Los análisis de combinaciones entre las demás actividades no presentaron relaciones estadísticamente significativas (Tabla 1 y Fig. 2).

Ateles chamek consumió por lo menos 29 especies vegetales en la zona de estudio con un 96.1 % de frutos y sólo

un 3.9% correspondiente a hojas u otras partes vegetales (Tabla 2). Se descartaron del análisis de la dieta 12 registros para los cuales no se pudo identificar la parte vegetal ni la especie consumida. Es importante resaltar que por lo menos tres especies de *Ficus* (*F. sphenophylla*, *F. trigona*, *F. cf. mathewsii*) fueron consumidas casi todos los meses y que en general, la dieta de *Ateles* estuvo dominada por pocas especies: *Protium montanum*, una especie indeterminada de nombre común “Canelón”, *Anomospermum* sp., *Casearia mariquitensis*, más de tres especies dentro de la familia Lauraceae y dos del género *Podocarpus* (Tabla 2).

No se observó un patrón claro en el número de individuos por grupo a lo largo del estudio (Fig. 3). Sin embargo, existe una correlación de tendencia positiva (no significativa estadísticamente) entre el tamaño de grupo y la disponibilidad de frutos no-*Ficus* ($R_s = 0.60$; $p = 0.08$; $n = 11$; Tabla 1). Distintas especies de *Ficus* presentaron dominancia para la mayoría de los meses (Fig 4). Otras especies con frutos disponibles por largos periodos de tiempo pertenecen al género *Cecropia* y diferentes especies de la familia Lauraceae (Tabla 3). La disponibilidad de frutos no-*Ficus* se incrementó hacia el periodo de transición entre la época seca y la húmeda (septiembre-diciembre, Fig. 4), la cual coincide con un mayor número de especies fructificando (Tabla 3). La disponibilidad de frutos no-*Ficus* sólo mostró una correlación significativa con la actividad de *alimentación* ($R_s = -0.7$, $n = 11$, $p = 0.02$; Tabla 1).

Tabla 1. Correlaciones de Spearman entre variables del comportamiento de *Ateles chamek*, disponibilidad de frutos y tamaño de grupo: a) entre disponibilidad de frutos no-*Ficus* y porcentaje de tiempo asignado a cada actividad, b) entre los porcentajes de tiempo asignado a cada actividad y c) entre disponibilidad de frutos no-*Ficus* y número de individuos por grupo.

Variables	R	p
a)		
no- <i>Ficus</i> - <i>alimentación</i>	-0.70	0.02
no- <i>Ficus</i> - <i>movimiento</i>	0.15	0.65
no- <i>Ficus</i> - <i>descanso</i>	-0.45	0.17
no- <i>Ficus</i> - <i>otros</i>	0.14	0.69
no- <i>Ficus</i> - <i>desplazamiento</i>	0.45	0.16
b)		
<i>alimentación</i> - <i>movimiento</i>	-0.13	0.71
<i>alimentación</i> - <i>descanso</i>	0.43	0.19
<i>alimentación</i> - <i>otros</i>	-0.46	0.15
<i>alimentación</i> - <i>desplazamiento</i>	-0.68	0.02
<i>movimiento</i> - <i>descanso</i>	-0.08	0.81
<i>movimiento</i> - <i>otros</i>	0.19	0.57
<i>movimiento</i> - <i>desplazamiento</i>	-0.29	0.39
<i>descanso</i> - <i>otros</i>	-0.31	0.36
<i>descanso</i> - <i>desplazamiento</i>	-0.65	0.03
<i>otros</i> - <i>desplazamiento</i>	0.19	0.57
c)		
no- <i>Ficus</i> - tamaño de grupo	0.60	0.08

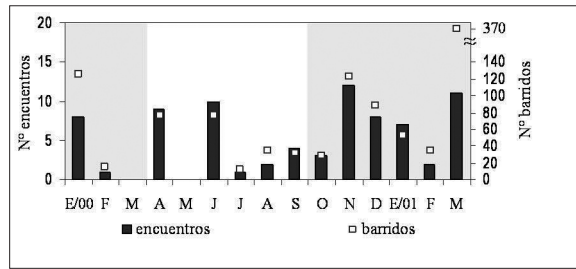


Figura 1. Número de encuentros y muestreos de barrido mensuales obtenidos para *Ateles chamek* en la Estación Biológica de Tunquini (PN-ANMI Cotapata), Bolivia. En fondo gris se representan meses en época húmeda y en blanco meses en época seca.

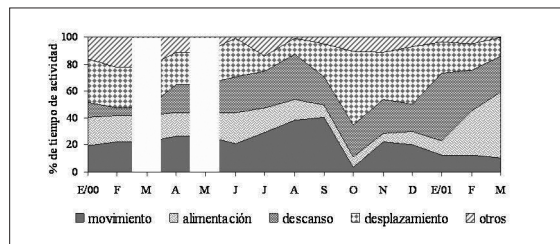


Figura 2. Porcentaje de tiempo asignado por *Ateles chamek* a cada actividad en la Estación Biológica de Tunquini (PN-ANMI Cotapata). Número de registros por mes: E=455, F=36, A=313, J=350, J=44, A=194, S= 82, O=106, N=427, D=251, E=211, F= 118 y M=1188. Áreas en blanco indican meses sin muestreo.

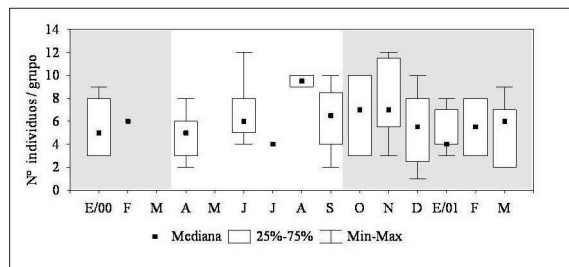


Figura 3. Mediana mensual del tamaño de grupo de *Ateles chamek* en la Estación Biológica de Tunquini (PN-ANMI Cotapata). En fondo gris se representan meses en época húmeda y en blanco meses en época seca.

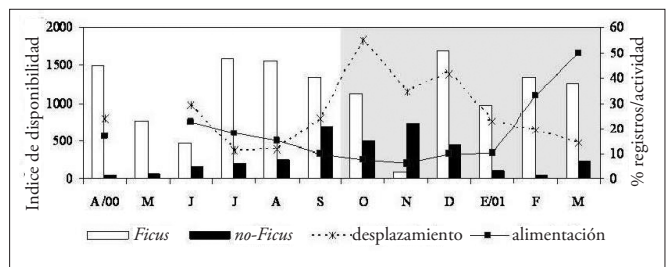


Figura 4. Relación entre la disponibilidad de frutos *Ficus* y no-*Ficus* consumidos por *Ateles chamek* y las actividades de *desplazamiento* y *alimentación*, en la Estación Biológica de Tunquini (PN-ANMI Cotapata). En fondo gris se representan meses en época húmeda y en blanco meses en época seca.

Tabla 2. Lista y consumo de especies en la dieta mensual de Ateles chameck en la Estación Biológica de Tunquini (PN-ANMI Cotapata). Se consideran tres categorías de especies consumidas dentro de frutos: 1) *Ficus*, 2) especies 1 (especies con un mínimo de 10 registros en un mes determinado) y 3) especies 2 (especies con menos de 10 registros en un mes determinado).

Familia	Especie	Nombre vernáculo	Parte consumida	Categoría	E/00	F	A	J	J	A	S	O	N	D	E/01	F	M	Total	% Total
CONSUMO DE FRUTOS																			
Moraceae	<i>Ficus sp</i> (1)	Gedion	fruto	<i>Ficus</i>															
	<i>Ficus sp</i> (2)	Gedion	fruto	<i>Ficus</i>															
	<i>Ficus sphenophylla</i> Standl.	Gedion	fruto	<i>Ficus</i>															
	<i>Ficus cf. mathusii</i> (Miq.) Miq	Gedioncillo	fruto	<i>Ficus</i>															
	<i>Ficus trigona</i> L. f.	Gedion	fruto	<i>Ficus</i>	4	0	5	25	0	24	6	2	3	4	12	3	578	666	67.20
	Total <i>Ficus</i>		Total <i>Ficus</i>																
Burseraeae	<i>Protium montanum</i> Swart	Copal	fruto	Especies 1															
Flacourtiaceae	<i>Casaria maripitensis</i> Kunth	Monte naranja	fruto	Especies 1															
Lauraceae	---	Maurel	fruto	Especies 1															
Menispermaceae	<i>Anomospermum</i> sp.	Mora	fruto	Especies 1															
Podocarpaceae	<i>Podocarpus</i> sp.	Romero	fruto	Especies 1															
Indeterminado	---	Canelon	fruto	Especies 1															
	---	Chili coca	fruto	Especies 1															
	Total Especies 1		Total Especies 1		70	5	38	51	0	0	2	0	2	15	0	33	8	224	22.60
Moraceae	<i>Morus insignis</i> Bureau	Leche leche	fruto	Especies 2															
Myristicaceae	<i>Virola</i> sp.	Karwakunka	fruto	Especies 2															
Sapindaceae	<i>Paullinia</i> sp.	Gaucha	fruto	Especies 2															
Theaceae	---	Espeque	fruto	Especies 2															
Ulmaceae	<i>Trema micrantha</i> (L.) Blume	Chinvia	fruto	Especies 2															
	---	---	fruto	Especies 2															
	---	---	fruto	Especies 2															
Cecropiaceae	<i>Cecropia</i> sp.	Keyaco	fruto	Especies 2															
Fabaceae	<i>Inga</i> sp.	Siquile	fruto	Especies 2															
	Total Especies 2		Total Especies 2		16	16	1	4	4	0	2	1	5	9	3	1	0	62	6.26
	Total Frutos		Total Frutos		90	21	44	80	4	24	10	3	10	28	15	37	586	952	96.06
CONSUMO DE OTRAS PARTES VEGETALES (NO - FRUTOS)																			
Annonaceae	---	Animal	hojas nuevas	---															
Burseraceae	<i>Protium montanum</i> Swart	Copal	hojas nuevas	---															
Cecropiaceae	<i>Pourouma minor</i> Benoist.	Jarape-jarapito	hoja	---															
Erythroxylaceae	<i>Erythroxylum</i> sp.	Jaluri	hoja (brote)	---															
Fabaceae	<i>Erybrina</i> sp.	Cuñuri	hoja (brote)	---															
Moraceae	<i>Heliconia tourensis</i> (Klotzsch & H. Karst.) C.C. Berg	Leche leche	hojas y flor	---															
Orchidaceae	---	---	pseudobulbo	---															
Indeterminado	---	otros+3 lianas	Hoja	---															
	Total no-Frutos		Total no-Frutos		3	1	2	0	4	0	0	1	11	2	9	3	3	39	3.94

Tabla 3. Disponibilidad de frutos maduros de especies consumidas por *Ateles chamek* en la Estación Biológica de Tunquini (PN-ANMI Cotapata).

Familia/especie	A/2000	M	J	J	A	S	O	N	D	E/2001	F	M	N° Ind.
Ficus													
Moraceae													
<i>Ficus cf. mathewsonii</i>	0	0	0	0	0	0	0	0	0	0	198.62	198.62	11
<i>Ficus guianensis</i>	91.35	0	0	0	181.2	77.35	77.35	0	154.7	0	231.4	365.42	4
<i>Ficus sp.</i>	238.41	0	238.41	238.41	238.41	0	0	0	0	0	238.41	0	1
<i>Ficus sphenophylla</i>	0	0	0	0	0	0	0	95.17	190.34	380.68	0	0	1
<i>Ficus trigona</i>	1160.24	773.49	230.77	1339.44	1128.72	1271.96	1060.29	0	1343.26	592.06	673.22	693.28	8
Total Ficus	1490	773.49	469.18	1577.85	1548.33	1349.31	1137.64	95.17	1688.3	972.74	1341.65	1257.32	25
No Ficus													
Burseraceae													
<i>Protium montanum</i>	41.27	0	0	0	0	0	0	0	0	0	0	0	1
Cecropiaceae													
<i>Cecropia spp.</i>	0	0	83.31	111.08	83.31	83.31	83.31	55.54	27.77	0	0	0	1
<i>Pourouma minor</i>	0	0	0	0	0	0	0	23.02	0	0	0	0	3
Euphorbiaceae													
<i>Alchornea sp. 1</i>	0	0	0	0	0	157.92	157.92	52.64	0	0	0	0	1
<i>Alchornea sp. 2</i>	0	0	0	0	0	11.78	11.78	26	14.22	11.78	0	12.77	5
Fabaceae													
<i>Inga spp.</i>	0	0	0	0	0	19.42	25.66	70.64	0	0	0	0	14
Flacourtiaceae													
<i>Casearia mariquitensis</i>	0	0	0	0	0	0	0	0	0	0	0	92.61	8
Lauraceae													
- - -	0	0	33.18	26.9	151.32	102	92.47	143.07	96.96	92.47	47.07	0	4
Moraceae													
<i>Morus insignis</i>	0	0	0	0	0	0	0	153.43	0	0	0	0	1
Myristicaceae													
<i>Virola sp.</i>	0	26.1	61.58	70.96	17.22	0	0	150.12	221.5	0	0	123.44	1
Podocarpaceae													
<i>Podocarpus sp.</i>	0	0	0	0	0	78.94	0	0	0	0	0	0	4
Theaceae													
- - -	0	35.92	0	0	0	0	0	39.48	39.48	0	0	0	12
Ulmaceae													
<i>Trema micrantha</i>	0	0	0	0	0	259.84	132.26	27.09	27.09	0	0	0	4
Total no - Ficus	41.27	62.02	178.07	208.94	251.85	701.43	503.4	741.03	427.02	104.25	47.07	228.82	59
Disponibilidad total	1531.27	835.51	647.25	1786.79	1800.18	2050.74	1641.04	836.2	2115.32	1076.99	1388.72	1486.14	84

Discusión

Algunas correlaciones entre variables encontradas en este estudio de la variación temporal de actividades de *Ateles chamek* apoyan lo reportado por Wallace (2005). Así, la correlación negativa entre los porcentajes de tiempo asignados a las actividades de descanso y desplazamiento podría indicar que la actividad descanso actúa como reserva para que otras actividades necesarias como desplazamiento puedan ser desarrolladas. Como sugiere Wallace (2005), la correlación negativa entre el tiempo asignado a las actividades de desplazamiento y alimentación, podría explicarse por el hecho de que *Ateles* se alimenta principalmente de recursos distribuidos en parches y energéticamente variables. Esto sugiere que este primate podría estar asignando más tiempo a desplazarse entre varios árboles con frutos de alta calidad en términos de contenido energético, para compensar la energía gastada en sus desplazamientos; futuros estudios deberían enfocarse en llevar a cabo análisis de la composición química de los frutos para comprobarlo. En concordancia con lo anterior y considerando que los meses con mayor disponibilidad de frutos no-*Ficus* incluirían por lo menos algunas especies energéticamente más ricas que las que fructifican en meses de menor disponibilidad, se esperaría mayor asignación de tiempo al desplazamiento en dichos meses. Sin embargo, en nuestro estudio no encontramos correlación entre la disponibilidad de frutos no-*Ficus* y el porcentaje de tiempo utilizado para desplazamiento; además encontramos una tendencia a una mayor asignación de tiempo a alimentación cuando la disponibilidad de frutos no-*Ficus* es menor. En este sentido, se puede sugerir que en meses de menor disponibilidad de estos frutos en el bosque, *Ficus* está disponible. Si bien *Ficus* constituye un recurso disperso espacialmente y de bajo valor energético (Morrison, 1978; Lambert y Marshal, 1991; Borges, 1993), los árboles de *Ficus* producen abundantes frutos maduros durante un periodo relativamente corto (Lambert y Marshal, 1991). Por lo tanto *Ateles* tendería a congregarse en estos árboles para alimentarse por periodos más largos ya que dispone de más frutos maduros que en árboles de especies cuya maduración de frutos es más prolongada y, en consecuencia, disponen de menor cantidad de frutos maduros en cada visita. De esta manera, *Ficus* parece ser un recurso muy importante y podría constituir un recurso clave, tal como se sugiere para otros hábitats (Terborgh, 1986; Ahumada *et al.*, 1998; Wallace, 1998; Aguilar, 2002).

