NEOTROPICAL PRIMATES

CONSERVATION INTERNATIONAL

SPECIES SURVIVAL COMMISSION

CENTER FOR APPLIED BIODIVERSITY SCIENCE
AT CONSERVATION INTERNATIONAL

THE DESCRIPTION OF A NEW MARMOSET GENUS, *CALLIBELLA* (CALLITRICHINAE, PRIMATES), INCLUDING ITS MOLECULAR PHYLOGENETIC STATUS

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Abstract

This paper describes a new genus of Amazonian marmosets, the dwarf marmoset *Callibella*, formerly identified as *Callithrix humilis* (Van Roosmalen *et al.*, 1998), and reports its phylogenetic relationship to other callitrichines, based on 902 base pairs (bp) of the mitochondrial control region DNA sequence. The molecular data indicate an early divergence of *Callibella humilis*, prior to the divergence of *Cebuella pygmaea* from the ancestral Amazonian marmoset stock. The high degree of divergence of this new taxon warrants its placement in a distinct genus, *Callibella*. New observations from the morphology, physiology, ecology, and ethology of the dwarf marmoset are presented which support this classification.

Key Words – Primates, Callitrichidae, Callitrichinae, *Callibella humilis* - dwarf marmoset, *Cebuella* - pygmy marmoset, *Mico* - Amazonian marmosets, *Callithrix* - Atlantic marmosets, molecular genetics, phylogeny.

Resumo

Descreve-se um novo gênero de sagüis da Amazônia Brasileira, o sagüi-anão *Callibella* antes identificado como *Callithrix humilis* (Van Roosmalen *et al.*, 1998), e relata-se a sua condição filogenética baseada em 902 pares de bases da região de controle mitocondrial. A seqüência da região de controle mitocondrial revela uma divergência cedo de *Callibella humilis*, antes da divergência de *Cebuella pygmaea* do sagüi Amazônico ancestral do *Mico*. O alto grau de divergência deste taxon novo justifica a sua colocação num gênero distinto, *Callibella*. Apresentam-se novas observações dos campos de morfologia, fisiologia, ecologia, e etologia do sagüi-anão os quais acrescentam a justificativa de ser classificado como o novo gênero *Callibella*.

Palavras-Chave – Primatas, Callitrichidae, Callitrichinae, *Callibella humilis* - 'sagüi-anão', *Cebuella* - 'mico-leãozinho', *Mico* - 'sagüis' da Amazônia, *Callithrix* - 'sagüis' Atlânticos, genética molecular, filogenia.

Introduction

Platyrrhines, the New World monkeys, were until recently comprised of two families, the Cebidae and the Callitrichidae (formerly Hapalidae) (Rosenberger, 1981). Schneider *et al.* (1996), however, propose three families:

1) Cebidae, including three subfamilies: Cebinae (*Cebus, Saimiri*), Aotinae (*Aotus*), and Callitrichinae (*Callithrix, Cebuella, Saguinus, Leontopithecus, Callimico*);
2) Atelidae, including one subfamily: Atelinae (*Ateles, Brachyteles, Lagothrix, Alouatta*); and
3) Pitheciidae (*Pithecia, Chiropotes, Cacajao, Callicebus*).

As presented in this paper, the callitrichine subfamily consists of seven distinct genera, including *Saguinus* (tamarins), *Leontopithecus* (lion tamarins), *Mico* (Amazonian marmosets), *Callithrix* (Atlantic marmosets), *Cebuella* (pygmy marmosets), *Callibella* (dwarf marmoset), and *Callimico* (Goeldi's monkey). On morphological grounds, *Callimico* stands apart in the family for its retention of third molars, its bearing single offspring rather than twins (although sharing this feature with *Callibella*), and its vocalizations (Snowdon, 1993). *Callimico* has been hypothesized as being basal to the callitrichid clade (Rosenberger, 1984), and some authors have proposed its placement in a separate family, Callimiconidae (Chiarelli, 1972; Hershkovitz, 1977).

Tamarins and lion tamarins have traditionally been viewed as sharing a common ancestry, separate from the marmosets and pygmy marmosets (Hershkovitz, 1977), but the molecular data do not support these arrangements. Cronin and Sarich (1978), based on the electrophoresis of plasma proteins, put *Callithrix* and *Callimico* in a clade that forms a trichotomy with *Saguinus* and *Leontopithecus*. Barroso *et al.* (1997), comparing the IRBP intron 1 sequences, and Schneider *et al.* (1993), comparing the ε-globin nuclear gene sequences, found the order of clade separation should be (*Saguinus* (*Leontopithecus* (*Callimico, Callithrix*))), whereas Horovitz and Meyer (1995) reversed the order of separation between *Leontopithecus* and *Saguinus* based on the 16S mitochondrial DNA sequences. Morphological

and molecular studies universally agree that marmosets and pygmy marmosets are most closely related (e.g., Hershkovitz, 1977; Canavez *et al.*, 1999; Porter *et al.*, 1997).

The callitrichine subfamily represents a specialized clade of diminutive primates that underwent secondary phyletic dwarfing, probably due to its highly specialized diet and feeding strategy—one based on insectivory, consumption of small-seeded fruits (berries), and tapping exudates from a number of woody plant species (Garber, 1992). Callitrichines are generally found in disturbed, edge or patchy habitats, where a greater abundance of insects and berries may be found (Peres, 1991). The callitrichines are unique among New World primates in their vertically clinging posture, made possible by claw-like nails that are specialized for grasping onto the sides of large-diameter tree trunks. This allows for more effective exploitation of tree sap and insect larvae. Marmosets actively tap trees and lianas for exudates by gouging small holes in the bark, which may serve as an indefinitely reliable or keystone source of food. Tamarins, lacking the tusked condition of the mandibular incisors found in marmosets, do not actually gouge holes themselves; but they do feed on exudates from damaged tree stems (Egler, 1992) and *Parkia* fruits (Peres, 1991) as well as "parasitizing" the gouge holes produced by sympatric pygmy marmosets (*Cebuella*) (Soini, 1988). The life histories of all callitrichines therefore indicate a highly specialized clade of New World monkeys, instead of an ancestral or proto-platyrrhine relic, as suggested by Hershkovitz (1977).

Another hallmark of the callitrichine subfamily is its relatively high diversity of taxa. *Saguinus* includes 33 recognized taxa, most of which should merit full species status upon closer morphological, molecular and biogeographical examination (Van Roosmalen and Van Roosmalen, in prep.). *Callithrix* is composed of six species, while at least 14 species comprise the Amazonian *Mico*; four species are recognized in *Leontopithecus*; and *Cebuella, Callibella* and *Callimico* are monotypic genera. The callitrichine subfamily can thus be summarized as a highly adaptive, thoroughly diverse clade of primates that has successfully radiated throughout much of South America.

Despite this diversity, little is known about the evolutionary relationships among the various species of marmoset. In fact, most molecular phylogenies to date have found that *Mico*, the Amazonian marmoset clade, is more closely related to *Cebuella* (pygmy marmosets) than to *Callithrix,* the Atlantic clade (Barroso *et al.*, 1997; Canavez *et al.*, 1999; Porter *et al.*, 1997; Tagliaro *et al.*, 1997). This evidence led Rylands *et al.* (2000) and Groves (2001) to separate the larger marmosets into the genera *Mico* (Amazonian clade) and *Callithrix* (Atlantic marmosets or ouistitis). This approach retained *Cebuella* in a distinct genus rather than merging all marmosets—Amazonian, Atlantic and pygmy—into a single genus. In a previous study (Van Roosmalen *et al.,* 2000), the phylogenetic standing of two newly described Amazonian marmosets, *Mico manicorensis* and *M. acariensis*, was investigated using the mitochondrial

control region. Given the relatively low number of species represented in the few genetic studies on callitrichine interrelationships to date, the addition of the dwarf marmoset to the existing phylogenies should help resolve evolutionary patterns of radiation and speciation among the marmosets.

The purpose of this study is to determine the phylogenetic status of the dwarf marmoset, discovered in 1996 and published conservatively as *Callithrix humilis* Van Roosmalen *et al.,* 1998, based on mitochondrial control region (D-loop) sequences. These sequences were selected for their high rate of evolution, and have thus been considered optimal for phylogenetic resolution among closely related organisms by previous studies (Aquadro and Greenberg, 1983; Tagliaro *et al.,* 1997). The addition of the dwarf marmoset to the marmoset phylogenetic tree—as well as new information on its morphology, physiology, ontogeny, ecology and ethology—should shed new light on the relationships between marmoset clades, providing insight into patterns of evolution, radiation and dispersal, and the mechanisms that regulate isolation and speciation in the Amazon basin.

Genus Description

Genus *Callibella* Van Roosmalen and Van Roosmalen

Callithrix Erxleben, 1777 – type species *Callithrix humilis* Van Roosmalen, Van Roosmalen, Mittermeier and Fonseca, 1998

Callibella humilis (Van Roosmalen, Van Roosmalen, Mittermeier and Fonseca, 1998)

Holotype: Museu Paraense Emílio Goeldi, Belém, Pará, Brazil, MPEG 24769, adult male, stuffed skin, skull. Specimen collected by Marc G. M. van Roosmalen and Tomas van Roosmalen on May 16, 1997, one km south of Nova Olinda, west bank of the lower Rio Aripuanã, right bank tributary of the Rio Madeira, south-central Amazonia, Brazil.

Type locality: West bank of the lower Rio Aripuanã, one km south of the settlement of Nova Olinda, 41 km SW of the town of Novo Aripuanã, Amazonas State, Brazil. This region is located in south-central Amazonia, Brazil, south of the Rio Amazonas and east of the Rio Madeira. Coordinates for the type locality are 05° 30' S, 60° 24' W. Altitude 45 m.

Geographical distribution: The species is known from the west bank of the lower Rio Aripuanã, from the mouth with the Rio Madeira just SW of the town of Novo Aripuanã south at least to the village of Tucunaré on the west bank of the Rio Aripuanã, and along the east bank of the Rio Madeira south as far as the mouth of the Rio Matauá. The southern limit for the species, in the interfluve delineated by the Rios Madeira, Matauá and Aripuanã, is probably the headwaters of the Rios Mariepauá and Arauá. A geographically isolated population has been found along the middle and upper reaches of the Rio Atininga, ca. 50 km southwest of the southern limit of the main population and

ca. 10 km east of the town of Manicoré, situated on the east bank of the Rio Madeira. A live specimen (INPA 4090) was collected by the locals when it fell off the mother's back, on the right bank of the Rio Atininga; coordinates for this locality are 05° 54' S, 61° 15' W. This individual was kept for two years in our breeding center in Manaus, where it died just two weeks after giving birth to a single infant. Fig. 1 shows the distribution and the localities where dwarf marmosets were seen in the wild.

Habitat: All observations of wild dwarf marmosets in their main distribution were in disturbed primary and secondary *terra firme* rain forest, in the immediate vicinity of plantations, fields and tree gardens managed by local

people (*caboclos*). In an earlier paper (Van Roosmalen *et al.*, 1998), we assumed that dwarf marmosets also occur away from human settlements, although at extremely low densities. However, four trained observers carried out an intensive survey along two transects laid out perpendicular on the left bank of the Rio Aripuanã, one measuring 5 km (Capimtuba) and the other 3.5 km (Monte Alegre). Accumulating 120 km of census observations, the survey revealed not a single sighting of dwarf marmosets in undisturbed primary *terra firme* forest nor in riparian *igapó* forest (Van Roosmalen and Peres, in prep.). Along both transects, trees known to be exudate sources for dwarf marmosets were carefully inspected, but only gouge holes made by *Mico manicorensis* were found. During the surveys, both
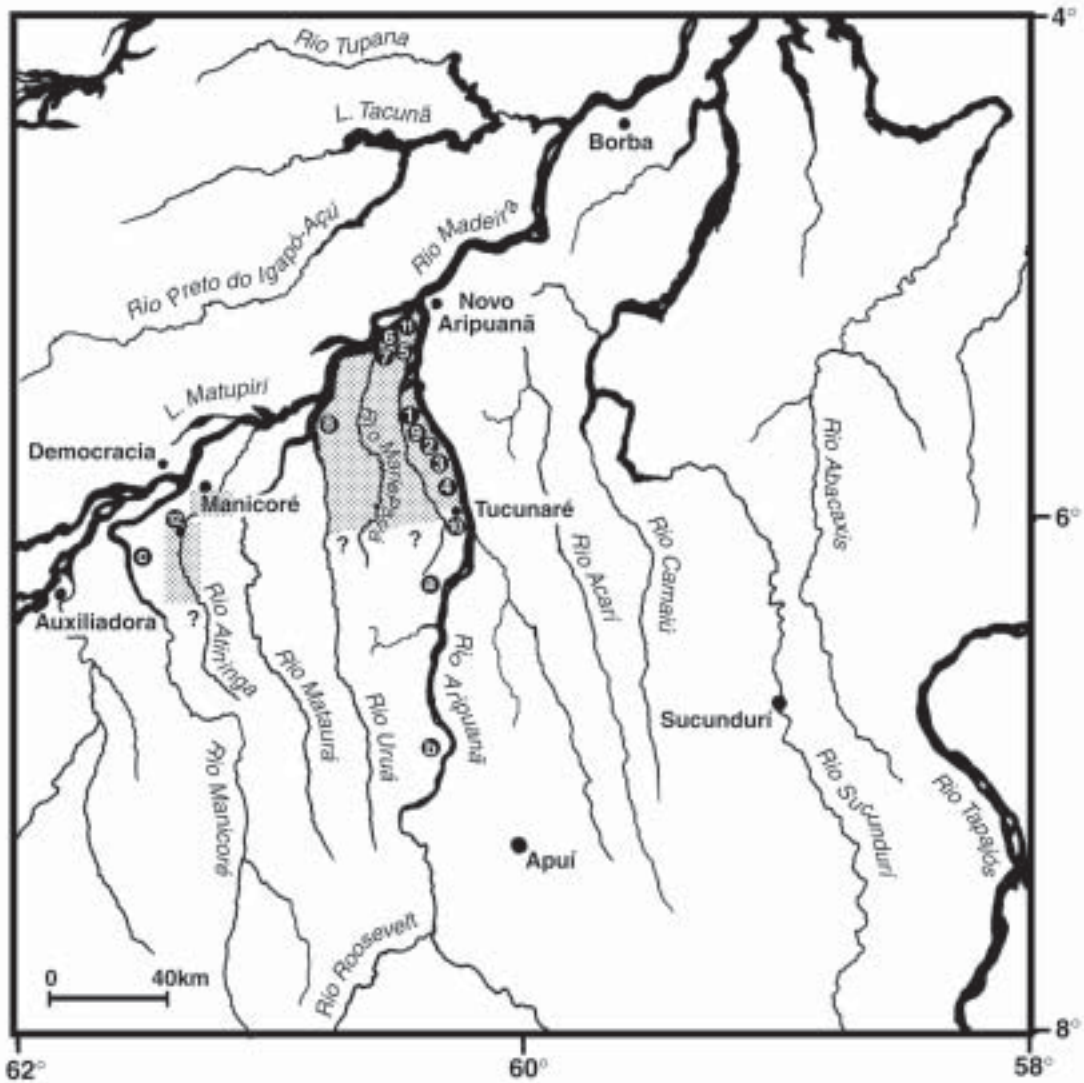
Figure 1. Distribution of *Callibella humilis*. Numbers indicate localities where we have observed dwarf marmosets in the wild: 1. Nova Olinda, type locality for *Callibella humilis* (05º30'63"S, 60º24'61"W); 2. Monte Alegre, opposite Ilha Monte Alegre, left bank of Rio Aripuanã (05º34'S, 60º23'W); 3. Novo Oriente, left bank of Lago Capimtuba (05º43'S, 60º17'W); 4. Terra Preta, left bank of Rio Aripuanã (05º45'S, 60º15'W) and Santa Maria, left bank of Rio Aripuanã; 5. Igarapé Arauazinho, left bank of Rio Aripuanã; 6. São Sebastião, east bank of Lago Paiucuru, right bank of Rio Madeira; 7. Santa Cruz, on right bank near mouth of Rio Mariepauá, right-bank tributary of Rio Madeira; 8. São Martin, right bank of lower Rio Mataurá, right-bank tributary of Rio Madeira; 9. Gethal selective logging site, 1 km north of Monte Alegre; 10. Tucunaré, left bank of Rio Aripuanã, 2 km north of Lago Açaí Grande; 11. Guariúba, west bank of Lago da Guariúba, left bank of Rio Aripuanã (05º13'03"S, 60º23'04"W); 12. Atininga, both banks of upper Rio Atininga, on mouth of Igarapé Santa Luzia and 5 km upstream from mouth of Ig. Santa Luzia (05º54'S, 61º15'W). (Map by Stephen Nash.)

Note: extensive surveys at (a) Rio Arauazinho (06º16'S, 60º20'W), (b) São Raimundo, (c) along both banks of the lower Rio Manicoré, and along the right bank of the lower Rio Aripuanã (Rio Aracú, Jatuarana, Frechal, Prainha, Cipotuba, Tabira) as far south as Rio Juma, Itapiranga and Prainha, did not reveal the presence of *Callibella*.

Mico manicorensis and *Callicebus bernhardi*—which share with *Callibella humilis* a preference for disturbed forest near human settlements, and abandoned or cultivated *terra preta* anthrosols—were regularly seen in natural secondary forest growing in treefall clearings away from human disturbance. Several groups of the disjunct southern dwarf marmoset population, however, were observed in both disturbed *terra firme* rain forest and seasonally inundated forest (*igapó*) of the Rio Atininga and its major tributaries. Its seasonal habitat preference for *igapó* in this area has been confirmed by the locals, but groups were also seen on and near the few *terra pretas* scattered along this river on higher ground behind the *igapó*. We assume that *Callibella* nowadays occurs almost exclusively on bluffs along blackwater and clearwater streams and lakes, where generations of ancient Indian farmers once lived and accumulated black-earth deposits (Mann, 2002). (For a fuller discussion of the anthropogenic black-earth areas known as *terra pretas*, please refer to Appendix I.)

Diagnosis: A very small marmoset (*sensu* Hershkovitz, 1977), slightly larger in size than *Cebuella* (adult head-body length = 160-170 mm; total length = 380-390 mm; weight 150-185 g), but sharing more physical and behavioral characteristics with *Mico*. Adults are distinguished from *Cebuella* by the following features: evenly non-banded hairs, dark olive brown (not tawny agouti) above, orange-yellow to golden to grayish-yellow below, including inner sides of limbs; upper surface of hands, feet and lower arms orange mixed with black; naked ears not concealed by a cape of hair; a black triangular crown; white "eyebrows" extending back to temples; triangular, naked face flesh-colored and unpigmented (lacking the white mustache or white dots beside the nostrils), except for blackish circumocular zone; larger inter-nostril distance; iris darker orange-brown; streaks of white hairs (avg. 12 mm long) growing from central pinna; tail longer, almost black, not or obscurely orangish-ringed and longer-haired; color patterns changing with age, particularly on head. Drastic color changes with age are unique among marmosets, as are hair tufts arising from the center of the pinnae (see Van Roosmalen *et al.*, 1998 for description and illustrations). Table 1 gives body measurements and weight, Figures 2a, -b, and -c provide adult cranial characteristics, and Table 2 lists cranial and dental measurements.

Origin of the name: *Callibella* is a combination of the Greek adjective *calo* or *calli* meaning 'beautiful' and the Portuguese/Italian adjective *bela/bella* meaning 'beautiful,' thus meaning 'double beautiful'; *humilis* means 'small' or 'dwarf' in Latin.

Comparisons with Other Callitrichines

In an earlier paper (Van Roosmalen *et al.*, 1998), we offered five hypotheses for the relationships and origins of the new species, all equally parsimonious for lack of basic data on behavior, ecology, geographic range and molecular genetics:
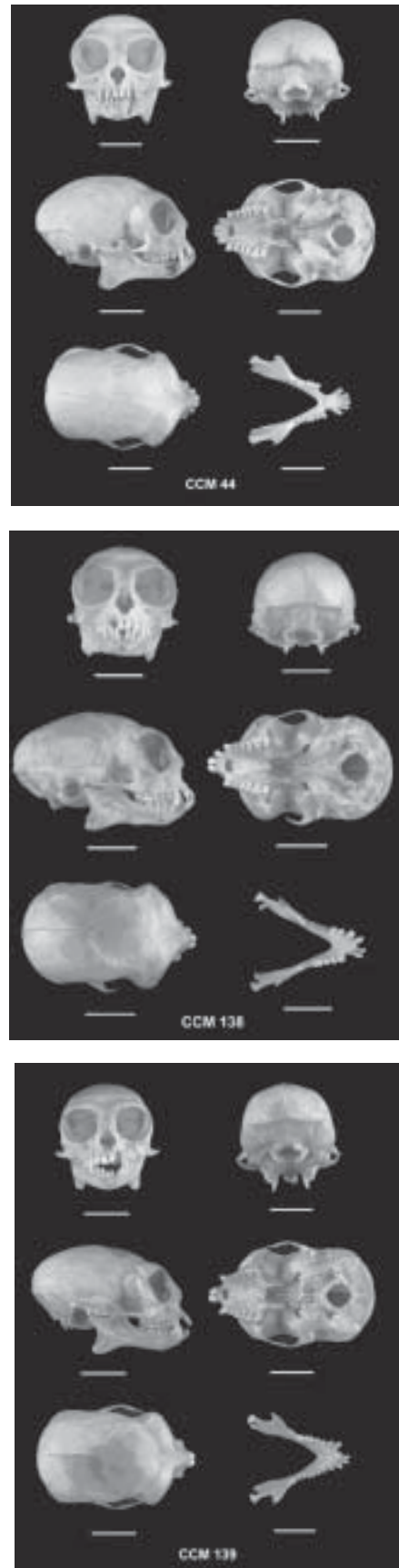
Figure 2. Skulls of adult male holotype *Callibella humilis* (CCM 44 = MPEG 24769), adult female *Callibella humilis* (CCM 138 = INPA 4090), and adult male *Callibella humilis* (CCM 139 = INPA 4091). Photographs by Stephen D. Nash. Scale bar = 1 cm.

Table 1. Measurements (mm) and weight (g) of several captive *Callibella humilis*.

Coll. nr.	Gender	Age (mths)	Head-Body	Tail	Total	Hand	Foot	Hallux	Ear	Weight
INPA 4090	Female	24	167	220	387	24	55	-	-	150
INPA 4091	Male	36	161	209	370	20	54	-	-	150
MPEG 24769	Male	>24	150	240	390	35	50	8	22x11	120
MvR 52	Male	>24	162	220	382	40	50	6	22	122
MvR 50	Female	>24	160	240	400	28	41	6	20x18	185
MvR 51	Male	12	130	205	335	32	48	6	20	95
MvR 53	Male	13	145	235	380	31	48	5	21x15	136
MvR 54	Female	2 days	65	85	150	15	20	-	-	16

1. The new species is just a species or subspecies of *Cebuella* that managed to raft across the Rio Madeira;
2. The new species is a "missing link" that is intermediate between *Cebuella* and *Mico*;
3. The new species is a small, primitive form of *Mico*, possibly ancestral to some of the other species;
4. The new species is just another form of *Mico* in this region; and
5. The new species represents a separate callitrichine radiation, and deserves recognition as a distinct *genus* that happens to have a very small geographic range.

We took a conservative stance in describing this monkey as a dwarf form of *Callithrix* (now *Mico*), inclining most to Hypothesis 4 in considering it just another form of Amazonian marmoset in this region, one which happens to be considerably smaller than any of its relatives. Hypothesis 5, however, was given some validity as well, since the monkey shares only a few behavioral features with other Amazonian marmosets (Table 3, Van Roosmalen *et al.*, 1998), and is to be considered an anomaly among marmosets for its loss of twinning and territoriality, among other features. In view of our recent molecular research, Hypothesis 5 now seems most appropriate, and we consider this new species to be a separate and basal marmoset divergence.

Dwarf marmosets are remarkable for displaying the following characteristics:

- their diminutive body size and weight;
- their apparent lack of territoriality, exceptional among primates—although an average group contains 6-8 individuals, we have observed group aggregations counting over 30 individuals in which no antagonistic behavior was noted, and scent marking of a common home range using urine or gland secretions has never been observed in captivity or in the wild;
- male and female genitals are not hypertrophied as in *Cebuella, Mico* and *Callithrix*;
- they represent the only New World primate with long hair tufts growing from the *center* of the pinna;
- two singleton births took place in captivity from different mated pairs, and adults were never seen carrying twins in the wild, which together imply obligate singleton births;
- lack of female reproductive inhibition by pheromones in a female's urine (a birth-controlling mechanism prominently developed in all other callitrichines);
- several observations in the wild of more than one reproductive female in a single group suggest that they do not perform an exclusive alpha-female reproductive system, although multiple reproductive females have been reported in some other callitrichid species (Masataka, 1981; Digby and Ferrari, 1994; French, 1996; Roda and Pontes, 1998);
- both in captivity and in the field we observed that only biological mothers carry the offspring on the back, and do not share transportation duties with the father or other adult/subadult group members, unlike other callitrichines;
- in captivity we observed so-called 'parking behavior' in which the mother, already as early as the fifth day after birth, leaves her infant behind on a twig or branch where it stays silent and immobile until it is picked up again, a behavioral pattern only known among some prosimians (lemurs, galagos, and loris) and *Cebuella*;
- they perform a clearly different vocal repertoire, including a double-tone contact or distant call (Van Roosmalen *et al.*, in prep.);
- the ontogeny is unique, with three discrete stages of pelage coloration and hair length (Van Roosmalen *et al.*, 1998);
- exudate-gouging of tree and vine barks seems as important a foraging pattern as in allopatric *Cebuella* and *Callithrix*, the gum functioning as a keystone resource during the dry season when fleshy fruits are scarce, much more so than in sympatric *Mico manicorensis* (Van Roosmalen *et al.*, in prep.);
- extreme commensalism with humans, making the dwarf marmosets almost totally dependent for survival on multi-species managed forests, fruit orchards and gardens growing on so-called *terra pretas* (anthropogenic soils, or 'black earth').

Molecular phylogenetics - Methods

Faecal samples were obtained from specimens kept in our Breeding Center for Endangered Amazonian Primates in Manaus, which were later deposited at the zoological museum of the Instituto Nacional de Pesquisas da Amazônia

Table 2. Cranial and dental measurements (mm) of three *Callibella humilis*: CCM 138 (= INPA 4090), adult female from Rio Atininga; CCM 139 (= INPA 4091), adult male, locality unknown; and CCM 44 (= MPEG 24769), holotype adult male from Novo Aripuanã.

Skull and Mandible (mm)	CCM 138	CCM 139	CCM 44
Greatest Skull Length (SL)	35.8	37.8	36.0
Zygomatic Width (ZW)	23.6 (broken)	25.7	25.3
Biorbital Width (BW)	22.0	22.3	20.9
Postorbital Width (PW)	18.3	19.5	18.9
Nasion-Basion	24.7	26.6	26.0
Basion-Prosthion	25.8	27.2	26.2
Biauricular Breadth	20.1	22.5	21.6
Height of Canine (CH)	3.3	4.3	3.8
Length of Mandible (ML)	21.3	25.1	23.8
Across First Molars (AM)	9.0	10.0	9.4
Across Canines	6.3	6.2	6.3
Dental Field (P2-M2)	8.3	9.1	8.9 (no P2)
Premaxillary Height	5.9	6.1	6.0
Intradentale Superior to Premaxilla-Maxilla Junction at Alveolus	3.6	3.6	3.4
Intradentale Superior to Nasion (IS-NA)	10.7	10.9	11.8
Intradentale Superior to Posterior Nasal Spine (IS-PNS)	11.9	12.9	12.7
Bregma to Nasion (BR-NA)	20.4	20.1	20.5
Nasion to Fronto-Malar Junction at Orbit (NA-FM)	11.7	11.9	12.0
Fronto-Malar Junction to Pterion	5.2	5.7	5.7
Fronto-Malar Junction to Zygomaxillare Superior (FM-ZS)	6.5	7.0	6.3
Fronto-Malar Junction to Maxillary Tuberosity (FM-MT)	10.2	10.9	11.8
Zygomaxillare Inferior to Premaxilla-Maxilla Junction at Alveolus	10.0	9.6	10.8
Zygomaxillare Inferior to Zygomaxillare Superior (ZI-ZS)	5.7	4.8	5.1
Zygomaxillare Inferior to Maxillary Tuberosity (ZI-MT)	3.4	4.2	4.2
Anterior Teeth			
I^1 Length	1.5	1.5	1.7
I^1 Breadth	1.2	1.1	1.2
I^1 Height	2.3	2.5	2.6
I^2 Length	1.5	1.6	1.6
I^2 Breadth	1.1	1.2	1.1
I_1 Length	1.0	1.2	0.9
I_1 Breadth	1.1	0.9	1.3
I_1 Height	2.2	2.8	3.1
I_2 Length	1.0	1.1	1.2
I_2 Breadth	1.7	1.5	1.7
C^1 Length	2.0	2.2	2.1
C^2 Breadth	1.3	1.2	1.1
Cheek Teeth			
P^2 Length	1.7	1.9	-
P^2 Breadth	1.2	1.2	-
P^4 Length	1.5	1.6	1.7
P^4 Breadth	1.3	1.5	1.6
M^1 Length	1.9	2.1	2.2
M^1 Width	1.5	1.6	1.8
M^2 Length	1.8	2.0	2.1
M^2 Width	1.4	1.4	1.6

(INPA), Manaus, Amazonas, Brazil. Sampled marmosets included three *Callibella humilis* and two *Cebuella pygmaea niveiventris,* all wild-caught.

DNA was extracted from the faecal samples following the protocol provided by Gibco BRL DNAzol extraction kit. The PCR amplification and sequencing methodology was the same as has been used for *Mico (Callithrix) manicorensis* and *Mico (Callithrix) acariensis* (see Van Roosmalen *et al.,* 2000).

For the control region, sequences of three *Mico (Callithrix) argentatus,* three *Mico (C.) mauesi,* two *Mico (C.) humeralifer,* four *Callithrix geoffroyi,* two *Callithrix penicillata,* two *Callithrix jacchus,* five *Callithrix kuhlii,* two *Callithrix aurita*, two *Cebuella pygmaea*, and one *Leontopithecus chrysomelas* were obtained from GenBank. Upon alignment, sequences were entered into the PAUP program (Swofford, 1993) for phylogenetic analysis. A maximum parsimony (MP) algorithm was used to analyze the data, and bootstrap analyses (100 replicates) were performed on the resulting consensus trees. Pair-wise nucleotide distances were also determined for the species under consideration.

Molecular phylogenetics – Results

Using PAUP, a maximum parsimony analysis with 100 bootstrap replications yielded the phylogenetic tree for the mitochondrial control region presented in Fig. 3. This tree does not include the shorter sequence of *Cebuella pygmaea* obtained in this study. When this sequence is included in the phylogeny, curtailed to only 532 bp for all species, bootstrap values are raised significantly for some nodes. Both trees agree, however, that *Callibella humilis* diverges before *Cebuella* from their common ancestor with the Amazonian marmoset clade. Pairwise divergences indicate a slightly greater genetic distance of *Callibella humilis* from *Mico (C.) argentatus* (approx. 13%) than the distance between *Cebuella* and *Mico (C.) argentatus* (11-12%). The status of the Atlantic marmosets (genus *Callithrix*), diverging before the radiation of Amazonian marmosets (including *Callibella humilis* and *Cebuella pygmaea*), remains in concordance with the phylogenetic trees presented by Tagliaro *et al.* (1997) before the addition of *Callibella humilis.*

The positioning of the dwarf marmoset further suggests that it should be elevated from its original generic status in *Callithrix* (Van Roosmalen *et al.,* 1998) to a distinct genus, here proposed as *Callibella.* We therefore suggest renaming the dwarf marmoset as *Callibella humilis.* Its divergence from the ancestral stock of the Amazonian marmosets (*Callithrix*, now *Mico*) prior to the divergence of the pygmy marmosets (*Cebuella*) is strongly suggested by these data. Morphological, physiological, ecological and ethological observations as described in Van Roosmalen *et al.* (1998), and above in this paper, corroborate the finding that *C. humilis* represents a new genus.

This conclusion is supported by the pairwise divergences

calculated for *Mico, Callithrix, Cebuella*, and *Callibella.* For the mitochondrial control region, pairwise divergences between the species of Amazonian marmosets (*Mico*) range from approximately 3% to 7%, with 6-7% between the two main subclades (*argentatus* and *humeralifer/mauesi*) and 2-4% between species within each subclade. Divergences between *Cebuella* and any species of *Mico* are on the order of 11-12%, while the average divergence between the Amazonian marmosets and *Callibella* is approximately 12-13%. It is also noteworthy that the pairwise divergence between *Callibella* and *Cebuella* is 13-14%, suggesting that they share no common ancestry after their divergence from the ancestral *Mico* stock. Within-species divergences for the species analyzed in this study range from 0-3%. Pairwise divergences between the Atlantic marmosets (*Callithrix*) and the Amazonian marmosets (*Mico*) range from 12-13%, while the divergences between *Callithrix, Cebuella* and *Callibella* range from 14-15%. Divergence between all marmosets (including pygmy and dwarf marmosets) and the outgroup, the lion tamarin *Leontopithecus,* is over 20%. It is important to keep in mind that these differences are reflective only of a single DNA sequence, the mitochondrial control region. Such divergences may differ if other sequences were to be analyzed. The authors also recognize
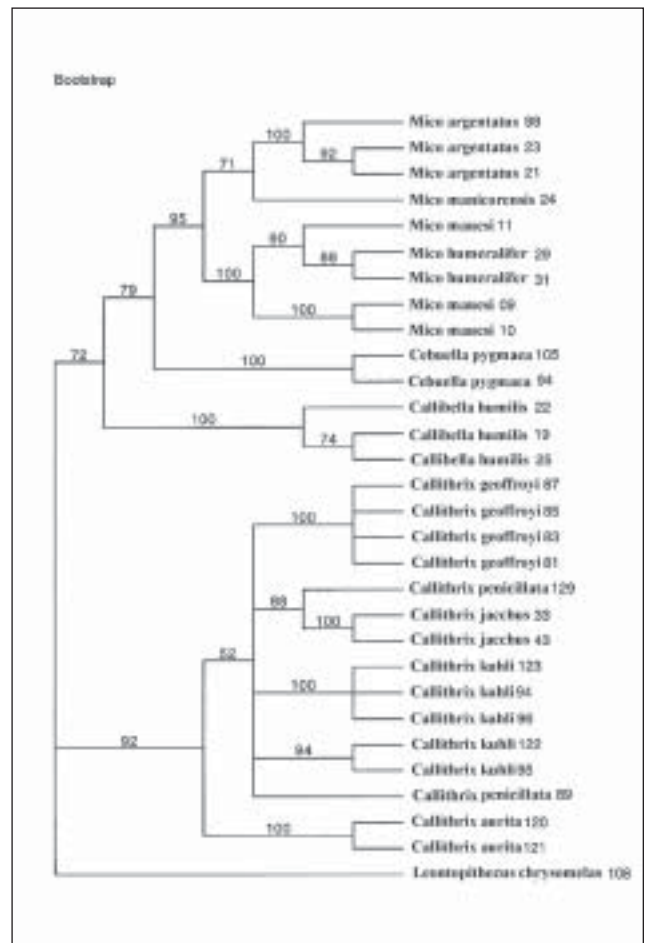
Figure 3. Callitrichid gene tree based on 902 base pairs (BP) of the mitochondrial control region, analyzed using maximum parsimony. Bootstrap values are given above branches.

that it would be more informative to include additional specimens from each species. Unfortunately, the remoteness of their geographic ranges, as well as their status as endangered species under Brazilian law, has precluded more intensive sampling.

