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Articles

BIOMETRY AND STOMACH CONTENTS OF SOME ATLANTIC FOREST PRIMATES, WITH A NOTE ON *BRACHYTELES* TOOTH REPLACEMENT

Currently, most information on the diets of primates comes from direct observations. However, primates are still commonly hunted or accidentally killed throughout most of the Neotropics, and provide as such opportunities for gathering data on food items and their processing, besides material for anatomical and genetic studies. Here we report on diet and biometric data from primate specimens collected in parks and reserves in the state of São Paulo, southeastern Brazil. Individuals were either found dead along roads or recovered from poachers (Table 1). Standard measurements were taken before the stomach contents were fixed in 70% alcohol for later analyses. These were washed under running water through a 1 mm mesh, and the excess liquid drained by gently compressing, and the remains weighed with a spring scale (precision 1g). Identifiable larger items were sorted and weighed, while the relative composition of the remaining mulch, or of contents too finely chewed to be sorted, was estimated. The results are shown in Table 2.

Although general patterns cannot be drawn from such a limited sample, some interesting findings are worthy of note. Insect remains were found in the capuchin, lion tamarin and titi samples, but the tamarin sample was too crushed for identification at a higher level. Besides fruit pulp and insects in its stomach, we found the tamarin's small intestine to be filled with a translucent exudate. These items present no surprise, agreeing with what is known for this species (see Fonseca *et al.*, 1994, pp. 97-107). The same can be said for the howlers, which had fed exclusively on leaves (see Mendes, 1989; Chiarello, 1994) although the ratio of stomach content to body mass of the adult male was remarkable, the monkey having ingested 15.75% of its own body weight. Compared to the immature male, the contents of the adult's stomach were not as finely chewed, and had many intact leaf petioles.

There is little information on the diet of *Callicebus personatus* (Kinzey, 1981; Müller and Pissinatti, 1995), the available data showing it to be mostly frugivorous. Müller and Pissinatti (1995) reported on the diet of *C. p. melanochir* as 76.6% fruits, 17.2% leaves, with other items making 1.8%. No animal prey were reported. Our specimen had gorged on *Campomanesia* sp. fruits, both ripe and green, ingesting and partly chewing a few green seeds, and had eaten a few insects and caterpillars. This omnivorous meal recalls the diet of some Amazonian titis, known to include insects in their diets (see Hernández-Camacho and Cooper, 1976; Kinzey, 1981).

The capuchin from Morro do Diabo had fed mostly on bamboo shoots and *Chorisia speciosa* seeds. Capuchins

have been observed to feed on bamboo shoots (*Guadua cf. angustifolia*) in the Atlantic forest of the coastal mountain ranges of São Paulo (Intervales and Carlos Botelho State Parks, pers. obs.) as well as on bamboo leaves (*Merostachys* sp.) in semideciduous forest further inland (Galetti and Pedroni, 1994). The large amount of *Chorisia speciosa* (an anemochoric cotton-tree) seeds, suggest the monkey spent a considerable time opening the hard fruits of the cotton-tree and separating the seeds from the attached cotton-like fibers. Dry-fruit seeds are known to be an important food item to capuchins in the semideciduous forests of São Paulo, such as in the Morro do Diabo State Park, where fleshy fruit are less abundant (Galetti and Pedroni, 1994).

The greatest surprise was the amount of crushed Sapotaceae and *Campomanesia* sp. seeds in the *Brachyteles* stomach contents, comprising c. 25% of the volume. Except for 11 *Campomanesia* and ~100 *Passiflora* seeds, the monkey had crushed all ingested seeds, identifiable only as finely chewed fragments. Very few of these fragments could be identified in the cecum, the contents of which were reduced to a green paste with a few fibers, plus 22 *Passiflora* and two *Campomanesia* seeds, suggesting that chewed seeds are efficiently digested. *Brachyteles arachnoides*, like other Atelinae, has been considered to be a seed disperser, rather than a predator (Terborgh, 1983; Milton, 1984; Van Roosmalen, 1985; Fonseca, 1986; Strier, 1991; Nunes, 1995), probably because obvious seed-crushing behavior is hard to observe, and fecal samples produce little evidence of seed predation. Nevertheless, considering the monkey's size and the importance of fruit in its diet (at least for the São Paulo Atlantic forest population, see Moraes, 1992a, 1992b), the miquiqui can evidently be an important predator of many of the soft-seeded species it consumes, such as many Lauraceae, Myrtaceae and Sapotaceae. This may be an interesting topic for future research.

The Ubatuba miquiqui showed all long bone epiphysis free, and the symphysis between the basisphenoid and basioccipital bones totally open. These, plus its dental characteristics and low mass proved it to be a juvenile (following De Blase and Martin, 1981). The dentary showed relevant information on the tooth eruption sequence and age of the specimen. Permanent incisors and first and second molars had already erupted, but the third molars were still

enclosed, under the still attached deciduous teeth. The deciduous canines and premolars were still present, showing abraded cusps, while the permanent ones were beginning to push them up.