Otros estudios han reportado que las variaciones en el tamaño de subgrupos se relacionan con la disponibilidad de frutos (van Roosmalen, 1985; Chapman, 1990; Wallace, 1998). Debido a que en nuestro estudio no tenemos certeza de haber observado grupos pertenecientes a una sola unidad social, no podemos concluir respecto a la tendencia a una relación positiva entre estas variables. Las variaciones en el tamaño de grupo en nuestro estudio podrían estar reflejando características propias de diferentes unidades sociales o de una muestra incompleta de una unidad social. Por lo tanto, nuestros resultados reflejan solamente una

situación particular para el área estudiada con respecto a las relaciones entre disponibilidad de frutos y tamaño de grupo.

Se ha postulado que el incremento en la actividad de descanso durante periodos de escasez de frutos podría estar asociado a un incremento en el consumo de hojas y la consecuente dificultad de digestión de esta parte vegetal (Stevenson *et al.*, 2000; Wallace, 2005). En nuestro caso, meses con menor disponibilidad de frutos no-*Ficus* ocurren tanto al final del periodo húmedo, como al comienzo del periodo seco, pero no registramos un periodo en que se evidencie mayor consumo de hojas por *Ateles*. En cuanto a la frugivoría, nuestro estudio concuerda con el elevado consumo de frutos carnosos previamente reportado para *Ateles* (Klein y Klein, 1977; van Roosmalen, 1985; Chapman, 1988), así como con la dominancia de pocas especies en la dieta (van Roosmalen, 1988; Wallace, 2005). Más del 50% de los registros de alimentación corresponden al género *Ficus* y aproximadamente 21% corresponde sólo a siete especies, cada una en diferentes meses. Como característica común, estas especies se encuentran generalmente dispersas y presentan copas grandes y abundante producción de frutos (*Ficus*, *Lauraceae*, *Protium montanum*, "Canelón", *Podocarpus spp.*, *Anomospermum sp* y *Casearia mariquitensis*).

Nuestro estudio no incluyó un periodo para la habituación de los animales, pudiendo ello enmascarar los resultados obtenidos en el comportamiento durante los primeros meses. Sin embargo, aunque se podría pensar que se obtuvieron pocos encuentros y también cortos periodos de observación durante los meses más secos, por ser los primeros meses de evaluación, el número de encuentros no incrementa linealmente hacia el final del estudio. Por tanto, es altamente probable que la baja frecuencia de encuentros durante esos meses corresponda a la menor disponibilidad de frutos no-*Ficus* en el bosque (Mendez, 1999; Aguilar, 2002). Es posible que durante estos meses los animales se hayan refugiado en zonas fuera del área de búsqueda, las cuales no eran accesibles por las abruptas pendientes de la zona.

Este estudio es pionero para la especie en este tipo de ambientes y brinda un panorama general acerca de la ecología conductual de *Ateles chamek* en un bosque húmedo montano. Es interesante enfatizar que algunas de las características de poblaciones de *Ateles* estudiadas en bosques amazónicos de tierras bajas, e incluso en Centroamérica, se mantienen en nuestra región de estudio: 1) una dieta altamente frugívora, 2) dominancia de pocas especies en la dieta, 3) tendencias a un intercambio del tiempo asignado a las actividades de alimentación y desplazamiento, así como entre descanso y desplazamiento, y 4) una correlación negativa entre la disponibilidad de frutos y el porcentaje de tiempo asignado a la alimentación. Aquellos aspectos de nuestro estudio que parecen contradecir los patrones conocidos sobre la ecología de *Ateles*, tales como el bajo porcentaje de flexibilidad de la dieta (no existe un periodo de mayor consumo de hojas) y la poca variación estacional en

el tamaño de grupo, podrían tener explicaciones distintas, por el hecho de haberse desarrollado en un ambiente muy diferente.

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Referencias

- Aguilar, M. S. 2002. Dispersión de semillas por tres especies de primates, *Ateles chamek*, *Cebus apella* y *Saimiri sciureus* en un bosque de la estación biológica del Beni, Bolivia. Tesis de licenciatura, Universidad Mayor de San Andrés, La Paz, Bolivia.
- Ahumada, J. A., Stevenson P. R. y Quiñónez, M. J. 1998. Ecological responses of spider monkeys to temporal variation in fruit abundance: The importance of flooded forest as a keystone habitat. *Primate Conserv.* 18: 10–14.
- Anderson, S. 1997. Mammals of Bolivia, taxonomy and distribution. *Bull. Amer. Mus. Nat. Hist.* 102: 560–561.
- Bach, K., Schawe, M., Beck, S., Gerold, G., Gradstein, S. R. y Moraes, M. 2003. Vegetación, suelos y clima en los diferentes pisos altitudinales de un bosque montano de Yungas, Bolivia: primeros resultados. *Ecol. Bolív.* 38: 3–14.
- Borges, R. 1993. Figs, malabar giant squirrels, and fruit shortage within two tropical Indian forests. *Biotropica* 25: 183–190.
- Carrizosa, U. J. 1990. La Selva Andina. En: *Selva y Futuro*, U. J. Carrizosa y J. C. Hernández (eds.), pp.151–184. El Sello, Bogotá.
- Chapman, C. 1988. Patch use and patch depletion by the spider and howling monkeys of Santa Rosa National Park, Costa Rica. *Behaviour* 105: 99–116.
- Chapman, C. A. 1990. Ecological constraints on group size in three species of Neotropical primates. *Folia Primatol.* 55: 1–9.
- Chapman, C. A., Chapman, L. J., Wrangham, R. W., Hunt, K., Gebo, D. y Gardner, L. 1992. Estimators of fruit abundance of tropical trees. *Biotropica* 24: 527–531.
- Dodson, C. y A. H. Gentry. 1991. Biological extinction in western Ecuador. *Ann. Miss. Bot. Gard.* 78: 273–295.
- Henderson, A., Churchill, S. P. y Luteyn, J. 1991. Neotropical plant diversity. *Nature* 351: 21–22.
- Izawa, K., Kimura, K. y Samper-Nieto, A. 1979. Grouping of the wild spider monkeys. *Primates* 20: 503–512.
- Johns, A. D. y Skorupa, J. P. 1987. Responses of rain-forest primates to habitat disturbance: a review. *Int. J. Primatol.* 8: 157–191.
- Klein, L. L. y Klein D. B. 1977. Feeding Behaviour of the Colombian Spider Monkey. En: *Primate Ecology*, T. H. Clutton-Brock (ed.), pp.153–181. Academic Press, London.
- Lambert, F. y Marshal, A. G. 1991. Keystone characteristics of bird-dispersed *Ficus* in a Malaysian lowland rain forest. *J. Ecol.* 79: 793–809.
- Martin, P. y Bateson, P. 1986. *Measuring behaviour: an introductory guide*. Cambridge University Press, New York.
- Mendez, P.F. 1999. La influencia de la distribución y abundancia de frutos sobre el tamaño de subgrupo de *Ateles chamek* en la EBB, Bolivia. Tesis de licenciatura, Universidad Mayor de San Andrés, La Paz, Bolivia.
- Milton, K., Windsor, D. M., Morrison, D. W. y Estribi M. A. 1982. Fruiting phenologies of two *Ficus* species. *Ecology* 63: 752–762.
- Morrison, D.W. 1978. Foraging ecology and energetics of the frugivorous bat *Artibeus jamaicensis*. *Ecology* 59: 716–723.
- Pacheco, L. F. y Simonetti, J. A. 1998. Consecuencias demográficas para *Inga ingoides* (Mimosidae) por la pérdida de *Ateles paniscus* (Cebidae), uno de sus dispersores de semillas. *Ecol. Bolív.* 31: 67–90.
- Pacheco, L. F. y Simonetti, J. A. 2000. Genetic structure of a mimosoid tree deprived of its seed disperser, the spider monkey. *Conserv. Biol.* 14: 1766–1775.
- Palomeque, de la C. E. S. 2001. Estimación y preferencia de hábitat del marimono (*Ateles chamek*) en el área de Chalalán (Parque Nacional y Área Natural de Manejo Integrado Madidi). Tesis de licenciatura, Universidad Mayor de San Andrés, La Paz, Bolivia.
- Paniagua, N., Maldonado, C. y Chumacero, C. 2003. Mapa de vegetación de los alrededores de la Estación Biológica de Tunquini, Bolivia. *Ecol. Bolív.* 38: 15–26
- Ragusa-Netto, J. 2002. Fruiting phenology and consumption by birds in *Ficus calyptroceras* (MIQ.) (Moraceae). *Braz. J. Biol.* 62: 339–346.
- Ribera, M. O. 1995. Aspectos ecológicos del uso de la tierra y conservación en el Parque Nacional y Área Natural de Manejo Integrado Cotapata. En: *Caminos de Cotapata*, C. B. Morales (ed.), pp.1–28. Instituto de Ecología, La Paz, Bolivia.
- Rios, B. 1999. Evaluación de métodos indirectos para detectar presencia de mamíferos medianos y grandes en hábitats de montaña. Tesis de licenciatura. Universidad Mayor de San Andrés, La Paz.
- Stevenson, R. P., Quiñones, J. M. y Ahumada A. J. 2000. Influence of fruit availability on ecological overlap among four Neotropical primates at Tinigua National Park, Colombia. *Biotropica* 32: 533–544.
- Tarifa, T. 2000. Abundancia, distribución y estado de conservación del marimono (*Ateles chamek*) en la Reserva de la Biosfera Estación Biológica del Beni, Bolivia. En: *Biodiversidad, conservación y manejo en la región de la Reserva de la Biosfera Estación Biológica del Beni, Bolivia*, O. Herrera-MacBryde, F. Dallmeier, B. MacBryde, J. A. Comiskey y C. Miranda (eds.), pp.275–296. SI/MAB Series N°4, Smithsonian Institution, Washington DC.
- Terborgh, J. 1986. Keystone plant resources in the tropical forest. En: *Conservation biology: the science of scarcity and*

- diversity*, M. E. Soule (ed.), pp.330–344. Sinauer, Sunderland, Massachusetts.
- van Roosmalen, M. G. M. 1985. Habitat preferences, diet, feeding strategy and social organization of the black spider monkey (*Ateles paniscus paniscus*) in Surinam. *Acta Amazonica* 15: 9–238.
- van Roosmalen, M. G. M. y Klein, L. L. 1988. The spider monkeys, genus *Ateles*. En: *Ecology and behavior of Neotropical primates*, R. A. Mittermeier, A. B. Rylands, A. Coimbra-Filho y G. A. B. Fonseca (eds.), pp.445-537. WWF, Washington DC.
- van Schaik, C. P. 1986. Phenological changes in a Sumatran rain forest. *J. Trop. Ecol.* 2: 327–347.
- Wallace, R. B. 2005. Seasonal variations in diet and foraging behavior of *Ateles chamek* in a southern Amazonian tropical forest. *Int. J. Primatol.* 26: 1053–1075.
- Wallace, R. B. 1998. The behavioural ecology of black spider monkeys in north-eastern Bolivia. Tesis de Doctorado, University of Liverpool Press, Liverpool.
- Wallace, R. B., Painter, R. L. E. y Taber A. B. 1998. Primate diversity, habitat preferences, and population densities estimates in Noel Kempff Mercado National Park, Santa Cruz department, Bolivia. *Am. J. Primatol.* 46: 197–211.
- White, F. 1986. Census and preliminary observations on the ecology of the black-faced spider monkey (*Ateles paniscus chamek*) in Manu National Park, Perú. *Am. J. Primatol.* 11: 125–132.
- Zar, J. H. 1996. *Biostatistical analysis*. Prentice-Hall, USA.

SHORT ARTICLES

ALTITUDINAL RANGE EXTENSION FOR *CEBUS ALBIFRONS* (PRIMATES: CEBIDAE) IN SOUTHERN ECUADOR

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Introduction

Capuchins in the genus *Cebus* (Cebidae) are medium-sized, gregarious, and generally arboreal monkeys found in Central and South America (Emmons and Feer, 1997; Eisenberg and Redford, 1999). Like other *Cebus*, the white-fronted capuchin (*Cebus albifrons* Humboldt, 1812) is omnivorous, consuming seeds, fruit, invertebrates, and vertebrates (Defler, 1979a; Eisenberg and Redford, 1999; Tirira, 2007). *Cebus albifrons* can occupy a home range as large as 120 ha and the species is known to wander to varied habitat types in search of widely separated food resources (Defler, 1979a; Terborgh, 1983; Haugaasen and Peres, 2005).

Capuchins are mostly lowland species although *Cebus apella* and *C. albifrons* have been recorded up to 2,130 m a.s.l. and 2,000 m a.s.l. respectively (Tate, 1939; Hershkovitz, 1949; Emmons and Feer, 1997). *Cebus albifrons* is known from humid to dry forests in isolated areas of northern Colombia and Venezuela, in western Ecuador, and in the upper and middle Amazon basin of Colombia, Ecuador, Peru, Bolivia, and Brazil west of the Ríos Tapajós and Negro (Emmons and Feer, 1997; Eisenberg and Redford, 1999; Tirira, 2007). *Cebus albifrons* includes several subspecies whose distributions and morphological differences have been incompletely studied. Historically, 11 subspecies were recognized (Cabrera, 1957), but more recently, Groves (2005) recognized only five, two of which occur in Ecuador, *C. a. aequatorialis* and *C. a. yuracus*. The latter is most likely involved in our records in southern Ecuador. *Cebus albifrons aequatorialis* is endemic to humid to dry tropical and subtropical forests west of the Andes in Ecuador (Albuja and Arcos, 2007; Tirira, 2007); its type locality is Río de Oro, Manabí province (Cabrera, 1957). *Cebus albifrons yuracus* is found in humid tropical and subtropical forests east of the Andes in Ecuador and northeastern Peru, between the Marañón and Putumayo rivers (Emmons and Feer, 1997; Tirira, 2007); its type locality is Montalvo, Río Bobonaza, Pastaza province, Ecuador (Cabrera, 1957).