In essence, these data suggest an early, almost simultaneous divergence of the genera *Callibella, Cebuella,* and *Mico*. These genetic distances indicate that, contrary to suggestions by previous molecular studies (e.g., Barroso *et al.,* 1997; Tagliaro *et al.,* 1997) to subsume *Cebuella* within the genus *Callithrix*, the Amazonian and Atlantic marmoset clades should be separated into different genera. Given a 3-7% divergence for species within either clade, and a 10-11% divergence between clades, it seems taxonomically more informative to group the two clades into separate genera in recognition of their evolutionary distinctiveness. This separation would uphold the generic status of *Cebuella*, which is also much more divergent from *Mico* than any amongspecies divergences found within *Mico*. With this in mind, the comparatively greater divergence (twice that between any two given *Mico* species) of *Callibella humilis* from any other known marmoset or pygmy marmoset warrants its placement in a distinct genus as well, assuming that taxonomic classifications should reflect actual evolutionary distinctiveness. Similarly, the separation of Atlantic marmosets ('ouistitis') from Amazonian marmosets has been proposed by Groves (2001), using the subgenera *Mico* Lesson, 1840 and *Callithrix* Erxleben, 1777, respectively. Rylands *et al.* (2000) already treat them as distinct genera, a classification with which we fully concur.

Conservation Status of the New Genus

The area in which *Callibella humilis* is confirmed to occur is only 250,000 to 300,000 hectares in size (Van Roosmalen *et al.*, 1998), perhaps the smallest distribution of any primate in the Amazon. The interfluvial basins of the secondary tributaries that drain this part of the interfluve (as delineated by the Rios Madeira and Aripuanã) are uninhabited. Since pre-Columbian Indians never settled far inland from riverbanks, no *terra pretas* are to be found there. Our analysis of Landsat images of the entire area of distribution, recognizing occupied as well as abandoned *terra pretas* by their specific green color, reveals that the total surface area of *terra pretas* accounts for less than 1% of the region as a whole. Suitable habitat therefore amounts to less than 3,000 ha. Since average home range size and group size is approximately known for a handful of *terra pretas*, an educated guess would be a total population of around 10,000 individuals.

Local people living nowadays on *terra pretas* alongside rivers and creeks consider the dwarf marmoset too small to hunt for food. The monkeys may be regularly seen crossing open areas, running over the ground to reach isolated trees in the middle of house gardens or orchards in order to gouge their bark for gum. In this way they expose themselves to predators such as domestic dogs and cats—as well as birds

of prey, which are drawn to mice, rats and poultry and often perch in nearby trees. A more serious threat to the dwarf marmosets' survival may come from the fact that, as commensals, they are often exposed to forest fires, since farmers regularly burn secondary growth to clear their *terra preta* fields. These fires may run out of control and destroy entire orchards and house gardens, including the forest edges where the monkeys spend most of their time. In addition, the future survival of *Callibella humilis* could be dramatically affected if locals were to commercialize the *terra preta* soil as humus or peat for gardening, a practice commonly seen in the vicinity of Amazonian towns and cities.

The State Department for the Protection of the Natural Environment in the State of Amazonas (IPAAM) has been repeatedly informed about the necessity of implementing protected areas in the municipalities of Novo Aripuanã and Manicoré, but thus far without results. In the meantime, our Brazilian Civil Non-Profit Entity A.A.P. (the Amazon Association for the Preservation of High Biodiversity Areas), based in Manaus, is supporting the creation of Private Natural Heritage Reserves (Reserva Particular de Patrimônio Natural, or RPPN), which are private nature reserves with a perpetually protected status. This will not only safeguard significant samples of Amazonian ecosystems, but will also guarantee the maintenance of their biodiversity. Our Association purchases legal land titles and transforms these private properties into RPPNs through the authority of IBAMA, the Brazilian Institute for the Environment and Renewable Natural Resources. The status of these reserves is guaranteed the most rigid protection under the Brazilian Environmental Law of June 5th, 1996 (Decree #1922). Therein, the President decrees the following articles, among others:

> *Art. 1*. The Private Reserve RPPN is an area of private ownership that is specially protected, by initiative of its owner, through the recognition of the government because of its relevant importance in terms of biodiversity, or its natural beauty, or its environmental characteristics that justify actions for its recuperation.
> *Art. 2*. The objective of RPPNs will be the protection of the environmental resources representative for the region.
> *Art. 3*. The RPPNs can be used for activities whose aim is scientific, cultural, educational, recreational, but always in line with the stated aim of the previous article. These activities must be authorized or licensed by the responsible organ for the recognition of the RPPN and executed in such a manner that they will not compromise the ecological balance or endanger the survival of the existing species populations, in view of the carrying capacity of the area that is determined by the management plan.

In addition to covering habitat for *Callibella humilis*, the RPPNs proposed by the A.A.P. will also include viable populations of eight other primates along the left bank of the Rio Aripuanã, and 11 primates along the right bank—of

which seven (including the genera *Ateles, Pithecia, Lago-thrix, Saimiri,* and *Aotus*) are species new to science, such as the recently described *Mico manicorensis* and *Callicebus bernhardi* (Van Roosmalen *et al.*, 2000; Van Roosmalen *et al.,* 2002).

Acknowledgements

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Appendix I: Terra Pretas

Terra pretas (literally "black earth") are exceptionally fertile soils which are thought to have been manufactured in pre-Columbian times by native Brazilian Indian farmers, who disappeared before the first European immigrants arrived (Mann, 2002). These farmers left their *terra pretas* on the bluffs above white-, black-, and clearwater rivers and streams, and along the margins of lakes with access to lime deposits (Van Roosmalen, in prep.). These ancient Indian farmers seem to have decomposed organic material to humus and then mixed it with large quantities of charcoal, calcium and phosphates. The charcoal may have been obtained from burning down large tracts of riparian forest (*igapó*), which is susceptible to fire during the peak of the dry season. Lime could have been obtained in large quantities from game and fish bones, freshwater turtle carapaces and molluscs (freshwater oysters, snails and mussels), commonly found in clear-water and white-water rivers.

Most *terra pretas* are currently occupied by families or small communities of *caboclos*, the descendants of acculturated Indians and immigrant settlers, who grow crops such as manioc, maize, sweet potatoes, sugar cane, bananas, and papaya on these almost inexhaustibly fertile soils. These current inhabitants do not know how to manufacture this black earth themselves. *Terra pretas* which have remained uncultivated by *caboclos* since their creators abandoned them are usually covered with an open type of primary rain forest, very different in composition from the matrix *terra firme* forest which covers the unmodified, extremely poor podzolic soils found elsewhere in Amazonia. Vines and twiners may dominate locally, or else dense stands of palms may be found, including species such as *babaçú* (*Attalea speciosa*), *inajá* (*A. maripa*), *caiaué* (*Elaeis oleifera*), *bacaba* (*Oenocarpus bacaba*), *bacabinha* (*O. minor*), and *tucumã* (*Astrocaryum vulgare* and *Astrocaryum aculeatum*).

Moreover, quite a few tree species found elsewhere only on richer soils, such as in whitewater floodplains (*várzea*), are known to thrive on *terra pretas*, such as *Spondias mombin, Tapirira guianensis, Annona montana* and other soursop species, *Duguetia* spp., *Rollinia mucosa, Didymopanax morototoni, Astrocaryum aculeatum, Astrocaryum murumuru* var. *ferrugineum, Astrocaryum vulgare, Elaeis oleifera, Ceiba pentandra* (the kapok tree, considered sacred by most indigenous Amazonian peoples)*, Carica papaya, Platonia insignis, Rheedia* spp., *Vismia* spp., *Cochlospermum orinocense, Acacia* spp., *Enterolobium schomburgkii, Inga* spp., *Parkia multijuga, Theobroma cacao* and several species of wild cacao.

Among these trees, many offer the dwarf marmosets exudates and/or edible fruits. Species such as *Didymopanax morototoni, Spondias mombin, Enterolobium schomburgkii, Parkia multijuga, Inga ingoides* and *I. alba,* as well as *Acacia* vines, often serve as aseasonal keystone resources for the monkeys. These are especially important during the end of the wet season and the first half of the dry season, when fruits are scarce, and they offer the dwarf marmosets (and, west of the Rio Madeira, the pygmy marmosets) reliable sources of exudate. These marmosets literally live in the locals' backyards and orchards, and are tolerated because they do very little damage to their fruit crops. Since the larger Amazonian marmosets (*Mico*)—and, in the case of *Cebuella,* tamarins (*Saguinus*)—do not venture into the house gardens, intergeneric interactions are seldom seen. It is possible that *Callibella* and *Cebuella* have "dwarfed" in response to competition with other, more opportunistic callitrichines, and have become more successful after the introduction of man in Amazonian moist forest regions around 12,000 BP. The consequent reduction in size, coupled with a change in foraging behavior (*Cebuella* and *Callibella* seem to be more specialized in gouging tree barks than *Mico*), has led to sufficient ecological divergence to allow for their co-existence with larger callitrichines.

ON THE MORPHOLOGICAL DISTINCTIVENESS OF *CALLITHRIX HUMILIS* VAN ROOSMALEN *ET AL.,* 1998

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Abstract

The dwarf marmoset, described as *Callithrix humilis* by van Roosmalen *et al.* (1998), is an anomaly among Amazonian marmosets for its size, morphology and behavior. We compare cranial and mandibular characters of the dwarf marmoset with representatives of four other callitrichid genera. *C. humilis* displays qualitative differences in skull morphology when compared to other callitrichids, and a discriminant analysis of quantitative characters suggests that the dwarf marmoset is strongly distinct from all other Amazonian genera, including *Callithrix*. These differences are most pronounced in the morphology of the lower jaw and may reflect specialized feeding adaptations, although little is known of the dwarf marmoset's behavior in the wild.

Key Words – Primates, Callitrichidae, marmosets, *Callithrix humilis*, dwarf marmoset, *Callibella*, morphology, morphometrics, Amazonia.

Resumo

O sagüi-anão, previamente descrito como *Callithrix humilis* van Roosmalen *et al.,* 1998, é uma anomalia entre os sagüis da Amazônia por causa de tamanho, comportamento e morfologia. Comparamos carácteres cranianos e mandibulares do sagüi-anão com exemplares dos quatro outros gêneros de calitriquídeos. *C. humilis* exibe diferenças qualitativas na morfologia do crânio em comparação aos outros calitriquídeos, e uma análise discriminante dos carácteres quantitativos sugere que o sagüi-anão é marcadamente distinto de todos outros gêneros da Amazônia, incluindo *Callithrix*. Estas diferenças são mais acentuadas na morfologia da mandibula, e talvez refletam adaptações especializadas para alimentação, apesar de que o comportamento do sagüi-anão na natureza ainda ser pouco conhecido.

Palavras-Chave – Primatas, Callitrichidae, sagüis, *Callithrix humilis*, sagüi-anão, *Callibella*, morfologia, morfometria, Amazônia.

Introduction

The dwarf marmoset, first described as *Callithrix humilis* van Roosmalen *et al.*, 1998, is by far the most unusual of the seven new marmosets discovered in the Brazilian Amazon during the past decade. Its small size and atypical behavior make it an anomaly among classic marmosets; yet *C. humilis* is clearly both phenotypically and geographically distinct from *Cebuella pygmaea* as well. The original description offered several plausible alternatives for its taxonomic status, ranging from another species of *Cebuella* to a new genus of its own. Recent taxonomic reviews of the marmosets have elevated the two major species groups, the Amazonian and Atlantic Forest clades, to subgeneric (Groves, 2001) or full generic status (Rylands *et al.*, 2000), as *Mico* and *Callithrix* respectively—in each case recognizing that, given *Cebuella*'s closer relationship with the Amazonian clade, the latter must be considered as a full genus in order for *Cebuella* to be retained. Although van Roosmalen *et al.* (1998) originally described *C. humilis* as a conventional marmoset, albeit a peculiar one, further observation

has convinced them that it deserves recognition as a novel monotypic genus (van Roosmalen, 2002; van Roosmalen and van Roosmalen, 2003).

The dwarf marmoset is exceptionally difficult to observe in the wild—one reason why it remained unnamed until the close of the twentieth century—and the most detailed observations have been made on a very limited number of captive specimens (van Roosmalen and van Roosmalen, 2003). This original group has since died from a variety of causes, including an outbreak of yellow fever (van Roosmalen, pers. comm.), but the type specimen (MPEG 24769) and two paratypes (INPA 4090, INPA 4091) have been cleaned and preserved at the Museu Paraense Emílio Goeldi (Belém, Pará) and the mammal collections of the Instituto Nacional de Pesquisas da Amazônia (Manaus, Amazonas), respectively. These three specimens, each consisting of skin and skull, represent the only material yet available for making direct morphological comparisons with other callitrichids. A comparative analysis of cranial and mandibular morphology is essential to evaluate the

distinctiveness of this new species, and may also generate useful predictions concerning its ecology and feeding behavior in the wild.

Methods

As part of a larger project on callitrichid morphometrics and biogeography, we examined the three extant specimens of *Callithrix humilis* and compared them with other specimens of *Callithrix* and *Cebuella* held at MPEG and INPA, plus additional material representing *Callithrix*, *Saguinus* and *Leontopithecus* at the following institutions: the United States National Museum of Natural History (Smithsonian) in Washington, D.C.; the American Museum of Natural History in New York; the Rijksmuseum van Natuurlijke Historie in Leiden, the Netherlands; the Museu Nacional do Rio de Janeiro, Brazil; the Museu de Zoologia da Universidade de São Paulo, Brazil; the Swedish Museum of Natural History in Stockholm, Sweden; and the Humboldt Museum für Naturkunde in Berlin, Germany.

We measured all specimens to the nearest 0.01 mm with Mitutoyo Digimatic digital calipers, series/model 500-196. We measured a total of 32 characters from each specimen, except where precluded by damage; we did not take partial measurements on damaged features. (A list of measurement codes and descriptions is included in Appendix I.) To avoid issues of ontogenetic size change, we only examined adult specimens; our primary criteria for adulthood were fully fused cranial sutures and fully descended upper canines, supplemented by the presence of sharply defined superior temporal ridges. We log-transformed and analyzed the data using the Discriminant Analysis module of SPSS 11.0, running through Windows 2000 on a Dell XPS-R400 Pentium computer.

Results

Statistical Analyses
We compared the morphology of *C. humilis* with representatives of four other callitrichid genera: *Cebuella pygmaea, Callithrix chrysoleuca, Saguinus midas midas*, and one specimen each of the four species of *Leontopithecus*. (See Appendix II for a complete list of accession numbers.) The primary purpose of the initial morphological assessment was to evaluate the classification probabilities of the five genera. In an overall discriminant analysis of 17 cranial and mandibular characters, all four genera plus *C. humilis* were sorted into well-defined clusters differing markedly in both size and shape. All groups returned a 100% correct classification. Figure 1a shows a clear gradient of size along the axis of Function 1, with a secondary gradient of shape widely dividing *Callithrix* and *Saguinus* on Function 2. A similar pattern obtains in a comparison of cranial dimensions alone, using eight characters (Fig. 1b); in both cases *C. humilis* is closely allied to *Cebuella pygmaea*, yet is classified as entirely discrete.

When features of the mandible are compared separately (nine characters), a different pattern emerges which fur-
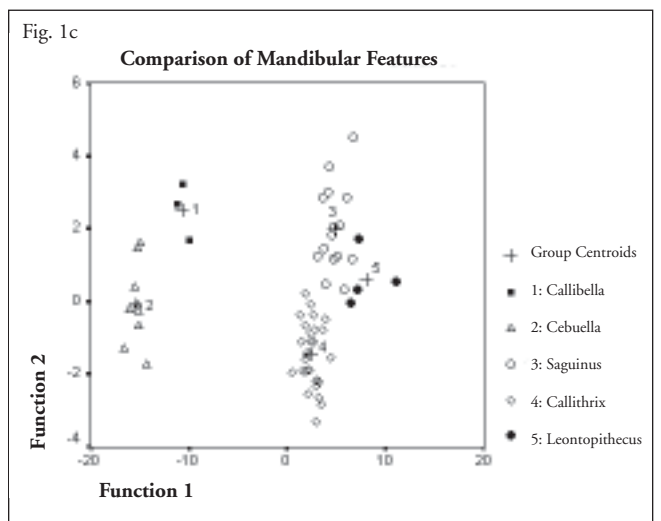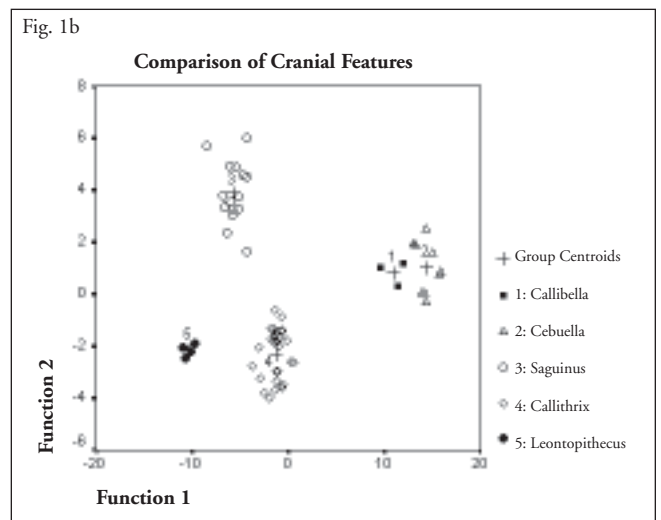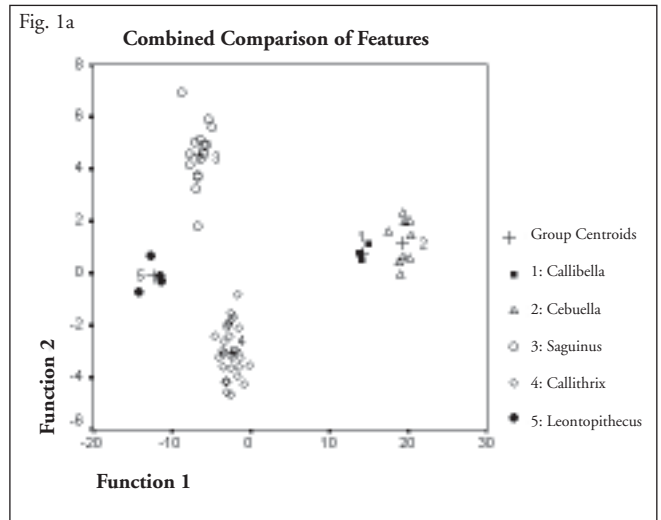

Figure 1. Discriminant plots of representative callitrichid taxa along gradients of size (Function 1) and shape (Function 2): a. combination of cranial and mandibular characters (17 total); b. cranial characters analyzed separately (8); c. mandibular characters analyzed separately (9).

ther separates *C. humilis* from *Cebuella* (Fig. 1c). The three larger genera—*Callithrix*, *Saguinus* and *Leontopithecus*—form a continuum of jaw shape, with a clear boundary between the exudate-gouging form of *Callithrix* and the non-gouging forms of *Saguinus* and *Leontopithecus*. There is also a recognizable gradient of size, with the latter two genera plainly larger than *Callithrix*. The dwarf and pygmy marmosets, meanwhile, are at an exceptional remove from the other callitrichids, isolated by their smaller size; yet *C. humilis* is further set apart on the dimensions of both size and shape. As expected from the visual examination, *C. humilis* separates out as slightly larger than *Cebuella*, and occupies a discrete subregion of morphospace. Intriguingly, *C. humilis* plots toward what might be considered the non-gouging axis, which might suggest that the dwarf marmoset is less reliant on active exudate-feeding than *Cebuella*, which is an extreme gum specialist (Soini, 1988).

Visual Examination

In his monumental description of the callitrichids, Hershkovitz (1977) gave the size of *Cebuella*—"smallest of known platyrrhines and absolutely smaller than all other callitrichids"—as its main diagnostic character, aside from a list of its ostensibly primitive features. Of marmosets, he admitted that "no single cranial character consistently separates *Callithrix* from *Cebuella* or *Saguinus*." Similarly, *C. humilis* shows no definitive cranial features which might easily distinguish it from classic *Callithrix* or *Cebuella*; the skull is significantly smaller than *Callithrix*, and visibly larger than *Cebuella*, but there are no structures or assemblies which are clearly unique. The mandible of *C. humilis*, however, is visually distinct from any other callitrichid, and is the focus of the comparative descriptions below.

When describing the shapes of callitrichid jaws, Hershkovitz (1977) concentrated on several key features: the height of the coronoid and condylar processes; the shape of the sigmoid notch between them; the depth of the angular process; and the overall shape of the ascending ramus (Fig. 2). When observed firsthand, these features combine to produce a gestalt impression of the characteristic jaw shape for each genus. The lower jaws of *Saguinus*, for instance, typically have a high, curving coronoid process with a "wavecrest" tip, above a compact, oval sigmoid notch and
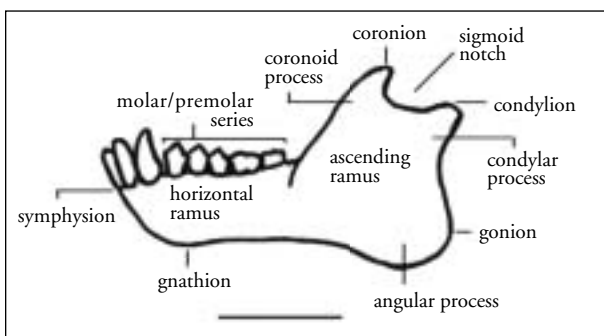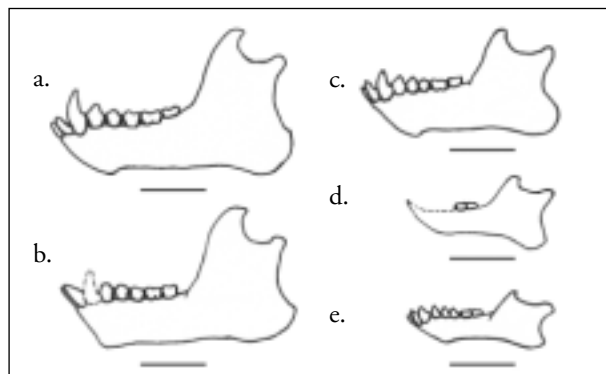
Figure 3. Jaws of representative callitrichid genera: a. *Leontopithecus*; b. *Saguinus*; c. *Callithrix*; d. *Callibella* (*sensu* van Roosmalen and van Roosmalen, 2003); e. *Cebuella*. Drawn from specimens at the Smithsonian National Museum of Natural History (a-c, e) and from a photograph by Stephen Nash (d). Scale bar = 1.0 cm.

a mandibular condyle positioned well above the toothrow plane (Fig 3b). *Leontopithecus* has a similar, slightly larger structure (Fig. 3a), and both tamarin genera display a nearly flat jaw base, with virtually no lower projection of the angular process.

The ascending ramus of a typical *Callithrix* jaw, by contrast, has a much lower coronoid process; there is a wider lateral separation between coronoid and condylar processes, with the sigmoid notch usually more of an open oval or a long, inclined fish-hook (Fig. 3c). The condyle is comparatively closer to the plane of the toothrow (though not quite as close as Hershkovitz implied, on p. 488) and the angular process is often a deep, rounded lobe beneath the jawline. *Cebuella* represents the extreme culmination of these trends: the coronoid process is modest, brief and shallow, with the most delicate of points; the sigmoid notch is wide open, more of a hyperbolic segment; and the condyle rides directly at or just above the molar plane (Fig. 3e). In *Cebuella* the angular process is sharp, lean and projects well below the baseline; the entire ascending assembly gives the impression of having been compressed and tilted from a *Saguinus*-like starting point, elongated and rotated downwards and aft. Following the genera in reducing size, the trend is for a lower and less arcuate coronoid; an increasingly wide and open sigmoid notch; a shallower condylar process, descending to meet the molar plane; and an angular process which extends ever deeper, creating an increasingly recurved jawline.

In this context, the jaw of *C. humilis* is intermediate in shape between *Callithrix* and *Cebuella* (Fig. 3d). The mandibular condyle is just barely above the occlusal plane, the coronoid just above that, with a shallow "fish-hook" sigmoid notch. The angular process, however, projects much lower than that of either *Cebuella* or *Callithrix*, and the composite of these features is immediately recognizable as a singular morphological package. In contrast with the *Cebuella* jaw, which is gracile and delicate, the jaw of *C. humilis* is comparatively robust, with lower canines that are visibly much larger than in *Cebuella*. The symphysial prow is not strongly procum-

Figure 2. A generalized callitrichid jaw, showing major features. Drawn from a specimen at the Smithsonian National Museum of Natural History. Scale bar = 1.0 cm.

bent as in *Cebuella*, but rather more vertical as in *Callithrix*; and in general the ascending ramus of *C. humilis* is not quite so angled and compressed as that of *Cebuella*.

In addition, *Cebuella* possesses another feature apparently unique to its genus: a strong, slender ridge on the inner face of each ramus, arising from the slight shelf interior to the gonion and running horizontally to just below each of the mandibular foramina. (This feature is distinct from the mylohyoid line, which originates from the inner edge of the mandibular condyle.) This feature is apparently unnamed (C. Groves, pers. comm.) and here we label it as the inner gonial flange. Although faint inner gonial flanges are frequently found in *Saguinus*, and often in *Callithrix*, they are never so exaggerated as in *Cebuella*—and *C. humilis* shows no trace of one.

Thus the mandible of *C. humilis* is set apart from that of *Cebuella* by several important features: the higher coronoid and condyle, the more vertical symphysial prow, the notably deeper angular process, the absence of any inner gonial flange, and a generally heavier aspect. If Hershkovitz were to write a description of the *C. humilis* mandible today, it might read something like this:

> "…ascending ramus broad, more or less oblong; average coronoidal height about 52% of condyloincisive length of mandible; coronoid process low, the rounded tip extending slightly above condyle; sigmoid notch broad and shallow; articular surface of condylar process hardly above the plane of molar crowns; inferior border of angular process deflected radically below basal plane of horizontal ramus."

Discussion

The dwarf marmoset, *Callithrix humilis*, was described as one among many new marmoset species discovered in the 1990s. Although the number of species-level taxa had more than doubled in the prior decade, this was almost entirely a result of the stepwise elevation of subspecies to full species status. Hershkovitz (1977) originally recognized only two species of marmosets from the Amazon basin: *Callithrix humeralifer* and *C. argentata*, with three subspecies apiece. Initially accepted without alteration (e.g., Mittermeier and Coimbra-Filho, 1981), this arrangement persisted throughout much of the 1980s. The first major change was the reassertion of *C. emiliae* by Mittermeier *et al.* (1988), a species which had been described by Thomas (1920) but later subsumed within *C. argentata* by Hershkovitz (1977). Earlier, de Vivo (1985) had noted the presence of a form of *Callithrix* in Rondônia, which he identified as *emiliae*; and following a morphometric survey of the genus, he treated *all* marmoset taxa as full species (de Vivo, 1991), which had the effect of more than tripling the recognized diversity of Amazonian marmosets—from the two species recognized by Hershkovitz (1977) to a total of seven.

Immediately afterwards, the first pair of new marmoset species was described: *Callithrix nigriceps* from Rondônia (Ferrari and Lopes, 1992) and *C. mauesi* from the Amazonian floodplain (Mittermeier *et al.,* 1992), the latter description adopting de Vivo's (1991) arrangement. Then Alperin (1993) described the new subspecies *C. argentata marcai*, later treated as a full species (Rylands *et al.*, 2000; Groves, 2001); and in 1998 two more new species were described, the distinctive *C. saterei* (Sousa e Silva and Noronha, 1998) and the singular *C. humilis* (van Roosmalen *et al.*, 1998). A final pair of *species novae*, *C. acariensis* and *C. manicorensis*, was described by van Roosmalen *et al.* (2000)—closing a decade of unexpected discoveries and bringing the complement of known Amazonian marmosets to a total of 14 species. Rylands *et al.* (2000) and Groves (2001), following de Vivo's (1991) lead, upheld the practice of considering all new taxa as de facto species. In addition, many researchers now believe the Rondônian *Callithrix*, which de Vivo (1985) had considered "*C.* cf. *emiliae*," to be another distinct species (L. Sena, pers. comm.), and the potential exists for additional discoveries in other, underexplored regions of the central Amazon.

In this rather heady context, the appearance of a new marmoset species unlike any other stimulated less discussion than it might otherwise have. *Callithrix humilis*, as it was originally described, is much closer in size to *Cebuella* than to other marmosets, but is set off from the pygmy marmoset by its bare ears, lack of full mane and a smoother, more even coloration. *C. humilis* is reported exclusively from a small region between the Rios Aripuanã and Manicoré, south of the Rio Madeira (van Roosmalen *et al.*, 1998; van Roosmalen and van Roosmalen, 2003). Wild sightings have been made principally along the western bank of the Rio Aripuanã, close to its convergence with the Madeira, which has led van Roosmalen *et al.* (1998) to consider its range "by far the smallest distribution of any primate in the Amazon" and of potential conservation concern.

When van Roosmalen *et al.* (1998) originally described the dwarf marmoset, they chose to include it within the genus *Callithrix*, but indicated that its unusual appearance and behavior had prompted them to consider a variety of taxonomic options—considering it either a form of *Cebuella*, or a separate species of *Callithrix*, or perhaps even a representative of a previously undescribed genus. After further explorations in the field, and prolonged observations of a captive group, van Roosmalen and van Roosmalen (2003) are now convinced it merits recognition as a new platyrrhine genus, for which they propose the name *Callibella*.

On purely morphological grounds, we would consider this to be appropriate. *Callibella*'s exceptionally small size clearly argues against combining it with other marmosets; and the distinctive features of its pelage and cranial morphology—in particular its unique mandibular design—separate it just as completely from *Cebuella*. Given this strong morphological differentiation from both *Cebuella* and the Amazonian marmosets, the case for a new genus

appears promising—although we recognize that a genus must be defined by its status as a monophyletic group (Groves, 2001) and that the separation of *Callibella* would be invalid if the remaining Amazonian marmosets (*Mico*, *sensu* Rylands *et al.*, 2000) were shown to be paraphyletic as a result. At present, however, we have no reason to suspect this, owing in part to a general scarcity of information on most aspects of its biology. Its remarkably elusive nature makes it difficult to locate and observe in the field (J. M. Aguiar, pers. obs.), and a long-term field study would help clarify our understanding of its distribution and behavior.

In the meantime, lacking comprehensive field data, can we generate predictions about its behavior from the morphological information now available? A range of studies have used cranial and mandibular characteristics to examine ecological trends in both extinct and extant organisms. The advantage of the latter is that their behavior may be observed in the field and directly correlated with morphological features, allowing for attempts at synthesis between ecological and morphological studies (e.g., Anapol and Lee, 1994; Dumont, 1997; Monteiro-Filho *et al.*, 2002). Although a number of studies have employed a deductive approach to explore the interaction of cranial morphology and ecological specialization (e.g., Hylander, 1979; Dumont, 1997; Vinyard *et al.*, 2003), some recent research has begun to integrate morphometrics and field ecology (Sicuro and Oliveira, 2002; Aguirre *et al.*, 2002), and cross-taxon comparisons may generate predictions which may be tested against both theoretical models and observations from the field (e.g., Williams and Wall, 1999; Aguirre *et al.*, 2003; Vinyard *et al.* 2003).

Although the jaw morphology of callitrichids is often quite variable within species (Aguiar and Lacher, 2002), certain trends may be seen between those marmoset species which rely heavily on exudate-feeding and those which do not. Amazonian marmosets such as *Callithrix humeralifer*, which feed more on fruits and insects and less on exudates (Stevenson and Rylands, 1988; Ferrari and Lopes Ferrari, 1989), often display a straighter, less arcuate jaw base, with the lobe of the angular process extending only minimally below the gnathion (Fig. 3c). Marmoset species from the Atlantic Forest clade, such as *C. jacchus* and *C. penicillata*, spend a greater proportion of their time parasitizing exudate sources (Lacher *et al.*, 1984; Kinzey, 1997); these species typically demonstrate a deeper angular lobe and a more strongly recurved inferior margin of the jaw. *Cebuella* likewise bears a strongly descending angular lobe, though more gracile in form, corresponding with the rest of the lightweight mandible. *Callibella humilis* also shows a prominent angular lobe—deeper than that of *Cebuella*—which by itself might suggest an emphasis on intensive exudate-gouging.

Another major feature differentiating callitrichid jaws is the position of the mandibular condyle in relation to the coronoid process, the sigmoid notch and the occlusal plane of the molars. In the larger-bodied callitrichids, the coronoid-condylar assembly rises high above the toothrow;

the sigmoid notch is tightly oval or nearly circular, and the coronoid process extends high above the condyle. (This reaches an extreme in *Saguinus bicolor*, whose coronoid blades sweep up and back like slender scimitars.) In the smaller, actively gouging *Callithrix*, however, the coronoids are much lower, closer to the level of the condyles, and the sigmoid notch opens out into a fish-hook shape. The condyle itself is still positioned above the toothrow, but lower than in the tamarins.

In *Cebuella*, the condyle is on a direct line with the occlusal surface of the lower molars, a dramatically different shape which seems to occupy the endpoint of a continuum beginning with the tamarins. In this context, *Callibella* is remarkable, as its coronoid-condylar assembly is intermediate between the sturdy, nearly level pattern of *Callithrix* and the gracile, sharply angled shape of *Cebuella*. If *Callibella* were merely another species of *Cebuella*, as its discoverers had once imagined, the mandible should show a similar morphology. That it does not, but rather displays a third, intermediate design, argues for a distinct ancestry and dietary habit which should be recognized taxonomically.

The distinctly lower condylar position of *Cebuella* and *Callibella* is congruent with the pattern of several other small, gum-feeding primates, notably *Phaner furcifer* and *Euoticus elegantulus*. In a new study on the morphology of exudate-eaters, Vinyard *et al.* (2003) examined the crania and mandibles of both gouging and non-gouging primates, including *Callithrix*, *Phaner*, *Euoticus*, *Galago* and *Cheirogaleus*. Although Vinyard *et al.* found virtually no morphological evidence for special strengthening in the skulls of gouging primates, they did detect a correlation between the height of the mandibular condyle and dietary reliance on gouging. According to their predictions, lower condyles should reduce the stretching of muscle fibers in the masseter and pterygoid, minimize the aft displacement of the jaw in motion, and increase the moment arm of the temporalis—the combination of which, according to Vinyard *et al.*, would help a gouging primate to produce more force in its bite, and presumably improve the efficiency of the gouging process.

This correlation between lower condyle position and active exudate-gouging is easily seen in callitrichids; the genera *Callimico*, *Saguinus* and *Leontopithecus*, which feed on available gum but do not stimulate its flow, all have mandibular condyles borne high above the occlusal plane of the teeth. Gouging marmosets—*Cebuella*, *Callithrix* and *Callibella*—bear condyles which are notably lower, and in both *Cebuella* and *Callibella* the occlusal plane passes through or directly beneath the condylar bulb. As noted above, this latter condition is also visible in *Phaner furcifer* and *Euoticus elegantulus*, which are well-established as archetypal exudate-feeders (Charles-Dominique, 1971; Hershkovitz, 1977; Nash, 1986). The extreme shift of the condyles and associated structures in *Cebuella* is almost certainly correlated with that species' reliance on gums as a staple food resource (Soini, 1988; Garber, 1992), and a

similar condition in *Callibella* may correspond to a parallel but less-pronounced focus on exudate-feeding.