Comparing our skull with 11 specimens in the Museum of Zoology of the University of São Paulo (in age sequence: MZUSP 11106, 8582, 24604, 11098, 11098, 19362, 1690, 1160, 19336, 11100, 19360, 3533) we found the teeth eruption sequence in *Brachyteles arachnoides* to be:

$$\frac{M^1 - I^1 - I^2 - M^2 - P^2 - P^3 - (P^4 - C) - M^3}{M_1 - I_1 - I_2 - M_2 - P_2 - P_3 - (P_4 - C) - M_3}$$

An adult male (MZUSP 3533) showing the basisphenoid and basioccipital bones fused had all permanent teeth, except for the third molars, which were still erupting. This, and the other specimens, showed these teeth to be the last to erupt. Although it is difficult to estimate the age of our specimen, Alcides Pissinatti (Centro de Primatologia do Rio de Janeiro - CPRJ) informed us that an individual showing dental characteristics and weight similar to ours was 6-8 months old. As captive specimens may show a more rapid growth due to better nourishing the Ubatuba specimen may have been somewhat older.

It is worth commenting on the way the monkeys were obtained. All but the miquiqui were road-kills on roads or avenues through or adjacent to state parks. This fact shows that monkeys of most species will descend to the ground to cross roads through habitat patches, making them vulnerable to the traffic. None of the many roads traversing the state's reserves have devices to allow safe wildlife crossing, making some of them true killing grounds. This fact is especially acute in Morro do Diabo State Park, where endangered species such as the black lion tamarin, tapirs, *Tapirus terrestris*, and pumas, *Puma concolor*, are frequently killed on the paved road that was built through the park without any effective measure so far being taken by the authorities, despite the problem being well known (see Valladares-Padua *et al.* 1995). The state's highway department has recently answered to requests for taking measures by contending that the present culverts and underground passages are enough to allow wildlife (including primates) to cross. This is unfounded and the roads present a serious threat to the already isolated populations of the larger mammals in the park; the last large remnant of mesophytic forest in the state. Cantareira State Park is

Table 1. Collecting and biometry data of the primate specimens studied. ¹ Killed by poachers, ² Road-kills. Weights are for whole specimens, including stomach contents.

Species	Collecting Date	Locality	Age and sex	Body Weight (g)	Head-Body Length (mm)	Tail Length (mm)
<i>Brachyteles arachnoides</i> ¹	20 Jan 96	Sertão do Puruba, Ubatuba (23°19' S, 44°56' W)	Juv. male	6,250	588	594
<i>Callicebus personatus</i> ²	17 Jan 96	Cantareira S.P. (23°22' S, 43°46' W)	Ad. female	1,692	358	468
<i>Cebus apella</i> ²	23 Jun 94	Morro do Diabo S.P. (22°23' S, 52°15' W)	Ad. male	3,864	394	395
<i>Alouatta fusca</i> ²	21 Nov 94	Cantareira S. P.	Ad. male	6,540	470	535
<i>Alouatta fusca</i> ²	July 96	Cantareira S. P.	Juv. male	1,143	285	338
<i>Leontopithecus chrysopygus</i> ²	Feb 95	Morro do Diabo S.P.	Ad. male	561	240	368

Table 2. Stomach contents of primate specimens from the state of São Paulo, Brazil.

Species and Collecting Data	Food Items (g)
<i>Brachyteles arachnoides</i>	Finely chewed leaves, flowers and fruit parts (~75% of volume) and crushed seeds (25%) - 266 g, including: <i>Ficus</i> sp. syconia, Sapotaceae (<i>Pouteria</i> ?) fruits and crushed seeds, <i>Passiflora</i> sp. (Passifloraceae) fruits and > 100 whole seeds <i>Campomanesia</i> sp. (Myrtaceae) fruits and 12 whole seeds Fabaceae (<i>Machaerium</i> or <i>Dalbergia</i> sp) flowers
<i>Callicebus personatus melanochir</i>	<i>Campomanesia</i> sp. (Myrtaceae) fruit peels and seeds - 20 g <i>Miconia</i> sp. (Melastomataceae) fruit peels - 3 g, Unidentified chewed mulch and fruit pulp - 20g. Insects - remains of 1 winged Hymenoptera, 4 Lepidoptera larvae, 1 cicada (Homoptera) and adult and larvae of Coleoptera (Chrysomelidae?)
<i>Cebus apella</i>	Bamboo shoots (<i>Merostachys</i> sp., Poaceae) - 32 g, <i>Chorisia speciosa</i> (Bombaceae) seeds - 5.5 g. Insects - 2 g; remains of large Hemiptera and winged Hymenoptera (Vespoidea?). Mulch (mostly crushed seeds and bamboo shoots) - 21 g
<i>Alouatta fusca</i> (adult male)	Chewed leaves and stems - 1,030 g, including parts of a Bignoniaceae liana
<i>Alouatta fusca</i> (immature male)	Finely chewed leaves - 16 g
<i>Leontopithecus chrysopygus</i>	Fruit pulp and chitin fragments - 4 g

quickly being engulfed by the urban sprawl of São Paulo and neighboring cities, urban areas and high-traffic avenues and roads cut or surround the park, and road-kills are frequent.