The highest altitude records for *C. albifrons* across its distribution are as follows. In Colombia, the highest known record of the species is 2,000 m a.s.l. in the department of Tolima (Defler, 2003). The highest confirmed record in Perú comes from the eastern foothills of the upper Río

Comainas, Cordillera del Cóndor (Amazonas department) at 1,738 m a.s.l. (Schulenberg and Awbrey, 1997; this record is of *C. a. yuracus*) and there are unconfirmed sightings from the headwaters of the Río Poyeni, Cordillera de Vilcabamba (Apurímac department) at 2,050 m a.s.l. (Alonso *et al.*, 2001). In Venezuela, the species is known up to 850 m a.s.l. (Linares, 1998). In Bolivia, the altitudinal range of the species has not been well documented but there are no specimen records at altitudes greater than 2,000 m a.s.l. (Anderson, 1997). In Ecuador, the highest previously reported altitudes for *C. a. yuracus* are 1,600 m a.s.l. from Sardinayacu in Sangay National Park (02°03'S, 78°09'W; Albuja, 1996) and 1,550 m a.s.l. in Coangos, Morona-Santiago province (03°29'S, 78°14'W; Schulenberg and Awbrey, 1997). *C. a. aequatorialis* was once reported from 1,660 m a.s.l. at Gualea, Pichincha province (Allen, 1914). Allen (1914) indicated that the altitude of Gualea is "7,000 ft" (2,330 m a.s.l.). As Gualea actually lies at 1,660 m a.s.l., this elevation must be erroneous and no future authors have included this high elevation record. Here we report *C. a. yuracus* (subspecies inferred by range) from 2,425-2,515 m a.s.l. in montane upper subtropical forest in the Cordillera de Sabanilla, Zamora-Chinchipec province, Ecuador. This record extends the known altitudinal range of the species by 515 m and for *C. a. yuracus* by 777 m.

Study Site and Methods

We observed *C. albifrons* in mature forest at 2,425-2,515 m a.s.l. (4°29'S, 79°07'W) in the Tapichalaca Biological Reserve, a 2,870 ha protected area administered by the Jocotoco Conservation Foundation located above the town of Valladolid, Zamora-Chinchipec province, adjacent to Podocarpus National Park. The forest in this area, characterized as upper subtropical forest (Krabbe *et al.*, 1999), has an average canopy height of approximately 10 m with 20 m emergent crowns and it receives about 4 m of rainfall annually. The canopy is characterized by Moraceae (*Ficus* sp.), Euphorbiaceae (*Croton* sp.), Lauraceae, and Rubiaceae, and the understory is largely made up of bamboo (*Chusquea* sp.), Piperaceae, and Melastomataceae. The vegetation at Tapichalaca is covered in abundant mosses and liverworts as well as vascular epiphytes in families such as Bromeliaceae, Araceae, and Orchidaceae (Krabbe *et al.*, 1999).

Results and Discussion

On 15 January 2007 at 11:00 (EST), PJAL and VMI observed one individual *C. albifrons* for 5 minutes at 2,425 m a.s.l. Then on 31 January, approximately 500 m up the same trail, JBCH and VMI observed three individuals for 2.5 hr (from 9:00-11:30) at 2,515 m a.s.l. The weather on both observation days was partly cloudy and warm (approx. 16° C). We photographed and made audio recordings of the group on 31 January. The capuchins fed on *Persea* sp. (Lauraceae) and *Croton* sp. (Euphorbiaceae) fruits, and unidentified small items inside bromeliads

(probably arthropods). We were unable to sex the capuchins but all individuals appeared to be adults (Fig. 1). The capuchins spent all of the observation time in trees. The following observations apply to the group of three capuchins we observed on 31 January. The capuchins made frequent, although quiet vocalizations, as is typical for the species (Defler, 1979b). The three individuals often made soft *yah* danger calls (Defler, 1979b) throughout the 2.5 h observation period, and were likely using the calls to communicate the presence of the human observers (T. Defler, pers. comm.). The capuchins vocalized frequently but the calls were quiet and could only be heard within approximately 30 m of the vocalizing individual. Once, a capuchin approached a human observer and stared and shook branches for 30 sec; this behavior is a common sign of aggression in *C. albifrons* (Defler, 1979b; Fig. 1). The dense vegetation and the abundance of epiphytes made it difficult to monitor all of the individuals constantly but it seemed no capuchin was ever farther than 20 m from another. During the observation period the group of capuchins traveled approximately 150 m.

Cebus albifrons is most often observed in groups of 7-35 individuals (Defler, 1979a,b; Defler, 1982; Terborgh, 1983; Eisenberg and Redford, 1999), and our observations of much smaller groups are unusual for the species. We are



Figure 1. Aggressive stare of white-fronted capuchin (*Cebus albifrons*) in upper subtropical forest (2,515 m) in southern Ecuador.

unsure why the species apparently lives in such small groups in the Tapichalaca area but we hypothesize that small group size may confer some advantage in the high altitude habitat. Additionally, *C. albifrons* may inhabit Tapichalaca in low numbers because the high Andes are at the very limit of the species' distribution. This pattern of rarity at the edge of a distribution is shown in many widely-distributed animals (Brown, 1984). It is also possible that we observed subgroups of larger capuchin groups in the area. Subgroups are sometimes formed in *Cebus* when seasonal changes cause resources to be dispersed (Izar, 2003; Lynch Alfaro, 2007). The high altitude environment at Tapichalaca may provide more dispersed food resources than lower elevation habitats which may result in similar *Cebus* subgrouping. More research is needed to better understand small group size of highland capuchins.

Cebus albifrons has never before been recorded at Tapichalaca, even though the area has been frequented by experienced observers since 1997. We searched for the species for several days following these observations but could not relocate any capuchins. In addition, we conducted extensive field work in the area for the following seven months and never re-encountered the species. The small number of records of *C. albifrons* can partially be explained by the species' large home range size and quiet, inconspicuous behavior, but the species is likely to be rare in the area. We hypothesize that *C. albifrons* is a low density resident in upper subtropical forest in the Tapichalaca region.

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References

- Albuja, L. 1996. Diagnóstico faunístico para la actualización del plan de manejo del Parque Nacional Sangay. Plan maestro para la protección de la biodiversidad mediante el fortalecimiento del Sistema Nacional de Áreas Protegidas. Proyecto INEFAN-GEF. INEFAN. Quito, Ecuador.
- Albuja, L. and Arcos, D. R. 2007. Evaluación de las poblaciones de *Cebus albifrons* cf. *aequatorialis* en los bosques

- suroccidentales ecuatorianos. *Revista Politécnica* 27(4), *Serie Biología* 7: 58–67.
- Allen, J. A. 1914. New South American monkeys. *Bull. Am. Mus. Nat. Hist.* 33: 647–655.
- Alonso, L. E., Alonso, A., Schulenberg, T. S., and Dallmeier, F. (eds.). 2001. Biological and social assessments of the Cordillera de Vilcabamba, Peru. **Rapid Assessment Program (RAP)**. Working Papers 12 and SI/MAB Series 6. Conservation International, Washington, DC.
- Anderson, S. 1997. Mammals of Bolivia, taxonomy and distribution. *Bull. Am. Mus. Nat. Hist.* 231: 1–652.
- Brown, J. H. 1984. On the relationship between abundance and distribution of species. *Am. Nat.* 124: 255–279.
- Cabrera, A. 1958. Catálogo de los mamíferos de América del Sur. *Revista del Museo Argentino de Ciencias Naturales "Bernardino Rivadavia"*, *Ciencias Biológicas* 4: 1–308.
- Defler, T. R. 1979a. On the ecology and behavior of *Cebus albifrons* in eastern Colombia: I. Ecology. *Primates* 20: 475–490.
- Defler, T. R. 1979b. On the ecology and behavior of *Cebus albifrons* in eastern Colombia: II. Behavior. *Primates* 20: 491–502.
- Defler, T. R. 1982. A comparison of intergroup behavior in *Cebus albifrons* and *C. apella*. *Primates* 23: 385–392.
- Defler, T. R. 2003. *Primates de Colombia*. Conservación Internacional. Serie de guías tropicales de campo 4. Bogotá DC.
- Eisenberg, J. and Redford, K. 1999. *Mammals of the Neotropics*, Vol. 3. The University of Chicago Press, Chicago.
- Emmons, L. H. and Feer, F. 1997. *Neotropical rainforest mammals. A field guide*. 2nd edition. The University of Chicago Press, Chicago.
- Groves, C. 2005. Order Primates. In: *Mammal species of the world, a taxonomic and geographic reference*, 3rd edition, D. E. Wilson and D. M. Reeder (eds.), pp.111–184, The John Hopkins University Press, Baltimore.
- Haugaasen, T. and Peres, C. T. 2005. Primate assemblage structure in Amazonian flooded and unflooded forests. *Am. J. Primatol.* 67: 243–258.
- Hershkovitz, P. 1949. Mammals of northern Colombia. Preliminary report 4: monkeys (Primates), with taxonomic revisions of some forms. *Proceedings of the U. S. National Museum* 98: 323–427.
- Izar, P. 2003. Female social relationships of *Cebus apella nigrinus* in a Southeastern Atlantic forest: An analysis through ecological models of primate social evolution. *Behaviour* 141: 71–99.
- Krabbe, N., Agro, D. J., Rice, N. H., Jacome, N., Navarrete, L., and Sornoza M., F. 1999. A new species of antpitta (Formicariidae: Grallaria) from the southern Ecuadorian Andes. *Auk* 116: 882–890.
- Linares, O. 1998. *Mamíferos de Venezuela*. Sociedad Conservacionista Audubon de Venezuela, Caracas.
- Lynch Alfaro, J. W. 2007. Subgrouping patterns in a group of wild *Cebus apella nigrinus*. *Int. J. Primatol.* 28: 271–289.
- Schulenberg, T. S. and Awbrey, K. (eds.). 1997. The Cordillera del Cóndor region of Ecuador and Peru: A biological assessment. Rapid Assessment Program (RAP). Working Papers 7. Conservation International, Washington, DC.
- Tate, G. H. H. 1939. The mammals of the Guiana region. *Bull. Am. Mus. Nat. Hist.* 76: 151–229.
- Terborgh, J. 1983. *The behavioral ecology of five species of Amazonian primates*. Princeton University Press, Princeton, New Jersey.
- Tirira, D. G. 2007. *Guía de campo de los mamíferos del Ecuador*. Publicación especial sobre los mamíferos del Ecuador 6, Ediciones Murciélago Blanco, Quito, Ecuador.

NEW OCCURRENCE RECORDS OF MAUÉS MARMOSET, *MICO MAUESI* (PRIMATES, CALLITRICHIDAE)

Maurício de Almeida Noronha
 José de Sousa e Silva Júnior
 Wilson Roberto Spironello
 Dayse Campista Ferreira

Introduction

The Maués marmoset, *Mico mauesi* (Mittermeier *et al.*, 1992), was described in the last decade of the 20th century and originally placed in the genus *Callithrix*. The species was described from a specimen at the Museu Paraense Emílio Goeldi (holotype: MPEG -22177) and observations of captive and wild animals. At the time of its description the species was only known to occur at the type locality, on the left bank of the Rio Maués-Açu (03°23'S, 57°46'W), just across from the city of Maués in the state of Amazonas, Brazil. Based on distribution patterns of other species of Amazonian marmoset, Mittermeier *et al.* (1992) predicted that the new species would occur throughout the entire medium to lower Maués-Urariá-Abacaxis interfluvium and that its range would be limited by these three rivers.

During primate surveys conducted in and around the Canumã-Urariá-Abacaxis interfluvium, Silva Jr. and Noronha (1995, 2000) registered the presence of *M. mauesi* at two localities on the right bank of the lower Rio Abacaxis: Abacaxis (03°55'S, 58°45'W) and Santa Maria (03°54'S, 58°46'W). Three specimens were collected at Santa Maria and deposited in the zoological collection of the Museu Paraense Emílio Goeldi (MPEG – 23962, 23963, 23964). These findings (Silva Jr. and Noronha, 1995, 2000) and data from the literature (Hershkovitz, 1977; Vivo, 1988, 1991), confirm the northern and western limits of the species' range as proposed by Mittermeier *et al.* (1992). According to the range map produced by these authors, the distribution of *M. mauesi* should be limited to the east by the Rio Maués-Açu and extend as far south as 05° S. The objective of this study is to update knowledge of the geographic distribution of *M. mauesi* through the collection and analysis of new field data.

Methods

Data on the occurrence and habitat of the maués marmoset were collected during a field trip to the lower Rios Madeira and Tapajós interfluvium (Noronha, 2004). The area surveyed during the study spanned the headwaters of the Rios Maués, Abacaxis and Sucundurí. Data were collected using two methods: direct sightings and interviews with local informants. *Mico mauesi* was identified based on the diagnostic characters described by Mittermeier *et al.* (1992) and comparisons with material from the zoological collections of the Museu Paraense Emílio Goeldi and the National Institute of Amazonian Research (MPEG-23962, 23963, 23964; INPA-4082, 4109, 4105, 4106).

Results and discussion

During the study, eight new occurrence records were obtained for *M. mauesi*, seven via direct sightings and one in an interview. Marmosets with the traits described by Mittermeier *et al.* (1992) were seen at sites 4, 5, 6, 7, 8, 9

and 10 (Fig. 1.). All records were obtained in *terra firme* primary forest, secondary growth and *igapó*, suggesting that the habitat requirements of this species are similar to other members of the genus (Digby *et al.*, 2005; Mittermeier *et al.*, 1992; Silva Jr. and Noronha, 1995, 2000). These new records demonstrate that the geographic distribution delineated by Mittermeier *et al.* (1992) underestimated the true range of the species. Although northern and western limits were predicted correctly, authors were over cautious with respect to the eastern and southern limits. Data from this study extend the range east to the Rio Maués-Açu; south almost as far as the Igarapé do Surubim (06°53'S, 59°03'W) along the corridor formed by the Rios Tapajós and Sucundurí; west to the Rio Sucundurí, reaching the mid and upper Sucundurí-Abacaxis interfluvium (the northernmost record was the *Cantagalo* site: 06°33'S, 59°05'W). Interviews with local residents suggest that the species may extend as far south as the region of Igarapé do Urucú (07°09'S, 58°56'W), on the right bank of the Rio Sucundurí.