Conclusions

The marmoset formerly known as *Callithrix humilis*, which van Roosmalen and van Roosmalen (2003) propose as the new genus *Callibella*, is morphologically distinct from all other marmoset and tamarin taxa. Discriminant analyses of cranial and mandibular characters all returned a 100% separation of groups. These differences are apparent on visual inspection, especially in the mandibular morphology, and aspects of the jaw structure appear to fit into general trends across the Callitrichidae. The dwarf marmoset is morphologically distinct from both *Callithrix* and *Cebuella* (presumably its nearest relatives) to an equal degree, and we consider its elevation to the genus *Callibella* to be an appropriate recognition of its exceptional nature.

Callibella's suite of craniomandibular traits, in turn, suggests a lifestyle somewhat similar to that of *Cebuella*, but perhaps with less of an emphasis on exudate-feeding. Van Roosmalen *et al.* (1998) reported a number of social, ecological and behavioral traits which seem unique to this genus, and which might imply a correspondingly unprecedented foraging niche. The dwarf marmoset's reported heavy reliance on a single tree species, *Didymopanax morototoni*, together with its restricted and potentially relict distribution, might suggest a closer coevolutionary link with a specific host tree than reported from any other marmoset; but only a full field study will provide the necessary ecological context for these initial speculations.

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Appendix I:
Baseline Morphometric Measurements

Code	Name	Description
CL	cranial length	Prosthion to rearmost point of cranium
OCP	occipital condyle-prosthion	Rear of left occipital condyle to prosthion
ZAZ	zygomatics at zygions	Width of zygomatic arches at zygions
SKW	skull width	Maximum skull width, at temporal ridges
OWC	orbital width at cyclosions	Maximum orbital width at cyclosions
BL	bregma-lambda	Distance from tripoint bregma to tripoint lambda
CONW	condylar width	Distance across base of occipital condyles
MW	molar width	Maximum width of upper molars, M1L-M1R
CW	canine width	Maximum width of upper canines, C1L-C1R
MSL-L	molar series length, left	Length of left upper molar/premolar row
MSL-R	molar series length, right	Length of right upper molar/premolar row
BN	bregma-nasion	Distance from tripoint bregma to tripoint nasion
PBG	prosthion-bregma	Distance from prosthion to tripoint bregma
NP	nasion-prosthion	Distance from prosthion to tripoint nasion
NL	nasion-lambda	Distance from tripoint nasion to tripoint lambda
PL	prosthion-lambda	Distance from prosthion to tripoint lambda
MWJ	molar width, jaw	Maximum width of lower molars, M2L-M2R
CWJ	canine width, jaw	Maximum width of lower canines, C1L-C1R
MSLJ-L	molar series length, jaw, left	Length of left lower molar/premolar row
MSLJ-R	molar series length, jaw, right	Length of right lower molar/premolar row
SGL-L	symphysion-gonion, left	Distance from symphysion to rearmost left gonial point
SGL-R	symphysion-gonion, right	Distance from symphysion to rearmost right gonial point
CJB-L	condylion-jaw base, left	Height from condylar knob to base of left jaw flange
CJB-R	condylion-jaw base, right	Height from condylar knob to base of right jaw flange
COR-L	coronion-jaw base, left	Height from coronion tip to base of left jaw flange
COR-R	coronion-jaw base, right	Height from coronion tip to base of right jaw flange
SCN-L	symphysion-condylion, left	Distance from symphysion to rearmost left condylion
SCOR-L	symphysion-coronion, left	Distance from symphysion to left coronial tip
SCN-R	symphysion-condylion, right	Distance from symphysion to rearmost right condylion
SCOR-R	symphysion-coronion, right	Distance from symphysion to right coronial tip
JWCR	jaw width, coronia	Maximum width between outer coronial tips
JWCY	jaw width, condylia	Maximum width between outer condylar knobs

Appendix II:
Specimens Examined

Callithrix chrysoleuca: AMNH: 91833, 91834, 91835, 91836, 91838, 91839, 92296; FMNH: 50821, 50822, 50828; MNRJ: 5947, 5948, 5950; MZUSP: 4886, 4892, 4976, 5008, 5022, 5028, 11410, 13466, 13467; SMNH: A611502, A611497, A611520, A611579. *Callithrix humilis:* MPEG: 24769; INPA: 4090, 4091. *Cebuella pygmaea:* AMNH: 74056, 74369, 75280, 76327, 76328, 182943, 182944; MPEG: 382, 26367. *Leontopithecus caissara:* MNRJ: 28861. *Leontopithecus chrysomelas:* MNRJ: 24573. *Leontopithecus chrysopygus:* HMNK: 304. *Leontopithecus rosalia:* NMNH: 337334. *Saguinus midas midas:* MPEG: 15269; RMNH: 20566, 20568, 20569, 20582, 20571, 20574, 20575, 20577, 20578, 20580, 22562, 22572, 24089, 22546.

Short Articles

A Report on a New Geographic Location of Red Uakaris (*Cacajao calvus ucayalii*) on the Quebrada Tahuaillo in Northeastern Peru

Nancy Swanson Ward
Janice Chism

The distribution of the red uakari (*Cacajao calvus ucayalii*) lies entirely in Peru, delimited by the Río Amazonas to the north, the Río Ucayali to the west, and the Río Yavari to the east (Hershkovitz, 1987; Heymann, 1992). Although the southern limit of the subspecies' range is believed to have once extended to the Río Urubamba (Hershkovitz, 1987), the evidence indicates that it is now limited to the Río Sheshea due to overhunting (Aquino, 1988). The red uakari's survival is seriously threatened throughout its range primarily due to hunting and loss of habitat (Aquino, 1988; Bartecki and Heymann, 1987), and *C. c. ucayalii* is listed as vulnerable on the *2002 IUCN Red List of Threatened Species* (Hilton-Taylor, 2002; Rylands *et al.*, 1997).

Although the red uakari's distribution has been tentatively established, its current status remains undetermined. In recent years, several published sightings have begun to provide better information about local population numbers. The majority were along the Quebrada Blanco and the Río Yavari corridor, within and to the east of the Reserva Comunal Tamshiyacu-Tahuayo (RCTT) in northeastern Peru (Aquino, 1998; Bartecki and Heymann, 1987; Heymann, 1990; Leonard and Bennett, 1995, 1996; Puertas and Bodmer, 1993). Others are from the Río Tapiche and its tributaries, approximately 300 km south of the RCTT (Aquino, 1988; Bennett *et al.*, 2001; Fontaine, 1979). Aquino (1988) reported an additional two troops in the area between the reserve and Río Tapiche (Fig. 1). Because most sightings are confined to these two main areas, documented encounters with wild troops of *C. c. ucayalii* elsewhere are important for a better indication of the actual numbers of wild *C. c. ucayalii*. With human intrusion slowly eradicating local populations of *C. c. ucayalii* (Aquino, 1988; Soini, 1982), it is imperative to assess existing populations before they decline further.

We conducted a preliminary survey of wild troops of *C. c. ucayalii* in and around the Reserva Comunal Tamshiyacu-Tahuayo over 13 days between 30 May and 23 June, 2001.
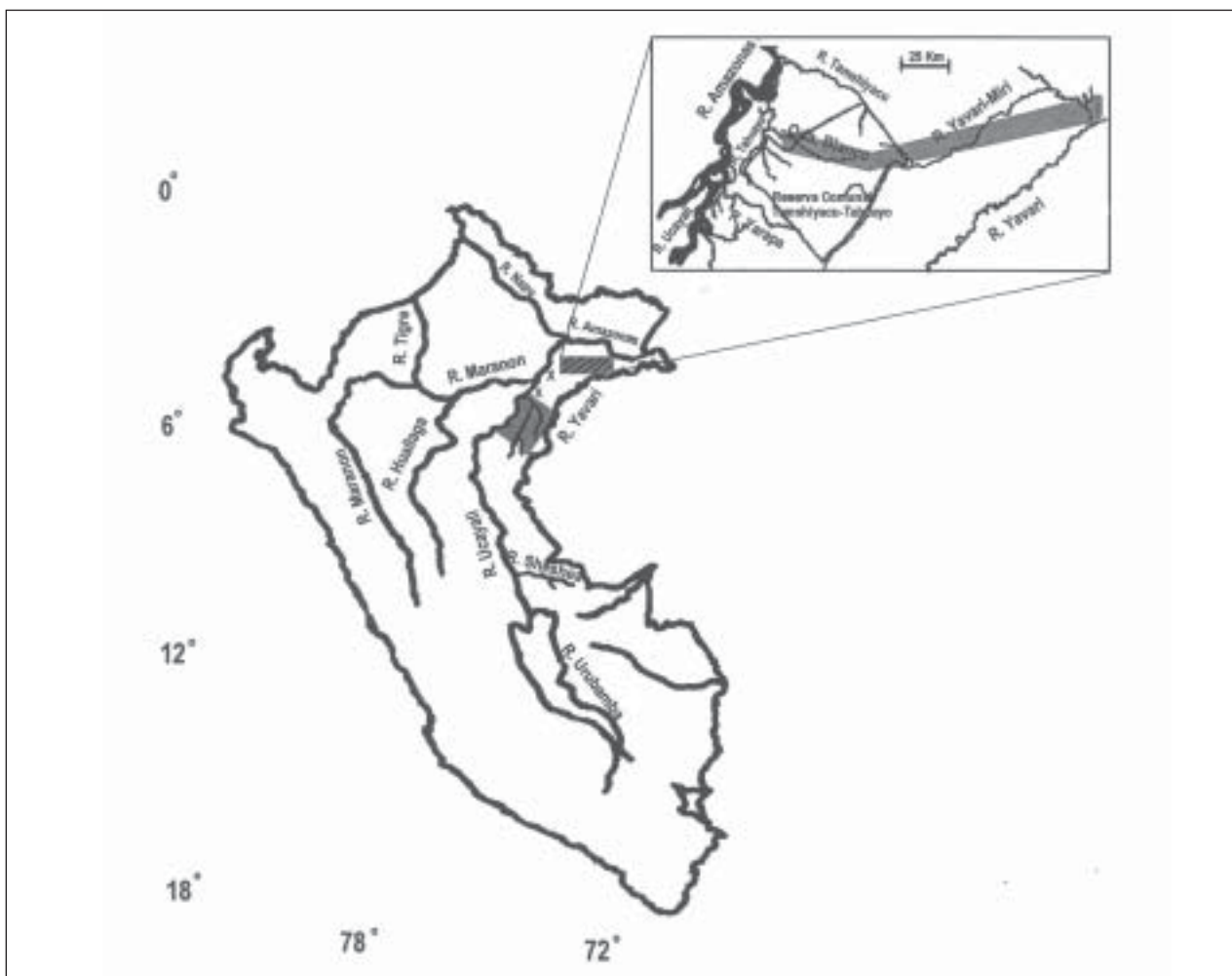
Figure 1. Location of documented sightings of *C. c. ucayalii* – Quebrada Blanco/Río Yavari corridor, and the Río Tapiche area. Two additional sightings between the two main locales are indicated by an "x". (Inset map modified from Bodmer *et al.*, 1997.)
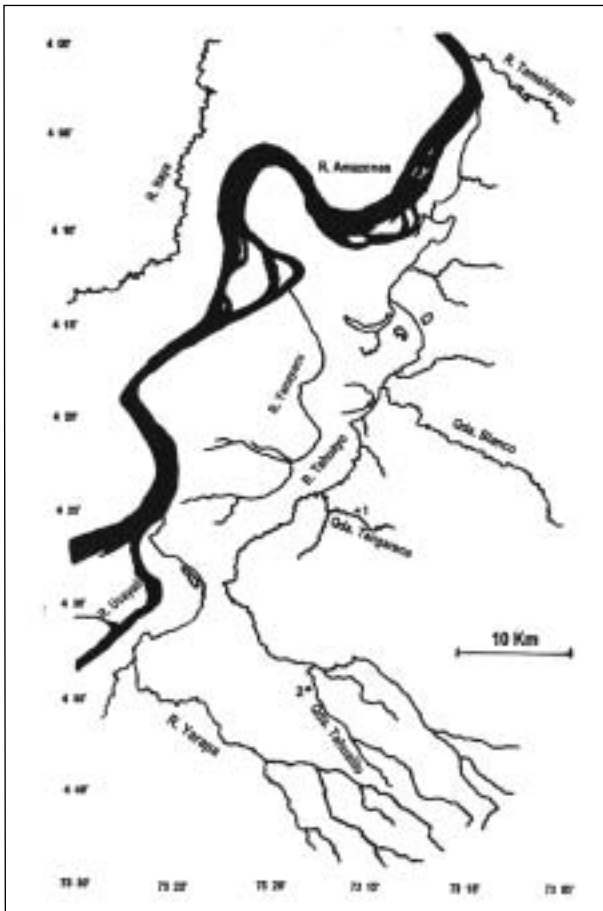
Figure 2. Area of our sightings of *C. c. ucayalii* during our survey. 1. Quebrada Tangarana, 2. Quebrada Tahuaillo.

The primary aim was to identify an area for a long-term study. We searched for *C. c. ucayalii* at various sites along the Quebrada Tangarana, Quebrada Blanco and Quebrada Tahuaillo, tributaries of the Río Tahuayo. Quebrada Tangarana and Quebrada Tahuaillo are black-water streams, while Quebrada Blanco is classified as a white-water stream. We traveled by motorboat and canoe 1-2 days up these tributaries to each destination, and hiked 6-10 hours per day into the forest with two experienced guides. Only the Quebrada Blanco site had trails. Once we encountered a uakari troop, we followed it and recorded *ad libitum* (Altmann, 1974) information on group size, group composition, location, time of day, vocalizations, and as much behavioral data as possible. Geographical coordinates were obtained using a Garmin GPS 12 global positioning system. Terms used for vocalizations are based on Fontaine's terminology (1981).

We located two troops in the course of the survey. We encountered a troop of *C. c. ucayalii* on 3 June 2001 at 04° 24'S, 73° 17'W on the Quebrada Tangarana (Fig. 2). The terrain there consists of undulating hills with primary terra firme forests. At 0957 h, our tracker heard distant contact calls of the uakaris, and we located the troop by following their vocalizations. These were mostly 'hic', with intermittent 'chick' contact calls. We observed the monkeys traveling rapidly in the mid- to upper-level of the canopy. Troop size was estimated at 70 individuals of mixed age/sex classes including both adults and immatures. Three different

bouts of screeching 'wa' vocalizations were heard. This call, emitted by the recipient of aggression (Fontaine, 1981), is usually associated with fights. Immediately after hearing one set of these calls, we saw an adult male displaying aggressively by jumping back and forth at the top of a tree and branch-shaking. After three seconds he stopped and looked in our direction.

At 1044 h, while we watched from 50-75 m away, the troop stopped to rest. Most individuals were hidden among the leaves so we could not accurately estimate group spread. All vocalizations ceased except for an occasional contact call. At 1112 h, we tried to move closer, but the troop dispersed. As the monkeys were moving away, they resumed contact calling, but in a more urgent manner (rapid, staccato 'hic' calls, interspersed with an increased frequency of 'chick' and loud 'chyook' calls). At one point, the troop briefly split into two contingents. As the front subgroup moved away, individuals in the rear subgroup stopped and vocalized. Loud and urgent 'chyook' calls were given by individuals which hesitated before jumping across to the next tree, while individuals behind them emitted 'hic' and 'chick' calls. Eventually, some individuals jumped into adjacent trees and the rest followed. We heard three more bouts of the screaming 'wa' vocalizations but again did not see any altercations. At 1400 h, we saw 10 woolly monkeys (*Lagothrix lagothricha*) traveling in the same direction as the uakaris. Previous field researchers have reported *C. c. ucayalii* in frequent associations with this species (Aquino, 1998; Leonard and Bennett, 1996).

The second encounter occurred on the Quebrada Tahuaillo on 22 June 2001 (04° 33'S, 73° 19'W) (Fig. 2) in swamp forest containing many *aguaje* palm trees (*Mauritia flexuosa*). The nearest settlement is Nuevo Jerusalem, a small Jivaro Indian village about 15 km downstream on the Río Tahuayo. At 1544 h, we heard a uakari troop moving through the canopy in the distance. When detected this troop was very quiet, with few contact calls as it traveled slowly towards us in the mid- to upper-level of the canopy. The troop numbered approximately 80 individuals spread over some 100 m, foraging as a single unit. It contained a mix of age/sex classes, including at least two infants each clinging dorsally to adult females.

We saw three individuals feed on *aguaje* fruits by clinging to the side of a strand of hanging fruits, one individual at a time. When one climbed away, another would take its place, plucking a fruit, eating it for a second or two, then dropping it. As the uakaris traveled and fed in the middle and upper canopy, they dropped so many fruits from several different species of trees that it sounded like heavy rainfall. As the troop eventually became aware of us, it moved off at a faster pace—but not as hurriedly, or noisily, as the troop encountered earlier on the Quebrada Tangarana. The Tahuaillo troop seemed more tolerant of our presence, possibly because it was headed towards its sleeping trees. We followed it in a wide loop until it stopped moving at 1750 h, when the area suddenly became quiet. We waited until 1800 h (almost dark), when they were settled, before

approaching them. One individual was in a *machimango* tree (*Eschweilera* sp.), and a female with a juvenile was in a mimosa tree (*Mimosa* sp.), all three at approximately 25 m high. The uakaris covered a distance of approximately 2 km during our observations. Fruits they consumed during this time (identified by the guide) included those of *aguaje* (*Mauritia flexuosa*), *pashaco* (*Parkia* sp.), *naranjo podrido* (*Parahancornia* sp.), *machimango* (*Eschweilera* sp.) and *shimbillo* (*Inga* sp.).

These are the first documented sightings of *C. c. ucayalii* on the Quebradas Tangarana and Tahuaillo. The Quebradas Blanco and Tangarana run parallel to each other in an easterly direction into the reserve and are about 10 km apart (Fig. 2). Although based on a very small sample (n = 4), Leonard and Bennett (1996) estimated an average daily travel path of 7.3 km and a home range of 3,000 ha. Thus, it is possible that the Tangarana troop was the same one that others have seen in the Reserva Comunal Tamshiyacu-Tahuayo on the Quebrada Blanco. The Quebrada Tahuaillo troop, on the other hand, was southwest and outside of the RCTT, and so represents the first documentation of *C. c. ucayalii* between the black-water Río Tahuayo (west side) and white-water Río Yarapa.

The local *C. c. ucayalii* populations are hunted. On the Quebrada Blanco, we met a local hunter carrying a dead female that he had shot an hour's walk from our camp. The next day we searched unsuccessfully for the group. Later, two tourists informed us that they met a hunter carrying two dead red uakaris at the same campsite a few days after we left. As we returned from our surveying trip to Quebrada Tahuaillo we encountered a Jivaro Indian at Nuevo Jerusalem who told us he had shot three (a male and two females, one with an infant) while hunting the previous week. Infant red uakaris are kept as pets in this area. An employee at Tahuayo Lodge and a villager at Jaldar Village on the Río Yarapa each possessed a female infant. Four male *C. c. ucayalii*, two subadults and two juveniles housed at a lodge on the Río Yarapa, were all obtained as infants when their mothers were killed by Jivaro Indian hunters on the Río Tahuayo.

Subsistence hunting is important for indigenous peoples in Amazonia (Peres, 1990), and the larger cebids are especially vulnerable. They are preferred because the quality and quantity of their meat makes hunting them cost-effective. Their populations are the first to be depleted and, in some cases, locally extirpated, and the slow reproductive rates of many cebids may hinder their chances of recovery (Mittermeier, 1987; Peres, 1990). Populations of the larger primates in the Río Tapiche basin and the Quebrada Blanco-Río Yavari corridor have declined dramatically. Puertas and Bodmer (1993) reported that the biomass of cebids in the more populated Tahuayo-Blanco area was only about half that of the less populated Río Yavari-Miri area, while that of callitrichids was similar. Over an 18-year period, populations of the larger primates in the Tapiche basin have also declined, while those of smaller primates stayed constant (Bennett *et al.*, 2001). Red uakaris may now be experiencing the same fate as the larger primates,

due to being 'next in line' in terms of body mass after the woolly (*Lagothrix* sp.), spider (*Ateles* sp.), and howler (*Alouatta* sp.) monkeys. Based on our observations and verbal accounts of hunted red uakaris around the Reserva Comunal Tamshiyacu-Tahuayo area, and our encounter with only one troop of woolly monkeys and no howler or spider monkeys, we believe that this is exactly what is happening. The *C. c. ucayalii* population in this area may be seriously threatened.

A management plan developed in the early 1990s as part of the conservation program for the Reserva Comunal Tamshiyacu-Tahuayo proposed that local market-hunters harvest only male artiodactyls and large rodents. Primates are apparently hunted mainly for subsistence rather than for sale in the market, and the model depended on substituting them with female artiodactyls and large rodents. It was hoped that this strategy would limit hunting of primates (Puertas and Bodmer, 1993), but from our observations this is not evident.

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Chest Circumference Differs by Habitat in Costa Rican Mantled Howler Monkeys: Implications for Resource Allocation and Conservation

Clara B. Jones

Introduction

Primates exhibit a significant degree of morphological variability within species (Fleagle, 1999); however, few studies have quantified this variation in relation to habitat differences, or examined its consequences. With the exceptions of human beings (*Homo sapiens*: e.g. Sundaram *et al.*, 1995) and, arguably, the genus *Pan* (Boesch *et al.*,

2002) and howlers (*Alouatta* spp.: e.g. Crockett, 1998; Jones, 1997), the functional ecology underlying phenotypic plasticity has received little attention by primatologists (but see Kappeler and Pereira, 2003; Jones and Agoramoorthy, 2003). In this brief communication, I present data showing that chest circumference is significantly smaller in adult male and female Costa Rican mantled howler monkeys (*Alouatta palliata*) in severely degraded habitat. These results have important implications for the conservation of threatened primates. Moreover, they may indicate the existence of developmental tradeoffs between energetic investment in cardiopulmonary structures on the one hand, and survival, growth, and/or reproduction on the other.

Methods

Morphometric data (weight, tail-to-crown length, length of tail, length of pubis, length of arm, circumference of chest, in addition to age) were collected in the mid-1970s at Hacienda La Pacifica, Cañas, Guanacaste, Costa Rica (10°18'N, 85°07'W) by Dr. Norman J. Scott, Jr. and his assistants, including the present author (Scott *et al.*, 1976). Marked animals (120 adult females, 36 adult males) were censused and measured in three habitats of tropical dry forest (Frankie *et al.*, 1974): riparian (canopy cover estimated at 65-100%), deciduous (canopy cover 40-75%), and a degraded secondary habitat contiguous to irrigation ditches (canopy cover 10-45%), which were constructed consequent to anthropogenic perturbation for the purposes of farming and cattle ranching. Some of the numbers (n) reported below are smaller than the total numbers of individuals for each sex measured because some data sheets were incomplete. *Alouatta palliata*, which has been classified as a "diurnal arboreal folivore", is wholly herbivorous (primary consumer), preferring new leaves, flowers, and fruit (Crockett and Eisenberg, 1987; Glander, 1975; Jones, 1996). All tests are two-tailed.

Results

For the sample as a whole, there was no significant difference between habitats in the proportion of each of four age classes represented in the sample (Chi Square test of independence: $\chi^2 = 6.6985$, df = 6, p = 0.350). There was a highly significant correlation between weight (g) and habitat for males (r = -0.5424, p < 0.003, n = 21) but not for females, possibly consistent with the view that females are "energy maximizers" (Schoener, 1971), working to obtain some threshold level of nutritional requirements despite variations in habitat quality. Males in the (presumably) poorest habitat (irrigation) weighed, on average, less than (5333.13 g, n = 15) males in riparian (5912.00 g, n = 10) or deciduous (5755.45 g, n = 11) habitat, a comparison approaching significance ($F_{2,33} = 3.1413$, p = 0.056), supporting the view that males are not investing a significant portion of their "fitness budget" in feeding (Schoener, 1971; also see Trivers, 1972). On average, female weight did not differ by habitat (irrigation:

4439.44 g, n = 39; deciduous: 4554.57 g, n = 37; riparian: 4530.91 g, n = 44; $F_{2,117}$ = 0.8602, n.s.).

Chest circumference (cm) correlated highly with habitat for both adult females (r = -0.1851, p = 0.021, n = 89) and males (r = -0.3273, p = 0.024, n = 21). For adults of both sexes, an ANOVA demonstrated that mean chest circumference was smallest in irrigation habitat (n = 39 females and 14 males), somewhat larger in riparian habitat (n = 44 females and 10 males), and largest in deciduous habitat (n = 37 females and 11 males). Chest size, however, was significantly smaller on average in the irrigation habitat only for females ($F_{2,117}$ = 3.5986, p = 0.03). No other comparisons of morphometric data were significant.

Discussion

The results presented here lead to two primary conclusions deserving further study. First, habitat—and presumably diet—appear to influence weight, probably through mechanisms of energy allocation (see Nagy *et al.*, 1999). Although mean weight x habitat did not reach significance in this study, a clear trend was evident, with mean weight decreasing from deciduous to riparian to irrigation habitats, possibly indicating differences in habitat quality and/or dietary habits of the animals across the three forest types. Future studies of functional ecology in howlers need to investigate possible differences in reproductive success as a function of habitat and the possibility of habitat selection in this species.

The finding that chest circumference is significantly smaller in the most degraded habitat may provide documentation of a tradeoff in the allocation of resources (energy) between cardiopulmonary function and some other structure or function related to survival, growth, or reproduction (see, for example, Sundaram *et al.*, 1995; Emlen, 1997; West-Eberhard, 2003). That adult females and males in deciduous habitat were found to have the largest chest circumference—and, it is proposed, the greatest allocation of resources to cardiopulmonary function in this regime—is also of interest. An investigation of the structural and functional costs associated with habitat heterogeneity, and in particular habitat disturbance, may enhance our understanding of the abiotic and biotic (including social) risks impacting population viability of mantled howlers and other primates. Studies of functional ecology are important for the conservation of endangered primates, since habitat destruction may lead to fundamental changes in the energetics of organisms, including their capacity to grow, survive, and reproduce.

Acknowledgments

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Reporte Preliminar Sobre el Uso de Recursos Alimenticios por Una Tropa de Monos Aulladores, *Alouatta palliata*, en El Parque La Venta, Tabasco, México

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Berenice Franco, Miguel Magaña, Yenit Decena
David Muñoz and Yasminda García

Introducción

En la parte septentrional de Mesoamérica, el estado de Tabasco es único por resguardar poblaciones representantes de las tres especies de primates que existen en México: *Alouatta palliata, A. pigra* y *Ateles geoffroyi* (Smith, 1970; Horwich y Johnson, 1986; Rylands *et al.*, 1995). Originalmente, cerca del 60% de la superficie del estado (24,141 km²) estaba cubierta por selvas, pero como resultado de la actividad humana, cerca del 80% de estos ecosistemas han desaparecido a una tasa de 600 km² ó más al año, siendo las tierras bajas en donde ha ocurrido la mayor transformación de la selva a pastizales, a otros agrosistemas y a áreas abiertas causadas por la explotación petrolera (Masera, 1996; SEMARNAP, 1999; INEGI, 1996).

La conservación de los primates silvestres de Tabasco es un problema íntimamente ligado a la destrucción de las selvas en esta entidad. La falta de información en el estado acerca de la distribución geográfica actual y tamaño de las poblaciones y la falta de datos sobre la historia natural, ecología, conducta y estado de conservación de las tres especies de primates dificulta su conservación. Este trabajo reporta los resultados de un estudio parcial sobre los patrones de alimentación de una tropa de monos aulladores (*Alouatta palliata*) existente en el Parque La Venta, localizado en la parte central de la ciudad de Villahermosa en Tabasco.

Métodos

Sitio de estudio

El Parque Museo La Venta está ubicado en el centro de la ciudad de Villahermosa (18º20'N, 93º18'O) a una altura de 10 m sobre el nivel del mar. El clima es cálido y húmedo, la precipitación media anual oscila entre 1600 y 2000 mm y la temperatura media anual varía de 22º a 26º C. El Parque, fundado en 1958, cubre una superficie de 8.0 ha, de las que 6.0 ha están forestadas. Aún cuando en el sitio existía vegetación selvática residual, se sembraron especies arbóreas y no arbóreas externas al Neotrópico, dando como resultado un área de vegetación heterogénea, compuesta por vegetación nativa e introducida. Algunas de las especies arbóreas nativas que predominan en el sitio son *Vochysia hondurensis, Cedrela odorata, Pouteria zapota, Ceiba pentandra* y *Bursera simaruba*. Entre las especies arbóreas introducidas sobresalen *Byrsonina crassifolia, Mangifera indica, Delonix regia, Pimenta dioica* y *Citrus sinensis* (Capello y Alderete, 1986).

Sujetos de estudio

En el Parque existe una tropa de monos aulladores cuyo origen no está documentado, pero se conoce su existencia desde la fundación del Parque a fines de los años cincuenta. Actualmente, la tropa está constituida por 15 individuos (dos machos adultos, ocho hembras adultas, dos juveniles y tres infantes).

Observaciones de los monos aulladores

Las observaciones del comportamiento de alimentación de los aulladores se llevaron a cabo durante ocho días de cada mes entre febrero y junio de 2001. Con el objeto de refinar los procedimientos de registro del comportamiento de alimentación de los monos aulladores, se llevó a cabo un muestro piloto dos meses antes del inicio del estudio. En este periodo se hicieron pruebas de confiabilidad entre observadores para establecer concordancia en las conductas registradas. El método de muestreo empleado en las observaciones fue el de animal focal (Altmann, 1974) y el tiempo de duración de la muestra focal para individuos representantes de cada clase de edad y sexo en la tropa (machos adultos, hembras adultas, juveniles e infantes) fue de 10 minutos. Los observadores (EF, BF y YD) se turnaron para la realización de las observaciones focales y éstas se concentraron durante las horas de mayor actividad alimentaria de los aulladores (0700-0100 hrs y 1600-1800 hrs), tratando de balancear las muestras obtenidas durante estas horas del día. Durante la muestra focal se registró el tiempo dedicado a cada una de las siguientes actividades generales: descanso, alimentación, locomoción, interacciones sociales y viaje. En el caso del comportamiento de alimentación, se especificó la parte consumida (hojas jóvenes, hojas maduras, frutos jóvenes, frutos maduros y flores) y se marcó e identificó, a nivel de especie, la planta de la cual se alimentaron. La distancia viajada por los individuos fue medida con un pédometro y el viaje se definió como el desplazamiento del individuo sincronizado con el del resto de la tropa de un árbol o grupo de árboles a otros y en donde la distancia recorrida excedía 20 m. A los árboles utilizados como fuente de alimento se les midió la altura y el diámetro a la altura del pecho (1.30 m). Cuando el comportamiento fue viaje, aparte de la duración de éste, se midió la distancia recorrida en metros.

La localización de los árboles utilizados por los aulladores se indicó en un mapa a escala del sitio de estudio. La

Tabla 1. Especies de plantas utilizadas como fuente de alimento (febrero – junio 2001) por los monos aulladores del Parque La Venta, Tabasco, México. Se muestra el porcentaje de tiempo que los aulladores pasaron alimentándose de cada parte de la planta. Las especies están listadas de acuerdo al porcentaje de tiempo total de alimentación registrado para cada una. La letra (I) indica especie foránea al Neotrópico. HJ – hojas jóvenes, HM – hojas maduras, FJ – frutos jóvenes, FM – frutos maduros, FL – flores.

Especie	Familia	HJ	HM	FJ	FM	FL	Total
		%	%	%	%	%	min
Mangifera indica (I)	Anacardiaceae	13.9	13.3	12.5	58.0	0.2	486.8
Ficus benjamina (I)	Moraceae	11.4	15.4	27.6	4.0		344.7
Andira galeottiana	Fabaceae	16.5	14.5				311.5
Casearia silvestris	Flacourtiaceae	12.0	3.9				192.3
Inga spuria	Mimosaceae	6.0	11.8				152.4
Tabebuia rosea	Bignoniaceae	1.4	2.7			71.9	138.1
Ceiba pentandra	Bombacaceae	6.3	6.8			28.0	134.5
Coccoloba barbadensis	Polygonaceae	2.2	6.8	21.3			98.4
Luehea speciosa	Tiliaceae	2.0	10.6	2.6			86.6
Xylopia frutescens	Annonaceae	1.6		27.6	4.0		79.6
Andira inermis	Fabaceae	4.0	3.7				76.7
Cecropia obtusifolia	Cecropiaceae	3.7	2.3				66.3
Vochysia hondurensis	Vochysiaceae	3.5	0.3	0.2	2.0		63.2
Tabernaemontana arborea	Apocynaceae	0.2			18.0		63.2
Enterolobium cyclocarpum	Fabaceae	3.3					49.2
Muntingia calabura	Elaeocarpaceae	2.2	0.7	4.8	0.0		44.6
Lysiloma bahamensis	Fabaceae	2.4					37.1
Bursera simaruba	Burseraceae	2.0	0.4				31.2
Delonix regia (I)	Fabaceae	1.6					24.0
Gliricidia sepium	Fabaceae	1.4	0.2				23.0
Lonchocarpus hondurensis	Fabaceae		3.0				13.7
Tamarindus indica (I)	Fabaceae	0.8					12.2
Syngonium podophyllum	Araceae		2.0				10.0
Trichilia havanensis	Meliaceae	0.1	1.6				9.4
Pachira aquatica	Bombacaceae			5.5			8.0
Sterculia apetala	Sterculiaceae	0.5					7.1
Calliandra houstoniana	Fabaceae	0.4	0.0				6.5
Guazuma ulmifolia	Sterculiaceae	0.1					6.2
Morinda citrifolia (I)	Rubiaceae	0.4					5.4
Cupania dentata	Sapindaceae	0.2					3.3
Haematoxylum campechianum	Fabaceae	0.0					0.3

diversidad mensual en la dieta de los aulladores se expresó por medio del índice de diversidad de Shannon (H´) y la similitud intermensual en el uso de especies se expresó por medio del índice de Sorensen (Brower y Zar, 1981; Ludwig y Reynolds, 1988). Con el objeto de determinar si la dispersión en el espacio de los árboles usados por los aulladores como fuente de alimento era al azar, uniforme o agregada, se uso el índice de Morisita (Brower y Zar, 1981). Para calcular este índice, se trazaron tres transectos en el mapa del sitio de estudio, uno de 25 x 325 m N-S y dos transectos de 25 x 500 m E-O que fueron divididos en cuadrantes de 25 x 25 m. Los árboles utilizados por los aulladores que quedaron ubicados en estos cuadrantes fueron contados obteniéndose los datos para el computo del índice de Morisita. Los datos sobre alimentación se expresaron como porcentajes del total de tiempo de alimentación registrado durante las observaciones. Para

la determinación de asociaciones entre variables se usó el coeficiente de correlación de Spearman (r_s).

Resultados

Muestreo
Durante el periodo de estudio se completaron 2691 muestras focales. Las muestras focales se repartieron del siguiente modo entre los representantes de las diferentes clases de edad y sexo presentes en el grupo: hembras adultas 42%, machos adultos 32%, juveniles 14% e infantes 12%.

Recursos utilizados
Los aulladores utilizaron como fuente de alimento 133 árboles (altura media 11.0 ± 3.0 m; diámetro medio a la altura del pecho 0.40 ± 0.23 m; r_s entre estas dos variables = 0.90, p < 0.001) de 30 especies representando a 20 familias

botánicas. Los monos también se alimentaron de las hojas de una trepadora *Syngonium podophyllum* (Araceae). Las especies arbóreas nativas utilizadas como fuente de alimento por los aulladores estuvieron representadas por 26 especies (17 familias) y las introducidas por cinco especies (cuatro familias) (Tabla 1). Cuatro especies de árboles (*Mangifera indica, Ficus benjamina, Andira galeottiana* y *Casearia silvestris*) contribuyeron al 50% del tiempo registrado en alimentación y al 42% de los árboles utilizados (Tabla 1), y cuatro especies adicionales (*Inga spuria, Tabebuia rosea, Ceiba pentandra* y *Coccoloba barbadensis*) aportaron un 20% del tiempo de alimentación y contribuyeron al 18% de los árboles utilizados (Tabla 1). El resto de las especies (n = 18) contribuyeron al 30% restante del tiempo de alimentación y al 40% de los árboles registrados (Tabla 1). El tiempo de alimentación estuvo asociado positivamente al número de árboles usados por especie (r_s = 0.80, p < 0.008).