A similar situation is arising with plans to improve the dirt road which bisects the Carlos Botelho State Park, currently under consideration by the state's environment secretary. Carlos Botelho is probably the most important reserve in the state in terms of wildlife populations and is crucial for the long-term global survival of endangered species that have their stronghold in the park and the adjacent Intervales State Park. These species include the muriqui and the jacutinga or piping guan, *Pipile jacutinga* (see Martuscelli *et al.*, 1994; Galetti *et al.*, in press). Road-kills, poaching, and palm-heart harvesting will likely increase with greater traffic and easier access to the park's interior. Despite the protection and limited access to the park, muriquis are occasionally poached (see Mittermeier *et al.*, 1987; Moraes, 1992a) and illegal palm-harvesting is currently a serious threat to Carlos Botelho and Intervales (Galetti and Chivers, 1995).

Our muriqui was one of three killed by poachers during a day-long hunting expedition over very difficult mountainous terrain in an area belonging to the Núcleo Picinguaba of the Serra do Mar State Park. The fact that the muriquis were poached inside a park by local "caiçaras" confirm the view of Martuscelli *et al.* (1994) that poaching by "traditional people" living in and around reserves is the greatest threat to the species in São Paulo, and show that the muriqui is not safe even in one of the conservation areas with the best infra-structure in the state. In fact, in terms of protection, most São Paulo parks are reserves only on paper, with only 11% of their total area being effectively protected, and just 29% being under the dominion of the state (Brazil, São Paulo, DRPE-IF, 1993). The difficult problem of "caiçara" populations in the state's conservation units and their depredations on the wildlife (see Martuscelli *et al.*, 1994; Martuscelli and Olmos, in press; Galetti *et al.*, in press) has not been acknowledged by the state's conservation authorities, and in fact the current view is that these communities should be allowed to continue living in the reserves with full access to their natural resources, as was outlined in a recent proposal in which up to 5% of the area of the state's ecological stations should

be given over to local populations, with 3% made available to agriculture, regardless of habitat type or extent. This proposal was being considered despite insufficient habitat being recognized as one of the main problems of fauna conservation in the state (Brazil, São Paulo, PROBIO, 1996). Such "politically correct" proposals are taken seriously despite the lack of scientific evidence that the activities of the occupants of the reserves are sustainable. The damage to these communities, including local extinctions of primates and larger mammals and birds, is easily perceived (Martuscelli *et al.*, 1994; Olmos 1996; Martuscelli and Olmos, in press). Without a more serious commitment on the part of the state government to conserve its protected areas, one sad consequence is that more primates will become available to studies such as this.

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COMPORTAMIENTO SOCIAL EN AULLADORES: EL CASO DE LA EMIGRACIÓN DE UNA HEMBRA SUB-ADULTA EN *ALOUATTA CARAYA*

Se ha dicho que en la mayoría de los primates gregarios del Viejo Mundo con más de una hembra reproductiva por grupo los machos son los que muestran una mayor tendencia a dejar la tropa natal, sin embargo en algunas especies se ha observado que ambos sexos emigran en tanto que en otras, generalmente lo hacen las hembras (Pusey y Packer, 1987). Con respecto a los primates neotropicales poco se conoce sobre los patrones de dispersión de los sexos, describiéndose en aquellas especies con estructura social polígama, dispersión de machos, tal es el caso de en *Cebus* (Robinson y Janson, 1987), *Saimiri* (Baldwin y Baldwin, 1981) y *Alouatta* (Neville *et al.*, 1988). De las especies mencionadas, *Alouatta*, también muestra dispersión de hembras (Jones, 1980; Crockett, 1984; Neville *et al.*, 1988; Calegario-Marques y Bicca-Marques, 1996).

Si bien no siempre es fácil determinar porqué un individuo emigra en un momento determinado de su vida, este tipo de conducta se puede clasificar según: a) emigración como consecuencia de comportamientos agresivos, b) emigración causada por la atracción hacia un individuo extragrupal, c) emigración causada por raptó (Pusey y Packer, 1987).

En especies que muestran dispersión regular de hembras, se ha visto que las mismas emigran después del primer estro; sin embargo, en hembras de hamadriadas (*Papio hamadryas*) este evento se produce aún en la etapa juvenil. En aulladores la dispersión se da generalmente antes del primer estro, en relación con el establecimiento de los rangos jerárquicos y es así como se ha descrito que en *Alouatta palliata*, *A. seniculus* y *A. caraya*, las hembras forman una jerarquía social en la que el rango se relaciona de manera inversa con la edad (Jones, 1980, 1983; Crockett, 1984). Si bien el mantenimiento de la jerarquía