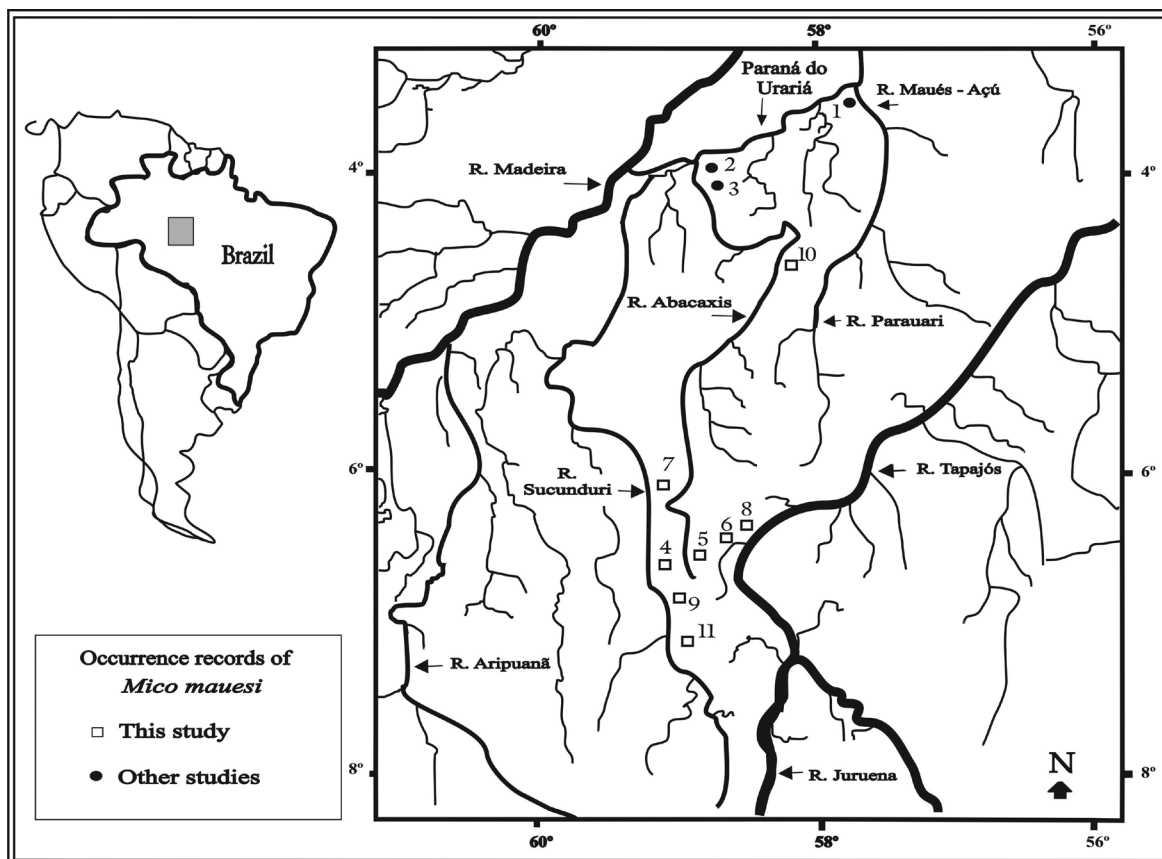


Figure 1. Geographic range of *Mico mauesi*, based on Mittermeier *et al.* (1992), Silva Jr. and Noronha (1995, 2000) and this study: (1) left bank of the Rio Maués-Açu (03°23'S, 57°46'W), across from Maués (type locality), municipality of Maués; (2) Abacaxis (03°55'S, 58°45'W), right bank of the Rio Abacaxis, municipality of Nova Olinda do Norte; (3) Santa Maria (03°54'S, 58°46'W), right bank of the Rio Abacaxis, municipality of Nova Olinda do Norte; (4) right bank of the Rio Sucundurí (06°48'S, 59°04'W), municipality of Apuí; (5) right bank of the Rio Abacaxis (06°41'S, 58°50'W) municipality of Maués; (6) left bank of the Rio Tapajós (06°34'S, 58°35'W), municipality of Maués; (7) Cantagalo, right bank of the Rio Sucundurí (06°33'S, 59°05'W), municipality of Borba; (8) left bank of the Rio Tapajós (06°34'S, 58°24'W), municipality of Maués; (9) mouth of the Igarapé do Surubim, right bank of the Rio Sucundurí (06°53'S, 59°03'W), municipality of Apuí; (10) Floresta Nacional do Pau Rosa, right bank of the Rio Abacaxis (04°40'S, 58°15'W), municipality of Maués; (11) mouth of the Igarapé do Urucú (07°09'S, 58°56'W), left bank of the Rio Sucundurí, municipality of Apuí.

According to Hershkovitz (1977), *Mico humeralifer* is expected to occur in the Sucundurí-Tapajós-Juruena interfluvium. Rylands (1994) suggested that this species' range could extend as far south as 8° S. This study however, does not support these expectations. It is possible that *Mico mauesi*'s range extends between the Rios Sucundurí and Juruena, reaching as far south as the transition between dense tropical forest, open tropical forest and savanna (BRASIL, 1975) at around 7°40'S, or even as far as the Serra do Sucundurí at 8°10'S. These predictions coincide with the southern limit for *M. humeralifer* proposed by Rylands (1994). According to Rylands (1981), south of this latitude the species *M. melanurus* should occur between the Rios Aripuanã and Juruena. This hypothesis is partially supported by the occurrence of *M. melanurus* in the Serra do Sucundurí (08°34'S, 59°08'W) and on the right bank of the Rio Bararati (08°21'S, 58°37'W). *Mico melanurus* was the only member of the genus occurring at these localities (M. A. Noronha, unpubl. data). Our results show that the geographic distribution of *M. mauesi* is large relative to that of other species of the genus in the Madeira-Tapajós interfluvium. We did not find any area of contact between *M. mauesi* and any other species of *Mico*, suggesting that the species is parapatric with respect to its congeneric neighbors *M. humeralifer*, *M. melanurus*, *M. acariensis* and *M. saterei*.

This study quadrupled the number of recorded localities for *M. mauesi*, and revealed a range over twice that proposed by Mittermeier *et al.* (1992). The improved knowledge of this taxon's geographic distribution also provides information about its occurrence within protected areas. The maués marmoset is probably present in the Floresta Nacional do Pau Rosa (994,800 ha), Parque Nacional do Juruena (2,002,565 ha) and the Floresta Nacional de Maués (438,440 ha), and if we assume that the southern limit of its range is close to the Serra do Sucundurí, it also occurs in the Reserva de Desenvolvimento Sustentável do Bararati (113,606 ha), Parque Estadual do Sucundurí (808,312 ha) and the Floresta Nacional do Apuí (185,946 ha).

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References

- Digby, L. J., Ferrari, S. F. and Saltzman, W. 2005. Callitrichines: The role competition in cooperatively breeding species. In: *Primates in perspectives*, C. J. Campbell, A. F. Fuentes, K. C. Mackinnon, M. Panger and S. Bearder (eds.), pp.85–106. Oxford University Press.
- Hershkovitz, P. 1977. *Living New World monkeys. Part 1: (Platyrrhini), with an introduction to Primates*. Chicago University Press, Chicago.
- Mittermeier R. A., Schwarz, M. and Ayres, M. 1992. A new species of marmoset, genus *Callithrix* Erxleben, 1777 (Callitrichidae, Primates) from the Rio Maués region, state of Amazonas, central Brazilian Amazonia. *Goeldiana, Zoologia* 14: 1–17.
- Noronha, M. A. 2004. Estado atual de conservação e distribuição geográfica do *Mico saterei* Silva Jr. & Noronha, M. A. 1998 (Primates: Callitrichidae), na Amazônia Central, Brasil. MSc thesis, Instituto de Florestas, Universidade Federal Rural do Rio de Janeiro, Rio de Janeiro.
- Rylands, A. B. 1981. Preliminary field observations on the marmoset, *Callithrix humeralifer intermedius* (Hershkovitz, 1977), at Dardelos, Rio Aripuanã, Mato Grosso. *Primates* 22 (1): 46–59.
- Rylands, A. B. 1994. Sagui-de-Santarém. In: *Livro vermelho das espécies de mamíferos brasileiros ameaçados de extinção*, G. A. B. Fonseca; A. B. Rylands; C. M. R. Costa; R. B. Machado; Y. L. R. Leite (eds), pp.63–72. Fundação Biodiversitas, Belo Horizonte, MG., Brazil.
- Silva Júnior, J. S. da and Noronha, M. A. 1995. A new record for *Callithrix mauesi* Mittermeier, Schwarz & Ayres, 1992. *Neotrop. Primates* 3(3): 79–80.
- Silva Júnior, J. S. da and Noronha, M. A. 2000. Resultados de uma pequena expedição primatológica à Amazônia Central (Primates, Platyrrhini). *A Primatologia no Brasil* 7: 291–304.
- Vivo, M. de 1988. *Sistemática de Callithrix Erxleben, 1777*. PhD thesis, Universidade de São Paulo, São Paulo.
- Vivo, M. de 1991. *Taxonomia de Callithrix Erxleben, 1777 (Callitrichidae, Primates)*. Fundação Biodiversitas, Belo Horizonte, Minas Gerais, Brasil.

NEW OCCURRENCE RECORDS FOR *MICO MELANURUS* (PRIMATES, CALLITRICHIDAE)

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The black-tailed marmoset (*Mico melanurus*) was first described by É. Geoffroy in Humboldt, 1812. He provided a brief description of the species but only noted Brazil as the type locality. Allen (1916, *in Vivo*, 1991) later determined the type locality to be Cuiabá, in the state of Mato Grosso. *Mico melanurus* was considered part of the group *Callithrix argentata sensu* Hershkovitz (1977) and Vivo (1988, 1991), and associated with the bare-

eared marmosets *Mico saterei* and *M. acariensis*. Diagnostic characters include pigmented ears and ear-surfaces, an absence of ear tufts, white or yellowish-white spots on the upper thighs, and a completely black tail (Vivo, 1991). Vivo (1991) noted color variations among the different individuals collected. Specimens from Cáceres, Palmeiras, Rio Aricád, Santo Antônio do Leverger, Chapada dos Guimarães, Aripuanã and Água Dulce (Chaco-Paraguay) were very similar, with brown torsos and anterior limbs, while those collected in Corumbá and a specimen from the Rio Paraguay were noticeably lighter.

The black-tailed marmoset has an ample geographic range, extending from the headwaters of the Rios Madeira, Mamoré and Guaporé, to the Rios Aripuanã and Juruena (van Roosmalen *et al.*, 2000). Prior to this study, the species was only known to occur in Bolivia, Paraguay and the states of Mato Grosso and Mato Grosso do Sul in Brazil. Fonseca *et al.* (1994) predicted that the northernmost limit of the species' range would probably occur in the area between the Rios Aripuanã and Juruena, near the Serra do Sucundurí or the headwaters of the Rio Sucundurí at 8°S, in the Brazilian state of Amazonas.

During a recent (June and July, 2006) primate survey of the Aripuanã-Juruena interfluvium in the state of Amazonas, we observed the brown form of *Mico melanurus* in both *terra firme* and *campinarana* forests at two locations near the Serra do Sucundurí. At the first site, three groups were spotted on the right bank of the Rio Sucundurí in the Floresta Estadual do Sucundurí (08°34'S, 59°08'W). A specimen was collected and deposited in the vertebrate collection of the National Institute of Amazonian Research (INPA- lote 2002). At the second site, a troop was seen on the right bank of the Rio Bararati, a left bank tributary of the Rio Tapajós, in the Parque Estadual do Sucundurí (08°21'S, 58°37'W). These new records confirm the northern limit of the species' range proposed by Fonseca *et al.* (1994) (Fig. 1.), and if predicted geographic ranges for the species *M. acariensis* (van Roosmalen *et al.*, 2000) and *M. mauesi* are correct, indicate possible contact zones with these species further north, on the left and right banks of the Rio Sucundurí, respectively.

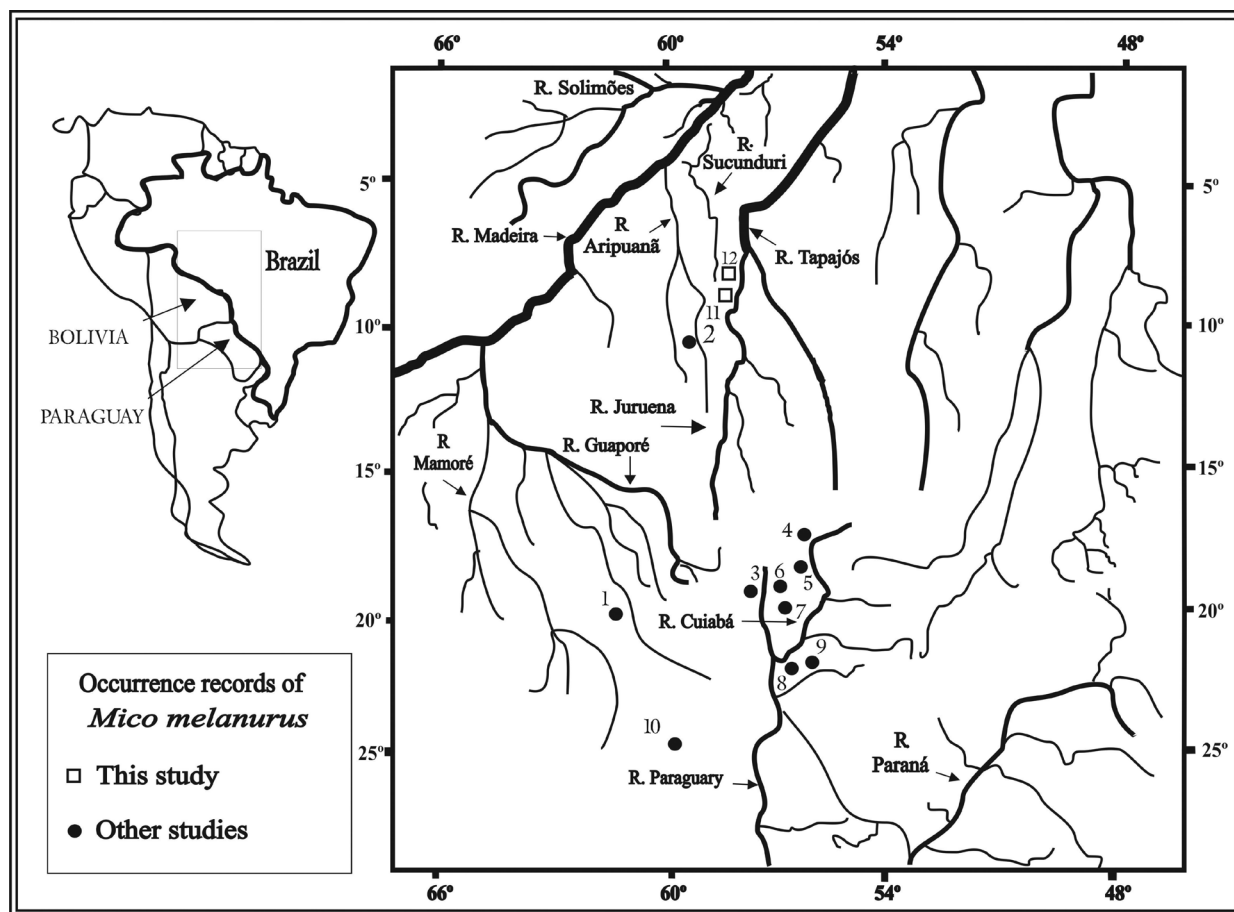


Figure 1. Geographic range of *Mico melanurus*, based on Vivo (1991) and records from this study: (1) N. Chiquitos, Rio Quiser, Santa Cruz, Bolivia; (2) Aripuanã, Mato Grosso, Brazil; (3) Cáceres, Mato Grosso; (4) Chapada dos Guimarães, Mato Grosso; (5) Rio Aricá, Mato Grosso; (6) Santo Antônio do Leverger, Mato Grosso; (7) Palmeiras, Mato Grosso; (8) Corumbá, Mato Grosso do Sul; (9) Urucum, Mato Grosso do Sul; (10) 48 km E de Água Dulce, Chaco, Paraguay; (11) Floresta Estadual do Sucundurí, right bank of the Rio Sucundurí, Amazonas, Brazil (08°34'S, 59°08'W); and (12) Parque Estadual do Sucundurí, right bank of the Rio Bararati, Amazonas (08°21'S, 58°37'W).