Las familias botánicas que sobresalieron en la dieta de los aulladores fueron Fabaceae, Anacardiaceae y Moraceae. Las especies en estas familias contribuyeron al 54% del tiempo de alimentación registrado y al 50% de los árboles utilizados; diez especies en la Fabaceae aportaron el 22% del tiempo de alimentación, una especie en la Anacardiaceae aportó el 19% y una especie en la Moraceae contribuyó con el 13%.

Selectividad en el consumo de hojas, frutos y flores
El consumo de hojas por los monos aulladores de La Venta contribuyó al 76% del tiempo de alimentación registrado, los frutos contribuyeron al 19% y el consumo de flores aportó el 5%. Las hojas jóvenes aportaron el 57% del tiempo de alimentación, las hojas maduras el 19%, los frutos maduros el 13%, los frutos jóvenes el 6% y las flores el 5%. Los monos utilizaron 28 especies de árboles como fuente de hojas jóvenes, pero cuatro de éstas (*Mangifera indica, Ficus benjamina, Andira galeottiana, Casearia silvestris*) contribuyeron al 54% del tiempo de alimentación. El tiempo empleado por los aulladores en el consumo de hojas jóvenes se encontró asociado positivamente con el número de árboles usados por especie (r_s = 0.98, p < 0.05), sugiriendo una búsqueda activa de árboles de las principales especies utilizadas como fuente de alimento. En el caso de las hojas maduras, los aulladores utilizaron 19 especies de plantas y cinco de éstas (*Andira galeottiana, Ficus benjamina, Mangifera indica, Luehea speciosa* y *Inga spuria*) contribuyeron al 60% del tiempo de alimentación (Tabla 1).

Ocho especies constituyeron la fuente de frutos jóvenes para la tropa y dos de éstas, *Xylopia frutescens* y *Ficus benjamina,* contribuyeron a un poco más del 50% del tiempo de alimentación. El consumo de frutos maduros fue más importante que el de frutos jóvenes, consumiendo los frutos maduros de seis especies, entre las que sobresale *Mangifera indica,* ya que contribuyó al 58% del tiempo de alimentación. Los tipos de frutos utilizados por los aulladores fueron cápsulas (*Xylopia frutescens, Luehea speciosa, Vochysia hondurensis, Pachira aquatica, Tabernaemontana arborea*), drupas (*Coccoloba barbadensis, Mangifera indica*), bayas *(Muntingia callabura)* y siconios *(Ficus benjamina).* En el
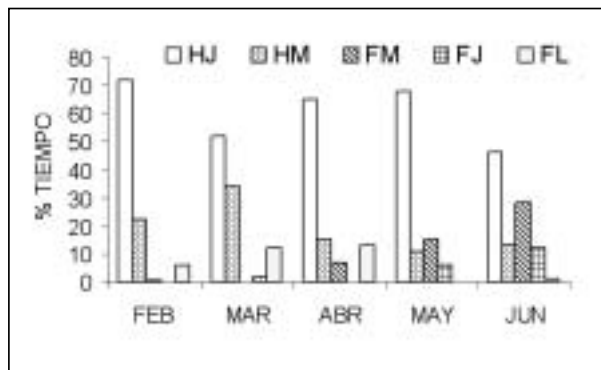

Figura 1. Variaciones mensuales en el consumo de hojas, flores y frutos por parte de la tropa de monos aulladores en el Parque La Venta, Tabasco, México. Notese que el consumo de hojas jóvenes predominó sobre las otras partes en todos los meses del período de estudio y que el consumo de frutos maduros y de flores fue marcadamente estacional. HJ – hojas jóvenes, HM – hojas maduras, FJ – frutos jóvenes, FM – frutos maduros, FL – flores.

caso del consumo de flores, los aulladores se alimentaron de tres especies, pero la especie *Tabebuia rosea* contribuyó al 71 % del tiempo de alimentación (Tabla 1).

Variación mensual en la dieta de los aulladores
El número medio de especies nuevas acumuladas mensualmente en la dieta de los aulladores fue de 6.0 (rango 1 a 13), pero en los dos primeros meses de muestreo se acumularon 24 (80%) de las 30 especies utilizadas. El consumo de hojas jóvenes predominó sobre el de hojas maduras en cada uno de los meses comprendidos en el estudio, pero cuando en el mes de marzo disminuyó el consumo de hojas jóvenes, se manifestó un incremento en el consumo de hojas maduras (Fig. 1). El consumo de flores y frutos maduros fue marcadamente estacional, siendo las primeras predominantes en los meses de febrero a abril y los segundos en los meses de abril a junio. El consumo de frutos jóvenes predominó en los meses de mayo y junio (Fig. 1). La diversidad media mensual (H′) en la dieta de los aulladores fue de 2.10 ± 0.17 y ésta varió de 1.90 en abril a 2.30 en junio. El índice medio de similitud intermensual a nivel de especie (índice de Sorensen) fue de 0.75 ± 0.13 y varió de 0.45 en febrero a 0.75 en abril (Fig. 2).
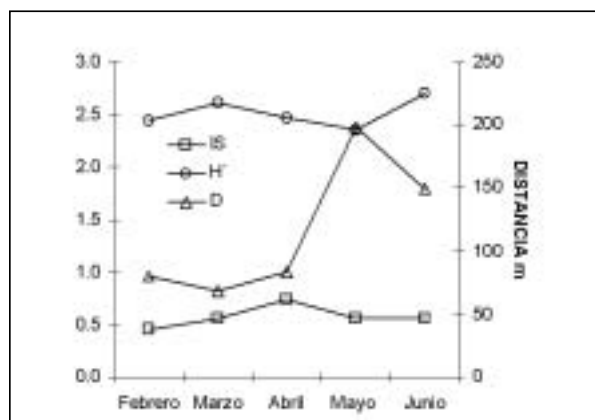
Figura 2. Variaciones mensuales en la diversidad dietética expresada por el índice de Shannon (H′). Se muestra también la similitud intermensual a nivel de especie por el índice de Sorensen (IS) y la distancia media recorrida por día en cada uno de los meses del periodo de estudio (D).

Dispersión en el espacio de los árboles utilizados por los aulladores

El valor medio del índice de Morisita calculado para determinar el patrón de dispersión en el espacio de los árboles utilizados por los aulladores como fuente de alimento fue 2.08 ± 0.97, indicando que estos árboles presentaron una distribución aglomerada en el espacio. El 60% de los árboles utilizados por los aulladores representaron a las ocho especies más importantes en su dieta, especies que contribuyeron al 70% del tiempo de alimentación registrado. Los aulladores respondieron al patrón agregado de sus recursos viajando distancias variables día a día y mes a mes. La distancia media recorrida por día por los aulladores entre fuentes de alimento fue 118.0 ± 106.0 m, pero ésta varió de 67.8 ± 59.5 m en marzo a 198.4 ± 180.5 m en mayo. Las diferencias entre meses en las distancias recorridas diariamente por los aulladores fueron estadísticamente significativas (Kruskal-Wallis test, H = 9.53, DF = 4, p = 0.049; H ajustado por empates = 9.54, DF = 4, p = 0.049), lo que sugiere variaciones en el tiempo y espacio en la disponibilidad de los recursos alimenticios y una búsqueda activa de éstos por los aulladores (Fig. 2).

Uso de especies introducidas

Las cinco especies arbóreas no nativas utilizadas por los aulladores como fuente de alimento fueron aprovechadas en todos los meses que duró el estudio y el número medio de especies utilizadas por mes fue de 3.0 ± 1.2 (rango 2-5). En el caso de las especies nativas, el número medio de especies usadas por mes por los aulladores fue de 12.4 ± 3.6 (rango 8-17). Aun cuando el número de especies nativas usadas por mes fue mayor que para el caso de las especies introducidas, estas últimas resaltan en importancia cuando se considera el tiempo de alimentación invertido por los aulladores en el consumo de sus hojas y frutos. Este tiempo varió de 10% (marzo) al 57% (febrero) con una media mensual de 36.4 ± 18.1% y solamente en el mes de febrero el porcentage de tiempo invertido en el consumo de las hojas y/o frutos de estas especies fue menor al 30%.

Discusión

Los datos que presentamos aquí sobre los tipos de plantas utilizadas por los aulladores como fuente de alimento son preliminares. Observaciones adicionales podrán aportar información acerca de las consistencias y variaciones, en el tiempo y espacio, en las preferencias alimentarias de los monos aulladores del Parque La Venta. Teniendo esto en mente, nuestros resultados indicaron que el uso de árboles en el entorno en el que existen los aulladores en el Parque La Venta estuvo directamente asociado a la utilización de estos como fuente de alimento. Estos árboles representaron a 30 especies, tienden a ser de tamaño moderado y le sirven a los aulladores como substrato físico y como fuente de alimento. El predominio de especies pertenecientes a las familias Fabaceae y Moraceae en la dieta de los monos aulladores también ha sido reportado en otras localidades en México como en Los Tuxtlas, Veracruz (Estrada, 1984; Estrada *et al.*, 1999; Juan *et al.*, 1999) y en Centro y Sudamérica, como en Belice (Silver *et al.*, 1998), Finca La Pacifica, Costa Rica

(Glander, 1975), Isla de Barro Colorado, Panamá (Milton, 1980), Finca Meremberg, Colombia (Gaulin y Gaulin, 1982) y en Brasil (Galetti *et al.*, 1994).

El predominio de *Mangifera indica* (Anacardiaceae) como fuente de hojas jóvenes y frutos maduros en la dieta de los aulladores en el Parque La Venta fue notorio. Los árboles de esta especie contribuyeron al 14% de los árboles registrados en la dieta de los aulladores y al 19% del tiempo de alimentación registrado y fueron asiduamente visitados por los aulladores. Es probable que debido a la predominancia de *M. indica* y de individuos de *Ficus benjamina* en el sitio de estudio, los aulladores cuentan con una fuente adecuada y más o menos constante de alimento en forma de hojas y de frutos a través del año.

Los monos aulladores presentan una marcada preferencia por las hojas y los frutos y diariamente ingieren cantidades variables de estos para lograr una dieta balanceada (Milton, 1998). Las hojas o los frutos predominan en la dieta (Crockett y Eisenberg, 1987; Kinzey, 1997). Durante el periodo de estudio los aulladores fueron más folívoros que frugívoros ya que pasaron el 76% del tiempo de alimentación consumiendo hojas y este patrón fue consistente de un mes a otro. Los aulladores del Parque La Venta mostraron más preferencia por las hojas jóvenes que por las hojas maduras en cada uno de los meses del estudio, preferencia que se podría atribuir a una alta concentración de proteína (33% más que las hojas maduras), altos contenidos de nutrientes digeribles y menor contenido (36% menos que las hojas maduras) de fibra que en las hojas maduras (Estrada, 1984; Glander, 1975; Milton, 1980, 1998). Esto sugiere una búsqueda activa por los aulladores por estas partes de las plantas dentro de su área de suministro. Los comportamientos arriba indicados se dieron a pesar de que la presencia de hojas maduras es más predecible en la selva, lo que sugiere la necesidad que tienen los aulladores de balancear su dieta y minimizar la ingestión de fibra y compuestos tóxicos (Glander, 1975; Milton, 1980, 1998; Gaulin y Gaulin, 1982; Braza *et al.*, 1983; Estrada, 1984; Estrada *et al.*, 1999).

Especies como *Xylopia frutescens, F. benjamina* y *Coccoloba barbadensis* contribuyeron de modo importante como fuente de frutos jóvenes para los aulladores, pero la dependencia de los aulladores de los frutos maduros de *M. indica* es enfatizada por el dato de que el 58% del tiempo registrado en el consumo de frutos maduros por los aulladores, se registró en esta especie. Es probable que la presencia de individuos de esta especie en la comunidad vegetal selvática del Parque La Venta haya sido un aspecto favorable para el sostenimiento de la población de monos aulladores en este sitio. Otras especies importantes en la dieta de los aulladores fueron aquellas que les sirvieron como fuente de flores, reforzando así la ingestión de proteína. Estas especies, *Tabebuia rosea* y *Ceiba pentandra,* fueron utilizadas brevemente (1-3 meses) enfatizando la marcada estacionalidad en la disponibilidad de flores consumidas por los aulladores. Por otro lado, el índice de similitud intermensual a nivel de especie sugiere que los aulladores asiduamente estaban buscando en su área

de suministro árboles de las especies preferidas y tomando ventaja de los periodos de tiempo en que las hojas, frutos y flores de estas especies estaban disponibles.

Es claro que los monos aulladores no utilizaron de modo uniforme el área selvática disponible, algo que estuvo fuertemente condicionado por el patrón agregado de las fuentes de alimento, especialmente de aquellas especies arbóreas que tuvieron una marcada presencia en su dieta, como fue el caso de *M. indica* y *F. benjamina*. Los aulladores respondieron a estos aspectos de sus recursos viajando distancias variables cada día, que fueron de 68 a 198 m, recorridos que los llevaron a distintas secciones dentro de su área de suministro. En resumen, podríamos decir durante el periodo de estudio, dos especies arbóreas introducidas jugaron un papel importante como suministro de hojas y frutos para los aulladores del Parque La Venta. El uso combinado de estas con las especies nativas confirma la flexibilidad en la dieta que caracteriza a las especies del genéro *Alouatta*. Es probable que aspectos como este le han permitido a los aulladores sobrevivir en el Parque La Venta.

Agradecimientos

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Parasitismo Natural em Sauás, *Callicebus nigrifrons* (Spix, 1823): Variação na Eliminação de Ovos de Nematoda e Cestoda

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Introdução

Os primatas não humanos são hospedeiros de diversos parasitos e, a despeito de muitas espécies terem sido relatadas para animais oriundos do ambiente silvestre (Kuntz e Myers, 1972; Luz *et al.*, 1987; Melo e Pereira, 1986; Melo *et al.*, 1987, 1997; Neri *et al.*, 1997; Pereira *et al.*, 1993a, 1993b, 1993c, 1993d; Resende *et al.*, 1994; Santa Cruz *et al.*, 2000), os estudos básicos sobre as diversas infecções naturais que acometem várias espécies de primatas são negligenciados (Kuntz, 1970). Entre essas espécies, encontra-se o *Callicebus nigrifrons* (Spix, 1823), o sauá ou guigó, um primata endêmico da Mata Atlântica, podendo ainda ocorrer em matas ciliares do Cerrado. É a maior das treze espécies do gênero, atingindo quando adulto até dois quilogramas. Geralmente vivem em unidades familiares compostas por um casal monógamo, um filhote e às vezes um jovem do ano anterior (Hershkovitz, 1988, 1990; Van Roosmalen *et al.*, 2002).

Após a implantação da unidade de conservação da CEMIG (Estação de Pesquisa e Desenvolvimento Ambiental de Galheiros), no município de Perdizes, Minas Gerais, foi escolhido um grupo de *C. nigrifrons* para acompanhamento diário com objetivo de se aumentar o conhecimento parasitológico desses animais.

Materiais e Métodos

Um grupo familiar de quatro primatas em ambiente natural, sendo dois adultos (fêmea [01], macho[02]), um subadulto (macho[03]) e um infante (macho[04]), foi identificado e observado sob a forma de "scan sampling", segundo Altmann (1974). Isto é uma varredura das atividades de todos os indivíduos, sendo três minutos de observação seguidos de sete de intervalo e assim por diante. As observações seguiram-se ao longo do dia, ou seja, de seis às dezoito horas. Totalizou-se 65 dias de observações e coletas assim distribuídos: oito em março, 14 em abril, 18 em maio, 14 em junho e 11 em julho. Após a identificação dos animais, amostras de fezes foram recolhidas, individualmente, em dias e horas diferentes e acondicionadas em frascos contendo formalina. Foram realizados exames parasitológicos pelos métodos de centrifugação (Ritchie, 1948) e de sedimentação (Hoffman *et al.*, 1934) de todas as amostras recolhidas com exame de três lâminas por amostra de fezes para cada técnica. Para efeito de comparação e apresentação de dados, as amostras obtidas em diferentes horários em um mesmo dia foram agrupadas (amostra diária) após análise individual.
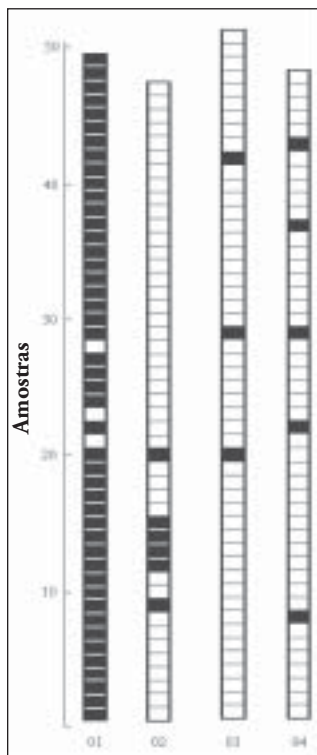
Resultados

Do material analisado, verificou-se a presença de ovos de Anoplocephalidae (*Mathevotaenia megastoma*), Hymenolepididae (*Hymenolepis* spp.), Subuluridae (*Primasubulura jacchi*), espécies já relatadas para *Callicebus nigrifrons*, e de Thelaziidae (*Trichospirura* cf. *leptostoma*), com relato anterior somente para *C. moloch*.

Os resultados iniciais dos exames revelaram que, entre as duas técnicas utilizadas, o método de centrifugação foi menos sensível para evidenciar, nas amostras de diferentes dias, ovos de *Mathevotaenia megastoma, Primasubulura jacchi* e *Trichospirura* cf. *leptostoma*, enquanto o de sedimentação espontânea apresentou-se com maior sensibilidade para detecção de ovos de *Hymenolepis, Mathevotaenia, Primasubulura* e *Trichospirura*.

No presente estudo, os dados obtidos para Anoplocephalidae e Thelaziidae não foram quantificados tendo em vista o encontro de somente uma amostra positiva durante todo o período analisado. Os ovos de *Hymenolepis* obtidos e mensurados, até o presente, não foram ainda identificados; aparentemente ocorre mais de uma espécie, sendo *H. cebidarum* já relatada para *C. nigrifrons*. Entretanto, uma confirmação específica em relação aos cestódeos só pode ser realizada quando de necrópsias de animais.

Verificou-se para todos os animais uma variação diária relativa à presença ou não de ovos de *Hymenolepis*. De 49 amostras diárias do sauá 01, 46 estavam positivas. O animal 02 apresentou seis amostras diárias positivas em 47. Já para o animal 03, verificou-se positividade em três das 51 amostras diárias. Para o animal 04, de 48, em cinco delas ocorreu a presença de ovos.

De acordo com a Figura 1 (sauá 01) os resultados negativos, em número de três, se concentraram entre as amostras 21 e 28. Ainda na Figura 1 (sauá 02), observa-se, entre a primeira (9) e a última amostra positiva (20), quatro amostras consecutivas (12-15), nas quais foram detectados ovos. Em todas as outras amostras analisadas o resultado foi consistentemente negativo. Também para o sauá 03 poucas amostras de fezes revelaram a presença de ovos (20,

Figura 1. Variação diária de positividade para ovos de *Hymenolepis* em amostras de fezes de *Callicebus nigrifrons.*

Figura 2. Percentual de positividade em amostras de fezes de *Callicebus nigrifrons.*
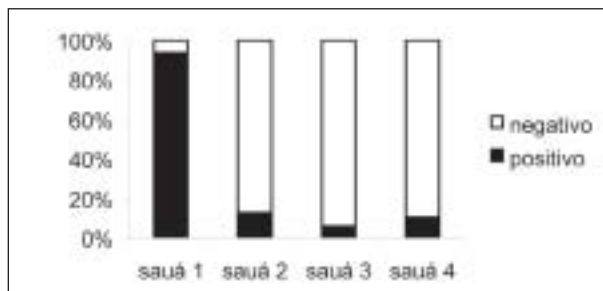
29 e 42). Não há indícios de um agrupamento seqüencial dos resultados positivos em amostras próximas (Figura 1). Nota-se ainda, que o mesmo ocorreu para o sauá 04, onde pode se observar intervalos aparentemente regulares entre uma e outra amostra positiva.

Comparando-se individualmente a contribuição em porcentagem de amostras diárias positivas (Figura 2) verificou-se que os animais 02, 03 e 04 apresentaram resultados próximos variando entre 5% e 12% do total de suas amostras. Já os exames do animal 01 diferentemente dos demais resultaram em 94% de positividade de suas amostras.

Discussão

Os dados obtidos foram analisados individualmente, já que variações individuais em infecções parasitárias estão, muitas vezes, relacionadas à alimentação, condições ambientais, período do ano em que foram recolhidas as fezes, sexo, idade e até mesmo fatores genéticos (Dunn, 1970; Freeland, 1979; Stuart e Strier, 1994; Garber e Kitron, 1997), dificultando assim o agrupamento dos resultados de todos os animais para caracterização mais aprofundada da infecção natural por helmintos parasitas.

São escassas na literatura informações básicas sobre a infecção por *Hymenolepis* em *C. nigrifrons*, apesar de *H. cebidarum* oriunda de *Callithrix nigrifrons* (= *Callicebus nigrifrons)* capturado em Minas Gerais, ter sido descrita por Baer em 1927. Outros registros de cestódeos pertencentes à mesma família estão dispersos na literatura, sem contudo uma confirmação definitiva da espécie—como,

por exemplo, em Melo *et al.* (1997) ao estudarem uma população de *C. nigrifrons* resgatada durante a construção da Usina Hidrelétrica Nova Ponte e mantida em recintos para translocação até a soltura dos mesmos. De 17 animais, 14 apresentavam-se parasitados por *Primasubulura jacchi*, sete por Anoplocephalidae e cinco por Hymenolepididae, indicando serem parasitos freqüentes em *C. nigrifrons*, considerando-se o curto período entre a captura no ambiente silvestre e o exame parasitológico além dos hábitos alimentares, já que a maioria das infecções parasitárias ocorre quando da ingestão de invertebrados hospedeiros intermediários de parasitos.

A obtenção de fezes depende da freqüência e período do dia em que as diferentes espécies defecam, quantidade de material excretado, além de outros fatores como condições fisiológicas e tipo de alimento ingerido pelo animal. Assim, através das anotações diárias do horário em que as amostras foram obtidas, pode-se relatar como aspecto biológico de *C. nigrifrons* a excreção de fezes predominantemente pela manhã, considerando-se o período de observação compreendido entre 6h e 18h. Não houve no entanto relação alguma entre o resultado dos exames e a hora em que foram obtidas as amostras.

Grande parte das informações parasitológicas sobre primatas não humanos encontradas na literatura, provém de animais que sob tensão, são capturados e mantidos em cativeiros distorcendo-se assim as características da infecção em condições naturais. Há portanto a valorização do estudo do parasitismo desses animais vivendo em ambiente natural, podendo estes conseqüentemente, se revelarem como reservatórios naturais de patógenos que afetam os humanos além de se obter dados essenciais para propostas de manejo e conservação bem como a sanção de questões de ordem ecológicas e filogenéticas de alguns primatas (Chitwood, 1970; Dunn, 1970; Kuntz, 1970; Resende *et al.*, 1994; Stuart e Strier, 1994; Melo *et al.*, 1997; Neri *et al.*, 1997).

É possível que a eliminação de ovos dos parasitos seja dependente de vários fatores inclusive uma carga parasitária maior refletindo o verificado em um dos animais, a única fêmea, que apresentou uma alta freqüência de ovos em diferentes amostras de fezes. Por outro lado, pode-se observar que a técnica de sedimentação espontânea apresentou-se mais adequada para o diagnóstico laboratorial, tendo

em vista a detecção de ovos de *P. jacchi* em três amostras oriundas de diferentes dias de um mesmo animal.

Resultados semelhantes foram verificados por Resende *et al.* (1994) ao analisar comparativamente por três diferentes técnicas, durante 18 meses, material de 21 exemplares de *Callithrix penicillata* inicialmente mantidos em cativeiro. Foram observadas oscilações mensais na eliminação de ovos de *Trichospirura leptostoma,* sem no entanto verificar a variação diária na excreção de ovos dos parasitos.

As informações obtidas no presente estudo permitem sugerir a realização de exames em dias diferentes para um diagnóstico parasitológico mais acurado, apesar de as técnicas utilizadas serem equivalentes, sensíveis e adequadas para monitoramento, por amostras fecais, de infecções causadas por helmintos gastrointestinais.

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Callicebus Sightings in Bolivia, Peru and Ecuador

Noel Rowe
Wilberto Martinez

The recent publication of the taxonomic revision of the genus *Callicebus* (Van Roosmalen *et al.*, 2002) encouraged us to look for three species—*C. dubius, C. oenanthe* and *C. medemi*—for which photographs were previously unavailable. Using available maps, drawings and descriptions (Van Roosmalen *et al.*, 2002), a survey was undertaken in October 2002. Three areas were surveyed: the Department of Pando in northern Bolivia, the Río Mayo valley in the province of San Martín in Peru, and the Cuyabeno National Park in the northeastern part of Ecuador.

Titi monkeys are cryptic, diurnal primates known to live in small family groups (Kinzey, 1981; Eisenberg, 1999). Although titis prefer to rest in the dense understory, their presence in the forest can be located by the loud territorial calls made by both the male and female. These duets are usually given in the morning (Emmons, 1997) between 06:00 and 10:00 in the morning. They often feed and call from higher, more exposed trees (Kinzey, 1981, p. 245) where they can be seen and photographed.

Methods

At all three locations we walked existing trails at a pace of 1.0 to 1.5 kilometers per hour from 6 to 10 AM unless otherwise noted. A CD player with an amplified external speaker was used to play a recording of *Callicebus* calls from *Sounds of Neotropical Rainforest Mammals* (Emmons *et al.*, 1998). In some cases the playback of titi calls elicited calls from wild *Callicebus* which helped us to locate them. In one instance, the CD allowed us to get a better look at the titi monkey who approached us in order to know from where the call was coming. No density data were taken. Coat color was also noted.

Bolivia

The Bolivian survey began with a meeting with Rob Wallace from the Wildlife Conservation Society. His surveys and information about Central Bolivia led us to concentrate our survey in the northern Bolivian Department of Pando, and neighboring northern sections of Department of Beni which border Brazil. The specific identity of *Callicebus* in this region is disputed. According to Van Roosmalen *et al.* (2002) this area should be inhabited by *Callicebus dubius*, with the Río Madre de Dios as the boundary between *C. dubius* and *C. modestus,* and with *C. donacophilus* along the south side of the Río Madre de Dios and east of the Río Beni. However, according to Anderson (1997) and Hershkovitz (1990), *C. brunneus* is found in Pando and the endemic Bolivian species *C. modestus* is found further south and east of the Río Beni, in the Department of Beni. Both authors report the range of *C. donacophilus* as starting further south than indicated in Van Roosmalen *et al.* (2002).

Our survey started on October 5 near the city of Cobija, in the lowland rainforest of the Callimico Biological Station run by Leila Porter (11° 25.142' S, 069° 00.144' W, elev. 237 m). Two groups of titis were heard, seen and photographed on two out of the three days. The *Callicebus* at this field site appear to be *Callicebus brunneus*. They had dark foreheads with no white visible, and their limbs, throat and belly were reddish with a grayish-brown back. The tail, however, did not appear to have nearly as much white as depicted in the illustration of *C. brunneus* by Stephen Nash in Van Roosmalen *et al.* (2002). On the individuals we observed, the tail was reddish-brownish with a white tip.

The survey proceeded to search for titis in a forest about 15 kilometers north of the Río Madre de Dios (11° 14.599' S, 067° 11.084' W, elev. 139 m). *Callicebus* were heard by one of our party but not seen. Local informants positively identified it as *C. brunneus*, except that only the tip of the tail was white.
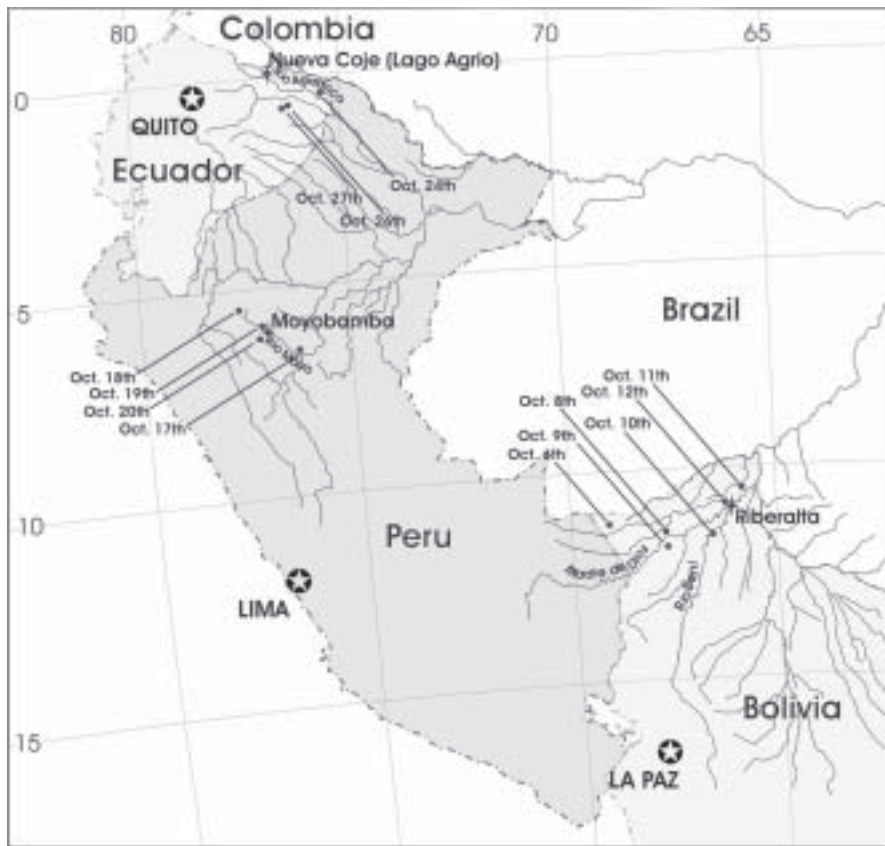
Figure 1. Sites visited in Bolivia, Peru and Ecuador.

Near a village called Suciri (11° 34.862' S, 067° 08.456' W, elev. 145 m), located between the Río Madre de Dios and the Río Beni—where the Van Roosmalen *et al.* (2002) map indicated *C. modestus* should be—we heard, saw, and photographed two titi monkeys which we identified as the same species we had seen at the Callimico Biological Station. Our local guides reported killing and eating a titi two weeks before and identified the titi as *C. brunneus*. Their method of preparing the meat is to burn off the hair over an open fire and boil the monkey whole. After the meat is consumed the bones are given to the dog. Our survey of a forest near the village of Porvenir (11° 32.542' S, 066° 29.266' W, elev. 157 m) on the east side of the Río Beni, in the northern part of the Department of Beni, did not produce any monkey sightings. The local informants did, however, identify the titi they hunt as *C. brunneus*.

From the city of Riberalta we surveyed a forest about 30 kilometers to the east (10° 46.725' S, 065° 44.338' W, elev. 164 m) but found no primates. We then proceeded up the Río Madre de Dios by boat to survey the north side of the river, where there is reported to be less hunting. A group of titis was heard by us and seen and identified as *C. brunneus* by our local guide (10° 56.783' S, 066° 20.293' W, 120 m). Our final survey in Bolivia was in a 100-hectare second-growth forest in the village of Tumichucua (11° 08.406' S, 066° 09.542' W, elev. 113 m), located south of Riberalta on the east side of the Río Beni. This was an afternoon survey and no primates were detected, but our local informant identified the titis there as *C. brunneus*.

Our brief survey results suggest that the Río Madre de Dios is not a boundary for *Callicebus*. *C. brunneus* appears to be distributed north of the Río Madre de Dios, between the Río Madre de Dios and the Río Beni and east of the Río Beni. More surveys will have to be conducted to find the exact distribution of *C. brunneus,* as well as whether *C. dubius* is actually present in Bolivia. Our observations are consistent with what is reported for the distribution of *C. brunneus* by Anderson (1997) and Hershkovitz (1990).

Peru

Recognized as a full species by Hershkovitz (1990), the Andean titi monkey, *C. oenanthe*, is reported to inhabit the Río Mayo valley in a restricted altitudinal range, between 750 to 950 meters. Our survey started north of the town of Tarapoto in the province of San Martín. At the University of San Martín Biodiversity Center (06° 27.757' S, 076° 17.389' W, elev. 973 m) we were informed that no titis were present in their forest, and it was suggested we go south to a dry forest near the confluence of the Río Mayo and the Río Huallaga. At an elevation of 511 meters (06° 38.109' S, 076° 22.574' W), we heard titis but did not see them. The local hunters who were our guides contradicted each other about which species was present, so no species was assigned. Hunting pressure was intense at this time of year; within two minutes of our playing the recorded titi call, four dogs and two hunters found us, surprised not to find titis.

We proceeded northwest through a wide cultivated valley to the town of Moyobamba, and met with the staff of the Bosque de Protección de Alto Mayo. Established in 1987, this protected area extends from the town of Rioja north along the border of the provinces of San Martín and Amazonas. Two mornings were spent walking trails (05° 41.608' S, 077° 39.437' W, elev. 1302 m) listening for primates. None were detected. Local farmers who illegally live in the protected area complained about *Cebus albifrons* raiding their crops, but did not report hearing titi monkeys near their farms. This survey began at an altitude of 1080 meters, and so may be above the range of *Callicebus oenanthe*.

We also did not detect any primates at the Reserva del Morro de Calzada (06° 01.272' S, 077° 02.533' W, elev. 1074 m) when we did a short afternoon survey. The guard, however, assured us that titis were present in the small forests which encircle this bare peak.

We then met with Ruben Ruiz Vappes of the faculty of the Moyobamba branch of the University of San Martín. We were invited to stay at the University's 200-hectare field site south of Moyobamba (06° 03.555' S, 076° 56.933' W, elev. 897 m). A student at the University, Magna Consuelo Lopez del Castillo, showed us the field site and participated in a short nocturnal survey. We were unable to find evidence of *Aotus miconax*, the endemic night monkey found in this region, but a local informant said this species is found at higher elevations, along with the yellow-tailed woolly monkey (*Oreonax flavicauda*) (Groves, 2001, p. 195).

We did hear the calls of at least four different groups of *Callicebus*, which we presumed to be *C. oenanthe*, on our last day in the Río Mayo Valley. They were found in small remnant forests at an altitude of 925 meters, in valleys surrounded by cattle pastures. We were able to photograph a captive family of *C. oenanthe*, which were trapped near Rioja and offered for sale for the equivalent of less than $10.00 US.

Conservation of Peruvian Titis

Further surveys and conservation actions need to be undertaken soon for the three endemic primates found in

this region of Peru. Slash-and-burn agriculture threatens the forest even on the steep slopes of the Alto Mayo protected area. A new hard-topped, all-weather road linking Tarapoto to Lima is just being completed, and colonists from the highlands are steadily moving into the region. Most of the forest in the Río Mayo valley between 750 and 950 meters, the only known range of *C. oenanthe*, has been cleared for rice cultivation in the last 20 to 30 years.

Ecuador

The map included in Van Roosmalen *et al.* (2002, p. 31) indicates the range of *C. medemi* to be between the Río Caquetá in Columbia and the Río Aguarico in Ecuador. We made arrangements to visit the village of Sabalo, which is a one-hour car ride and subsequent five-hour boat trip down the river from Nueva Loja (Lago Agria). The village is inhabited by the indigenous Cofán people and is part of the Cuyabeno National Park. Local informants were positive that the titi on the south side of the Río Aguarico was *C. discolor*. Later in the trip we visited Yasuní National Park (00° 41.670' S, 076° 27.736' W, elev. 248 m) south of the Río Aguarico, and heard, saw, and photographed *C. discolor*. The titi on the north bank was said not to have the black front feet of *C. medemi*. We heard, saw and photographed one pair of titis in three days of surveying (00° 21.087' S, 075° 40.110' W, 202 m). These titis were first thought to be *C. lugens* (dark all over with a white collar and white hands), but the photographs later proved that they were reddish-brown in color and had the yellow/gold hands of *C. lucifer*. The range of *C. lucifer* must thus extend further west than described by Van Roosmalen *et al.* (2002), and the corresponding range of *C. medemi* is perhaps limited by the Río Putamayo, which forms the border of Colombia and Ecuador. This range would be consistent with Hershkovitz (1990, Fig. 44) and Groves (2001, p. 177).

Conservation

In all the forests we surveyed, hunting for food and pets was a major threat to primates. Though no systematic data were collected, the general impression we received from interviews was that hunting was mainly for subsistence for meat, and not for the commercial market. We did,

Figure 2. *Callicebus lucifer*, found on the north side of the Río Aguarico in Ecuador.

Figure 3. *Callicebus oenanthe*, found on the west side of the Río Mayo near Moyobamba, Peru.

however, find a commercial trade in pets in Bolivia and Peru. We observed many young primates in captivity in all three countries. The following is a list of the species kept in captivity by individuals: saddle-back tamarin (*Saguinus fuscicollis*), red-bellied tamarin (*S. labiatus*), Spix's black-mantled tamarin (*S. nigricollis*), Andean titi monkey (*Callicebus oenanthe*), squirrel monkey (*Saimiri* sp.), white-fronted capuchin (*Cebus albifrons*), brown capuchin (*Cebus apella*), red howler (*Alouatta sara*), woolly monkey (*Lagothrix lagotricha*), Peruvian spider monkey (*Ateles chamek*) and white-bellied spider monkey (*Ateles belzebuth*). Most were kept in appallingly small cages or tied at the waist on a short leash. Young tapirs were also kept as pets, as were many species of birds, especially parrots and macaws.

The hunting pressure for meat and pets appears to be high in all three countries. No primates bigger than titis were seen in our surveys except at field sites where primatologists were studying and protecting them. More conservation education is needed in all three countries. In Peru, people only had one name for "monkey" and did not discriminate between species, nor realize that some were endemic to their region.

In the lowlands of Bolivia there is still extensive forest, except along the roads. But Brazil nut extractors have cut trails throughout the forest and many hunters are now using this trail system. This may be preferable, however, to colonists who slash and burn the forest to grow crops and cattle.

The lowland region of Ecuador has a great deal of protected forest on the map. However, the indigenous inhabitants are allowed to hunt all they want in these forests, and many have newly acquired shotguns. Some of these forests also have oil reserves under them, and there is a great deal of pressure to extract this oil whether it lies in a protected area or not. The oil companies build roads which will later be used by colonists, and the forest will inevitably disappear as a result.

Conclusion

This survey for titi monkeys found that the distributions in northern Bolivia and northern Ecuador are not consistent with the distributions described by Van Roosmalen *et al.* (2002). Rather, our observations are consistent with what is reported for the distribution of *C. brunneus* by Anderson (1997) and Hershkovitz (1990) in Bolivia. In Ecuador we found *C. lucifer*, not *C. medemi*, which is consistent with Hershkovitz (1990, Fig. 44) and Groves (2001, p. 177). More surveys are needed in these regions to determine the exact distributions of *Callicebus*. The distribution of *C. oenanthe* in Peru was consistent with Van Roosmalen *et al.* (2002).

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SOCIAL SPACING IN A BACHELOR GROUP OF CAPTIVE WOOLLY MONKEYS (*LAGOTHRIX LAGOTRICHA*)

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Jodi A. Fuller
Lisa A. Houser

Introduction

In the wild, woolly monkeys (*Lagothrix lagotricha*) form social groups with several adult males and females. Recent evidence (Nishimura, 1999) has indicated that males stay in the natal group and females emigrate. This suggests that in the formation of natural groups adult males are tolerant of each other, having a common developmental experience, long periods of familiarity, and the possibility of shared kinship. Nishimura (1994, 1997) reported that even though these males have had much in common and many years together, it is extremely rare for them to form feeding aggregates that are exclusively male.

Stevenson (1998) also found that close association among adult males is rare. He studied spacing in a different group of woolly monkeys in Tinigua National Park in Colombia, in the same region as Nishimura. In Stevenson's study, adult males were never observed within 2 m of each other. Of all age/sex categories, adult males and subadult females were most often at distances greater than 5 m from the other animals. The subadult females were likely to move between groups, and this distance may be a precursor to emigration, but the adult males appeared to be stable members of the group. Stevenson reported that adult males were the most

Table 1. Summary of distinguishing characteristics of a woolly bachelor group.

Study animal #[1]	ID	Mother's #[1]	Date of birth	Date moved from Louisville	Location of move	Date returned
132	MO	116	8 Jan 1988	5 Mar 1990	Lowry	12 Oct 1995
135	JA	115	17 Feb 1989	29 Oct 1992	St. Paul	19 Apr 1998
138	WI	116	26 Oct 1989	29 Oct 1992	St. Paul	19 Apr 1998
141	BR[2]	116	2 Nov 1991	28 Dec 1995	St. Paul	19 Apr 1998
143	LY	114	7 Mar 1992	28 Dec 1995	St. Paul	19 Apr 1998
144	JE	115	13 Jun 1992	-	-	-

[1] Studbook numbers from 1998 North American Regional Studbook.
[2] Subject BR died between the summers of 1998 and 2001.

aggressive age/sex class. He suggested that avoidance of conflict, competition for resources, and a lower predation risk may contribute to adult males maintaining greater social distances. In wild groups, adult male tolerance of each other may depend on sufficient space for the individuals to avoid or minimize close encounters.

In contrast to social grouping in the wild, captive-breeding groups have usually been maintained with a single adult male. Aggression among adult males has been the primary reason for this practice. Although there are no published reports, there have been cases where adult male aggression has resulted in the death of one of the animals, even when the males were siblings. Maintaining captive groups with one adult male generates a surplus of males, which have been placed in bachelor groups. With the limited space available in zoo exhibits, this has the potential for creating an unnatural concentration of males and forcing close association among them.

We studied the formation of a six-member bachelor group in order to characterize their adjustment in social distance three years later. A group of four monkeys was merged with a pair of animals. Each group had been together for at least two years prior to being merged into the study group. On the basis of spacing studies in the wild, we expected the captive males to maintain substantial social distance within the limitations of the enclosure, allowing for a relatively peaceful accommodation to their new social arrangements. We also predicted that individuals housed together before the present group was formed would be likely to continue their close association throughout the study period.

Methods

Study Site and Subjects
Six adult male woolly monkeys (*Lagothrix lagotricha poeppigii*) were studied during the summers of 1998 and 2001 at the Louisville Zoo (Louisville, Kentucky, USA). All were paternal siblings, and some were full siblings, as shown in Table 1. Their ages ranged from six to 10 years in 1998. Only the youngest had been at the Louisville Zoo since birth. Table 1 shows placement of the animals at other zoological parks. The death of BR during the course of the

study had no apparent relationship to the grouping of the animals.

The Louisville exhibit comprised two connected rooms inside a building (floor space approximately 40 m²) with two ramps leading to the larger of two outdoor islands (combined island area of approximately 100 m²). All areas had ropes, cargo nets, trees, and/or elevated platforms for arboreal activity. The islands were surrounded by a wet moat and connected by ropes and a log. In May of 1998, the four animals from St. Paul were placed in the exhibit with MO and JE. Partial separation of the two groups was maintained as various combinations of animals were allowed access to each other during a six-month period of gradual introductions. By November of 1998, all of the monkeys were allowed to move freely within the exhibit, except when access was restricted for cleaning or inclement weather.

Procedure
Two observers performed 241 instantaneous focal observations during the summer of 1998 (18 June through 31 July), over the course of 136.7 observer-hours at the exhibit. In the summer of 2001, a single observer recorded 277 observations (11 June through 26 July), during 109.5 hours at the exhibit. Focal observations lasted for 15 minutes, during which the behavior of the focal animal and the proximity of other animals were recorded from scans every 30 seconds. Proximity was scored in mutually exclusive categories of contact: within reach, nearest, or alone (no other monkey on the island or in the stall area with the focal). Mutually exclusive categories of behavior included feeding (consuming or handling food), resting (stationary and not standing), and other (for example, play, groom, aggression, locomotion, stationary alert). Our preliminary observations revealed that with the exception of locomotion and stationary alert, these "other" behaviors were rare. We used Radio Shack Model 100 handheld computers and The Observer 2.0 (Noldus Technology Services) software for the focal observations. All instances of screaming and chest-rubbing were recorded in *ad libitum* notes throughout the time an observer was at the exhibit.

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Using the proximity results, we calculated an association index (AI) similar to Nishimura's feeding association index (Nishimura, 1997). AI represented the percentage of the scans in which a pair of monkeys was nearest to each other based on their total scans when they were in proximity to any monkey. We used the Spread of Participation Index (SPI; Dickens, 1955; Shepherdson *et al.*, 1993) to quantify the degree to which an individual's associations were spread among the group. Participation in chest-rubbing was also evaluated with the SPI. This index ranges in value from 0 to 1.0. In this paper we have reported SPI as 1-SPI so that the higher number represents a more even spread of participation.

Results

From 1998 to 2001, there was a dramatic decline in the mean proportion of days on which an animal screamed (mean for 1998 = 0.10; mean for 2001 = 0.04; paired t(4) = 3.52, p = 0.02). The mean proportion of days on which an animal chest-rubbed also declined from 1998 to 2001 (mean for 1998 = 0.36; mean for 2001 = 0.18; paired t(4) = 3.71, p = 0.02). In 1998, participation in chest-rubbing was spread quite evenly among the animals (1-SPI = 0.85). In 2001, three of the animals did almost all of the chest-rubbing (1-SPI = 0.64).

Proximity measures also changed over the three years of the study. Contact between animals was rare in 1998 (< 3% of 7230 scans) and in 2001 (< 1% of 8310 scans). The next level of proximity that we measured was an estimate of how often these animals were within reach of another animal and not in contact. This measure declined from 12% of the scans in 1998 to 3% in 2001. A proportion test applied to the frequencies of within-reach scans yielded a statistically significant decline (z = 8.37; p < 0.001). The low incidence of animals within reach or in contact precluded more detailed statistical analysis of these measures. There was no change in the time that an animal spent alone. We also recorded the frequency and identity of the nearest monkey when no animal was within reach or in contact. In 1998, 72% of the scans included a nearest animal while 82% were recorded in 2001.

Figure 1 shows the sociograms constructed with the AI for each year and each animal. The grouping in 1998 largely reflects the maintenance of the previous living constraints while the animals were being introduced. The 2001 sociogram illustrates the accommodation of the animals after 2.5 years of unrestrained grouping by the keepers (from November 1998 to July 2001). The AI for monkey pairings in 2001 was significantly correlated with the 1998 AI (r(9) = 0.64, p = 0.04), but not with genetic relatedness or total time together. To evaluate the change in the distribution of associations, we calculated SPI for each animal in each year based on the frequency of their being nearest to each other. In Figure 2, we have expressed this as 1-SPI so that a high score represents a more even spread of association among the animals. The mean 1-SPI increased
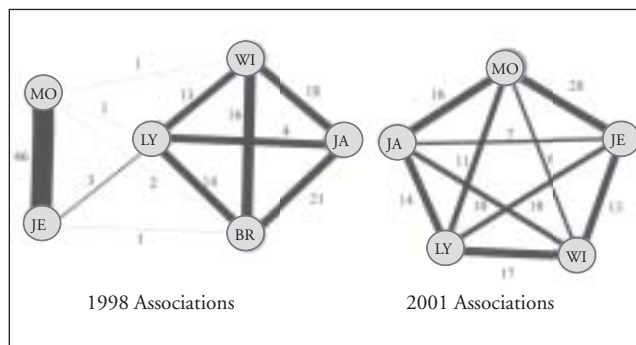

Figure 1. Sociograms for 1998 and 2001. The values represent the AI (see text) for each possible pairing of the animals.

significantly from 1998 to 2001 in all behavioral categories: feeding (paired t(4) = 3.84, p = 0.02), resting (t(4) = 5.00, p = 0.008), and other behaviors (t(4) = 4.83, p = 0.009).

Discussion

As expected from the behavior of wild woolly monkeys (Nishimura, 1994, 1997; Stevenson, 1998), the bachelor group spent very little time in contact or within reach. Our assessment of the nearest animals when none was within reach revealed a more even distribution of proximity in 2001 than in 1998. The correlation between the 1998 and 2001 AIs illustrates the persistence of the earlier bonding of the animals. We expected this result based on the apparent long-term association of adult males in wild populations (Nishimura, 1994, 1997). Kinship could be a factor in the adjustment of these animals. All were related at the level of paternal siblings and some were full siblings. Degree of relatedness did not predict final association as reflected in the nearest-neighbor AIs, but the correlation approached statistical significance. A better test of the role of kinship would include animals with a wider range of relatedness and a larger sample.

Applying the SPI to nearest-neighbor associations revealed a more even spread of associations among the individuals
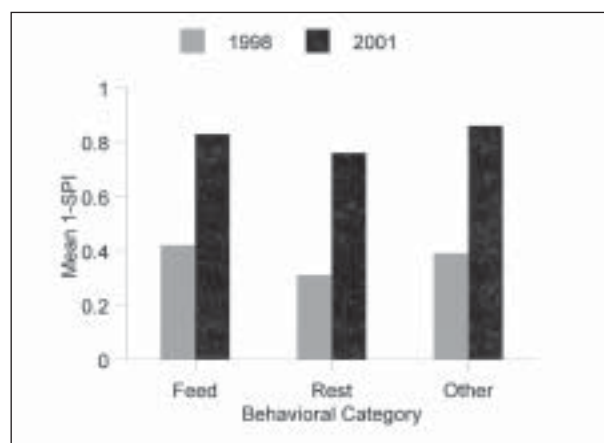
Figure 2. Mean 1-SPI showing increasing spread of association among the animals from 1998 to 2001 as they engaged in the three types of behavior. Higher values of 1-SPI indicate a more even spread of associations among the animals in the group.

after three years together. This more equitable spread of associations was consistent across the three categories of behavior, indicating that it was not limited to the feeding context, which is likely to force close association.

The sociograms and the SPIs show that the adult males are capable of adapting to the presence of relatively unfamiliar males. This has not yet been reported in wild populations. Perhaps the tendency of adult males to maintain social distance provides the basis for accommodation when additional adults are introduced. Our results suggest that two components of this social adjustment include maintenance of a minimal social distance and increasing tolerance of other individuals at that minimal distance.

The scream and chest-rubbing results suggest that the accommodation achieved by this group was stable and peaceful. The change in the rate of screaming and chest-rubbing over the three years of the study indicates a reduction in tension. In earlier studies of a breeding group in this exhibit, we found scream interactions to be a measure of social tension that could be used to characterize the social hierarchy of the group (White *et al.*, 1988; Stearns *et al.*, 1988). These earlier studies yielded a scream rate of 0.12 screams/hour/animal, which is slightly lower than the rate for the present bachelor group in 1998. By 2001 the bachelor group's social accommodation resulted in a dramatically reduced scream rate. In fact, the incidence of screaming was insufficient for us to use it to construct a social hierarchy.

Chest-rubbing is common in captive woolly monkeys, but its function is unknown. From our earlier studies of a breeding group (White *et al.*, 2000), we found chest-rubbing was exhibited by adult monkeys and most often by males. We were not surprised to find a high incidence of chest-rubbing in the present study when the bachelor group was formed. Whether its role is spacing among groups of monkeys, or as a displacement activity, we would have predicted that a group of adult males would exhibit a high frequency of this behavior. However, an unexpected result was the marked decline to a rate similar to our studies of the breeding group (0.05 chest-rubs/hour/animal). Nearly all of the chest-rubbing in the breeding group was done by the adult male (White *et al.*, 2000) and it is interesting that the present all-male group had a similar rate of chest-rubbing after three years. Participation in chest-rubbing was distributed more widely when the bachelor group was first put together in 1998. The broad participation at the point of disruption of the group is similar to the increased involvement of females in chest-rubbing in the breeding group when the adult male died (White *et al.*, 2000). Disturbance of the social group appears to produce wider participation in chest-rubbing. An increase when group relationships are altered is consistent with a displacement function for this behavior in captivity. It may be appropriate to conclude from our captive studies that the frequency and participation in chest-rubbing reflects the level of disruption of the group.

Our results suggest similar behavioral spacing mechanisms may be operating in captivity and the wild. Further study of group formation and social dynamics is likely to improve the management of this species and may contribute to the understanding of the high sensitivity of *Lagothrix* to fragmentation of its habitat.

Acknowledgments

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In Memoriam: José Márcio Ayres and Ulysses S. Seal

José Márcio Ayres 1954-2003: A Primatologist Who Liked To Create Parks*

Cláudio Valladares-Pádua

Photo: Russ Mittermeier

I first met Márcio Ayres at a primate conservation workshop organized by the University of Leicester in 1982. He was a postgraduate student in England then, and Dr. Bob Martin, a mutual friend, introduced us, certain that we would have a lot in common. Bob was right. The long conversations and laughs we had together then were the essence of all our future meetings; he had a tremendous sense of humour and a passion for the conservation of nature. The years followed, punctuated by innumerable meetings with Márcio; always anxious to tell me his news, his plans, his progress. Márcio had the enormous energy of one who is working for a mission – Amazonia, a mission he never lost sight of throughout his life.

Márcio Ayres graduated in Biological Sciences in 1976 at the University of São Paulo. Even when young, he showed his determination to put his ideas into practice when, only 20 years old, he took the job of administrator at the Ribeirão Preto Zoo. But he was not content to stop there, and enrolled in the Master's course in Ecology of the National Institute for Amazon Research (INPA) and the University of Amazonas (INPA/FUA), under the supervision of Dr. Paulo Emílio Vanzolini. His thesis was pioneer and challenging, as in all he did – a field study of the white-nosed saki, *Chiropotes albinasus*, at Aripuanã (along with some observations of the Guiana bearded saki, *Chiropotes satanas*, at the field site of the Biological Dynamics of Forest Fragments Project, north of Manaus). It was then that he experienced at first hand the enormous threats hanging over the Amazonian forests, and realized that the salvation of its primates and enormous wealth of biodiversity was only possible through the creation of protected areas. I believe it was then that the seed of young Márcio's future vision as a creator of protected areas was planted, and the only reason he did not pursue his objective then with the vigour of later years was the need to complete his qualifications. Not content with a Master's degree, Márcio followed on with a doctoral degree at the University of Cambridge, England, under the supervision of Dr. David J. Chivers. In the early 1980s, his Ph.D. research took him back to Amazonia in search of primates – this time to the white uakaris, *Cacajao calvus*, and the middle Solimões. The *várzeas* of Mamirauá were under numerous threats. The risk to his study animals inspired him to initiate a campaign for a protected area for the region, until then known only

from the descriptions of Henry Walter Bates in the middle 19th Century. On one occasion, Márcio recounted that the communities of the region were convinced he was a missionary priest, and those who knew him then could well believe it; his appearance was that of a monk with the mission not to save souls, but to save biodiversity! In 1987, Marcio was appointed to the Wildlife Conservation Society (WCS) Carter Chair in Rainforest Ecology.

In 1985, he sent a proposal to the Secretary of the Environment for the creation of the Mamirauá Ecological Station, the first with the specific aim of protecting Amazonian *várzea* and its regional biodiversity while at the same guaranteeing the well-being and prosperity of the human populations living there. To his frustration, the proposal languished; but in 1990, undeterred, he convinced the Governor of the State of Amazonas to declare the area (the confluence of the Rios Solimões and Japurá, bounded on the west by the Auatí-Paraná) a reserve. His original proposal was for 36,000 ha, and I remember his bemusement (and slight alarm at the consequence) at his powers of persuasion when the reserve was decreed with an area of 1,124,000 ha! To deal with its enormous size, he drew up a plan for a "focal area" of 260,000 ha, where he established a pilot programme for research, community work, and the management of the reserve. From 1994 to 1996, further inspiration on the part of Márcio (and the determination to go with it) resulted in the State of Amazonas passing a law which created a new protected areas category, the State Sustainable Development Reserve (later, in 2000, incorporated into the National System of Protected Areas – SNUC), and Mamirauá was the first.

Márcio's major challenge was to ensure that protected areas such as Mamirauá did not remain only as decrees, and with the creation of an NGO – the Sociedade Civil Mamirauá – he set up a system of participative active management and protection by the local communities themselves.

In 1997, we were staying in the same hotel in Manaus. His eyes were bright with enthusiasm once again as he recounted his plans for the creation of a new reserve, Amanã, which would connect Mamirauá with the Jaú National Park to create an enormous "corridor" of protected forests and waters in the central Amazon. The Governor of the State of Amazonas decreed the Amanã State Sustainable Development Reserve in 1998. The two reserves combined protect more than 3 million ha. The Management Plan for Mamirauá, based on more than 10 years of research, surveys, monitoring and community development, is considered exemplary.

The overwhelmingly positive results of the innovative experiences in the conservation and management of the two reserves brought Márcio international recognition in the field of conservation biology, and he was consequently the recipient of numerous awards – the American Society of Primatology's Conservation Award, the WWF-International Gold Medal, the Society for Conservation Biology Award, and the Rolex Award for Enterprise. The

Sociedade Civil Mamirauá, which he created, was awarded the Von Martius Prize from the Brazil-Germany Chamber of Commerce in 2000, and the UNESCO Prize in the Science and Development category in 2001.

The final time I heard Márcio's voice was last year, during the annual Congress of the Society for Conservation Biology in Kent, UK. Although Márcio was physically absent, victim of cancer which stopped him travelling, his colleague of many years, Dr. Gustavo Fonseca, arranged for a telephone call to be broadcast at the ceremony which was to give him a special tribute from the Society. Talking from the hospital where he was already severely ill, once more he showed his enormous courage, enthusiasm and hope in talking of how important the award was for him and for his future plans.

Twice after this I tried to visit Márcio in New York, but his illness made it impossible, and he died on 7 March 2003. We have lost, prematurely, one of the greatest conservationists our country has ever seen. One certainty remains, however: on high, our untiring friend Márcio is creating new protected areas in Heaven. A sincere and sad goodbye from all of us primatologists who admired him so much.

*Translated from the Portuguese, originally published in the *Boletim Informativo da Sociedade Brasileira de Zoologia*, June 2003, No. 72: 6-7.

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JOSÉ MÁRCIO AYRES

Russell A. Mittermeier

José Márcio Ayres and I shared a love for a very special primate, the white uakari of the *várzea* forests of the upper Solimões. I had originally planned to do my thesis on this animal, and carried out an expedition to find it in 1973. I succeeded in locating several populations, especially in the tiny Rio Panauá, but the logistics of working there (and the mosquitos) were so difficult that I gave up and chose another thesis topic. It would be a decade before Márcio, who was also fascinated by this bizarre monkey with a short tail, long shaggy white fur and a bright red face, demonstrated his dedication and persistence by conducting the first detailed field study of this animal. This study, which Márcio carried out in spite of many hardships and a variety of health problems that he encountered during his work, is now a classic and one of the most important bodies of research ever carried out on an Amazonian primate. What is more, his commitment to the species and the region in which it occurs led to the creation of the 1,124,000 ha Mamirauá Sustainable Development Reserve, and later the huge Mamirauá-Amanã-Jaú Corridor, one of the most important protected-area complexes on Earth.

But Márcio was not satisfied with the mere creation of a new protected area. Rather, he decided that Mamirauá should become a model for conservation in Amazonia, and he began, more than a decade ago, to create an infrastructure and find the funding to make Mamirauá work at a scale that was meaningful and relevant to the region, its human inhabitants and its biodiversity—something that had never been done before. He used his considerable skills in science, communications, and fund-raising to create a program that is unmatched anywhere in Amazonia, and that has set new standards for conservation. Several years ago, before his illness began, he and I talked about trying to recreate the Mamirauá model in 10 other places in Amazonia. He first looked at me like I was crazy, but, after a brief reflection, indicated that he was ready to go. I have no doubt that, had he lived, he would have over the course of his career been instrumental in the creation of many more reserves of this kind. Indeed, the Sustainable Development Reserve model, of which Mamirauá was the first, has already become an integral part of conservation strategies for Amazonia, with another four, covering 3,281,021 ha, having been created in Márcio's lifetime and many more in the planning stages.

Márcio Ayres, in the simplest possible terms, was the greatest conservationist ever to work in Amazonia. He was a true leader, a visionary, a practical implementer, a clever communicator, and an amazing salesman who succeeded in finding funds for his work from a wide range of different sources. On top of that, he was a world-class scientist, whose grasp of the biodiversity conservation business was unsurpassed and whose scientific contributions will long be remembered. And, last but not least, he was a loyal and steadfast friend who could always be counted upon in any circumstance. I first met Márcio at a primate meeting in Belém in 1977, and over the next quarter century, we shared many experiences in the field, in international gatherings of many different kinds, and as members of the Steering Committee of the IUCN's Species Survival Commission. As with so many others who shared his life, I will miss him very much and still find it hard to believe that he is gone. He had so much to contribute in so many ways, and it is truly sad that he left us before he could realize all of his dreams. The best thing that we can do to honor him is to help continue what he so effectively started, and to make sure that his vision of Amazonia becomes a reality.

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THE GRAND VISION OF MÁRCIO AYRES

Gustavo A.B. da Fonseca

The life of José Márcio Ayres—Márcio to his colleagues, and Zé Márcio to his relatives—epitomized the power of articulating strong links between good science and effective

conservation action, something that is often said but much less frequently accomplished. He would derive as much pleasure from having a high-profile paper of his appearing in *The American Naturalist*, supporting the allopatric model of speciation driven by Amazonian rivers, as he would by dumbfounding an unimaginative government bureaucrat into committing sizable sums of money to his beloved reserves. I remember him being as proud of himself from being accepted into the Brazilian Academy of Sciences, and receiving countless prizes and honors internationally, as he was of showing the progress in the human health statistics resulting from investments in the Amazonian communities he loved to work with. He definitely lived what he preached.

Very funny, personable and unassuming, Márcio definitely had the Midas touch. While working on a doctoral dissertation with the white uakari, *Cacajao calvus*, he envisioned the largest flooded forest reserve in the world, the Mamirauá Sustainable Development Reserve. While thinking about new ways of ensuring the long-term ecological integrity of the Amazon basin, Márcio dreamt of the most extensive and unbroken network of protected areas and Indigenous reserves in the world: the Central Amazon Corridor, in excess of 12 million hectares. Transplanting to the national and international arenas the political skills acquired through many years of the soft talk that characterizes the social environment of all native Amazonids, his dreams and vision slowly but surely became reality. The protected area management models pioneered in the Mamirauá and Amanã Sustainable Development Reserves, anchored on solid conservation biology and socio-economic research agendas, will remain Márcio's most enduring legacy, and the principal inspiration to those who follow in his footsteps.

Since the diagnosis of his illness in late 2001, Márcio and I spoke on the phone every couple of days or so, his condition permitting. The usual optimism and the constant scheming up of great new things never slowed down, even in the worst phases of his treatment. Márcio would continue spending many hours a day on the Internet working on numerous projects but, as a master junk-mailer, he never ceased to continue playing tricks and teasing friends with jokes of all tastes and colors. Above all, Márcio was a great optimist who enjoyed life.

During my few visits to his apartment in New York, where he was staying while receiving the best medical care possible—almost always in the company of his wife, sons and parents—he suggested writing a book on the work that we and many other colleagues did in 1996: designing and proposing, at the request of the Brazilian government, the creation of seven major "Ecological Corridors" in the Amazon and the Atlantic Forest which encompassed many dozens of reserves and other forms of managed landscapes. He likely knew this would be his last publication, and his choice was emblematic of how he would like to be remembered – as an advocate of bold new ideas.

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ULYSSES S. SEAL: 1929-2003

Ulie Seal, Chair of the IUCN/SSC Conservation Breeding Specialist Group (CBSG), died on 19 March, 2003. He was a truly remarkable man. He took over the CBSG with 15 members and, over the course of 24 years, turned it into a global network of over 1000 members, which has had, and still has, an enormous impact on the conservation of the world's biodiversity. The CBSG network has become a widespread and highly effective interdisciplinary vehicle for communication and collaboration between people from the captive breeding community, wildlife managers, NGOs, governments and the private sector. Ulie further expanded CBSG's capacity by establishing a regional network of offices in South Asia, Mesoamerica, Indonesia, Mexico, South Africa, and Europe. As Chairman, Ulie contributed to the survival of thousands of plant and animal species throughout the world, from the tiny goblin fern in the northern Minnesota forests to the mountain gorillas in Uganda. Ulie influenced and touched countless individuals who continue to carry on his passion for the conservation of wildlife. (Adapted from *CBSG News*, 14(1), 2003, a special edition in his honor.)

With CBSG, he developed the various workshop mechanisms that have contributed so much to prioritizing and organizing conservation strategies worldwide – notably the Population and Habitat Viability Assessment (PHVA) and the Conservation Assessment and Management Plan (CAMP). CBSG organized three workshops for Brazilian primates – Ulie Seal led and facilitated two of them: the Lion Tamarin, *Leontopithecus*, PVA held in Belo Horizonte, Minas Gerais, in 1990, and the Muriqui PHVA, also in Belo Horizonte in 1998 (see *Neotropical Primates* 6(2): 52-53, 1998). (The second Lion Tamarin PHVA, held in 1997, was orchestrated by Ulie and facilitated by Susie Ellis and Robert Lacy; see *Neotropical Primates* 5(2): 53-55, 1997). PHVAs have also been held for *Alouatta palliata* in Mexico (1995), *Saimiri oerstedii citrinellus* in Costa Rica (1994), and *Saguinus oedipus* in Colombia, and CAMP workshops were also organized through CBSG for Mexican Primates (1995), Panamanian Endemic Species (1994) and Mesoamerican Primates (1997).

Robert C. Lacy, of the Department of Conservation Biology of the Chicago Zoological Society, Brookfield Zoo, who developed the Vortex population analysis software used in these PHVAs, was appointed to the Chair of the

CBSG in Ulie's place. There follows a letter from him, and also Onnie Byers, Executive Officer of the CBSG.

A letter from Robert C. Lacy

It is with great sadness that I write to let you know that Ulysses S. Seal, Chairman of the Conservation Breeding Specialist Group since its inception several decades ago, succumbed to cancer on 19 March, 2003. Ulie's seemingly boundless energy was drained by the effects of the disease and the treatments, but he continued to provide wise and caring advice up to his last days with us.

Ulie's legacy is so vast that it would be impossible to summarize in a short letter. Through his several careers, he made tremendous contributions to human health, animal health, wildlife conservation, and the development of effective processes for collaboration. Perhaps most importantly, he inspired, challenged, and worked with an amazing network of friends and colleagues (and even with his professional antagonists) to make progress on the problems of conservation about which he felt so passionately. It is a tribute to Ulie, and to his direct personal influence, that the CBSG has more than 1,000 members, has more than 130 organizational and individual sponsors, and has impacted countless more people globally. Appropriately, Ulie has received almost every conservation medal and award that there is.

At the recommendation of the CBSG Steering Committee and with Ulie's approval, David Brackett as Chair of the IUCN Species Survival Commission has asked me to become the next chair of the CBSG. Taking on this role is obviously a daunting challenge for me. I decided to accept this challenge because of the tremendous value I place on, and energy I receive from, the philosophies and people that are the CBSG. The CBSG has always recognized that the problems of conservation are caused by many, diverse, interacting threats, resulting from the actions of humans. The solutions, therefore, will require collaborative efforts of many people from diverse backgrounds and with varied expertise and styles. To obtain and sustain the critically needed benefits of productive collaborations requires that the CBSG adhere to and promote a philosophy of openness, listening to and embracing the diverse and at times discordant views of our colleagues, seeking knowledge and expertise wherever we can find it, and keeping focused on ideas, ideals, and actions, rather than on personalities, assumed motivations, and rhetoric. The threats to wildlife species and natural systems arising from the exploding numbers and impacts of humans can be extremely depressing. Yet, it is impossible not to see hope in a loose network of more than a thousand talented people who have committed themselves to working together to find solutions. In addition, formal partnerships with other conservation organizations provide opportunities for successes that neither CBSG nor any one organization could achieve on its own. Finally, the staff of the CBSG office in Minneapolis, as well as in our regional network offices in India, Costa Rica, Mexico, Indonesia, South Africa, Japan, and Denmark, are remarkable resources upon which we can all call for support and guidance.

Last month, I asked Ulie what guidance he could provide to me and to the CBSG. His response was that the CBSG has the people and the philosophy it needs to make a difference to conservation around the world. He said that specific advice from him is unnecessary and unwarranted, as the organization needs to continue to grow in whatever directions we can all take it, making maximal use of our talents, resources, and passion to conserve the natural world that sustains us. It is up to us to determine where Ulie's legacy will lead, which is as he always wanted it to be. I very much look forward to working with all of CBSG's members, partners, colleagues, and staff as we continue and grow the efforts and successes of the CBSG.

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A letter from Onnie Byers

Dr. Ulysses S. Seal, one of the conservation world's most effective leaders, was born 13 June 1929 in Mullens, West Virginia, and died on 19 March 2003 in Burnsville, Minnesota. It may seem strange, at least for those who don't know him, that when I think of the future of conservation I think of Ulie. Those of you who are familiar with the personality, impact and reach of this man, will understand that he is not just the past and present but also the future.

Ulie originally trained as a psychologist before receiving his PhD in biochemistry. Following a post-doc in endocrinology, he took a position at the Veterans Administration Hospital in Minneapolis, MN, in the US where he spent the majority of his career conducting research on prostate cancer. During this time he became interested in developing safe techniques for wildlife anesthesia and contraception, conducting research on a variety of species, including white-tailed deer, wolves and Siberian tigers. His interest in applying science to endangered species conservation continued to grow.

In 1973, he developed the International Species Information System, ISIS, a record keeping system for zoos, which grew into a fully functional entity of its own. In 1979, Sir Peter Scott appointed Ulie Chairman of the IUCN/SSC's Conservation Breeding Specialist Group (CBSG). In the early 1980s Ulie developed the first model for Species Survival Plan programs on which most SSP/EEP-type captive population management programs have been based. In the mid-1980s, when, in the southwestern US, the black-footed ferret was discovered to have been reduced to just 18 animals, Ulie became a champion of interdisciplinary collaborations to solve complex conservation problems. This theme continued to play a key role in Ulie's long-term philosophy.

Over the years, Ulie combined social processes with biological science to address a significant number of complex problems and to turn conservation theory into conservation action. Ulie and CBSG conducted more than 300 species-based conservation workshops in over 60 countries. Ulie commanded the respect of international leaders in conservation, zoo directors, scientists and wildlife managers throughout the world. He was a recognized leader.

I had the privilege of spending time with Ulie, after his illness was diagnosed, talking to him about his life and what he saw as the reasons for his success and that of CBSG. The man was a genius but he did not talk about intellect as the factor responsible for his effectiveness. He talked about emotional qualities that have been with him since childhood. These are qualities such as being a good listener, being respectful and accepting, making people feel valued, viewing everyone as a potential partner and making people believe in themselves.