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References

- Fonseca, G. A. B. da, Rylands, A. B., Costa, C. M. R., Machado, R. B. and Leite, Y. L. R. 1994. *Livro vermelho dos mamíferos brasileiros ameaçados de extinção*. Belo Horizonte, Fundação Biodiversitas.
- Hershkovitz, P. 1977. *Living New World monkeys (Platyrrhini) vol. 1*. University of Chicago Press, Chicago.
- van Roosmalen, M. G. M., van Roosmalen, T., Mittermeier, R. A. and Rylands, A. B. 2000. Two new species of marmoset, genus *Callithrix* Erxleben, 1777 (Callitrichidae, Primates) from the Tapajós/Madeira interfluvium, South Central Amazonia, Brazil. *Neotrop. Primates*, 8(1): 2-18.
- Vivo, M. de 1988. Sistemática de *Callithrix* Erxleben, 1777. PhD thesis, Universidade de São Paulo, São Paulo.
- Vivo, M. de 1991. *Taxonomia de Callithrix Erxleben, 1777 (Callitrichidae, Primates)*. Fundação Biodiversitas, Belo Horizonte, Minas Gerais, Brasil.

PREDACÃO DE NINHOS POR UM GRUPO HÍBRIDO DE SAGÜIS (*CALLITHRIX JACCHUS/PENICILLATA*) INTRODUZIDOS EM ÁREA URBANA: IMPLICAÇÕES PARA A ESTRUTURA DA COMUNIDADE

Rodrigo Anzolin Begotti
Laura Frey Landesmann

Além da perda e fragmentação do habitat, principais ameaças à sobrevivência de mamíferos no Brasil (Costa *et al.*, 2005), alguns primatas da Mata Atlântica têm enfrentado o problema da introdução acidental ou intencional de espécies competidoras. Este é o caso de alguns calitriquídeos dos estados do Rio de Janeiro e porção centro-sul de São Paulo, onde representantes do gênero *Callithrix*, principalmente *C. jacchus* e *C. penicillata* têm sido introduzidos (Olmos e Martuscelli, 1995; Costa *et al.*, 2005; Bicca-Marques *et al.*, 2006; Ruiz-Miranda *et al.*, 2006). Estas espécies possuem alto potencial de colonização de habitats florestais,

hibridização e competição com representantes da fauna local, além da possível transmissão de doenças (Costa *et al.*, 2005; Bicca-Marques *et al.*, 2006; Ruiz-Miranda *et al.*, 2006; Mendes Pontes *et al.*, 2007). Das 25 espécies de primatas que ocorrem na Mata Atlântica, 16 se encontram em risco de extinção por um conjunto destas ameaças (Costa *et al.*, 2005; Mendes Pontes *et al.*, 2006).

Apesar da grande preocupação gerada pela introdução destas espécies (Bicca-Marques *et al.*, 2006), poucos estudos têm focado a auto-ecologia dos sagüis em ambientes recentemente colonizados. Ruiz-Miranda *et al.* (2006), por exemplo, observaram que a presença de grupos introduzidos e híbridos de *C. jacchus* e *C. penicillata* provocou mudanças no comportamento de forrageio e defesa de território em grupos de micos-leões-dourados (*Leontopithecus rosalia*, Callitrichidae) no município de Silva Jardim, Estado do Rio de Janeiro. Neste trabalho relatamos eventos relacionados à predação de ninhos de aves por um grupo híbrido de *C. jacchus* e *C. penicillata* introduzidos em uma área residencial arborizada, adjacente a pequenos fragmentos florestais na região metropolitana de São Paulo.

O estudo foi realizado no Condomínio Nova Higienópolis, município de Jandira, localizada na Grande São Paulo (23°33'S, 46°52'O). A área de estudo apresenta temperatura média anual de 20°C e precipitação entre 1,500 e 1,600 mm. O clima segundo a classificação de Köppen é do tipo Cfb (temperado de inverno seco). A área se encontra dentro da distribuição do sagüi-da-serra-escuro (*Callithrix aurita*), endêmico da Mata Atlântica e classificado na categoria "Vulnerável" na lista de mamíferos ameaçados do Brasil (Olmos e Martuscelli, 1995; Costa *et al.*, 2005). Não há relatos de moradores e nenhum indivíduo desta espécie foi encontrado na área e adjacências. As observações foram realizadas entre os dias 27 e 28 /10/2006 através do método de amostragem instantânea (Altmann, 1974) totalizando 21 horas, estando o grupo estudado habituado à presença humana. Uma fêmea e um macho adultos, um macho subadulto, uma fêmea jovem e dois infantes compunham o grupo estudado.

Dois eventos de predação de ninhos de aves foram registrados. O primeiro evento ocorreu por volta das 15:20 do dia 27. O grupo estava movimentando-se entre arbustos e árvores quando detectou um ninho de avoante (*Zenaida auriculata*, Columbidae) a aproximadamente 6 m de altura. Imediatamente, os indivíduos adultos (o macho carregando os dois infantes) se aproximaram, afugentando a ave que incubava os ovos (provavelmente dois). Estes foram rapidamente consumidos, estando a fêmea adulta à frente. A jovem fêmea se encontrava na mesma árvore e somente se aproximou depois que os adultos se afastaram do ninho. Ela permaneceu próxima ao ninho por cerca de 30 min., manipulando os fragmentos das cascas dos ovos predados. O indivíduo de *Z. auriculata* que incubava os ovos permaneceu nas proximidades observando a movimentação. O segundo evento ocorreu por volta das 9:30

do dia 28, após deslocamento de aproximadamente 200 m por árvores e cabos telefônicos, quando o grupo começou a ser atacado em vôos rasantes por um indivíduo de sabiá-barranco (*Turdus leucomelas*, Turdidae). O grupo, então, dissipou-se. Nesta ocasião, os infantes estavam sendo carregados pelo macho subadulto acompanhado pela fêmea jovem. Os adultos se dirigiram para outra árvore, quando foram atacados por um sabiá-do-campo (*Mimus saturninus*, Mimidae) em vôo rasante. Para tentarem se abrigar dos ataques de ambas as aves, a fêmea e o macho adultos se refugiaram em uma árvore na qual se encontrava, a aproximadamente 8 m de altura, um ninho de *M. saturninus*, que foi imediatamente atacado. A ave que incubava os ovos defendeu o ninho por meio de bicadas e peitadas nos sagüís por aproximadamente 20 min. até que eles se afastaram sem pregar qualquer ovo ou filhote. No mesmo período, em duas ocasiões, o grupo foi atacado em locais distintos por indivíduos de *T. leucomelas*.

A predação de ninhos é citada na literatura como sendo um recurso eventualmente utilizado por sagüís (Miranda e Faria, 2001; Lyra-Neves *et al.*, 2007). Mendes Pontes e Soares (2005) citam a predação de filhotes em ninhos de pombo-doméstico (*Columba livia domestica*, Columbidae) e sabiá-laranjeira (*T. rufiventris*, Turdidae), além do relato de interações agonísticas entre esta última e os sagüís. Há registros de *C. jacchus* predando ovos e filhotes de ninhos de *T. leucomelas* e de mais 10 espécies na Estação Ecológica do Tapacurá em Pernambuco (Lyra-Neves *et al.*, 2007). O fato justificaria o comportamento de defesa empregado pela ave frente à simples aproximação do grupo de sagüís da árvore onde estava o ninho. Os mesmos autores ressaltam o comportamento de predação sempre efetuado pelos indivíduos adultos e dominantes do grupo. A predação de ninhos pode interferir negativamente na riqueza e diversidade da avifauna (Argel de Oliveira, 1995), embora seus efeitos sejam difíceis de serem mensurados por estudos comportamentais. Em áreas urbanas, Sinclair *et al.* (2005) encontraram maior abundância de mamíferos predadores de ninhos em manchas lineares e estreitas de vegetação. A região metropolitana de São Paulo apresenta poucas áreas verdes, sendo a maioria destas composta por jardins e arborização de ruas e avenidas. Assim, a comunidade de aves em ambientes urbanos pode ser seriamente comprometida pela introdução de sagüís oriundos do tráfico de animais. Além disso, a avifauna destes ambientes e de pequenas manchas de vegetação nativa localizadas próximas às áreas de soltura destes animais sofrem o sinergismo dos efeitos da fragmentação, caça, incidência constante de incêndios e o aumento das taxas de predação de ninhos.

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Referências

- Altmann, J. 1974. Observational study of behavior: sampling methods. *Behaviour* 49: 227–267.
- Argel de Oliveira, M. M. 1995. Aves e vegetação em um bairro residencial da cidade de São Paulo (São Paulo, Brasil). *Rev. Brasil. Zool.* 12(1): 81–92.
- Bicca-Marques, J. C., Silva, V. M. e Gomes, D. F. 2006. Ordem Primates. Em: *Mamíferos do Brasil*, Reis, N. R., Peracchi, A. L., Pedro, W. A., Lima, I. P. (eds.), 437 p. Londrina-PR.
- Costa, L. P., Leite, Y. L., Mendes, S. L. e Ditchfield, A. D. 2005. Mammal Conservation in Brazil. *Cons. Biol.* 19(3): 672–679.
- Lyra-Neves, R. M., Oliveira, M. A., Telino-Júnior, W. R., e Santos, E. M. 2007. Comportamentos interespecíficos entre *Callithrix jacchus* (Linnaeus) (Primates, Callitrichidae) e algumas aves de Mata Atlântica, Pernambuco, Brasil. *Rev. Brasil. Zool.* 24 (3): 709–716.
- Mendes Pontes, A. R. e Soares, M. L. 2005. Sleeping sites of common marmosets (*Callithrix jacchus*) in defaunated urban forest fragments: a strategy to maximize food intake. *J. Zool.* 266: 55–63.
- Mendes Pontes, A. R., Malta, A. e Asfora, P. H. 2006. A new species of capuchin monkey, genus *Cebus* Erxleben (Cebidae, Primates): found at very brink of extinction in the Pernambuco Endemism Center. *Zootaxa* 1–12.
- Mendes Pontes, A. R., Normande, I. C., Fernandes, A. C., Ribeiro, P. F. e Soares, M. L. 2007. Fragmentation causes rarity in common marmosets in the Atlantic Forest of northeastern Brazil. *Biodiv. Conserv.* 16(4): 1175–1182.
- Miranda, G. H. e Faria, D. S. 2001. Ecological aspects of black-pincelled-marmoset (*Callithrix penicillata*) in the Cerradão and dense Cerrado of the Brazilian Central Plateau. *Braz. J. Biol.* 61(3): 397–404.
- Olmos, F. e Martuscelli, P. 1995. Habitat and distribution of the Buffy-tufted-ear marmoset *Callithrix aurita* in São Paulo State, Brazil, with notes on its natural history. *Neotrop. Primates* 3(3): 75–79.
- Ruiz-Miranda, C. R., Affonso, A. G., Morais, M. M., Verona, C. E., Martins, A. e Beck, B. 2006. Behavioral and ecological interactions between reintroduced golden lion tamarins (*Leontopithecus rosalia* Linnaeus, 1766) and introduced marmosets (*Callithrix spp.*, Linnaeus, 1758) in Brazil's Atlantic coast forest fragments. *Brazilian Archives of Biology and Technology* 49(1): 99–109.
- Sinclair, K. E., Hess, G. R., Moorman, C. E., e Mason, J. H. 2005. Mammalian nest predators respond to greenway width, landscape context and habitat structure. *Landscape and Urban Planning* 71: 277–293.

CONSUMO DE NÉCTAR POR *AOTUS LEMURINUS* Y SU ROL COMO POSIBLE POLINIZADOR DE LAS FLORES DE *INGA EDULIS* (FABALES: MIMOSOIDEAE)

Oscar Humberto Marín-Gómez

Introducción

El género *Aotus* comprende un grupo de primates ampliamente distribuidos en el neotrópico que habitan en bosques primarios y secundarios hasta los 3,200 msnm (Wright, 1994). En Colombia se encuentran 5 especies de este género, tres de ellas agrupadas en el complejo *Aotus lemurinus*, conformado por las "especies gemelas" *A. lemurinus*, *A. zonalis* y *A. griseimembra* (Defler, 2003). *A. lemurinus* se conoce como mico de noche andino o marteja y habita en todo tipo de bosques, fragmentos de sucesión secundaria y plantaciones de café de la cordillera de los Andes de Colombia entre los 1,000 a 1,500 msnm (Defler, 2003).

La mayoría de los primates tienen una dieta que consiste de frutos, hojas, insectos y en menor proporción de flores y néctar (Terborgh, 1983; Wright, 1994). El néctar aporta nutrientes y energía que no se encuentran en otros recursos alimentarios, por lo que su consumo ocurre en los primates como recurso alternativo cuando la disponibilidad de frutos es baja (Janson *et al.*, 1981; Garber, 1988; Ferrari & Strier, 1992). Los frutos de un gran número de especies de plantas de los bosques neotropicales son consumidos por primates, los cuales pueden actuar como dispersores de sus semillas (Chapman, 1995; Lambert & Garber, 1998; Stevenson, 2000), y polinizadores potenciales al no dañar las flores (Prance 1980; Assumpcao, 1981; Janson *et al.*, 1981; Terborgh, 1983; Ferrari & Strier, 1992). El consumo de néctar es raro dentro del género *Aotus* (Wright, 1994) y sólo existen reportes para *A. trivirgatus* y *A. vociferans* (Janson *et al.*, 1981; Puertas *et al.*, 1992). En esta nota reporto el consumo de néctar de las flores de *Inga edulis* por *A. lemurinus* y discuto su papel como un posible polinizador de esta planta en un paisaje ganadero.

Métodos

Realicé las observaciones durante el mes de marzo del 2006 en un agroecosistema ganadero, específicamente en un potrero arborizado con dominancia de árboles de *I. edulis*, cercanos a un fragmento de bosque de la reserva natural "La Montaña del Ocaso", ubicada en el municipio de Quimbaya, Departamento del Quindío, Colombia (4°34'81.8"N, 75°51'87.0"W) a una altura entre 975 y 1,100 msnm (CIBUQ, 2006). *I. edulis* es conocido localmente como guamo y es una especie ampliamente utilizada como árbol de sombrío en la zona cafetera Colombiana. Los árboles tienen una altura entre 6 y 20 m y presentan dos periodos de floración al año, durante los meses de julio a noviembre y de febrero a junio, mientras que la fructificación es constante a lo largo del año con picos en los

meses de diciembre, febrero y junio (Marín, 2006). Las flores duran un día, tienen el perianto reducido, numerosos estambres de color blanco y secretan abundante néctar que se acumula en el tubo formado por los filamentos estaminales; el fruto es una legumbre con numerosas semillas cubiertas por un arilo dulce y es consumido por loros y mamíferos (Marín, 2006). Las flores de *I. edulis* presentan su antésis a partir de las 13:00, hasta finalizar por completo a las 19:00, periodo durante el cual las flores secretan pequeñas cantidades de néctar, siendo su producción continua durante la noche y decreciendo en el día. Los picos de producción de néctar ocurren a las 21:00, 00:00 y 03:00, durante este periodo las flores presentan un promedio de 160 µl de néctar, un porcentaje de sucrosa de 16.6 y un contenido energético de 505 Julios/flor (Marín, 2006).