Ulie's academic and emotional intelligence led him to develop a unique, influential organization and a set of species-based processes for biodiversity conservation. He influenced people all over this planet, many of whom think, work and live their lives differently and more effectively because of their interaction with him. This is why Ulie Seal was a world leader and catalyst in the conservation community and why he will live on as the future of conservation. I was honored to be a part of this man's life and his death and I learned as much from him in his dying as I did in his living. Our work will always be a tribute to him.

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News

Official List of Brazilian Fauna Threatened with Extinction - 2003

A workshop, involving about 200 Brazilian and international specialists, was held from 9-12 December, 2002, in Belo Horizonte, Minas Gerais, to revise the Official List of Brazilian Fauna Threatened with Extinction (*Lista Oficial da Fauna Brasileira Ameaçada de Extinção*). The previous revision was in 1989 (Edict 1.522, 19th December, 1989; Bernardes *et al.*, 1990). The workshop was coordinated by the Fundação Biodiversitas, in collaboration with the local NGO Terra Brasilis, Conservation International do Brasil, the Sociedade Brasileira de Zoologia (SBZ), and the Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis (IBAMA). Sponsorship was provided by the Projeto de Biodiversidade (PROBIO) of the Ministry of the Environment (MMA), Shell do Brasil, Grupo Odebrecht,

and Conservation International do Brasil, and support from the US Fish and Wildlife Service and Avina.

Demonstrating the importance given to this workshop as a major evaluation of the status of the Brazilian fauna by the scientific community, the opening ceremony was attended by the Minister of the Environment, José Carlos Carvalho; the Minas Gerais State Secretary for the Environment, Celso Castilho; the President of Biodiversitas, Roberto Messias Franco; the President of IBAMA, Rômulo José Fernandes Barreto Melo; the President of SBZ, Olaf Mielke; the Director President of CI do Brasil, Roberto Brandão Cavalcanti; and the Director of Terra Brasilis, Sonia Rigueira.

Prof. Ângelo B. M. Machado, world expert on Neotropical dragonflies, and Professor of Zoology at the Federal University of Minas Gerais, led the assessment process in 1989 (Bernardes *et al.*, 1990), representing the Sociedade Brasileira de Zoologia (SBZ). He was again the driving force for the 2002 re-assessment of the Official List of Brazilian Fauna Threatened with Extinction. This time, representing the Fundação Biodiversitas, he was general coordinator for the workshop and the assessment, and most competently supported by the staff, who are uniquely experienced in carrying out these sorts of workshops (see, for example, Fonseca *et al.*, 1994; Lins *et al.*, 1997; Machado *et al.*, 1998; Mendonça and Lins, 2000), and deserve special acknowledgment: Gláucia Moreira, Cassio Soares Martins, Cláudia Costa, Lívia Vanucci Lins and Gisela Hermann. Considerable support was also provided by Mônica Fonseca and Adriano Paglia of Conservation International do Brasil, Belo Horizonte.

The Official List of Brazilian Fauna Threatened with Extinction was published by the Ministry of the Environment (MMA), through the Brazilian Institute for the Environment and Renewable Natural Resources (IBAMA), on 22 May, 2003 (website: <http://www.mma.gov.br/port/sbf/fauna/index.cfm>).

The Primate Assessment

The list of threatened species tripled from 218 in the 1989 revision to 627 species with two extinct in the wild (still maintained in captivity) and a further nine extinct. The increase in numbers was due to the inclusion of new groups (fish and invertebrates) which had not been assessed previously, but also to an increase in our knowledge of the status of the country's fauna. Of the 26 primates placed on the list, 24 are endemic to Brazil. The criteria used to evaluate threatened status were those of the IUCN – World Conservation Union Species Survival Commission (SSC), Version 3.1 (IUCN, 2001).

Adriano Chiarello was the coordinator for the Mammal Group, and Anthony Rylands was coordinator of the Primates Sub-group. Prior to the workshop, information and the opinions of numerous biologists and conservationists were solicited through a site on the

Table 1. The number of people who provided information for the assessment of the threatened status of Brazilian mammals in the pre-workshop consultation, and the number of contributions regarding a particular species.

Sub-group	Informants	Contributions
Primates	15	103
Carnivora	21	93
Chiroptera	6	33
Aquatic mammals	8	42
Small mammals	13	42
Other mammals	22	79

Table 2. The number of contributions in the pre-workshop consultation for each primate genus.

Genera	No. of contributions
Alouatta	18
Callicebus	14
Leontopithecus	12
Brachyteles	10
Cebus	10
Callithrix	7
Saguinus	6
Mico	5
Ateles	4
Cacajao	3
Callimico	2
Chiropotes	2
Lagothrix	2
Saimiri	1

internet specifically set up for the purpose by the Fundação Biodiversitas. To give an idea of the extent to which the scientific and conservation community were consulted, we give here some statistics. Fifty-two people replied to the consultation for Brazilian mammals, providing a total of 392 "contributions" in terms of pertinent information on a particular species (Table 1). Dividing them into six groups, it can be seen that the Primates and Carnivora attracted the most attention, with 103 contributions from 15 people for the former, and 93 contributions from 21 people for the latter. *Alouatta* (n = 18 or 18.8%), *Callicebus* (n = 14 or 14.6%) and *Leontopithecus* (n = 12 or 12.5%) were the genera given most attention (see Table 2). In terms of species, *Alouatta guariba clamitans* was the subject of nine contributions, *Cebus xanthosternos* was the subject of six, and *Brachyteles hypoxanthus*, *B. arachnoides*, the Atlantic forest titi monkeys and *Callithrix aurita* each drew five contributions.

The following people contributed to the pre-workshop consultation for primates: Julio César Bicca-Marques, Bras Cozenza, Antônio Rossano Mendes Pontes, Ana Alice Biedzicki de Marques, Rosana Vera Marques, Marcelo Gordo, Carlos Eduardo Grelle, Fabiano Rodrigues de Melo, Raquel Moura, Fábio Olmos, Fernando de Camargo Passos, Rogério Cunha de Paula and José de Sousa e Silva Jr., besides those who were able to participate directly in the workshop's subgroup for primates to finalize the list: Maria Iolita Bampi, Adriano G. Chiarello, Gustavo A. B. da Fonseca, Sérgio Lucena Mendes, Marcelo Marcelino and Anthony B. Rylands.

Threatened Primates

Following the criteria and categories of IUCN (2001), the assessments for 103 species and 133 species and subspecies of Brazilian primates resulted in the listing of 26 as threatened, seven as "Near Threatened" (NT), and a further 16 as "Data Deficient" (DD). Of those which are threatened, 10 were ranked as "Critically Endangered" (CR), six as "Endangered" (EN), and 10 as "Vulnerable" (VU). Fifteen of the threatened primates are from the Atlantic forest, and 11 from Amazonia. They occur in 11 Brazilian states: Minas Gerais (9), Bahia (8), Amazonas (6), Espírito Santo (5), Pará (4), São Paulo (4), Maranhão (3), Sergipe (3), Rio de Janeiro (3), Paraná (2) and Mato Grosso (1).

Changes

There are a number of changes from the 1989 list (Bernardes *et al.*, 1990), resulting mainly from the use, for the first time, of the IUCN (2001) criteria as opposed to expert opinion; but also due to improved knowledge on the status and distributions, the inclusion of newly discovered primates, and conservation efforts on behalf of the species.

Cebus kaapori was described only in 1992, and *Callicebus coimbrai* in 1999 – both enter the list for the first time, and both as critically endangered. In the 1989 list the Atlantic forest titi monkeys were all considered subspecies of *Callicebus personatus*, and the form *barbarabrownae*, described only in 1990, was included by default. *Leontopithecus caissara*, described in 1990, was included on Brazil's Official List in 1992 by special edict (Edict No. 045/92-N / 27th April 1992).

A number of primates were dropped from the 1989 list. *Alouatta belzebul belzebul* was included in 1989 due to the fact that it is critically threatened over a very large part of its former range in the northern Atlantic forest and North-east Brazil. Considering only this region, its status as the most threatened primate in South America we believe would be unchallenged. However, no evidence has come forward that it is distinct from populations in eastern Amazonia, which are widespread and disqualify the subspecies from categorization as threatened. The Amazonian pitheciines, *Cacajao melanocephalus*, *Chiropotes albinasus* and *Pithecia albicans*, although hunted, are now known to have relatively broad distributions, large portions of which are still remote. *Cacajao melanocephalus* occurs in two of the three largest national parks in Brazil: Pico da Neblina (2,200,000 ha) and Jaú (2,270,000 ha).

Despite the fact that *Ateles paniscus* occurs over an enormous area of remote forests of the Guayana Shield, it was considered a threatened species – along with other spider monkeys and the woolly monkeys, *Lagothrix* – due to the susceptibility of these large, relatively slow-

breeding species to hunting, habitat degradation, and forest fragmentation and loss. They are the first primates to disappear near villages or wherever there is hunting pressure anywhere more than insignificant. These species have long gone from many areas of the Amazon. Their still-large, wide-ranging populations, however, disqualify them from the IUCN (2001) criteria for threatened status, and in the particular case of *Ateles paniscus*, it now occurs in a considerable number of protected areas, including the Mountains of Tumucumaque National Park of 3.8 million ha decreed in August 2002 (see *Neotropical Primates* 10(3): 158-160). *Ateles marginatus* has a considerably more restricted distribution in southern Pará, centered on the current wave of deforestation moving north with Brazil's agricultural frontier and the paving of the Cuiabá-Santarém highway. Its range is also dissected by the Transamazon, and it does not occur in any strictly protected areas of any significant size. *Ateles belzebuth* also has a more restricted distribution in the northwest Brazilian Amazon, and is classified as vulnerable. The Brazilian woolly monkeys, although having quite wide distributions, are classified as near threatened. Their extreme susceptibility to hunting and forest fragmentation has been well-documented.

While the nominal, northern subspecies of the brown howler, *Alouatta guariba*, is evidently now extremely rare – only a handful of localities in Minas Gerais and southern Bahia are known to maintain small isolated populations – the southern brown howler has a broad distribution extending south from Minas Gerais and Espírito Santo to Rio Grande do Sul and the province of Misiones in northern Argentina. Its broad range, although covering enormous areas where the forests have been very largely destroyed, means that the overall population size, the number of populations, and its presence in large protected areas through the Serra do Mar, for example, exclude it from entering the threatened category according to the criteria required. It is classified as near threatened. A similar situation applies to the black-horned capuchin, *Cebus nigritus*, and the masked titi, *Callicebus nigrifrons*, also classified as near threatened.

Goeldi's monkey, *Callimico goeldii*, has a geographic distribution which is large – through the upper Amazon of Bolivia and Peru, and a small area of southern Colombia – but it is always rare and its occurrence very patchy; it is absent from large areas throughout its range. In Brazil it occurs in Acre, and here and there in southern and western parts of the state of Amazonas. It is ranked as near threatened. The recent discovery of numerous marmoset species in the interfluvium of the Purus and Madeira, all with very small ranges, has diluted somewhat the arguments prevailing in the past which pinpointed as threatened those species with, what seemed then, alarmingly small ranges: *Mico leucippe*, *M. humeralifer*, *M. nigriceps*, *M. chrysoleucus* and *Saguinus imperator*. Specifically in the case of the emperor tamarin, *S. imperator*, the creation of a large number of protected areas of various categories in Acre over the last two decades at least provides some guarantees for the permanence of

large areas of forest within its range. These animals are poorly known, however, with their evidently minute ranges often being good guesses based on at best a mere handful of localities. Along with the newly discovered species, they were placed in the category of "Data Deficient" in the hopes of inspiring more research on their distributions and status. *Mico marcai* is known only from three specimens in the National Museum, all from the type locality (Alperin, 2002).

Cebus robustus is now added to the list – as vulnerable, although we believe that further study on its status may well result in it being more properly classified as endangered. In 2001, José de Sousa e Silva Jr., researcher at the Museu Goeldi, Belém, completed a full systematic review of the genus and argued solidly that it should be considered a full species (Silva Jr., 2001). A review of its status in Espírito Santo, and the Rio Doce valley in Minas Gerais, resulted in its categorization as vulnerable. Its threatened status had been recognized for some time, however, with its forests largely destroyed and fragmented, and along with *Cebus xanthosternos*, it is not only hunted for food, but prized as a pet. In 1992, the Brazilian Institute for the Environment (IBAMA) created an International Management Committee specifically for these two species, not only to promote their conservation in the wild, but to support the establishment of breeding programs to accommodate the large numbers of pets and individuals confiscated from animal dealers (Edict No. 111, 16 October, 1992). Since then, captive breeding programs have been set up for both species (Baker and Kierulff, 2002). *C. robustus* (VU) and especially *C. xanthosternos* (CR) are evidently declining very rapidly. Conservation International do Brasil and the Instituto de Estudos Sociambientais do Sul da Bahia (IESB), Ilhéus, are currently carrying out surveys to establish better the status and geographic range of *C. xanthosternos*, and Waldney Pereira Martins is planning a similar project for *C. robustus*, under the auspices of the post-graduate program in Ecology, Conservation and Wildlife Management of the Federal University of Minas Gerais (UFMG), Belo Horizonte.

The status of three of the four lion tamarins has remained unchanged. *Leontopithecus rosalia* has, however, just slipped out of the "Critically Endangered" category, and is now considered "Endangered". This testifies to the remarkable efforts of the Golden Lion Tamarin Conservation Program, begun in 1983, currently being administered in Brazil by the Associação Mico-Leão-Dourado (AMLD), Casimiro de Abreu, Rio de Janeiro, and personnel of the National Zoological Park, Washington, DC. The program has successfully protected the population in the Poço das Antas Biological Reserve, established a reintroduced population (now numbering about one-third of the total animals in the wild), created a new protected area, the União Biological Reserve, and populated it through the translocation of six groups threatened in other parts of the golden lion tamarin's highly fragmented range (Kleiman and Rylands, 2002; Kierulff and Rylands, 2003). The population in the wild is believed to be about 1,000 animals. Current estimates for

Table 3. Primates on the Official List of Brazilian Fauna Threatened with Extinction, their category and the criteria of threat (following IUCN, 2001), and their distributions in terms of countries, states, and biome. Workshop "Revisão da Lista Oficial da Fauna Brasileira Ameaçada de Extinção", December 2002.

Species and subspecies	Common name	Distribution	States	Biome MA	Biome AM	Criteria (IUCN, 2001)
Critically Endangered (CR)						
1. *Alouatta guariba guariba* (Humboldt, 1812)	Barbado, bugio, northern brown howler monkey	Brazil	BA, MG	X		B2ab(i,ii,iii), C2a(i), D
2. *Alouatta ululata* Elliot, 1912	Guariba-de-mãos-ruivas, red-handed howler monkey	Brazil	MA		X	C1, C2a(i)
3. *Brachyteles hypoxanthus* (Kuhl, 1820)	Muriqui, northern muriqui	Brazil	BA, ES, MG	X		B1ab(i-v), B2ab(i-v), E
4. *Callicebus barbarabrownae* Hershkovitz, 1990	Guigó, Northern Bahian blond titi, Barbara Brown's titi monkey	Brazil	BA, SE	X		B2ab(i,ii,iii), C2a(i), D
5. *Callicebus coimbrai* Kobayashi & Langguth, 1999	Guigó-de-Coimbra-Filho, Coimbra-Filho's titi monkey	Brazil	BA, SE	X		B1ab(i,ii,iii), C2a(i), D
6. *Cebus kaapori* Queiroz, 1992	Caiarara, Ka'apor capuchin	Brazil	MA, PA		X	A2cd
7. *Cebus xanthosternos* (Wied, 1820)	Macaco-prego-de-peito-amarelo, buff-headed or yellow-breasted capuchin	Brazil	BA, MG, SE	X		A2cd, C2a(i)
8. *Leontopithecus caissara* Lorini & Persson, 1990	Mico-leão-de-cara-preta, black-faced lion tamarin	Brazil	PR, SP	X		C2a(i), E
9. *Leontopithecus chrysopygus* (Mikan, 1823)	Mico-leão-preto, black lion tamarin	Brazil	SP	X		C2a(ii), E
10. *Saguinus bicolor* (Spix, 1823)	Sagüi-de-duas-cores, pied tamarin	Brazil	AM		X	A2acde
Endangered (EN)						
11. *Ateles marginatus* (É. Geoffroy, 1809)	Coatá, white-whiskered spider monkey	Brazil	PA		X	A4cd
12. *Brachyteles arachnoides* (É. Geoffroy, 1806)	Muriqui, mono-carvoeiro, southern muriqui	Brazil	RJ, PR, SP	X		C2a(i)
13. *Callithrix flaviceps* (Thomas, 1903)	Sagüi-da-serra, buffy-headed marmoset	Brazil	ES, MG	X		C2a(i)
14. *Chiropotes satanas* (Hoffmannsegg, 1807)	Cuxiú-preto, black saki	Brazil	MA, PA		X	A2cd, B2ab(i,ii,iii), C2a(i)
15. *Leontopithecus chrysomelas* (Kuhl, 1820)	Mico-leão-de-cara-dourada, golden-headed lion tamarin	Brazil	BA, MG	X		B2ab(i-v), C2a(i), E
16. *Leontopithecus rosalia* (Linnaeus, 1766)	Mico-leão-dourado, golden lion tamarin	Brazil	RJ	X		C2a(i), E
Vulnerable (VU)						
17. *Cacajao calvus rubicundus* (I. Geoffroy & Deville, 1848)	Uacari-vermelho, red uakari	Brazil, Colombia	AM		X	B1ab(iii)+C1
18. *Cacajao calvus novaesi* Hershkovitz, 1987	Uacari-de-Novaes, Novaes' bald uacari	Brazil	AM		X	B1ab(iii)+C1
19. *Cacajao calvus calvus* (I. Geoffroy, 1847)	Uacari-branco, white bald-headed uacari	Brazil	AM		X	B1ab(iii)+C1
20. *Callithrix aurita* (É. Geoffroy in Humboldt, 1812)	Sagüi-da-serra-escuro, buffy-tufted-ear marmoset	Brazil	MG, RJ, SP	X		C2a(i)
21. *Callicebus personatus* (É. Geoffroy, 1812)	Guigó, sauá, northern masked titi	Brazil	ES, MG	X		A3c, B1ab(i-v), C2a(i), D1
22. *Callicebus melanochir* (Wied-Neuwied, 1820)	Guigó, sauá, southern Bahian masked titi	Brazil	BA, ES, MG	X		A3c, B1ab(i-v), C2a(i), D1
23. *Saimiri vanzolinii* Ayres, 1981	Macaco-de-cheiro, Vanzolini's squirrel monkey	Brazil	AM		X	A3c, B1b(i,ii,v)
24. *Cebus robustus* (Kuhl, 1820)	Macaco-prego, robust tufted capuchin	Brazil	BA, ES, MG	X		B2ab(i-v), C2a(i)
25. *Chiropotes utahicki* Hershkovitz, 1985	Cuxiú, Uta Hick's bearded saki	Brazil	MT, PA		X	A3cd

Species and subspecies	Common name	Distribution	States	Biome		Criteria (IUCN, 2001)
26. *Ateles belzebuth* (É. Geoffroy, 1812)	Macaco-aranha, coatá, long-haired spider monkey, white-bellied spider monkey	Brazil, Colombia, Ecuador, Peru, Venezuela	AM		X	A3cd
Near Threatened (NT)						
27. *Callicebus nigrifrons* (Spix, 1823)	Guigó, sauá, black-fronted titi	Brazil	BA	X		
28. *Alouatta guariba clamitans* (Cabrera, 1940)	Barbado, bugio, guariba, southern brown howler monkey	Argentina, Brazil	BA, ES, MG, RJ, PR, RS, SC, SP	X		
29. *Callimico goeldii* (Thomas, 1904)	Mico-de-Goeldi, Goeldi's monkey	Bolivia, Brazil, Colombia, Peru	AC, AM		X	
30. *Cebus nigritus* (Goldfuss, 1809)	Macaco-prego, black-horned capuchin	Argentina, Brazil	MG, PA, RG, SC, SP	X		
31. *Lagothrix lagothricha* (Humboldt, 1812)	Macaco-barrigudo, Humboldt's woolly monkey	Brazil, Colombia, Venezuela	AM		X	
32. *Lagothrix cana cana* (É. Geoffroy in Humboldt, 1812)	Macaco-barrigudo, Geoffroy's woolly monkey	Brazil, Peru	AC, AM, PA, RR		X	
33. *Lagothrix poeppigii* (Schinz, 1844)	Macaco-barrigudo, Poeppig's woolly monkey	Brazil, Ecuador, Peru	AC, AM		X	
Data Deficient (DD)						
34. *Cacajao calvus ucayalii* (Thomas, 1928)	Uacari, Ucayali bald-headed uacari	Brazil (?), Peru	AM		X	
35. *Mico saterei* (Silva Jr. & Noronha, 1998)	Sagüi-de-Sateré, Sateré marmoset	Brazil	AM		X	
36. *Mico leucippe* (Thomas, 1922)	Sagüi, golden-white bare-ear marmoset	Brazil	PA		X	
37. *Mico humilis* (Van Roosmalen, Van Roosmalen, Mittermeier & Fonseca, 1998)	Sagüi-anão, dwarf marmoset	Brazil	AM		X	
38. *Mico marcai* (Alperin, 1993)	Sagüi-de-Marca, Marca's marmoset	Brazil	AM		X	
39. *Mico manicorensis* (Van Roosmalen, Van Roosmalen, Mittermeier & Rylands, 2000)	Sagüi-de-Manicoré, Manicoré marmoset	Brazil	AM		X	
40. *Mico acariensis* (Van Roosmalen, Van Roosmalen, Mittermeier & Rylands, 2000)	Sagüi-do-rio-Acari, Rio Acarí marmoset	Brazil	AM		X	
41. *Mico nigriceps* (Ferrari & Lopes, 1992)	Sagüi-de-coroa-preta, black-headed marmoset	Brazil	AM		X	
42. *Mico chrysoleucus* (Wagner, 1842)	Sagüi, soím, golden-white tassel-ear marmoset	Brazil	AM		X	
43. *Mico humeralifer* (É. Geoffroy in Humboldt, 1812)	Sagüi-de-Santarém, Santarém marmoset	Brazil	AM		X	
44. *Saguinus fuscicollis cruzlimai* Hershkovitz, 1966	Sagüi, Cruz Lima's saddleback tamarin	Brazil (?)	AC?		X	
45. *Saguinus imperator imperator* (Goeldi, 1907)	Bigodeiro, black-chinned emperor tamarin	Brazil, Peru	AC		X	
46. *Cebus albifrons cuscinus* (Thomas, 1921)	Caiarara, shock-headed capuchin	Bolivia, Brazil, Peru	AC		X	
47. *Alouatta seniculus amazonica* Lönnberg, 1941	Guariba vermelho, red howler monkey	Brazil	AM		X	
48. *Alouatta seniculus juara* Elliot, 1910	Guariba vermelho, red howler monkey	Brazil, Peru	AM		X	
49. *Alouatta seniculus puruensis* Lönnberg, 1941	Guariba vermelho, red howler monkey	Brazil, Peru	AM		X	

States: AC = Acre, AM = Amazonas, BA = Bahia, ES = Espírito Santo, MA = Maranhão, MG = Minas Gerais, MT = Mato Grosso, PA = Pará, PR = Paraná, RJ = Rio de Janeiro, SC = Santa Catarina, RG = Rio Grande do Sul, SE = Sergipe, SP = São Paulo. *Biomes*: MA = Mata Atlântica, AM = Amazônia.

Table 4. Primates removed from and added to the *Lista Oficial da Fauna Brasileira Ameaçada de Extinção*.

Dropped from the list of 1989:	
Alouatta belzebul belzebul	Critically endangered in the North-East of Brazil, but widely distributed in eastern Amazonia
Alouatta fusca	Taxonomic revision. Now referred to as *A. guariba*. The species was ruled NT, but *A. guariba guariba* CR
Ateles paniscus	Not threatened according to criteria of IUCN (2001)
Cacajao melanocephalus	Not threatened according to criteria of IUCN (2001)
Callimico goeldii	Near threatened NT
Chiropotes albinasus	Not threatened according to criteria of IUCN (2001)
Lagothrix lagothricha	Near threatened NT
Callithrix humeralifer	Taxonomic revision. Now in the genus *Mico*. Data deficient DD
Callithrix argentata leucippe	Taxonomic revision. Now considered a full species in the genus *Mico*. Data deficient DD
Pithecia albicans	Not threatened according to criteria of IUCN (2001)
Saguinus imperator	Data deficient DD
Entered the list of 2002:	
Alouatta ululata	New evaluation. Taxonomic revision. Previously considered a subspecies of *Alouatta belzebul*
Ateles marginatus	Taxonomic revision. On the 1989 list, but as a subspecies of *A. belzebuth*
Brachyteles hypoxanthus	Taxonomic revision. On the 1989 list, but as a subspecies of *B. arachnoides*
Cacajao calvus rubicundus	On the 1989 list, but as a subspecies of *C. calvus*
Cacajao calvus novaesi	New subspecies - Hershkovitz, 1987
Callicebus coimbrai	New species - Kobayashi & Langguth, 1999
Callicebus barbarabrownae	New species - Hershkovitz, 1990
Callicebus melanochir	Taxonomic revision. On the 1989 list, but as a subspecies of *C. personatus*
Cebus kaapori	New species - Queiroz, 1992
Cebus robustus	New evaluation. Taxonomic revision. Previously considered a subspecies of *Cebus apella*

the black lion tamarin, *L. chrysopygus*, also indicate about 1,000 surviving in scattered populations in the state of São Paulo, but this species remains in the category "Critically Endangered" because the large majority occur in just one site, the Morro do Diabo State Park – the other few forests still maintaining the species are minimal in size (Valladares-Pádua *et al.*, 2002).

Two distinct forms of muriqui, *Brachyteles*, are now recognized (by some as subspecies, others as distinct species), while the *1989 Official List* included them both under the name of *B. arachnoides*. The highly fragmented and small populations of the northern muriqui, *B. hypoxanthus*, are considered "Critically Endangered", whereas the more widespread southern muriqui, *B. arachnoides*, occurs in a number of parks and reserves in the Serra do Mar in São Paulo and Rio de Janeiro and is ranked only as "Endangered" (see Strier and Fonseca, 1996/1997). The situation of the muriqui is reflected somewhat in that of the buffy-headed marmoset, *Callithrix flaviceps*, listed as "Endangered" in the highly fragmented forests of Espírito Santo and eastern Minas Gerais, and the buffy-tufted-ear marmoset, *C. aurita*, listed as "Vulnerable", occurring to the south in southern Minas Gerais, São Paulo and Rio de Janeiro (see Mendes, 1993; Coimbra-Filho, 1991).

Summary: Comparison with the 1989 Lista Oficial da Fauna Brasileira Ameaçada de Extinção
A number of changes resulted from this re-assessment of the status of the Brazilian primates. Eleven primates were dropped from the *1989 Official List*, and 10 new names

were added. The reasons for the loss or addition of the species and subspecies are indicated in Table 4. Four of the primates "added" to the list were, in fact, implicitly on the *1989 Official List*, but were named for the first time on the 2003 list: *Ateles marginatus* was considered a subspecies of *A. belzebuth*; *Brachyteles hypoxanthus* was considered a subspecies of *B. arachnoides*; *Callicebus melanochir* was considered a subspecies of *C. personatus*; and *Cacajao calvus* was listed, but not its subspecies. Four of the new additions are species described after 1989, and a further two were added as a result of new information. Six primates, then, were in fact added to the *2003 Official List*.

Summary: Comparison with the 2002 IUCN Red List of Threatened Species
The fact that 24 of the 26 primates on Brazil's new threatened species list are endemic to the country means that their status assessments are valid globally. The *2002 IUCN Red List* for primates is still based on IUCN's *1994 Red List* categories and criteria, which are slightly different from the new scheme (Version 3.1) in terms of the categories and less stringent in terms of the criteria. We expect that IUCN will adopt the results of the assessments of these (and the other 52) primates which occur only in Brazil. Key changes, resulting from the strict application of the IUCN (2001) criteria and a better understanding of the distributions, taxonomic status and conservation status of many of the species, are as follows: *Alouatta guariba clamitans* from VU to NT; *Brachyteles arachnoides* from CR to EN; *Callicebus nigrifrons* from VU to NT; *Callithrix aurita* from EN to VU; *Callithrix geoffroyi* from

VU to "Least Concern" (LC); *Cebus kaapori* from VU to CR; *Cebus nigritus* from LC to NT; *Leontopithecus rosalia* from CR to EN; *Mico chrysoleucus* from VU to DD; *Mico leucippe* from VU to DD; *Mico nigriceps* from VU to DD; *Saguinus bicolor* from EN to CR; and *Saguinus imperator imperator* from VU to DD.

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PRIMATES IN THE SERRA DOS ÓRGÃOS NATIONAL PARK: NEW RECORDS

The Serra dos Órgãos National Park occupies 11,800 ha of the coastal forest of the Serra do Mar ecoregion (*sensu* Dinerstein *et al.*, 1995) in the state of Rio de Janeiro, Brazil. The park, which ranges from 300 to 2263 m above sea level in the municipalities of Magé, Guapimirim, Petrópolis and Teresópolis (Brazil, IBAMA, 1980), protects a number of vegetation types of the Atlantic forest, including upper montane, montane and lower montane dense forest and high altitude grassland (*campos de altitude*) (*sensu* Veloso *et al.*, 1991). The Serra dos Órgãos National Park, founded in 1939, is contiguous with a number of other protected areas (Table 1), comprising as such a large ecological corridor in the region, internationally recognized as a conservation priority (Conservation International do Brasil *et al.*, 2000). With widespread fragmentation being typical of the vast majority of the remnants of Brazil's Atlantic forest, relatively extensive continuous forests such as can be found in this corridor undoubtedly play an important role in maintaining intact the mammalian faunas typical of the region (Chiarello, 1999). The composition and ecology of the medium-sized and large mammal fauna of the Serra do Mar is, however, still poorly known.

Schirch (1931) was the first to register *Brachyteles arachnoides* in the region. Grelle (2000), examining museum specimens and reviewing the literature, found records for *B. arachnoides*, *Alouatta guariba*, *Cebus nigritus* (*sensu* Silva Jr., 2001), and *Callithrix aurita* in the Serra dos Órgãos. *C. aurita* was also registered as occurring there by Cerqueira *et al.* (1998). Surveys in the Park by Garcia and Andrade Filho (2002) have confirmed the presence of *B. arachnoides* and also indicated the continued presence of *A. guariba*, *Cebus nigritus*, and *Callithrix aurita*. Although the masked titi, *Callicebus nigrifrons*, would also be expected to occur there

Table 1. Protected areas of the Serra dos Órgãos region, state of Rio de Janeiro, Brazil.

Protected Areas	Area (ha)	Decree	Municipalities
Federal			
Serra dos Órgãos National Park	11800	1939	Guapimirim; Magé; Teresópolis; and Petrópolis
Tinguá Biological Reserve	26000	1989	Petrópolis, Duque de Caxias; Queimados Nova Iguaçu; Miguel Pereira; and Japerí
Petrópolis Environmental Protection Area (APA)	59049	1982	Petrópolis, Duque de Caxias; Guapimirim; and Magé
State			
Paraíso Ecological Station	4920	1987	Guapimirim and Cachoeiras de Macacu
Araras Biological Reserve (inside the APA of Petrópolis)	2068	1950	Petrópolis
Três Picos State Park*	40000	2002	Teresópolis; Guapimirim; Cachoeiras de Macacu; Nova Friburgo; and Silva Jardim
Bacia dos Frades Environmental Protection Area (APA)	7500	1990	Teresópolis
Floresta do Jacarandá Environmental Protection Area (APA)	2700	1985	Teresópolis

Source: Secretaria de Estado do Meio Ambiente e Desenvolvimento Sustentável do Rio de Janeiro (SEMADS). 2001. * Not included on the data source.

according to its supposed distribution, it has not to date been recorded in the Serra dos Órgãos. In Rio de Janeiro it is known only from its type locality, in the north of the state in the municipality of Campos (Van Roosmalen *et al.*, 2002), and from Itatiaia in the south-west (Grelle, 2000).

Since 1998, I have worked as a guide in the Park, also coordinating field studies on small mammals for the Vertebrate Laboratory of the Department of Ecology of the Federal University of Rio de Janeiro. Here I report on some observations of the primates occurring in the Serra dos Órgãos National Park.

In December 1999, I observed a male brown howler, *Alouatta guariba*, foraging alone in bracts of *taquaraçu* (*Guadua* sp.) by a road near the hostel of the Teresópolis headquarters of the Park (22° 27'28"S, 42° 59'42"W, altitude 1050 m). In August 2000, I also heard howlers vocalizing at the base of the Verruga do Frade mountain, and again in March 2003, I heard them in the forest above the Mozart Catão visitor's trail.

The Serra dos Órgãos is the type locality of the black-horned capuchin, *Cebus nigritus* (Goldfuss, 1809) (see Hill, 1960). I have seen it there twice. In July 1999 and October 2000, the same group of 8-12 individuals was observed in a secondary forest at 1100 m above sea level, behind the Park hostel. In August 2000, while carrying out a preliminary survey of medium-sized and large mammals (Cunha, 2003), I also found some tracks of capuchin monkeys located in upper montane dense forest (*Floresta Ombrófila Densa Alta Montanha*, *sensu* Veloso, 1991) at 1550 m, along the Pedra do Sino trail.

Marmosets were recorded by Limeira and Rocha (1999), but they were unable to identify the species. Garcia and Andrade Filho (2002) indicated the presence of *Callithrix aurita*, but without confirming they had seen them. In October 2002, a single semi-tame *Callithrix penicillata* was seen near to

the Park hostel, but this was undoubtedly due to somebody releasing it. They occur naturally only to the west, in the Cerrado of Central Brazil, and are not native to the state of Rio de Janeiro. I have never seen, nor have any evidence of, the occurrence of *Callithrix aurita* in the region.

The presence of the black-fronted titi, *Callicebus nigrifrons* (Spix, 1823), in the Serra dos Órgãos was recorded in October 2002 in two different areas of the National Park by its unmistakable vocalizations. The first locality was near Rio Soberbo, at around 1000 m, and the other in the upper reaches of the Rio Bonfim, at around 1300 m, above the Véu da Noiva waterfall in the Petrópolis side of the Park. The distance and the relief between the two areas suggest that these observations are from different populations. I compared the calls with those of *Callicebus personatus* in the CD of *Sounds of Neotropical Rainforest Mammals: An Audio Field Guide* by Emmons *et al.* (1998).

In August 2003 I registered a small group of muriquis (*Brachyteles arachnoides*) on the upper Rio Paquequer, at around 1600 m at 11:30 am. They saw me first and fled; I could count only two adult individuals and a single juvenile on the female's back. *B. arachnoides* and *C. nigrifrons* apparently occur only in the more remote areas of the Park, avoiding the presence of humans.

Urgently needed are detailed studies on the primates occurring in the Serra dos Órgãos to obtain a better understanding of their distribution in the park, their densities and the vegetation types and altitudes where they are occurring. Except for *Callithrix penicillata*, all are endemic to the Atlantic Forest (Fonseca *et al.*, 1996) and, excepting *Cebus nigritus*, are ranked as threatened in the state of Rio de Janeiro (Bergallo *et al.*, 2000). A recent reassessment of Brazil's threatened species has listed *Brachyteles arachnoides* as "Endangered", and *Callicebus nigrifrons*, *Cebus nigritus* and *Alouatta guariba* as "Near Threatened" (Rylands and Chiarello, 2003). Further surveys are needed

to establish the presence or otherwise of *Callithrix aurita*, listed as "Vulnerable" on the 2003 Brazilian List of Species Threatened with Extinction.

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Primate Studies in Argentina: Evolution and Ecology

Overview

For the last 20 years Argentinean primatologists have developed numerous studies of the platyrrhine taxa that inhabit northern Argentina and neighboring Paraguay and Bolivia. The species include *Alouatta caraya*, *Alouatta*

guariba (= fusca), *Aotus azarae*, *Cebus apella* and *Saimiri boliviensis*, and the studies have centered on their geographical distribution, population parameters, social organization, habitat use, behavior, and genetics (Mudry, 1983; Brown, 1986; Zunino, 1986; Rumiz, 1987; Giudice, 2000; Szapkievich, 2001; Ascunce, 2002).

The main goal of our genetic studies has been to provide essential information necessary to infer evolutionary patterns and the taxonomic status of these primates. Karyological studies of *Alouatta caraya*, *Aotus azarae*, *Cebus apella* and *Saimiri boliviensis* have been conducted employing banding techniques (G, C, NOR, G/C, Q, DAPI and enzyme digestion) and also fluorescence *in situ* hybridization (FISH) techniques (Mudry *et al.*, 1998, 2001a, 2001b; Rahn *et al.*, 1996; Nieves *et al.*, 2002). Through mitotic studies in both sexes and meiotic studies in males, the multiple sexual system of *A. caraya* (2n = 52) $X_1X_2Y_1Y_2/X_1X_1X_2X_2$ was described for the first time (Rahn *et al.*, 1996). Chromosomic sexual determination analyses in *Alouatta palliata mexicana* also showed a multiple sexual system while the modal number is different in males and females (Mudry *et al.*, 2001b; Solari *et al.*, 2002). Meanwhile meiotic analyses in specimens of *Ateles* and *Cebus apella* confirmed an XY chromosomic sexual system determination. Genotoxic studies are being developed that consider the effect of chemical agents on the chromosomal liability in *Cebus apella* chromosomes through the analysis of fragile sites (Martinez, doctoral thesis project).

Biochemical analysis of electrophoretic loci was used to characterize natural populations of *Alouatta caraya* from both margins of the Río Paraná (Szapkievich, 2001; Szapkievich and Mudry, 2002a). Molecular systematic studies based on mitochondrial DNA sequences have investigated the phylogenetic relationships among New World monkeys (Ascunce, 2002; Ascunce *et al.*, 2002, 2003a, 2003b). The genetic variability of the southernmost populations of *Alouatta caraya* also has been analyzed by mitochondrial DNA and through microsatellite markers (Ascunce, 2002; Ascunce *et al.*, 2003b).

In the past few years, GIBE has begun to develop projects with zoological institutions in Argentina in order to study the genetics of captive primates, to contribute to their correct taxonomic identification, and to provide data to improve the management of breeding colonies (Szapkievich *et al.*, 2002b). Another aspect of the collaborative projects includes environmental enrichment, allowing for the development of the first study of this aspect of captive primates in Argentina conducted on *Cebus apella* (Giudice, 2000). The functional and social behavior of *Alouatta caraya* have been studied in its natural habitat (Giudice, 1997; Giudice and Mudry, 2000), and we have also analyzed the adaptability of this species in a forest fragment outside its natural geographic range (Giudice and Ascunce, 1998).

Currently, ecological studies are focusing on the impact of habitat fragmentation, and aspects such as seed dispersal, demography and mating behavior. One of the main goals is to evaluate the role of *Alouatta caraya* in the dynamics and regeneration of the flooded forest of the Río Paraná (Bravo, doctoral thesis, in prep.; Bravo *et al.*, 1995; Bravo and Zunino, 1998, 2000; Bravo and Sallenave, submitted). The other objective is to obtain an understanding of demographic and social patterns in *Alouatta caraya* related to food availability, type of habitat, and geographic distribution. These studies involve two doctoral projects (Kowalewski; Oklander) and were subjects of three "Licenciatura" theses (Kowalewski, 1995; Bravo, 1996; Bazzalo, 1998), a Master's thesis (Kowalewski, 2000) and a number of publications (Kowalewski *et al.*, 1995; Zunino *et al.*, 1996; Fernandez-Duque and Bravo, 1997; Zunino *et al.*, 2000; Santa Cruz *et al.*, 2001; Gonzalez *et al.*, 2002).

Other ecological studies on *Aotus azarae* and *Cebus apella* by Argentinean primatologists have focused on seasonal birth patterns, allogrooming behavior and demography (Di Bitetti, 1997; Di Bitetti and Janson, 2000; Di Bitetti *et al.*, 2000; Fernandez-Duque *et al.*, 2001; Rotundo *et al.*, 2002). Considering the importance of New World monkeys as biomedical models, their reproduction, neurology, nutrition and endocrinology have also been the subject of research programs (Rey *et al.*, 1996; Pucciarelli and Dressino, 1996; Pucciarelli *et al.*, 2000; Colombo, 2001). Finally, paleontological studies by Argentinean paleontologists have helped to elucidate platyrrhine evolutionary history (Tejedor, 1996, 1998).

The Corrientes Biological Station (EBCo) (originally the Argentinean Primate Center - CAPRIM) was inaugurated in July 2001 as a research center under the supervision of CONICET, the Argentine Museum of Natural Sciences (MACN) and the Directorate of the Fauna and Flora of Corrientes Province (Argentina). The Biological Station continues to breed *Saimiri boliviensis* and *Cebus apella*, but the objectives have been expanded to cover not only primate breeding and research but also education, conservation, and field research. For more information about the Biological Station and its program of scientific activities, you can visit its website at: <http://ar.geocities.com/yacarehu>, or contact Dr. Gabriel Zunino at <gezunino@yahoo.com.ar> or <yacarehu@yahoo.com.ar>.

Future research will concentrate on the genetic and ecological dynamics of the primates of the region to help us understand the patterns of speciation, their distributions, and the different ecological strategies they have evolved. However, the future of Argentinean primatology will depend on the continuity of national grants and the availability of international funds during these difficult times that Argentina is facing.

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FOREST FRAGMENTS IN BARREIRO RICO, SOUTHEASTERN BRAZIL: THE NEED FOR CONSERVATION ACTION

Barreiro Rico is a privately-owned cattle ranch in the Atlantic Forest, near the confluence of the Rios Piracicaba and Tietê (22°41'S, 48°06'W), in the eastern part of the Central Plateau (*c.* 450-586 m altitude) of the state of São Paulo, southeastern Brazil. Despite being in a region of remarkably intense agriculture and ranching, the farm harbors some semi-deciduous forest remnants, each surrounded by pastureland and fields. Through the years, the owners have maintained the fragments for recreational game hunting (common in the past) and birdwatching. Mittermeier *et al.* (1987) estimated the total remaining forest area as 3259 ha. Currently, however, the forests have been reduced to 2325 ha, in three fragments of 1450, 501, and 374 ha (J. C. Magalhães, pers. comm.). All patches have broken canopies with dense understorys of lianas and old selectively-logged areas in regeneration. The largest forest has the oldest logged areas, with a moderately open understory but still large-crowned individuals of *Hymenaea courbaril* (Leguminosae) and *Aspidosperma polyneuron* (Apocynaceae).

Recently, the Brazilian Institute for the Environment (IBAMA) of the Ministry of the Environment, along with a number of non-governmental institutions, identified the forest fragments of Barreiro Rico as one of the most important areas for the conservation of mammals in the Atlantic Forest (Conservation International do Brasil *et al.*, 2000). The site is the richest in São Paulo in terms of primate species—no other includes five: the buffy-tufted-ear marmoset (*Callithrix aurita*), the masked titi (*Callicebus nigrifrons*), the capuchin monkey (*Cebus nigritus*), the brown howler (*Alouatta guariba*), and the muriqui (*Brachyteles arachnoides*).

Its proximity to a number of academic institutions has been an attraction for biologists. For decades, research in Barreiro Rico was possible through the hospitality of Sr. José Carlos R. de Magalhães, one of the landowners, who provided accommodation and logistical support to researchers and visitors. Sr. Magalhães, who passed away on 21 August 2002, was a keen naturalist, one who contributed significantly to our understanding of the behavior and songs of many bird species (Magalhães, 1999). Thirty-one scientific publications have been and still are being produced with data partially or totally gathered in the forest fragments of Barreiro Rico. Four relate to flora, 10 to bird species or community ecology, and 17 to primates.

Primatological studies in Barreiro Rico, which began in the early eighties, continue up to the present time. Katherine Milton studied *Brachyteles arachnoides* from 1980-89, including their ecology (Milton, 1984), reproductive behavior (Milton, 1985a, 1985b, 1985c), population surveys, and conservation status (Milton and de Lucca, 1984; Milton, 1986; Mittermeier *et al.*, 1987). The primate community as a whole was studied by Torres de Assumpção (1981, 1983). In the nineties, the successful darting and capture of two muriquis (Lemos de Sá and Glander, 1993) provided morphological and genetic data for analysis of differences between the southern variety, *arachnoides,* and the northern, *hypoxanthus* (Lemos de Sá *et al.*, 1990; Pope, 1998). Strier and Fonseca (1996) revised the species' population status throughout the muriquis' range, and Galetti (1996) carried out a study on predation avoidance behavior by four of the primate species there. More recently, Azevedo (2001) studied the ecology of a *B. arachnoides* group and Martins (in prep.) has investigated feeding strategies and seed dispersal by syntopic *A. guariba* and *B. arachnoides* groups.

Brachyteles arachnoides is endangered (IUCN, 2002). Eighty-seven percent of the remaining populations of the southern variety occur in large protected areas (Strier and Fonseca, 1996/1997; Strier, 2000), all of them in the evergreen coastal forest. Individuals observed in at least six different groups in Barreiro Rico appear to be healthy. Apart from the isolation of groups within forest patches, the most evident threat to *Brachyteles* in Barreiro Rico is selective logging, especially of the commercially valuable *guarantã*, *Esenbeckia leiocarpa* (Rutaceae). Over a year, muriquis fed on the immature seeds of this species in 18.1% of 724 fruit/seed feeding records. *E. leiocarpa* is also important for the howlers of Barreiro Rico. One group used an *Esenbeckia* tree as a sleeping site on 13 of 46 occasions (Martins, in prep.). Many saplings of this species can be found in old logging trails, however (pers. obs.), and locally it is probably under no risk of extinction.

Four aspects of the Barreiro Rico forests make them a priority for the implementation of conservation actions: 1) recognized biological importance of the mammal fauna; 2) primate richness on a regional scale; 3) the existence of some information on the flora and fauna sufficient to provide a basis for management plans; and 4) the lack of protected areas in the semi-deciduous forests of the Atlantic Forest of the State of São Paulo where *B. arachnoides* occurs. Financial resources are required for the elaboration and implementation of a management plan. Landowners, with few exceptions, have always been unwilling to invest in the sustainable management of their timber resources, besides their antipathy when targeted for a commitment to wildlife conservation.

Large protected areas are, of course, vital for holding viable primate populations; but, as argued by Mendes (1994), small, well-protected, privately-owned forests represent a valuable summation of the genetic material vital for the survival of a threatened species. Combining the efforts of São Paulo's environmental authorities and international non-government institutions would be the most appropriate road to conserving the remaining biodiversity in Barreiro Rico.

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Participación Comunitaria en Proyecto de Conservación del Mono Aullador Negro (*Alouatta palliata aequatorialis*) en el Pacífico Colombiano

Durante marzo de 2002 ejecutamos el proyecto "Conservación del mono aullador negro (*Alouatta palliata aequatorialis*) en un bosque húmedo tropical del Chocó Biogeográfico de Colombia" cuyo objetivo fue realizar el primer censo de *A. p. aequatorialis* en Colombia para estimar su abundancia poblacional y tener una aproximación preliminar a su estado de conservación en la región de Cabo Corrientes (Departamento de Chocó, Colombia). El estudio se llevó a cabo en la Estación Biológica "El Amargal", ubicada sobre la costa pacífica a 5 km de Arusí, población que posee alrededor de 600 habitantes. El bosque húmedo tropical de esta zona alcanza una extensión de 25 000 ha y pertenece a la comunidad negra de Arusí por disposición de las leyes colombianas. Gran parte de la población asentada en la región vive del aprovechamiento directo de los recursos naturales: la extracción de madera, la pesca y la caza; sin embargo, su interés por la conservación de estos recursos ha aumentado gracias a la presencia activa de la Fundación Inguedé (Colombia), a través de la Estación Biológica El Amargal y los diferentes proyectos comunitarios que se han realizado en la zona.

Un componente fundamental en el proyecto de conservación del mono aullador fue la participación de la comunidad de Arusí. Antes de llevar a cabo el censo de aulladores realizamos una charla informativa con ayudas audiovisuales en el colegio local. Asistieron aproximadamente 40 personas, entre niños y adultos de la comunidad negra y algunos colonos residentes en la región. La presencia de tal cantidad de gente, teniendo en cuenta el tamaño reducido de la población, demuestra el interés generado por la presentación del proyecto. La charla comprendió 3 aspectos: 1) Dar a conocer los resultados de un estudio realizado en esa misma zona entre 1995 y 1996 por la bióloga Carolina Ramírez, acerca de la dieta, comportamiento alimentario y etnozoologia de los monos aulladores, 2) Explicar detalladamente el censo de monos que pretendíamos realizar en la zona y 3) Sostener un diálogo sobre la importancia de estudiar y conservar a este primate. Durante la charla, algunas personas formularon preguntas sobre el proyecto, propusieron modificaciones a la metodología y demostraron interés en participar activamente de los censos. Hablamos de la importancia que tiene el árbol "lechero" (*Brosimum utile*, Moraceae) para los monos aulladores y para los habitantes locales porque los primeros consumen los frutos y las hojas, y los habitantes lo aprovechan para uso artesanal (elaboración de lanchas) y medicinal (uso del exudado del tronco). Aunque éste árbol es abundante en la zona, planteamos la importancia de utilizarlo racionalmente y de propender por

la conservación del mono aullador que es dispersor de sus semillas. Los niños, por su parte, reconocieron la presencia de michichís (*Saguinus geoffroyi*) en la zona, pero muchos de ellos desconocen a los monos aulladores. Los adultos explican que esto se debe a que los michichís suelen encontrarse en áreas de vegetación intervenida y cerca de viviendas, mientras que los monos aulladores permanecen en el interior del bosque maduro, donde los niños ya no acceden por razones de seguridad. Adicional a esto, la reciente llegada del paramilitarismo y de la televisión satelital han llamado la atención de algunos jóvenes reemplazando el interés que pueda existir por aprovechar económicamente el bosque, ocasionando una pérdida del conocimiento tradicional en las nuevas generaciones de la comunidad negra.

Una vez finalizada la charla, obsequiamos a los niños, materiales escolares (libretas, esferos y carpetas) con motivos alusivos a los monos aulladores, que fueron donados al proyecto por el Centro de Primatología Araguatos. Por intermedio de uno de sus líderes comunitarios, los habitantes nos expresaron su agradecimiento por exponerles previamente el proyecto ya que esto no había sucedido con los proyectos de investigación anteriormente desarrollados en esta zona. En días posteriores, nos manifestaron sus expectativas por conocer el progreso del censo, algunos de ellos nos comentaron sus observaciones recientes de los aulladores en diferentes zonas y sus propias identificaciones al respecto (conteo de los monos, diferenciación por clases de edad y sexo y su comportamiento), información que fue valiosa al momento de identificar claramente la localización de los grupos de monos.

Otro componente fundamental en el proyecto fue el entrenamiento de un líder local como auxiliar de campo. Durante los censos contamos con la ayuda del señor Juan de Dios Grueso, perteneciente a la comunidad negra. Él colaboró en las observaciones de campo, la toma de datos y sus comentarios acerca de la metodología fueron valiosos al momento de realizar algunos ajustes y adaptaciones a las condiciones del terreno. Gracias a sus conocimientos sobre la región, aportó información valiosa para fortalecer la continuidad de estudios posteriores en la zona.

El interés y la participación activa de la comunidad de Arusí en la conservación del mono aullador negro demuestran que los procesos de sensibilización ambiental deben ser un componente fundamental de las diferentes iniciativas de investigación, porque no solamente se abren espacios de discusión e intercambio cultural, sino también se identifican las perspectivas de la comunidad y los elementos necesarios para implementar estrategias de conservación. Consideramos de suma importancia que proyectos cortos o programas a largo plazo proyectados para esta zona y para el Chocó Biogeográfico en general, sean dados a conocer previamente a las comunidades locales y reconozcan los aportes que ellos pueden dar al desarrollo de los mismos.

Este proyecto contó con la valiosa participación de entidades como Margot Marsh Biodiversity Foundation que brindó el soporte económico, el Centro de Primatología Araguatos

por su apoyo institucional, la Fundación Inguedé por su apoyo logístico en la Estación Biológica El Amargal y las empresas VARTA y KODAK de Colombia por la donación de sus productos.

Carolina Ramírez y **Iván Sánchez**, Centro de Primatología Araguatos, Calle 96 Nº 22-08 Bogotá, D.C., Colombia. E-mail: <info@araguatos.org>, <lira33@yahoo.com>.

IV Curso Latino-Americano em Biologia da Conservação e Manejo da Vida Silvestre

O Curso Latino-Americano em Biologia da Conservação e Manejo da Vida Silvestre, 4 de novembro a 6 de dezembro de 2003, será ministrado pelo IPÊ – Instituto de Pesquisas Ecológicas em parceria com a Smithsonian Institution – USA, com apoio do Instituto Florestal do Estado de São Paulo. O curso será oferecido em português e sua parte introdutória será realizada no Centro Brasileiro de Biologia da Conservação (CBBC) do IPÊ, localizado no município de Nazaré Paulista, próximo a cidade de São Paulo. Grande parte de seu conteúdo será abordado no Parque Estadual Morro do Diabo, localizado no Pontal do Paranapanema, oeste do Estado de São Paulo. No Pontal do Paranapanema existem muitos dos mais importantes remanescentes da Mata Atlântica do Interior. Destaca-se o Parque Estadual Morro do Diabo que, com seus 35.000 ha de floresta contínua, representa o maior monumento vivo desse raro e ameaçado ecossistema. Entre os representantes das diversas e integras fauna e flora do Morro do Diabo ainda existem o raro e endêmico mico-leão preto (*Leontopithecus chrysopygus*) bem como a maioria dos carnívoros e ungulados brasileiros, como a onça pintada, a onça parda, a jaguatirica, a anta, veados, queixadas e caetetus. Instrutores com experiência nos temas conduzirão aulas teóricas e exercícios de campo em aspectos relevantes em biologia da conservação e manejo da vida silvestre. Pesquisadores com trabalhos específicos na conservação da biodiversidade brasileira apresentarão palestras sobre os resultados e a aplicação de suas pesquisas. Todos os participantes apresentarão um seminário de 30 minutos sobre seus trabalhos específicos na área de conservação da natureza. Os participantes usarão também seus conhecimentos adquiridos durante o curso para a elaboração de projetos de pesquisa de campo sobre os tópicos abordados durante o curso. *Instrutores:* Cláudio Valladares-Pádua, Universidade de Brasília e IPÊ – Instituto de Pesquisas Ecológicas; Cristiana Saddy Martins, IPÊ – Instituto de Pesquisas Ecológicas; Helder Henrique Faria, Instituto Florestal do Estado de São Paulo; José Augusto Pádua, Universidade Federal do Rio de Janeiro; Laury Cullen Junior, IPÊ – Instituto de Pesquisas Ecológicas; Paulo Rogerio Mangini, Pesquisador Associado, IPÊ – Instituto de Pesquisas Ecológicas; Patrícia Medici, IPÊ – Instituto de Pesquisas Ecológicas; Paulo de Marco Jr., Universidade Federal de Viçosa (UFV); e Suzana Machado Padua, IPÊ – Instituto de Pesquisas Ecológicas. *Palestrantes e colaboradores:* Edu-

ardo Humberto Ditt, Fabiana Prado, Luiz Henrique Lima, e Maria das Graças de Souza, todos do IPÊ – Instituto de Pesquisas Ecológicas. *Prazo de Inscrição:* 31 de Agosto, 2003. Terão preferência os candidatos que se inscreverem com mais antecedência**.** *Candidatos:* Profissionais relacionados à conservação de vida silvestre, alunos de graduação, pós-graduação e áreas afins. *Inscrição/Seleção:* Os interessados em se candidatar deverão enviar para o IPÊ os seguintes documentos, que serão considerados no processo seletivo: Uma carta de intenções justificando como esse curso poderá contribuir para a carreira profissional (1-2 páginas), uma carta de recomendação, e uma cópia do *Curriculum Vitae* (CV). Enviar todos os documentos por e-mail (em arquivo atachado de Word) para: <cbbc@ipe.org.br>. Ou pelo correio para: IPÊ – Instituto de Pesquisas Ecológicas, Caixa Postal 47, Nazaré Paulista 12960-000, São Paulo, Brasil. *Preço:* US$ 1,350.00. Inclui hospedagem, alimentação, transporte local, material didático e bibliográfico e material de campo utilizado durante o curso. *Logística:* Alojamento, transporte local e equipamentos durante o período do curso. *Organização:* IPÊ – Instituto de Pesquisas Ecológicas, Smithsonian Institution – USA e Wildlife Trust – USA. *Apoio Logístico:* Instituto Florestal de São Paulo – IF/SMA, Parque Estadual Morro do Diabo – IF/SMA, e Centro Brasileiro em Biologia da Conservação – CBBC/IPÊ. *Apoio Financeiro:* IPÊ – Instituto de Pesquisas Ecológicas e SI – Smithsonian Institution, USA. *Mais informações:* Tel: +55-11-4597-1327 ou +55-11-9789-4827, e-mail: <cbbc@ipe.org.br>. Website: <www.ipe.org.br>.

5º Curso Latino Americano de Especialização em Animais Silvestres: Conservação na Amazônia

A Sociedade Brasileira de Medicina Veterinária (SBMV), Presidente René Dubois, Secretário Geral Milton Thiago de Mello, a Rede Nacional de Combate ao Tráfico de Animais Silvestres (RENCTAS) e a Universidade Federal Rural da Amazônia (UFRA), com apoio de muitas outras instituições, promoverão, de 09 de setembro a 28 de novembro de 2003, o "5º Curso Latino Americano de Especialização em Animais Silvestres: Conservação na Amazônia". O curso incorpora támbem o "1º Curso De Especialização em Combate ao Tráfico de Animais Silvestres" e o "1º Curso de Extensão em Conservação e Uso Sustentável de Animais Silvestres na Amazônia". Os coordenadores são Milton Thiago de Mello (SBMV), Raulff Lima (RENCTAS) e Maria das Dores Correia Palha (UFRA).

O Curso abrangerá os seguintes temas:

- Importância dos animais silvestres. Conservação da biodiversidade. Destruição de habitats. Espécies ameaçadas de extinção. Legislação.
- Bases para o estudo da fauna silvestre. Sistemática e taxonomia. Biogeografia e demografia. Ecologia. Etologia e bem estar animal. Fauna Amazônica.
- Conservação, manejo e reprodução de animais silves-

tres em cativeiro. Alimentação. Reprodução de espécies ameaçadas de extinção.

- Criação de animais silvestres para conservação e educação ambiental. Exemplos de zoológicos, centros criatórios e de projetos de educação ambiental visando à conservação da fauna silvestre.

- Conservação, manejo e reprodução de animais silvestres em áreas submetidas a impacto ambiental. Resgate, adaptação, reprodução e manejo em cativeiro. Reintrodução, translocação e introdução. Fornecimento a instituições do País e do exterior. Exemplos das Usinas Hidro-Elétricas, mineração e projetos agropecuários.

- Participação em reuniões científicas sobre animais silvestres, congressos, simpósios, encontros, conferências, seminários, etc.

- Participação no XXX Congresso Brasileiro de Medicina Veterinária (CONBRAVET/2003, Manaus, 5 a 9 de outubro de 2003) e na comemoração dos 20 anos dos Cursos de Animais Silvestres.

- Atividades de repressão ao tráfico.

O Curso começará e terminará em Belém, Pará. As principais cidades de onde se irradiarão as atividades serão as seguintes: Belém, Santarém (Pará), Manaus (Amazonas), Macapá (Amapá), Boa Vista (Roraima) e Rio Branco (Acre). O financiamento das viagens de avião para as cidades incluídas no roteiro será providenciado pelos participantes, o que poderá ser feito em parcelas, por meio de cartão de crédito. *Número de Vagas*: 15, sendo 10 para participantes brasileiros e 5 para participantes de outros países latino americanos. *Clientela*: Profissionais de nível superior, oriundos de instituições governamentais ou não governamentais (ONGs) relacionadas com animais silvestres, meio ambiente, legislação, monitoramento, policiamento e fiscalização ambiental, principalmente Jardins Zoológicos, Museus, Institutos e Polícias Florestais, Secretarias de Meio Ambiente, Unidades de Conservação e entidades correlatos; pesquisadores ou docentes de ensino técnico ou superior, de profissões e especialidades relacionadas com animais silvestres, que desejem aprofundar o conhecimento de áreas específicas ao tema; e outros profissionais de nível superior. *Inscrições:* Até 01 de agosto de 2003, no seguinte endereço (por correspondência ou pessoalmente): Sociedade Brasileira de Medicina Veterinária (SRTVS), a/c Coordenador do 5º Curso: Prof. Milton Thiago de Mello, Quadra 701, Bloco E, Ed. Palácio do Rádio II, Sala 333, 70340-902 Brasília, DF, Brasil. Telefax: (61) 468-2808 ou (61) 226-3364, e-mail: <anmil@uol.com.br>.

WILDLIFEDECISIONSUPPORT.COM

WildlifeDecisionSupport.com was launched a year ago by Dr. Andrew McKenzie, the editor of the *Capture and Care Manual*—which has become the definitive text for wildlife managers, ranchers and veterinarians—and Peter Morrison, a well-known ecotourism manager.

The first edition of the *Capture and Care Manual* is virtu-

ally sold out and at this stage there is no definite plan for a second edition; however, the full text of the *Manual* is now online at <http://wildlifedecisionsupport.com>. The site also has a community-based section where members can share their experiences, knowledge, techniques and queries with colleagues and experts globally. A "news and smalls" section keeps the members up-to-date with their industry and the option to market or purchase services or products. The site also distributes the specialized wildlife publications of the Wildlife Group and has recently become the South African distributor for the World Organization for Animal Health. For further information contact: Peter Morrison, Member Communications at <http://wildlifedecisionsupport.com>.

MAMMALIAN SPECIES

Mammalian Species, editor Virginia Hayssen, is published regularly by the American Society of Mammalogists with 25-30 new accounts issued each year. Each account summarizes the current understanding of the biology of a single species, including systematics, distribution, fossil history, genetics, anatomy, physiology, behavior, ecology, and conservation. The American Society of Mammalogists have now put 631 mammalian species accounts online as PDF files, and subscriptions to the series are also available for $30.00 per year. For more information on the series e-mail David Stadler at Allen Press: <dstadler@allenpress.com> or visit the *Mammalian Species* website at <www.science.smith.edu/departments/Biology/VHAYSSEN/msi/msiaccounts.html>.

THE AUTOMATED TELEMETRY PROJECT, STUDYING SPECIES INTERACTIONS IN A TROPICAL FOREST

Presently being installed on Barro Colorado Island (BCI), Republic of Panama, the premier field station of the Smithsonian Tropical Research Institute, an automated telemetry system will permit the radio-tracking of tagged animals on a large scale in a tropical forest. The project is being funded by the Celerity Foundation, Gray Island Systems and the Smithsonian Tropical Research Institute and will address many of the most important questions in biology and conservation, including species interactions and the evolution of diversity, competition, predation, seed dispersal, effects of fragmentation and human disturbance. Applying telemetry will also allow for the ability to consistently find a study animal, which opens up future possibilities to research behavior, eco-physiology, disease, etc.

The project will utilize an automated telemetry system designed by William Cochran, and described by Larkin *et al.* (1996). The system uses a scanning receiver which measures the relative signal strength from an array of six directional antennas to estimate the direction of a transmitter. The correct placement of towers should provide good coverage of the entire island for large terrestrial animals and medium-sized high-flying animals, and respectable coverage

for smaller animals. Initial tests suggest an accuracy of about 5 degrees in direction finding. Wireless communication will link each receiver to the main lab and will allow the transmission of data back to the lab in real time which will be used to triangulate the location of the animal. Data will be immediately available online through software provided by Gray Island Systems and will be used both for educational purposes, open to the general public, and also through password-protected areas available only to researchers involved in specific projects. Presently, three initial projects are planned to test the system, which will hopefully include a study of ocelots, high-flying bats, and large frugivorous bats.

For further information contact: Roland Kays, Ph.D., Curator of Mammals, New York State Museum, CEC 3140, Albany, NY 12230, USA, Tel: 518-486-3205, Fax: 518-486-2034, email: <rkays@mail.nysed.gov>, <http://www.princeton.edu/~wikelski/research/index.htm>.

Reference:

Larkin, R. P., Raim, A., & Diehl, R. H. 1996. Performance of a nonrotating direction-finder for automatic radio tracking. *Journal of Field Ornithology* 67: 59-71.

Topics in Primate Conservation

Topics in Primate Conservation (TPC) of Primate Info Net (Wisconsin Regional Primate Research Center, University of Wisconsin, Madison) presents conservation news and reports from Asia, Africa, Madagascar and the Neotropics. Coverage includes the following: conservation strategies and activities; systematics and geographic distribution; habitat evaluation; and field research on ecology, evolution and behavior. The TPC Coordinators welcome collaboration with those engaged in conservation work with primates. Suggestions for topics or brief synopses of current research or conservation activities should be sent to the TPC Coordinators: Nancy Ruggeri (Department of Zoology, University of Wisconsin-Madison, e-mail: <nruggeri@facstaff.wisc.edu>), or Liza Moscovice (Department of Psychology, University of Wisconsin-Madison, e-mail: <lrmoscovice@students.wisc.edu>). TPC is available at <http://www.primate.wisc.edu/pin/cons/index.html>.

SSC Re-Introduction Specialist Group: Resource CD-ROM

The SSC Re-introduction Specialist Group (RSG) has produced a resource CD (RSG Resource CD v. 1.0 January 2003), which includes an introduction to the RSG, 22 issues of RSG's newsletter (November 1990 - January 2003), RSG Guidelines, SSC and other conservation policies and reports, Re-introduction Practitioners Directory, Specialist Group Bibliography, and RSG and SSC Strategic Plans. The CD was produced to fulfill the objectives of the RSG and SSC Strategic Plan. It provides access to RSG lit-

erature for the wider conservation community and especially for those who may have little or no Internet access. The following organizations supported the production and distribution of the RSG CD: Denver Zoological Foundation, USA; Environmental Research & Wildlife Development Agency, UAE; Durrell Wildlife Conservation Trust, Channel Islands; National Tropical Botanical Garden, USA. The CD is available on the SSC website via: <http://www.iucn.org/themes/ssc/sgs/rsg/index.htm>. For further information contact: IUCN/SSC Re-introduction Specialist Group, Environmental Research & Wildlife Development Agency, P.O. Box 45553, Abu Dhabi, United Arab Emirates (UAE), Tel: +971-2-693-4650, Fax: +971-2-681-0008, e-mails: Chairman, Frederic Launay, <FLaunay@erwda.gov.ae>, and Executive Officer, Pritpal S. Soorae, <PSoorae@erwda.gov.ae>.

New Species Information Service Manager

SSC's information management initiative, the Species Information Service (SIS), has received fresh impetus with the appointment of Mr. Stuart Salter as SIS manager. Previously Stuart was Director General, Science, Technology and Advisory Services Division, Policy Branch at the Canadian International Development Agency. He has broad domestic and international experience both within Government and the private sector. Based at IUCN headquarters in Gland, Stuart takes on the critical position of coordinating this multi-million-dollar initiative and is working closely with SSC Chair, David Brackett on fundraising.

Resource Available to Help Students Locate Primate Conservation Grants

Primate-Science announces an on-line resource available through Primate Info Net which is intended to help students locate grants to fund research in primate conservation and behavior. The grants list includes pertinent information and links to websites for a number of grants focused on primate conservation. It was compiled by Liza Moscovice, one of the coordinators for Topics in Primate Conservation and a University of Wisconsin graduate student. The site is currently focused on grants that are accessible to students, either at the undergraduate or graduate level. However, the list is in no way comprehensive, and Liza hopes to continue to expand it in the future to include a wider range of grant opportunities in primate behavior and conservation. You can help by bringing other grant opportunities to her attention. The grants website is online at: <http://www.primate.wisc.edu/pin/grants.html>.

Grants which are limited to a particular country, state or locale are certainly appropriate for listing on this site. As with all other related resources on Primate Info Net, international input is most welcome. Liza hopes this resource will provide a useful starting point for aspiring primate conservationists. As you look over the list, please send Liza your comments and alert her to other grant opportunities that should be added. You can contact her at: <lrmoscovice@students.wisc.edu>.

PRIMATE SOCIETIES

PRIMATE SOCIETY OF GREAT BRITAIN (PSGB) – CURRENT PRIMATE FIELD STUDIES

A supplement issue of Number 79 of the Primate Society of Great Britain's publication *Primate Eye* provides a listing of primate field studies worldwide, compiled by Eluned Price of the Durrell Wildlife Conservation Trust (DWCT), Jersey, British Isles. Each entry includes the following information: country, field site, species involved, the research team, the start date, duration and project status, the project aims, and correspondence address. It is the second to be produced in collaboration with the Wisconsin Regional Primate Research Center, Madison. Overall, 248 projects were listed in 48 countries, a considerable increase over the 2000 survey, which recorded 186. For the Americas, three projects are listed for Argentina, three for Belize, two for Bolivia, 30 for Brazil, six for Colombia, two for Ecuador, four for French Guiana, two for Honduras, five for Mexico, one each for Nicaragua and Panama, three for Peru, and one each for Suriname, Trinidad, and Venezuela.

The numbers of projects in Asia, Africa and the Neotropics were similar (each contributing a little less than one-third to the total), while Madagascar contributed 10%. Conservation was listed as the aim for 46% of the 248 projects, while research on behaviour was listed in 38%, ecology – 33%, population ecology – 29%, and behavioural ecology – 28%. Physiology, genetics, evolution, community ecology and life histories were each listed for less than 10% of the projects and programs. Using the *2002 IUCN/SSC Red List of Threatened Species*, Price analysed the extent to which threatened primates were the subject of studies in the wild, with the following results: Globally, 47% of 19 "Critically Endangered" (CR) species, 63% of the "Endangered" (EN) species, and 45% of the "Vulnerable" (VU) species were the subject of one or more studies. For the Americas, threatened primates listed in the field projects were as follows: CR - *Brachyteles arachnoides* (Brazil), *B. hypoxanthus* (Brazil), *Leontopithecus chrysopygus* (Brazil), *L. rosalia* (Brazil), *L. caissara* (Brazil), *Cebus albifrons trinitatis* (Trinidad); EN - *Callithrix aurita* (Brazil), *Callithrix flaviceps* (Brazil), *Saguinus oedipus* (Colombia), *Chiropotes satanas satanas* (Brazil); VU - *Callimico goeldii* (Bolivia), *Callithrix geoffroyi* (Brazil), *Callicebus personatus* (Brazil), *Alouatta guariba (fusca) clamitans* (Argentina, Brazil), *Alouatta seniculus insulanus* (Trinidad), *Ateles belzebuth* (Colombia, Ecuador). *Cebus albifrons aequatorialis*, listed as Data Deficient, is being studied in Ecuador.

For membership in the Primate Society of Great Britain or copies of the *Current Primate Field Studies Supplement* (£5.00), please write to Dr. Russell Hill, Treasurer and Membership Secretary – Primate Society of Great Britain, Evolutionary Anthropology Research Group, Department of Anthropology, University of Durham, 43 Old Elvet, Durham DH1 3HN, UK.