Resultados

A las 00:30 del 14 de marzo observé dos individuos de *A. lemurinus* alimentándose de frutos de *I. edulis*. Los monos prefirieron los frutos maduros que estaban parcialmente abiertos, ya que después de agarrarlos por el pedúnculo con una mano, con la otra desprendían parcialmente su cubierta para dejar expuestas las semillas y consumir el arilo que las cubría. Las semillas fueron dejadas caer al suelo. Ambos individuos consumieron entre 7 y 10 frutos en un periodo de 20 minutos, y después se desplazaron a otro árbol donde los perdí de vista. A las 02:20 observé en el mismo árbol dos individuos, al parecer los mismos observados inicialmente. Sin embargo esta vez no consumieron frutos, sino que se alimentaron de néctar; los monos probaron entre 5 y 7 flores en tres minutos y luego se movieron hacia otro árbol de la misma especie. El 17 de Marzo a las 01:00 observé dos individuos de *A. lemurinus* desplazándose entre las ramas altas de los árboles de *I. edulis* y emitiendo constantemente una serie de sonidos guturales de baja intensidad, que al parecer son emitidos frecuentemente cuando los animales se encuentran cerca de un recurso alimentario (Moynihan, 1964, citado por Defler 2003). Los monos sólo consumieron el néctar, para lo cual con una mano acercaron una inflorescencia y probaron el néctar con la lengua tras aproximar el hocico al tubo floral. De esta forma contactaron las estructuras reproductivas con en el hocico y la frente, aunque la cantidad de polen depositado no fue conspicua. Durante 35 minutos probaron entre 3 y 5 flores por minuto. Para un individuo contabilicé un total de 27 flores probadas legítimamente (haciendo contacto con las estructuras reproductivas). Esta actividad finalizó cuando empezó a llover.

Discusión

Es posible que los individuos de *A. lemurinus* observados tengan su lugar de reposo en el bosque, y que su presencia en el potrero obedezca a la abundancia de alimento (néctar o frutos) ofrecido por *I. edulis* en esta zona. Los frutos de los árboles del género *Inga* son un recurso importante en la dieta de varias especies de primates neotropicales, en áreas de bosque más no en zonas abiertas (Lambert & Garber,

1998; Stevenson, 2000), sin embargo este es el primer reporte del consumo de néctar de las plantas de este género por parte de monos.

Los sistemas de polinización en mamíferos no voladores incluyen generalmente a especies de tamaño pequeño como roedores, marsupiales y prosimios (Gautier & Marsels, 1994). En África hay evidencia indirecta de la polinización por los primates de los géneros *Cercopithecus* y *Cercocebus* en dos especies de leguminosas, *Parkia* sp. y *Daniella pynaertii* (Gautier & Marsels, 1994), mientras que en el Neotrópico hay una mayor cantidad de registros de consumo de néctar por primates (Terborgh, 1983), los cuales pueden causar pequeños daños a las flores o destruirlas totalmente (Terborgh 1983, Garber 1988), o por el contrario pueden no hacer daño alguno a la flor y consumir el néctar de forma legítima, actuando como posibles polinizadores (Prance, 1980; Assumpcao, 1981; Janson *et al.*, 1981; Terborgh, 1983; Ferrari & Strier, 1992).

Janson *et al.* (1981) mencionaron que las flores erectas dispuestas en inflorescencias terminales, de perianto fusionado en forma de copa, con estambres numerosos, largos y exsertos, la producción sincrónica de abundante néctar y la tendencia a producir frutos grandes, son rasgos que facilitan la transferencia de polen por mamíferos no voladores en el Neotrópico. Estas características coinciden parcialmente para todas las especies del género *Inga*, en particular para las especies de flores grandes como *I. edulis*. Sin embargo las flores de estas plantas presentan un perianto reducido y el néctar se acumula en un tubo formado por los filamentos estaminales (Koptur, 1983). Las plantas de este género no muestran un síndrome de polinización hacia un solo tipo de vector, pues son polinizadas por insectos, aves y murciélagos (Koptur, 1983; Marín 2006). Aunque las flores de *I. edulis* presentan antésis crepuscular y producen la mayor cantidad de néctar en la noche, presentan una baja tasa de visitas por parte de animales nocturnos, principalmente de insectos (escarabajos y polillas), que actúan más como ladrones de polen y de néctar (Marín, 2006). El néctar se acumula durante la noche y es disponible en el día a una gran variedad de insectos y aves, los cuales constituyen sus principales “polinizadores” (Marín, 2006).

Al parecer los *A. lemurinus* no son visitantes florales frecuentes de esta especie, pero por su comportamiento de forrajeo, especialmente al tomar el néctar, probar varias flores de un mismo árbol y moverse entre árboles vecinos en busca de flores y frutos, podrían estar desempeñando un papel importante como polinizadores potenciales de esta planta, aunque esto debe validarse con observaciones más detalladas en otras localidades de Colombia. La evidencia de polinización por primates corresponde generalmente a observaciones indirectas de este proceso, dependiendo de la efectividad de la polinización de la morfología floral, la frecuencia de uso, el contacto con las partes reproductivas, la carencia de daño a las flores, el transporte de polen y

el acceso limitado a un determinado número de visitantes (Gautier & Marsels, 1994). Es probable que en este caso *A. lemurinus* favorezca más la polinización cruzada de *I. edulis* que la geitonogamia, pues esta última no es conveniente ya que todas las plantas de este género son autoincompatibles (Koptur, 1984). *I. edulis* es una especie oportunista con rasgos florales que permiten la polinización por una amplia diversidad de visitantes florales como insectos, aves y mamíferos (Marín, 2006). Son árboles comunes que constituyen una fuente importante de alimento para la fauna y puedan atraer a una gran variedad de visitantes del bosque, por lo cual deben considerarse como una especie de interés en los proyectos silvopastoriles, para el manejo de los agroecosistemas o en la adecuación de corredores biológicos en la zona cafetera; estos árboles son utilizados en la región por *Alouatta seniculus* para desplazarse entre parches de vegetación (Marín, obs. pers).

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Referencias

- Assumpcao, C. T. 1981. *Cebus apella* and *Brachyteles arachnoides* (Cebidae) as potential pollinators of *Mabea fistulifera* (Euphorbiaceae). *J. Mammal.* 62(2): 386–388
- Chapman, C. A. 1995. Primate seed dispersal: coevolution and conservation implications. *Evol. Anthropol.* 4: 74–82.
- CIBUQ. 2006. Reserva Natural “La Montaña del Ocaso”. Consultado en Noviembre 23, 2006. URL: http://www.uniquindio.edu.co/uniquindio/facultades/basicas/centro-biodiversidad/ocaso_ubicacion.htm
- Defler, T. R. 2003. Primates de Colombia. Serie Guías de Campo # 4. Conservación Internacional de Colombia, Bogota DC.
- Ferrari, S. F. and K. B. Strier. 1992. Exploitation of *Mabea fistulifera* nectar by Marmosets (*Callithrix flaviceps*) and Muriquis (*Brachyteles arachnoides*) in South East Brazil. *J. Trop. Ecol.* 8(3): 225–239
- Garber, P. A. 1988. Foraging decisions during nectar feeding in Tamarin monkeys *Saguinus mystax* and *Saguinus fuscicollis* (Calitrichidae: Primates) in Amazonian Peru. *Biotropica* 20: 100–106
- Gautier-Hion, A. and F. Marsels. 1994. Mutualism between a leguminous tree and large African monkeys as pollinators. *Behav. Ecol. Sociobiol.* 34: 203–210

- Janson, C. J. Terborgh and L. H. Emmons. 1981. Non-flying mammals as pollinating agent in the Amazonian forest. *Biotropica* 13: 1–6
- Koptur, S. 1983. Flowering phenology and floral biology of *Inga* (Fabaceae: Mimosoideae). *Systematic Botany* 8(4): 354–368
- Koptur, S. 1984. Outcrossing and pollinator limitation of fruit set: breeding systems of Neotropical *Inga* trees (Fabaceae: Mimosoideae). *Evolution* 38: 1130–1143.
- Lambert, J. E. and P. A. Garber. 1998. Evolutionary and ecological implications of primate seed dispersal. *Am. J. Primatol.* 45: 9–28.
- Marín, O. H. 2006. Composición, actividad de forrajeo y “polinización” de las aves e insectos que visitan el guamo *Inga edulis* Martius (Fabales: Mimosaceae) en dos agroecosistemas del Quindío. Tesis de grado. Licenciatura en Biología y Educación Ambiental. Facultad de Educación. Universidad del Quindío.
- Prance, G. T. 1980. A note on the probable pollination of *Combretum* by *Cebus* monkeys. *Biotropica* 12: 239
- Puertas, P., R. Aquino y F. Encarnación. 1992. Uso de alimentos y competición entre el mono nocturno *Aotus vociferans* y otros mamíferos, Loreto, Perú. *Folia Amazónica* 4(2): 147–156
- Stevenson, P. R. 2000. Seed dispersal by woolly monkeys (*Lagothrix lagothricha*) at Tinigua National Park, Colombia: Dispersal distance, germination rates, and dispersal quantity. *Am. J. Primatol.* 50: 275–289.
- Terborgh, J. 1983. Five new world Primates. A study in comparative ecology. Princeton University, New Jersey.
- Wright, P. C. 1994. The behavior and ecology of the owl monkey. In: Baer, J. F., R. C.

British Empire in December 2007 for her longstanding commitment to protecting primates. As one of the highest honors that can be bestowed to an individual by the Queen of England, the Order of the British Empire observes “distinguished service to the arts and sciences, public services outside the Civil Service and work with charitable and welfare organizations of all kinds.” Dr. McGreal, involved in primate rescue since the early 1970s, is known for uncovering illicit trade in primates and doggedly pushing for prosecution of the perpetrators.

Animal Welfare Institute

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PRIMATES, A PRIORITY FOR WORLD WIDE CONSERVATION

Guadalajara Zoo celebrating its 20 years of service and commitment to conservation, the Wild Fauna and Companion Animal Mexican Institute and the Autonomous University of Guadalajara have the pleasure of inviting you to its Conferences Cycle about: Primates, A Priority For World Wide Conservation, which will be held at the Autonomous University of Guadalajara and Guadalajara Zoo facilities from November 26-29, 2008. The conference cycle will address topics such as conservation in the field, veterinarian medicine in primates, agreements and the role of zoos in primate conservation. If you are interested please e-mail mmartinez@zooguadalajara.com.mx or zoogdl@zooguadalajara.com.mx.

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STRESS AND ITS IMPLICATION ON PRIMATE WELFARE

This course will be held at the German Primate Center, from October 13-16, 2008. The registration deadline is September 30th, 2008. For more information visit the web site <http://www.euprim-net.eu/network/courses/course7.htm> or contact Deike Terruhn terruhn@dpz.eu.

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RECENT PUBLICATIONS

BOOKS

Manipulative Monkeys: The Capuchins of Lomas Barbudal, by Susan Perry and Joseph H. Manson. 2008. Harvard University Press. 368pp. ISBN: 978-0674026643. *Manipulative Monkeys* takes us into a Costa Rican forest teeming with simian drama, where since 1990 primatologists Susan Perry and Joseph H. Manson have followed the lives of four generations of capuchins. What the authors describe is behavior as entertaining –and occasionally as alarming– as it is recognizable: the competition and cooperation, the jockeying for position and status, the peaceful years under an alpha male devolving into bloody chaos, and the complex traditions passed from one generation to the next. Interspersed with their observations of the monkeys' lives are the authors' colorful tales of the challenges of tropical fieldwork –a mixture so rich that by the book's end we know what it is to be a wild capuchin monkey or a field primatologist. And we are left with a clear sense of the importance of these endangered monkeys for understanding human behavioral evolution. *Contents:* 1. All in a day's work; 2. The social intelligence debate and the origins of the Lomas Barbudal monkey project; 3. The challenges of foraging and self-medication; 4. Predators, prey and personality; 5. Capuchin communication; 6. Two females' political careers; 7. The career of an alpha male; 8. The strategies of incoming alpha males; 9. Lethal aggression and the importance of allies; 10. Capuchin mothers, infants and babysitters; 11. Innovation and tradition in the creation of blood-testing rituals; 12. Social learning and the roots of culture; 13. Conservation of tropical dry forest.

Conservation and Sustainable Use: A Handbook of Techniques, by E.J. Milner-Gulland and J. Marcus Rowcliffe. 2008. Oxford University Press. 320pp. ISBN: 978-0198530350. *Conservation and Sustainable Use* provides a practical and integrated approach to carrying out research on the conservation of exploited species. It is relevant to both tropical

and temperate biomes and is applicable to all exploited species, including mammals, fish and plants. It describes both the practical (field) and theoretical (modeling) techniques for obtaining and interpreting information, integrating biological, social, economic and institutional analyses. It also demonstrates how to translate information into effective action through appropriate interventions, from legislation to changing people's attitudes. *Contents:* 1. Introduction; 2. Techniques for surveying exploited species; 3. Understanding natural resource users' incentives; 4. Assessing current sustainability of use; 5. Developing predictive models; 6. Choosing management approaches; 7. Implementing management for long-term sustainability.

Economics of Poverty, Environment and Natural Resource Use, edited by Rob B. Dellink and Arjan Ruijs. 2008. Springer. 218pp. ISBN: 978-1402083037. This book contributes to an improved understanding of the economic dimensions of environmental and natural-resource management and poverty alleviation. The ten chapters of the book offer an overview of the current knowledge concerning the relation between poverty, environment and natural-resource use. Three sides of the debate receive particular attention. First, the relation between resource use and poverty is discussed from a theoretical point of view. Second, it is questioned whether payments for environmental services or considering values of resources can be an effective tool for stimulating both sustainable resource use and poverty alleviation. Third, alternative strategies to break the land degradation poverty cycle are discussed. *Contents:* 1. Introduction – A. Ruijs, R. B. Dellink, and D. W. Bromley; 2. Poverty traps and resource dynamics in smallholder agrarian systems – C. B. Barrett; 3. Water resource management and the poor – P. Hellegers, K. Schoengold and D. Zilberman; 4. The role of measurement problems and monitoring PES schemes – G. Meijerink; 5. Can ecotourism be an alternative to traditional fishing? An analysis with reference to the case of the Saloum Delta (Senegal) – O. Sarr, J. Boncoeur, M. Travers and M. C. Cormier-Salem; 6. Effects of poverty on deforestation: distinguishing behavior from location – A. Pfaff, S. Kerr, R. Cavatassi, B. Davis, L. Lipper, A. Sanchez and J. Timmins; 7. Willingness to pay for systematic management of community forest for conservation of non-timber forest products in Nigeria's rainforest region: implications for poverty alleviation – N. A. Chukwuone and C. E. Okorji; 8. Traditional institutions and sustainable livelihood: evidences from upland agricultural communities in the Philippines – M. Omura; 9. Farmers investing in sustainable land use at a tropical forest fringe, the Philippines – M. R. Romero and W. T. de Groot; 10. A bargaining model of migration: getting the permission of the farm household – A. Mensah-Bonsu and K. Burger.

Hyperspectral Remote Sensing of Tropical and Sub-tropical Forest, edited by M. Kalacska and A. Sanchez-Azofeifa. 2008. CRC. 352pp. ISBN: 978-1420053418. While frequently used in temperate environments, hyperspectral sensors and data are still a novelty in the tropics. Exploring the potential of hyperspectral remote sensing for assessing

ecosystem characteristics, *Hyperspectral Remote Sensing of Tropical and Sub-Tropical Forests* focuses on the complex and unique set of challenges involved in using this technology and the data it provides. *Contents:* 1. Tropical dry forest phenology and discrimination of tropical tree species using hyperspectral data – K. L. Castro-Esau and M. Kalacska; 2. Remote sensing and plant functional groups: physiology, ecology and spectroscopy in tropical systems – M. Alvarez-Añorve, M. Quesada and E. de la Barrera; 3. Hyperspectral data for assessing carbon dynamics and biodiversity of forest – R. Lucas, A. Mitchell and P. Bunting; 4. Effects of soil type on plant growth. Leaf nutrient/Chlorophyll concentration and leaf reflectance of tropical tree and grass species – J. C. Calvo-Alvarado, M. Kalacska, G. A. Sanchez-Azofeifa and L. S. Bell; 5. Spectral expression on gender: a pilot study with two dioecious neotropical tree species – J. P. Arroyo-Mora, M. Kalacska, B. L. Caraballo, J. E. Trujillo and O. Vargas; 6. Species classification of tropical tree leaf reflectance and dependence on selection of spectral bands – B. Rivard, G. A. Sanchez-Azofeifa, S. Forey and J. C. Calvo-Alvarado; 7. Discriminating *Sirex noctilio* attack in pine forest plantations in south Africa using high spectral resolution data – R. Ismail, O. Mutanga and F. Ahmed; 8. Hyperspectral remote sensing of exposed wood and deciduous trees in seasonal tropical forests – S. Bohlman; 9. Assessing recovery following selective logging of lowland tropical forests based on hyperspectral imagery – J. P. Arroyo-Mora, M. Kalacska, R. L. Chazdon, D. L. Cirvco, G. Obando-Vargas, and A. A. S. Hernández; 10. Technique for reflectance calibration of airborne hyperspectral spectrometer data using a broad multiband radiometer – T. Miura, A. R. Huete, L. G. Ferreira, E. E. Sano and H. Yoshioka; 11. Assessment of phenologic variability in Amazon tropical rainforests using hyperspectral hyperion and MODIS satellite data – A. R. Huete, Y. Kim, P. Ratana, K. Didan, Y. E. Shimabukuro and T. Miura; 12. Hyperspectral remote sensing of canopy chemistry, physiology and biodiversity in tropical rainforests – G. P. Asner; 13. Tropical Remote Sensing-Opportunities and challenges – J. A. Gamon.

ARTICLES

- Aguiar, L. M., Pie, M. R. and Passos, F. C. 2008. Wild mixed groups of howler species (*Alouatta caraya* and *Alouatta clamitans*) and new evidence for their hybridization. *Primates* 49(2): 149–152.
- Aldrich, B. C., Molleson, L. and Nekaris, K. A. I. 2008. Vocalizations as a conservation tool: an auditory survey of the Andean titi monkey *Callicebus oenanthe* Thomas, 1924 (Mammalia: Primates: Pitheciidae) at Tarangue, northern Peru. *Contrib. Zool.* 77(1): 1–6.
- Ange-van Heugten, K., Timmer, S., Jansen, W. L. and Verstegen, M. W. A. 2008. Nutritional and health status of woolly monkeys. *Int. J. Prim.* 29(1): 183–194.
- Arroyo-Rodriguez, V., Asensio, N. and Cristobal-Azkarate, J. 2008. Demography, life history and migrations in a

- Mexican mantled howler group in a rainforest fragment. *Am. J. Primatol.* 70(2): 114–118.
- Arroyo-Rodriguez, V., Mandujano, S. and Benitez-Malvido, J. 2008. Landscape attributes affecting patch occupancy by howler monkeys (*Alouatta palliata mexicana*) at Los Tuxtlas, Mexico. *Am. J. Primatol.* 70(1): 69–77
- Babb, P. L., Gagneux, P., Fernandez-Duque, E. and Schurr, T. G. 2008. Genetic variation and population structure in the owl monkey, *Aotus azarai*. *Am. J. Phys. Anthropol.* Suppl 46: 62.
- Baker, M. E. 2008. Use of a mirror as a data collection aid. *Lab. Prim. Newsletter.* 47(1): 9–10.
- Bezanson, M., Garber, P. A., Murphy, J. T. and Premo, L. S. 2008. Patterns of subgrouping and spatial affiliation in a community of mantled howling monkeys (*Alouatta palliata*). *Am. J. Primatol.* 70(3): 282–293.
- Bezerra, B. M., Barnett, A. A., Souto, A. and Jones, G. 2008. Predation by the tayra on the common marmoset and the pale-throated three-toed sloth. *J. Ethol.* online (1–6).
- Caesar, C., Franco, E. S., Soares, G. C. N. and Young, R. J. 2008. Observed case of maternal infanticide in a wild group of black-fronted titi monkeys (*Callicebus nigrifrons*). *Primates.* 49(2): 143–145.
- Casar, C. and Young, R. J. 2008. A case of adoption in a wild group of black-fronted titi monkeys (*Callicebus nigrifrons*). *Primates.* 49(2): 146–148.
- Cecilia, V., Elena, B., Laura, D. and Paolo, A. 2008. Systematic revision of the neotropical primates in the primatological collection of the Natural History Museum 'La Specola', Florence. *Folia Primatol.* 79(3): 153.
- Chalk, J., Wright, B. W., Lucas, P. W., Verderane, M. P., Fragaszy, D., Visalberghi, E., Izar, P. and Ottoni, E. B. 2008. The mechanical properties of foods processed by *Cebus libidinosus* at Boa Vista, Brazil. *Am. J. Phys. Anthropol.* Suppl 46: 77.
- Chollet, M. B. and Teaford, M. F. 2008. Ecological stress and linear enamel hypoplasia in *Cebus*. *Am. J. Phys. Anthropol.* Suppl 46: 78–79.
- Clarke, M. R. and Glander, K. E. 2008. Natal emigration by both sexes in the La Pacifica population of mantled howlers: when do some stay?. *Am. J. Primatol.* 70(2): 195–200.
- Covey, R. M. 2008. Prehensile tail use in white-faced capuchins *Cebus capuchinus* at La Suerte Biological Field Station, Costa Rica. *Am. J. Phys. Anthropol.* Suppl 46: 82.
- Derby, A. M. 2008. The interrelationship between population structure, forest ecology and behavior in red howler monkeys (*Alouatta seniculus*). *Am. J. Phys. Anthropol.* Suppl 46: 89.
- Di Fiore, A., Link, A. and Spehar, S. N. 2008. Multiple males sire offspring in groups of wild spider monkeys (*Ateles belzebuth*). *Am. J. Phys. Anthropol.* Suppl 46: 90.
- Ehmke, E. and Boinski, S. 2008. Proximity patterns of female brown capuchins in Suriname are inconsistent with expectations of female-bonded primates. *Am. J. Phys. Anthropol.* Suppl 46: 94.
- Fernandez-Duque, E., Juarez, C. P. and Di Fiore, A. 2008. Adult male replacement and subsequent infant care by male and siblings in socially monogamous owl monkeys (*Aotus azarai*). *Primates.* 49(1): 81–84.
- Field, M. Y. 2008. So hot you could fry a monkey: behavioral thermoregulation in human-commensal white-fronted capuchins (*Cebus albifrons*). *Am. J. Phys. Anthropol.* Suppl 46: 95–96.
- Forgey, K., Scalzitti, J., Rizzo, K., Garza, J. and Stahler, A. 2008. Molecular genetic study of non-invasively collected samples from *Alouatta pigra* at the Calakmul Biosphere Reserve, Mexico. *Am. J. Phys. Anthropol.* Suppl 46: 97.
- Garber, P. A., Gomes, D. F. and Bicca-Marques, J. C. 2008. Experimental field study of hand preference in wild black-horned (*Cebus nigritus*) and white-faced (*Cebus capucinus*) capuchins: evidence for individual and species differences. *Anim. Cognition.* (Advance online publication): online (1–11).
- Garber, P. A., Gomes, D. F. and Bicca-Marques, J. C. 2008. Pull or push? Experimental field study of problem-solving using tools in wild capuchins (*Cebus nigritus*). *Am. J. Phys. Anthropol.* Suppl 46: 101.
- Gibson, K. N., Vick, L. G., Palma, A. C. and del Rocio Carrasco, F. M. 2008. Intra-community infanticide and forced copulation in spider monkeys: a multi-site comparison between Cocha Cashu, Peru and Punta Laguna, Mexico. *Am. J. Phys. Anthropol.* Suppl 46: 103.
- Gomes, M. T., Baccarella, A. and Sineo, L. 2008. Conservation activities for southern miquiri in Brazil's Atlantic Forest. *Folia Primatol.* 79(3): 155.
- Guillot, D. M. 2008. A video based study of wild Aeteline positional behavior. *Am. J. Phys. Anthropol.* 46: 109–110.
- Gunst, N., Boinski, S. and Fragaszy, D. M. 2008. Acquisition of foraging competence in wild brown capuchins (*Cebus apella*), with special reference to conspecifics' foraging artefacts as an indirect social influence. *Behaviour.* 145(2): 195–229
- Hanson, K. L. 2008. Juvenile-directed aggressive and agonistic interactions in *Alouatta palliata*, mantled howler monkeys. *Am. J. Phys. Anthropol.* Suppl 46: 112.
- Jones, C. B., Milanov, V. and Hager, R. 2008. Predictors of male residence patterns in groups of black howler monkeys. *J. Zool.* 275(1): 72–78.
- Jost, C. A. 2008. Effects of habitat characteristics on the behavioral ecology and habitat use patterns of mantled howler monkeys, *Alouatta palliata*. *Am. J. Phys. Anthropol.* Suppl 46: 127.
- Kowalewski, M., Garber, P. A., Paker, S. M. and Zunino, G. E. 2008. Reproductive competition and ambush behaviors in black and gold howler monkeys. *Am. J. Phys. Anthropol.* Suppl 46: 134.
- Martins, M. M. 2008. Fruit diet of *Alouatta guariba* and *Brachyteles arachnoides* in Southeastern Brazil: comparison of fruit type, color, and seed size. *Primates.* 49(1): 1–8.
- Matsuda, I. and Izawa, K. 2008. Predation of wild spider monkeys at La Macarena, Colombia. *Primates.* 49(1): 65–68.

- Matthews, L. J. 2008. Ranging behavior of white-fronted capuchins (*Cebus albifrons*) in the Ecuadorian Amazon: effects of resource use and intergroup interactions. *Am. J. Phys. Anthropol. Suppl* 46: 151.
- McKinney, T. and Orozco Zamora, C. 2008. Crop-raiding of mango fruits, *Mangifera indica*, by mantled howlers (*Alouatta palliata*) in the Refugio de Vida Silvestre Curu, Costa Rica. *Am. J. Phys. Anthropol. Suppl* 46: 153.
- Melin, A. D., Fedigan, L. M., Hiramatsu, C. and Kawamura, S. 2008. Polymorphic color vision in white-faced capuchins (*Cebus capucinus*): Is there foraging niche divergence among phenotypes?. *Behav. Ecol. Sociobiol.* 62(5): 659–670.
- Muniz, L. and Vigilant, L. 2008. Isolation and characterization of microsatellite markers in the white-faced capuchin monkey (*Cebus capucinus*) and cross-species amplification in other New World monkeys. *Mol. Ecol. Resources.* 8(2): 402–405.
- Nadjafzadeh, M. N. and Heymann, E. W. 2008. Prey foraging of red titi monkeys, *Callicebus cupreus*, in comparison to sympatric tamarins, *Saguinus mystax* and *Saguinus fuscicollis*. *Am. J. Phys. Anthropol.* 135(1): 56–63.
- Notarnicola, J., Pinto, C. M. and Navone, G. T. 2008. Host occurrence and geographical distribution of *Dipetalonema* spp. (Nematoda: Onchocercidae) in neotropical monkeys and the first record of *Dipetalonema gracile* in Ecuador. *Comparative Parasitol.* 75(1): 61–68.
- Perrin, E. M. and Kitchen, D. M. 2008. Using proximity to understand association patterns among adult mantled howler monkeys (*Alouatta palliata*). *Am. J. Phys. Anthropol. Suppl* 46: 170.
- Perry, S. E., Muniz, L., Manson, J. H., Gros-Louis, J. and Vigilant, L. 2008. Kin biased social behavior in wild white-faced capuchin monkeys, *Cebus capuchinus*. *Am. J. Phys. Anthropol. Suppl* 46: 171.
- Power, M. L., Verona, C. E., Ruiz-Miranda, C. and Oftedal, O. T. 2008. The composition of milk from free-living common marmosets (*Callithrix jacchus*) in Brazil. *Am. J. Primatol.* 70(1): 78–83.
- Raguert-Schofield, M. 2008. The effects of human encroachment and seasonality on the risk of mantled howler monkey (*Alouatta palliata*) predation by dogs on Ometepe Island, Nicaragua. *Am. J. Phys. Anthropol. Suppl* 46: 176.
- Rodrigues, M. A. 2008. The emergence of sex-segregated association patterns in juvenile spider monkeys (*Ateles geoffroyi*). *Am. J. Phys. Anthropol. Suppl* 46: 181–182.
- Rosales-Meda, M., Estrada, A. and López, J. E. 2008. Demographic survey of black howler monkey (*Alouatta pigra*) in the Lachua Eco-region in Alta Verapaz, Guatemala. *Am. J. Primatol.* 70(3): 231–237.
- Sabatini, V. and Ruiz-Miranda, C. R. 2008. Acoustical aspects of the propagation of long calls of wild *Leontopithecus rosalia*. *Int. J. Primatol.* 29(1): 207–223.
- Schrauf, C., Huber, L. and Visalberghi, E. 2008. Do capuchin monkeys use weight to select hammer tools?. *Anim. Cognition.* (Advance online publication): online(1–10).
- Spehar, S. N. and Di Fiore, A. 2008. The role of long-distance vocalizations in regulating association patterns and social interactions in white-bellied spider monkeys (*Ateles belzebuth*). *Am. J. Phys. Anthropol. Suppl* 46: 199.
- Stone, A. I. 2008. Seasonal effects on play behavior in immature *Saimiri sciureus* in Eastern Amazonia. *Int. J. Primatol.* 29(1): 195–205.
- Tinney, A. and Bezanson, M. 2008. Effects of food exploitation on activity and group size of mantled howlers (*Alouatta palliata*). *Am. J. Phys. Anthropol. Suppl* 46: 208.
- Tolentino, K., Roper, J. J., Passos, F. C. and Strier, K. B. 2008. Mother-offspring associations in northern muriquis, *Brachyteles hypoxanthus*. *Am. J. Primatol.* 70(3): 301–305.
- Van Belle, S., Strier, K. B. and Estrada, A. 2008. To fight or to cooperate? Reproductive dilemmas in male black howler monkeys. *Am. J. Phys. Anthropol. Suppl* 46: 213.
- Wallace, R. B. 2008. Towing the party line: territoriality, risky boundaries and male group size in spider monkey fission-fusion societies. *Am. J. Primatol.* 70(3): 271–281.
- Webster, T. H. and Suarez, S. A. 2008. Transfer behavior and association patterns of female spider monkeys (*Ateles belzebuth belzebuth*) in Yasuni National Park, Ecuador. *Am. J. Phys. Anthropol. Suppl* 46: 219.
- Wheeler, B. C. 2008. Are the alarm calls of tufted capuchin monkeys (*Cebus apella*) functionally referential?. *Am. J. Phys. Anthropol. Suppl* 46: 221.
- Wolovich, C. K., Perea-Rodriguez, J. P. and Fernandez-Duque, E. 2008. Food transfers to young and mates in wild owl monkeys (*Aotus azarai*). *Am. J. Primatol.* 70(3): 211–221.
- Wright, B. W., Wright, K. A., Chalk, J., Verderane, M. P., Fragaszy, D., Visalberghi, E., Izar, P. and Ottoni, E. B. 2008. Fallback foraging as a way of life: dietary variability and skeletal morphology in tufted capuchins. *Am. J. Phys. Anthropol. Suppl* 46: 225–226.
- Young, H., Fedigan, L. M. and Addicott, J. F. 2008. Look before leaping: foraging selectivity of capuchin monkeys on acacia trees in Costa Rica. *Oecologia.* 155(1): 85–92.

ABSTRACTS

Selected abstracts from the 30th Meeting of the American Society of Primatologists. Salem, Wisconsin, June 20-23, 2007 <http://www.asp.org/asp2007/showConfSchedule.cfm>

- Bales, K. L., J. M. Dietz, A. J. Baker, W. A. Mason & S. P. Mendoza. Perspectives on cooperative Breeding from golden lion tamarins and coppery titi monkeys.
- Bonnie, K. E. Considering the social in socially-mediated learning: lessons from capuchins and chimpanzees.
- Burrell, A. M. & J. A. French. Variation in early parental care influences stress reactivity in juvenile Geoffroy's marmosets (*Callithrix geoffroyi*).
- Caine, N. G. Is satiation a factor in time of retirement by Callitrichid groups?
- Caselli, C. B. & E. Z. Setz. Seasonality in long calls by Titi monkeys (*Callicebus nigrifrons*) in the Atlantic forest of southeast Brazil.

- Clarke, M. R., R. Ford, D. Arden & K. E. Glander. Survey of the howler population of la Pacifica, 2006.
- Courtney, W., S. McGrath, D. Locke, V. Magrini, M. Hick-enbotham, J. Armstrong, A. Quinlan, G. Marth & E. R. Mardis. Use of next generation sequencing technologies for generating non-human primate genomic resources.
- Crast, J. & D. Fragaszy. How to account for the induction of traditions in captive groups of Capuchin monkeys (*Cebus apella*).
- Crockett, C. M., K. L. Bentson & R. U. Bellanca. Alopecia and overgrooming in laboratory monkeys vary by species but not sex, suggesting a different etiology than self-biting.
- Cronin, K. A. Cooperative problem solving by captive Cotton-top tamarins (*Saguinus oedipus*): the effects of inequitable rewards
- De la Torre S., C. T. Snowdon & P. Yezpe. Precious variability: behavior, ecology and conservation of Pygmy marmosets in Ecuador.
- Depeine, C. D., D. E. Bernhards & J. D. Newman. Consistency of vocal behavior during brief separations in common marmosets.
- Dindo, M., B. Thierry, F. B. de Waal & A. Whiten. Social transmission of experimental foraging techniques in Capuchin monkeys (*Cebus apella*).
- Drea, C. M. How to study socially biased learning in primates? Trends and future directions.
- Ginther, A. J. & C. T. Snowdon. Like father, like son: social strategies of cottontop tamarin family males (*Saguinus o. oedipus*) in two life history stages.
- Gunst, N., S. Boinski & D. M. Fragaszy. Studying how social context aids acquisition of foraging skills in wild brown Capuchins (*Cebus apella*) in Suriname.
- Hankerson, S., M. Pitts, J. Dietz & B. Raboy. A test of exploitative and interference competition in wild golden-headed Lion tamarins (*Leontopithecus chrysomelas*).
- Hostetler, C. M., S. P. Mendoza, W. A. Mason & K. L. Bales. Neuroendocrinology of alloparental care in Titi monkeys (*Callicebus cupreus*).
- Huntsberry, M. E., P. G. Roma, C. J. Christensen, A. M. Ruggiero & S. J. Suomi. Token exchange and the selective-value effect in Capuchin monkeys (*Cebus apella*).
- Jarcho, M. R., S. P. Mendoza, W. A. Mason, S. A. Blozis & K. L. Bales. Neuroendocrinology of maternal behavior in captive Titi monkeys (*Callicebus cupreus*).
- Kurdziel, L. B. & P. G. Judge. Picture recognition of food in brown Capuchin monkeys (*Cebus apella*).
- Lilak, A. L. & K. A. Phillips. Consistency of hand preference across unimanual and bimanual tasks in Capuchin monkeys (*Cebus apella*).
- Long, L. A., S. Gibson, L. Williams & C. Abee. Owl monkeys (*Aotus* sp.) utilize food directed and non-food directed enrichment items.
- Lukas, K. & C. Kuhar. An analysis of efforts to integrate science and behavioral management of zoo primates.
- Martin, A. L., M. A. Bloomsmith, A. W. Clay, M. E. Kelley, M. J. Marr & T. L. Maple. The role of behavior analysis in the behavioral management of nonhuman primates.
- Matthews, S. A., J. E. Fite, M. Rukstalis, C. N. Ross, A. M. Burrell & J. A. French. Early infant care, hypothalamic-pituitary-adrenal (Hpa) axis activity, and pubertal timing in a cooperatively breeding New World primate, Wied's black tufted-ear marmoset (*Callithrix kuhlii*).
- Pappano, D. J., M. Ayers, D. Cairnes, M. C. May & J. R. Kaplan. Unrelated females housed in unisexual groups interfere in fights in a male-like pattern that is unassociated with affiliation and that tends to prolong aggressive encounters.
- Phillips, K. A. & W. D. Hopkins. Cerebellar asymmetry and handedness in chimpanzees (*Pan troglodytes*) and Capuchins (*Cebus apella*).
- Pickering, T., J. Pan, B. von Ammon, E. H. Kennedy & D. Fragaszy. A Capuchin monkey masters mazes.
- Pokorny, J. J. & F. B. de Waal. Capuchin monkeys (*Cebus apella*) demonstrate knowledge of social group members via an oddity task.
- Prudom, S. L., J. R. Gorst & T. E. Ziegler. The role of prolactin and testosterone on male paternal care in the common marmoset (*Callithrix jacchus*).
- Rapaport, L. Socially mediated learning about food and foraging in wild golden Lion tamarins (*Leontopithecus rosalia*).
- Rivera, J., C. K. Wolovich & S. Evans. Will work for food: foraging behavior of owl monkeys (*Aotus nancymaae*).
- Rukstali, M. Plasticity, development, and the social environment: vocal communication in the marmoset.
- Savage, A., T. E. Ziegler & J. A. French. Chuck Snowdon's contributions to Callitrichid biology: communication, reproduction, and conservation.
- Siani, J. M. & J. M. Dietz. Costs of providing infant care in wild golden Lion tamarins at Poço Das Antas Biological Reserve, Brazil.
- Smith, A. S., K. R. Lane, A. K. Birnie & J. A. French. Functional significance of sexually dimorphic acoustic structures in Wied's black tufted-ear marmoset (*Callithrix kuhlii*).
- Tapanes, E., C. K. Wolovich & S. Evans. Leaping into the night: when owl monkeys (*Aotus* sp.) awake
- Thomas, S. J., M. L. Schwandt, S. G. Lindell, S. J. Suomi, C. S. Barr & J. D. Higley. Heritability of dominance rank in laboratory-housed juvenile nonhuman primates.
- Williams, S. H., C. J. Vinyard, K. E. Glander, M. F. Teaford, M. Deffenbaugh & C. L. Thompson. EMG telemetry in free-ranging primates: pilot data from howling monkeys (*Alouatta palliata*) at La Pacifica, Costa Rica.
- Wolovich, C. K., S. Evans & J. A. French. Dads don't pay for sex but do buy the milk: food sharing and reproduction in Owl monkeys (*Aotus nancymaae*).
- Ziegler, T. E. & C. T. Snowdon. Proximate mechanisms of cooperative breeding in Cotton-Top tamarin and Marmoset monkeys by chemical communication.
- Zucker, E. & M. Clarke. Proximities to specific adult males by adult female howling monkeys (*Alouatta palliata*) in Costa Rica.

MEETINGS

2008

31st Meeting of the American Society of Primatologists.

June 18 - 21, West Palm Beach, Florida. For more information visit the web site: <http://www.asp.org/asp2008/index.htm> or contact Matthew Novak novakm@mail.nih.gov

II Congreso Colombiano de Primatología. Junio 26-28, Universidad Nacional de Colombia, Bogotá D.C. El II Congreso Colombiano de Primatología organizado por la Asociación Colombiana de Primatología (ACP) tiene como objetivos el intercambio de conocimientos y experiencias en el área de la Primatología, el establecimiento de redes de trabajo (alianzas) en busca del desarrollo científico en los países neotropicales y el mejoramiento de la calidad de vida, no solamente de las especies de primates sino también sus ecosistemas. Durante el congreso se abarcarán tres grandes temáticas: conservación *in situ*, conservación *ex situ* y ciencias aplicadas, sociales y humanas. La recepción de trabajos finalizará el 30 de Mayo de 2008. Para mayores informes visitar la página <http://primatologiacolombia.org/index.html> o escribir a congreso2008@primatologiacolombia.org

22nd Annual Meeting of the Society of Conservation Biology. July 13-17, the Chattanooga Convention Center, Chattanooga, Tennessee, USA. The chair of the meeting will be Dr. David A. Aborn, from the Department of Biological and Environmental Sciences, University of Tennessee at Chattanooga. As evidenced by several previous meeting themes, there are connections among many aspects of the environment and its conservation, and recognizing those connections is critical for achieving the goals of conservation biology. To that end, the theme for the 2008 SCB annual meeting "*From the mountains to the sea*" will examine several major ecosystems, both as separate components and as a connected entity. For more information and submission dates, go to: www.conbio.org/2008/

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

XXth International Congress of Zoology. August 26th to 29th 2008, Jussieu Grand Campus, Paris, France. Held every four years, the International Congress of Zoology gives zoologists and professionals from all fields related to zoology the chance to come together to discuss the current status of zoology and to share ideas about future development of all its disciplines. The International Society of Zoological Sciences (ISZS) and the Societe Zoologique

de France invite you to the XX International Congress of Zoology, that will be co-hosted by the Universities Pierre et Marie Curie (PVI), Paris-Sud (PXI) and the Museum National d'Histoire Naturelle. Registration opened on 1st December 2007. For information about the Congress, please visit: <http://icz2008.snv.jussieu.fr> or <http://www.globalzoology.org/index-new/20icz.htm>

6th International Conference on Methods and Techniques in Behavioral Research. August 26 to 29, Maastricht, The Netherlands. The theme of the 6th international conference on methods and techniques in behavioral research will be *Measuring Behavior*. This conference is the premier interdisciplinary event for scientists and practitioners concerned with the study of human or animal behavior. This unique conference focuses on methods, techniques and tools in behavioral research in the widest sense, from behavioral ecology to neuroscience and from physiology to ergonomics. In doing so, *Measuring Behavior* responds to a growing need to cross disciplines and create bridges between them. For more details go to www.noldus.webaxxs.net/mb2008/

XII Congreso de la Sociedad Mesoamericana para la Biología y la Conservación. Noviembre 10-14, Hotel Real Intercontinental, San Salvador, El Salvador. Es un evento particularmente atractivo para estudiantes y profesionales ya que es un Foro activo para la biología de la conservación y desarrollo sostenible regionales. El envío de resúmenes de ponencias orales y carteles será hasta el 30 de Junio de 2008. Para mayor información visitar la página <http://www.smbcelsalvador2008.com/>

2009

11th Meeting of the German Society of Primatology. February 24-26, University of Veterinary Medicine, Hannover, Germany. The abstract submission deadline is September 30th, 2008. For more information go to <http://www.gfp2009.de/index.html>

Neotropical Primate Husbandry, Research, and Conservation Conference. October 13-15.

Brookfield Zoo is pleased to announce that it will host a Neotropical Primate Husbandry, Research, and Conservation Conference. This conference will focus on a variety of topics pertaining to Neotropical primates like husbandry, conservation, and emergent issues pertaining to captive and wild populations. The workshop will include three days of presentations, a poster session, as well as an icebreaker, silent auction, and banquet. Additional information regarding registration fees, travel information, and submission of abstracts will be made available in late 2008. For questions please contact vince.sodaro@czs.org

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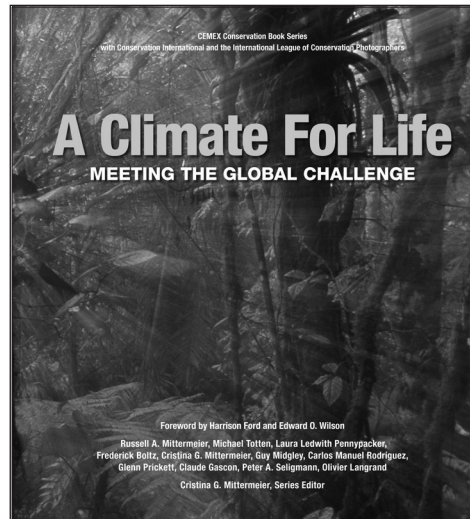
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A Climate for Life by Russell A. Mittermeier, Michael Totten, Laura Ledwith Pennypacker, Frederick Boltz, Cristina G. Mittermeier, Guy Midgley, Carlos Manuel Rodriguez, Glenn Prickett, Claude Gascon, Peter A. Seligmann, and Olivier Langrand. 2008.
ISBN: 978-0-9818321-0-4.

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Notes to Contributors

Scope

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

Submissions

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

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"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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