Eluned Price, 2 La Grange, La rue de Cambrai, Trinity, Jersey JE3 5AL, British Isles, e-mail: <eluned.price@durrell.org>.

INTERNATIONAL PRIMATOLOGICAL SOCIETY (IPS) – LIFETIME ACHIEVEMENT AWARD

The IPS is inaugurating its first award for service to the field of Primatology with the Lifetime Achievement Award. It is to be given to a member of IPS for outstanding career contributions to research, conservation and/or captive care and breeding of nonhuman primates, with attention to efforts with enduring international scope (in keeping with the international scope of the society). Current members of the Council are not eligible. The first Lifetime Achievement Award will be given at the next IPS Congress, in Torino, Italy, 23-28 August, 2004. The recipient will be selected in April 2004 by the Awards Committee, chaired by the President of the Society and with three or more other members of the Society. The recipient will be notified by April 30, 2004, and invited to attend to the IPS Congress to receive the Award. Any member of the IPS can nominate someone for this award. To do so please send a brief letter (not more than 600 words) documenting the person's career accomplishments to the Chair of the Committee, Dorothy Fragaszy, by September 1, 2003. Ask a second person (who does not need to be a member of IPS) to do the same.

Dorothy M. Fragaszy, President of IPS, Psychology Department, University of Georgia, Athens, Georgia 30602, USA, e-mail: <doree@arches.uga.edu>.

INTERNATIONAL PRIMATOLOGICAL SOCIETY (IPS) – CONSERVATION AWARDS

The Conservation Committee of IPS is soliciting applications of up to $1,500 to support the development of primate conservation field programs. The Committee is expecting to distribute up to $5,000 this year with a strong probability of a substantial increase next year. The deadline for this award is 30 September 2003. For the guidelines about the application process, contact: Dr. Cláudio Valladares-Pádua, IPS Vice President for Conservation, IPÊ – Instituto de Projetos e Pesquisas Ecológicas, Caixa Postal 47, 12960-000 Nazaré Paulista, São Paulo, Brazil, e-mail: <cpadua@unb.br>, or visit the IPS website: <www.primate.wisc.edu/pin/ips.html>.

Martha J. Galante Award. Grant proposals are solicited from professionals of habitat countries of primates. Money awarded should be used for conservation training; transportation to a course or event location; course or event fees; or expenses during the event. People interested in receiving this award should be officially enrolled in an academic institution or a similar organization (either taking or giving

courses or doing research or conservation work). To apply, send information about the program of interest (courses, congresses, symposia, field work, etc.); send a letter explaining your interests in participating in the course or event (in English); send a CV in English; send a letter of acceptance for the respective course; and send two recommendation letters (including information about the referee). Deadline for applications for the 2004 Martha J. Galante Award is 1 May 2004. Send the completed grant proposal by e-mail to Cláudio Valladares-Pádua (address above).

INTERNATIONAL PRIMATOLOGICAL SOCIETY (IPS) – CAPTIVE CARE GRANTS

The Captive Care and Breeding Committee of IPS awards grants of up to $500 for projects focusing on captive care issues that relate to: 1) the status of primates in captivity (for example, sanctuaries, private, commercial) in range countries, 2) information from local wildlife officials and field researchers on the problems relating to captive primates, and 3) improving conditions for the well-being of captive primates in range countries. Interested individuals should send a proposal (maximum three pages including a one-page CV of the principal investigator) outlining the project, including: background/introduction, methods, application of results to the captive care issue, and a budget. Deadline for applications is 1 June each year. Please send proposals to Dr. Colleen McCann, IPS Vice President for Captive Care and Breeding, c/o Wildlife Conservation Society, 2300 Southern Boulevard, Bronx, NY 10460, USA, e-mail: <cmccan@wcs.org>.

XXTH CONGRESS OF THE INTERNATIONAL PRIMATOLOGICAL SOCIETY 2004 – AN UPDATE

The IPS 2004 Congress Organizing Committee is working hard on several aspects to ensure to all a great meeting in Torino. The Congress has been included in the events that will celebrate the 600th Anniversary of Torino University. This is a very important role for the meeting and a great chance to give Primatology a better visibility in Italy. Both the Department of Animal and Human Biology and the Associazione Primatologica Italiana (API) are doing the hard work of getting in contact with possible sponsors and funding institutions. We have already firmed the contract for low cost student accommodations and the hotel accommodations have also been allotted. Symposium proposals are listed on the website. Anyone interested in submitting a proposal should contact the organizers as soon as possible. Elisabetta Visalberghi, Giovanna Spinozzi, Patrizia Poti and Maria Cristina Riviello are organising a pre-Congress workshop on "Capuchins: The State of the Art" in Radicondoli (Siena), 19-22 August, 2004, and Cláudio Valladares-Pádua is setting up a pre-Congress workshop on Primate Conservation in Torino, 19-22 August 2004. A post-Congress workshop on "Social Learning in Callitrichidae: Recent Trends and Perspectives" will be organised by API President

dent Augusto Vitale in Rome, and another on "Primate Cytogenetics and Comparative Genomics" will be held in Firenze, organised by Luca Sineo, Daniela Romagno and Roscoe Stanyon. It is now possible to register and book accommodation – go to <http://www.ips2004.unito.it> and follow the instructions. For further information (registration forms, abstract preparation, guidelines, presentation tips, student instructions, tourist information, etc.) go to the website or contact the professional congress organizer at <info@congressiefiere.com>. The Congress is from 23-28 August, 2004.

Cristina Giacoma and **Marco Gamba**, V. Accademia, Albertina 17, 1-10123 Torino, Italy, Phone +39 011 670 4761, Fax: +39 011 670 4732, e-mail: <ips2004@unito.it>.

INTERNATIONAL PRIMATOLOGICAL SOCIETY (IPS) – STUDENT AWARDS FOR OUTSTANDING ORAL AND POSTER PRESENTATIONS

The IPS Education Committee is excited to announce that they will be conducting a student competition for best oral and poster presentations, beginning at the 2004 Torino Congress. The winners will be presented with $100. Student prize winners will be encouraged to submit their work to the International Journal of Primatology for publication, which will be listed in the following year's meeting issue of the journal and in the IPS Bulletin, and their abstract will be put up on the Society's website. For questions about the competition please contact Anne Savage (address below) or refer to the IPS website. The following criteria determine eligibility: the student must be the first author, but need not be sole author; must be a student when the abstract is submitted and a current member of IPS; the student must present the paper or attend the poster; if the student cannot attend the meeting to which an abstract has been submitted, it should be withdrawn in writing no less than 5 days before the start of the meeting (failure to do this will disqualify the student from future competitions); if the student wishes to withdraw, even though presenting the paper or abstract, the VP for Education should be notified before the meeting; when applying, an extra copy of the abstract and presentation information should be included in the mailing to the IPS Congress Organizers.

Anne Savage, IPS Vice President for Education, Disney's Animal Kingdom, PO Box 10,000, Lake Buena Vista, FL 32830, USA, e-mail: <Anne.Savage@disney.com>.

SOCIEDADE BRASILEIRA DE PRIMATOLOGIA

Informo as últimas modificações realizadas em nossa homepage (<http://planeta.terra.com.br/educacao/SBPr>): (1) Link para os últimos fascículos do periódico *Laboratory Primate Newsletter* em formato PDF no item "Publicações"; (2) Divulgação de cursos, vagas para estágio e oportunidades de trabalho encontram-se agora no item

"Oportunidades", saliento o edital FNMA/PROBIO e a vaga para residência em Estudos Amazônicos na área de mastozoologia do Museu Goeldi; (3) Notícias científicas encontram-se no item "Notícias", o qual poderá ser atualizado semanalmente; (4) Inclusão da lista atualizada dos primatas brasileiros ameaçados de extinção. A sócia Milene Martins sugeriu que se criasse uma lista de discussão em primatologia e se dispôs a ser uma das mediadoras. Precisamos, no entanto, de outro profissional que se disponha a dividir esta tarefa com ela. Solicito aos interessados que a contatem pelo email <mmartins@unicamp.br>.

Não deixem de enviar sugestões e informações para a homepage. Mandem informações sobre vagas para estágio, trabalho, divulgação de encontros científicos relevantes, notícias, links interessantes, etc. Nossa idéia é que a página esteja em permanente atualização e, para isto, precisamos da colaboração de todos.

Julio César Bicca-Marques, Faculdade de Biociências/ PUCRS, Avenida Ipiranga 6681, Pd. 12A, Porto Alegre 90619-900, Rio Grande do Sul, Brasil, e-mail: <jcbicca@pucrs.br>.

RECENT PUBLICATIONS

ANTHROPOLOGY AND PRIMATOLOGY INTO THE THIRD MILLENNIUM – SUPPLEMENT ISSUE OF *EVOLUTIONARY ANTHROPOLOGY*

A special supplement issue (Vol. 11, Suppl. 1, 2002) of *Evolutionary Anthropology*, Editor John G. Fleagle (State University of New York (SUNY) – Stony Brook), is dedicated to the proceedings of the Centenary Congress of the Zürich Anthropological Institute and Museum 1899-1999, "Anthropology and Primatology into the Third Millennium". The proceedings were edited by Christophe Soligo, Gustl Anzenberger and Robert D. Martin. A fascinating collection of short review and research papers; they are divided into six parts. *Editorial* – Into the Third Millenium: One hundred years of Anthropology in Zürich – C. Soligo, G. Anzenberger & R. D. Martin, pp.1-2. *Part 1 - Primatology and Anthropology*. Primatology as an essential basis for biological anthropology – R. D. Martin, pp.3-6; Zoos and universities: Collaborating for primate conservation – A. T. C. Feistner & E. C. Price, pp.7-11; Historical explanation and the concept of progress in primatology – M. Cartmill, pp.12-15; Historical aspects of primatological collections – H.-K. Schmutz, pp.16-19; The primate fossil record – J. G. Fleagle, pp.20-23; Primatology, paleoecology, and a new method for assessing taphonomic bias in fossil assemblages – C. Soligo, pp.24-27; Taxonomy and evolution of gibbons– T. Geissmann, pp.28-31. *Part 2 - Hominid Evolution*. Adaptive radiations and dispersal in hominin evolutionary ecology – R. Foley, pp.32-37; New perspectives on the hominids of the Turkana Basin, Kenya – A. Walker, pp.38-41; Early hominid body proportions and emerging com-plexities in human evolution – L. R. Berger, pp.42-44; The Gladysvale Project – P. Schmid, pp.45-48; Characteristics of vertical climbing in gibbons – K. Isler, pp.49-52; New insights into the locomotion of *Australopithecus africanus* based on the pelvis – M. Haeusler, pp.53-57; New perspectives on the Neanderthals – C. Stringer, p.58-59; When did Neanderthals and modern humans diverge? – P. Beerli & S. V. Edwards, pp.60-63; A computational approach to paleoanthropology – C. P. E. Zollikofer, pp.64-67; Computerized paleoanthropology and Neanderthals: The case of Le Moustier 1 – M. S. Ponce de León, pp.68-72. *Part 3 - Primate Behavior, Ecology, and Conservation*. Topics gained and lost in primate social behavior – H. Kummer, pp.73-74; Adaptive array of lemurs of Madagascar revisited – R. W. Sussman, p.75-78; Biology of the fat-tailed dwarf lemur (*Cheirogaleus medius* É. Geoffroy, 1812): New results from the field – A. E. Müller & U. Thalmann, pp.79-82; Cathemerality in lemurs – D. J. Curtis & M. A. Rasmussen, pp.83-86; Fungus and *Callimico goeldii*: New insights into *Callimico goeldii* behavior and ecology – L. M. Porter & A. Christen, pp.87-90; Self-organizing properties of primate social behavior: A hypothesis for intersexual rank overlap in chimpanzees and bonobos – C. K. Hemelrijk, pp.91-94; Ecological plasticity of Barbary macaques (*Macaca sylvanus*) – N. Ménard, pp.95-100; Alaotran gentle lemur: Some aspects of its behavioral ecology – T. Mutschler, pp.101-104; Contrasts between two nocturnal leaf-eating lemurs – U. Thalmann, pp.105-107. *Part 4 - Primate Senses, Physiology, and Behavior*. Comparative studies of basal rate of metabolism in primates – M. Genoud, pp.108-111; Nature of proximate mechanisms underlying primate social systems: Simplicity and redundancy – S. P. Mendoza, D. M. Reeder & W. A. Mason, pp.112-116; Comparison of a beholder's response to confrontations involving its pairmate or two unfamiliar conspecifics in common marmosets (*Callithrix jacchus*) – P. Gerber, C. R. Schnell & G. Anzenberger, p.117-121; Why do New World monkey fathers have enhanced prolactin levels? – C. Schradin & G. Anzenberger, pp.122-125; Big brain for bad genes: Nonmental correlates of encephalization – H.-P. Lipp & D. P. Wolfer, pp.126-131; Progress toward understanding the evolution of primate color vision – G. H. Jacobs, pp.132-135; Experimental studies of primate sensory capacities – D. Glaser, pp.136-139. *Part 5 - Genetics, Molecular Evolution, and Conservation*. Evolution and immunology – L. A. Knapp, pp.140-144; Chromosomal and molecular primatology – Y. Rumpler, pp.145-149; Phylogenetic relationships of gentle lemurs (*Hapalemur*) – J. Pastorini, M. R. J. Forstner & R. D. Martin, pp.150-154; The nature of relationships among founders in the captive population of Goeldi's monkey (*Callimico goeldii*) – K. Vàsàrhelyi, pp.155-158; Conservation genetics of Barbary macaques (*Macaca sylvanus*) – F. von Segesser, pp.159-161; Technical challenges in the microsatellite genotyping of a wild chimpanzee population using feces – L. Vigilant, pp.162-165; Reconstructing the demography of prehistoric human populations from molecular data – L. Excoffier, pp.166-170; Human population genetics in a primatological context – W. Scheffrahn, C. Brandt-Casadeval & A. Kratzer, pp.171-174; Genetic

variability and phylogeography in the wild Alaotran gentle lemur population – C. M. Nievergelt, J. Pastorini & D. S. Woodruff, pp.175-179. *Part 6 - Reproductive Biology*. Non-invasive assessment of reproductive function in primates – J. K. Hodges & M. Heistermann, pp.180-182; Monitoring reproduction in Callitrichidae by means of ultrasonography – A.-K. Oerke, M. Heistermann, I. Küderling, R. D. Martin & J. K. Hodges, pp.183-185; Reproductive biology of non-human primates – M. H. Jurke, pp.186-189; Bio-behavioral description of social and reproductive relationships in captive Goeldi's monkeys – C. R. Pryce, J. Pastorini, K. Vàsàrhelyi & A. Christen, pp.190-194; Sexual selection by cryptic female choice and the evolution of primate sexuality – A. Dixson, pp.195-199; Anthropology of human reproduction: The male factor – K. Christiansen, pp.200-203; Correlates of infant-directed behavior in captive gorillas: A brief review – N. I. Bahr, pp.204-206; Reproduction and development in Goeldi's monkey (*Callimico goeldii*) – A. C. Dettling, pp.207-210. *Evolutionary Anthropology* (ISSN 1060-1538) is published by Wiley Liss Inc. Subscription enquiries to: John Wiley & Sons, Inc., Attn: Subscription Distribution US, 111 River Street, Hoboken, NJ 07030, USA, Tel: (800) 825-7550, (201) 748-6645, Fax: (202) 748-6021, e-mail: <subinfo@wiley.com>.

A RED DATA BOOK FOR THE MAMMALS OF ECUADOR

The Red Data Book for Ecuadorean Mammals (*Libro Rojo de Los Mamíferos de Ecuador*) is edited by Diego Tirira, S. It is an attractively produced and informative evaluation, in Spanish, of the threatened mammals of Ecuador. Authors of the treatments of the various mammal groups include: Carlos Boada (SIMBIOE), Santiago Burneo (Museo de Zoologia, Pontificia Universidad Católica del Ecuador), Armando Castellanos (Fundación Zoobreviven, Quito), Cristina Castro, A. (Yaqu-Pacha, Organización para la Conservación de Mamíferos Acuáticos en Sudamérica), Francisco Cuesta (Fundación EcoCiencia, Quito), Stella de la Torre (Quito), Judith Denkinger (Yaqu-Pacha, Organización para la Conservación de Mamíferos Acuáticos en Sudamérica), Godfrey Merlen (Estación Científica Charles Darwin, Galápagos), Sandie Salazar (Estación Científica Charles Darwin, Galápagos), Luis Suárez (Fundación EcoCiencia, Quito), Diego Tirira, S. (SIMBIOE) and Victor Utreras, B. (Wildlife Conservation Society – Ecuador). The list of threatened species was the result of two years' work and the participation of more than thirty people. Following training in threatened species assessment and the use of the 2000 IUCN criteria given by the IUCN/SSC Red List program staff, the list was finalized at a workshop organized by SIMBIOE and the Fundación EcoCiencia in Quito, September 2000.

Each threatened species is nicely illustrated, with information on the distribution, current status, principal threats, and measures already undertaken and measures proposed for their conservation. The IUCN 2000 criteria are used for the assessments (IUCN, 2001). In the introduction, Diego Tirira, Francisco Cuesta and Luis Suárez explain that Ecuador has the richest biodiversity per unit area of any country in the world. They report 369 mammal species, 19 of which are primates. The book includes some valuable analyses of the biogeography and status of Ecuadorean mammals in general by Santiago Burneo and Diego Tirira. Nine of the 13 mammal orders in Ecuador have threatened species. Forty-nine mammals are listed as threatened, and four orders account for nearly 78% of them – Rodents 14 of 100 species, Carnivora 11 of 31 species, Cetacea 7 of 33 species and Chiroptera 6 of 132 species. Of the 19 primate species Tirira recognizes for Ecuador, the following are listed as threatened: Critically Endangered (CR) – *Ateles fusciceps [fusciceps]* A4acd; Vulnerable (VU) – *Alouatta palliata [aequatorialis]* C1+2a(i), *Ateles belzebuth* A4acd, *Cebus capucinus [capucinus]* C2a(i), *Lagothrix lagothricha [lagothricha* and *poeppigii]* A4acd; Near threatened (NT) – *Saguinus fuscicollis [lagonotus]*, *Saguinus tripartitus*, *Cebus albifrons aequatorialis*, *Cebus apella [macrocephalus]*; Data Deficient (DD) – *Aotus lemurinus*, *Pithecia aequatorialis*.

Two books to accompany this one are *Biología, Sistemática y Conservación de los Mamíferos del Ecuador* (1998) and *Mamíferos del Ecuador* (1999), both also by Diego Tirira. The first is an edited volume, which reviews numerous aspects of Neotropical mammalogy and Ecuadorean mammals in particular. The second is a more formal review of the diversity, distributions and taxonomy of Ecuadorean mammals, including chapters on diversity, Ecuadorean species and their distributions, an identification guide, bibliography and scientific collections. Besides the species mentioned above in the Red Data Book, Tirira (1999) lists for Ecuador – *Callithrix [Cebuella] pygmaea*, *Saguinus nigricollis [graellsi]*, *Alouatta seniculus*, *Aotus vociferans*, *Callicebus cupreus [discolor]*, *Callicebus torquatus [lucifer]*, *Pithecia monachus [monachus]* and *Saimiri sciureus [macrodon]*.

The Red Data Book is available from: SIMBIOE, Av. Amazonas 2915 e Inglaterra, Edifício Inglaterra, Piso 2, Apartado 17-11-6025, Quito, Ecuador, Tel: (593-2) 431-097 or 452-596, Fax: (593-2) 442-771; e-mail: <mamiferosdelecuador@yahoo.com>.

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Tirira S., D. 1999. *Mamíferos del Ecuador*. Publicación Especial 2. Museo de Zoología. Centro de Biodiversidad

y Ambiente, Pontificia Universidad Católica del Ecuador y Sociedad para la Investigación y Monitoreo de la Biodiversidad Ecuatoriana (SIMBIOE), Quito. 392pp. ISBN 9978-40-835-5.

Tirira S., D. (ed.) 2001. *Libro Rojo de Los Mamíferos de Ecuador*. Sociedad para la Investigación y Monitoreo de la Biodiversidad Ecuatoriana (SIMBIOE) / Ecociencias / Ministerio del Ambiente / UICN. Serie Libros Rojos del Ecuador, Tomo 1. Publicación Especial sobre los Mamíferos del Ecuador. 236pp. ISBN 9978-41-614-5.

BOOKS

Diversidad y Conservación de los Mamíferos Neotropicales, edited by Gerardo Ceballos and Javier A. Simonetti, Comisión Nacional para el Conhecimento y Uso de la Biodiversidad (CONABIO) and Universidad Nacional Autónoma de México, México, DF. 2002. 582pp. ISBN 970-9000-18-7. This edited volume provides excellent country-by-country reviews of the mammal faunas of South America, Costa Rica, Cuba, Panama, and Mexico. In Spanish but with English abstracts. The Prologue is by Michael Mares (Oklahoma Museum of Natural History and Department of Zoology, University of Oklahoma). Contents: Mamíferos de Argentina – R. A. Ojeda, C. E. Borghi & V. G. Roig, pp. 23-63; Mamíferos de Bolivia – J. G. Bravo, T. L. Yates & L. M. Zalles, pp.65-113; Mamíferos de Brasil – C. J. R. Alho, M. L. Reis & P. Seixas, pp.115-150; Mamíferos de Chile – J. E. Mella, J. A. Simonetti, A. E. Spotorno & L. C. Contreras, pp.151-183; Mamíferos de Colombia – M. Alberico & V. Rojas-Diaz, pp.185-226; Mamíferos de Costa Rica – D. E. Wilson, R. M. Timm & F. A. Chinchilla – pp.227-253; Mamíferos de Cuba – G. S. Taboada, pp.255-270; Mamíferos de Ecuador – L. Albuja V., pp.271-327; Mamíferos de Guyana – M. D. Engstrom & B. K. Lim, pp.329-375; Mamíferos de México – G. Ceballos, J. Arroyo-Cabrales & R. A. Medellin, pp.377-413; Mamíferos de Panamá – R. Samudio Jr., pp.415-451; Mamíferos de Paraguay – P. Myers, A. Taber & I. G. de Fox, pp.453-502; Mamíferos de Perú – V. Pacheco, pp.503-549; Mamíferos de Uruguay – P. O. Baes, S. Sühring & G. Ceballos, pp.551-565; Mamíferos de Venezuela – G. Ceballos, P. O. Baes, S. Sühring, Y. Domínguez & H. Zarza, pp.567-582. *Available from*: Comisión Nacional para el Conhecimento y Uso de la Biodiversidad (CONABIO), Liga periférico-Insurgentes sur 4903, Col. Parques del Pedregal, Tlalpan, 14510, México, DF, México.

Primates in Fragments: Ecology and Conservation, edited by Laura K. Marsh, 2003, Kluwer Academic / Plenum Publishers, New York. ISBN 0-306-47696-7. Price: US$139.00 (hardbound). This volume resulted from a symposium of the same name presented at the XVIII Congress of the International Primatological Society in Adelaide, South Australia, 6-12 January 2000. One of the primary goals of this book is to be a reference not only in the primate literature but in fragmentation science. The contributors to this volume realize the significance of working within fragments as a whole no matter how disturbed, and that these systems respond to and depend upon the matrix they are embedded within. It seeks to address several key questions regarding primates in fragments: to clarify some of the issues, but perhaps in trying to bring to light the complexity of the situation with primates in disturbed habitats. The book is divided into sections based on broad categories of research on primates in fragments. In the Genetics and Population Dynamics section, the authors cover topics in viability, metapopulations, and species that remain in remnant forests. In the Behavioral Ecology section, authors take a closer look at feeding, ranging, and other behaviors that allow primates to remain in or disperse between fragments. In Conservation and Management, authors bring knowledge of species which remain in fragments together with plans to implement strategies for their long-term viability. Finally, in the Integration and Future Directions section, authors synthesize the information in this volume and make recommendations for future and continued work in this field. *Contents*: The nature of fragmentation – L. K. Marsh. Section I: Genetics and Population Dynamics – L. K. Marsh. Effects of habitat fragmentation on the genetic variability of silvery marmosets, *Mico argentatus* – E. C. Gonçalves, S. F. Ferrari, A. Silva, P. E. G. Coutinho, E. V. Menezes & M. P. C. Schneider; Changes in distribution of the snub-nosed monkey in China – Baoguo Li, Zhiyun Jia, Ruliang Pan & Baoping Ren; Analysis of the hypothetical population structure of the squirrel monkey (*Saimiri oerstedii*) in Panama – A. R. Rodriguez-Vargas; Primate survival in community-owned forest fragments: Are metapopulation models useful amidst intensive use? – C. A. Chapman, M. J. Lawes, L. Naughton-Treves & T. Gillespie; Relationships between forest fragments and howler monkeys (*Alouatta palliata mexicana*) in southern Veracruz, Mexico – E. M. Rodriguez-Toledo, S. Mandujano & F. Garcia-Orduña; Primates of the Brazilian Atlantic forest: The influence of forest fragmentation on survival – A. G. Chiarello; Dynamics of primate communities along the Santarém-Cuiabá highway in south-central Brazilian Amazonia – S. F. Ferrari, S. Iwanaga, A. L. Ravetta, F. C. Freitas, B. A. R. Sousa, L. L. Souza, C. G. Costa & P. E. G. Coutinho; Primates and fragmentation of the Amazon forest – K. A. Gilbert. Section II: Behavorial Ecology – L. K. Marsh; Impacts of forest fragmentation on lion-tailed macaque and Nilgiri langur in Western Ghats, South India – G. Umapathy & A. Kumar; Population size and habitat use of spider monkeys at Punta Laguna, Mexico – G. Ramos-Fernandez & B. Ayala-Orozco; Changes in forest composition and potential feeding tree availability on a small land-bridge island in Lago Guri, Venezuela – M. A. Norconk & B. W. Grafton; Foraging strategy changes in an *Alouatta palliata mexicana* troop released on an island – E. Rodríguez-Luna, L. E. Dominguez-Dominguez, F. E. Morales-Mavil & M. Martinez-Morales; Dietary flexibility, behavioral plasticity, and survival in fragments: Lessons from translocated howlers – S. C. Silver & L. K. Marsh; Howler monkeys (*Alouatta palliata mexicana*) as seed dispersers of strangler figs in disturbed and preserved habitat in southern Veracruz, Mexico – J. C. Serio-Silva & V. Rico-Gray; How do howler

monkeys cope with habitat fragmentation? – J. C. Bicca-Marques. Section III: Conservation and Management – L. K. Marsh. Fragments, sugar, and chimpanzees in Masindi District, western Uganda – V. Reynolds, J. Wallis & R. Kyamanywa; Shade coffee plantations as wildlife refuge for mantled howler monkeys (*Alouatta palliata*) in Nicaragua – C. McCann, K. Williams-Guillen, F. Koontz, A. A. R. Espinoza, J. C. Martinez Sanchez & C. Koontz; Effects of habitat fragmentation on the Cross River gorilla (*Gorilla gorilla diehli*): Recommendations for conservation – E. A. Eniang; Wild zoos: Conservation of primates *in situ* – L. K. Marsh. Integration and Future Directions. Fragmentation: Specter of the future or the spirit of conservation? – L. K. Marsh, C. A. Chapman, M. A. Norconk, S. F. Ferrari, K. A. Gilbert, J. C. Bicca-Marques & J. Wallis. *To order*: Andrea Macaluso, Editor, Kluwer Academic / Plenum Publishers, New York, NY 10013, USA, Tel: (212) 620-8007, Fax: (212) 463-0742, e-mail: <amacaluso@wkap.com>. Website: <http://www.wkap.com>.

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Meetings

2003

28th International Ethological Conference, 20-27 August 2003, Costão do Santinho Resort, Florianopolis, Brazil. On behalf of the International Council of Ethologists and hosted by the Brazilian Society of Ethology. Deadline for submission of symposia: 31 January 2003. Deadline for submission of abstracts, financial aid applications, and standard reduced registration rate: 20 February 2003. For more information on the conference contact: Professor Kleber del Claro, e-mail: <delclaro@ufu.br>, or on the scientific program, contact Professor Regina Macedo, e-mail: <rhmacedo@unb.br>. Website: <http://www.iec2003.org/home.htm>.

Vth World Parks Congress 2003 – Benefits Beyond Boundaries, 8-17 September, 2003, Durban, Republic of South Africa. The World Conservation Union (IUCN), World Commission on Protected Areas (WCPA). Preliminary registration by 30 April 2003, but attendance

by invitation only. Contact: Peter Shadie, World Parks Congress 2003, IUCN, The World Conservation Union, Rue Mauverney 28, CH-1196 Gland, Switzerland. Websites: <http://www.iucn.org/themes/wcpa/wpc2003/> and <http://www.wcpa.iucn.org>.

16th Congress of the Société Francophone de Primatologie, 22-25 October, 2003, Bruxelles, Belgium. The congress is held in conjunction with the Institut royal des Sciences naturelles de Belgique, and its focus will be on evolution in primates. Deadline for abstracts: September 20, 2003. Registration fees: SFDP members 80 euros, students 40 euros, others 110. For more information, contact Regine Vercauteren at <106514.41@compuserve.com> or visit the Congress website at <http://www-sfdp.u-strasbg.fr/ancolloque.html>.

16th Congress of the Associazione Primatologica Italiana, 28-30 October, 2003, Convento dell'Osservanza, Radicondoli (Siena), Italy. Held with: Centro Studi Etologici. Focus: Recent trends in Italian primatological research. Registration: no fees; deadline June 30, 2003. Abstract deadline July 15, 2003. Contact: Daniele Formenti, Dip. Biologia Animale, Piazza Botta 10, 27100 Pavia, Italy, Fax: +39/0382/0431140, e-mail: <apinetnews@yahoo.it>, website: <http://www.unipv.it/webbio/api/cong16/cong16.htm>.

XXI Encontro Anual de Etologia, III Simposio de Ecologia Comportamental e de Interações, 31 de outubro a 02 de novembro de 2003. Sociedade Brasileira de Etologia e Instituto de Biologia da Universidade de Uberlândia, Minas Gerais, Brasil. Comissão Organizadora, Coordenação Geral - Kleber Del-Claro, email: <delclaro@ufu.br>; Coordenadora Ana Paula Korndorfer, e-mail: <korndorfer@hotmail.com>. Data final para inscrições: 07 de setembro de 2003. Website: <http://www.xxieae2003.ufu.br/principal.html>.

VII Congreso de la Sociedad Mesoamericana para la Biología y la Conservación, 3-7 de noviembre, 2003. Tuxtla Gutiérrez, Chiapas, Mexico. Fechas límite para el envío de: Propuestas de conferencistas centroamericanos 1 de abril 2003; Propuestas preliminares de simposios, cursos y talleres 15 de abril 2003; Propuestas completas de simposios, cursos y talleres 30 de junio 2003; Resúmenes de presentaciones orales o en cartel (afiche) 30 de junio 2003; Respuesta de aceptación o rechazo de resúmenes 15 de agosto 2003; Pago de inscripción temprana 30 de septiembre 2003. Website: <http://www.socmesoamericana.org/ev.php>.

XVIII Jornadas Argentinas de Mastozoología, La Rioja, 4 al 7 de noviembre de 2003. Ciudad Universitaria de la Ciencia y la Técnica. Av. Laprida y Vicente Bustos, La Rioja (Capital), Argentina. Organizan: Instituto para el Desarrollo Socioeconómico de Los Llanos de La Rioja (INDELLAR) y Cátedra de Fauna Silvestre, Sede Chamical - Universidad Nacional de La Rioja. Disertantes: Dr. Mauricio Lima Arce, Departamento de Ecología, Pontificia Universidad Católica de Chile, y el Dr. Milton H. Gallardo, Instituto

de Ecología y Evolución, Universidad Austral de Chile. Nos encontramos realizando gestiones para contar con la participación de investigadores en Paleontología, Ecología, Comportamiento, Biogeografía, Conservación y Manejo, Parasitología, Fisiología, Histología, Anatomía, Genética, Taxonomía, Sistemática, Morfología y Colecciones de mamíferos. *Fechas importantes*: Límite propuestas de simposio, mesas redondas, talleres - 19/7/03; Límite presentación de resúmenes - 1/8/03. Informes: Dra. Victoria R. Rosati, Comisión Organizadora Local, XVIII Jornadas Argentinas de Mastozoología, INDELLAR - Sede Chamical - Universidad Nacional de La Rioja, Castro Barros 557-5380, Chamical, La Rioja, Argentina, Tel: 54-3826-422011, Fax: 54-3826-422012, e-mail: <seus@arnet.com.ar>.

VI Congresso de Ecologia do Brasil, 9 a 14 de novembro de 2003, Fortaleza, Ceará. Tema: "Ecossistemas brasileiros: manejo e conservação". Realização: Sociedade Brasileira de Ecologia e a Universidade Federal do Ceará (UFC). Doze principais simpósios temáticos: 1) Floresta Pluvial Tropical Amazônica, 2) Floresta Pluvial Tropical Atlântica, 3) Floresta Temperada com Araucária, 4) Florestas Estacionais, 5) Cerrado, 6) Caatinga, 7) Complexo do Pantanal, 8) Ecossistemas Aquáticos Continentais e Marinhos, 9) Biodiversidade, Unidades de Conservação, Bioindicadores Ambientais, 10) Ecologia da Paisagem, 11) Educação Ambiental, 12) Ensino de Ecologia. Maiores informaçoes: <geograf@ufc.br> ou <vcs@ufc.br>.

2004

VI International Conference on Wildlife Management in Amazonia and Latin America, 5-10 September 2004, Iquitos, Peru. Hosted by The National University of the Peruvian Amazon (UNAP), the Durrell Institute of Conservation and Ecology (DICE) and the Wildlife Conservation Society (WCS). Discussions and presentations will look at the advances made for conservation, and the lessons learnt in the design, development, implementation, methods, and management plans for wildlife in Amazonia and Latin America. For further information about the conference, submission of abstracts, workshops, and courses, and information on registration and hotels, please visit the conference website at <http://www.vicongreso.com.pe/>, or contact the conference organisers by e-mail at <congresofauna@amauta.rcp.net.pe>.

2005

XI Congresso Brasileiro de Primatologia, 6 a 11 de fevereiro de 2005, Pontifícia Universidade Católica do Rio Grande do Sul, Porto Alegre, Rio Grande do Sul, Brasil. Website: <http://planeta.terra.com.br/educacao/SBPr/>.

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 Portuguese contributions to: John M. Aguiar, Conservation International, Center for Applied Biodiversity Science, 1919 M St. NW, Suite 600, Washington, DC 20036, Tel: 202 912-1000, Fax: 202 912-0772, e-mail: <j.aguiar@conservation.org>, and all Spanish contributions to: Ernesto Rodríguez-Luna, Instituto de Neuroetología, Universidad Veracruzana, Apartado Postal 566, Xalapa 91000, Veracruz, México, Tel: 281 8-77-30, Fax: 281 8-77-30, 8-63-52, e-mail: <saraguat@speedy.coacade.uv.mx>.

Contributions

Manuscripts may be in English, Spanish or Portuguese, and should be double-spaced and accompanied by the text on diskette for PC compatible text-editors (MS-Word, WordPerfect, Excel, and Access), and/or e-mailed to <j.aguiar@conservation.org> (English, Portuguese) or <saraguat@speedy.coacade.uv.mx> (Spanish). 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 texts 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), Biogeography, Ecology and Conservation. Texts for full articles should not exceed about 20 pages in length (1.5 spaced, and including the references). Please include an abstract in English, and (optional) one in Portuguese or Spanish. Tables and illustrations should be limited to six, excepting only the cases where they are fundamental for the text (as in species descriptions, for example). Full articles will be sent out for peer-review.

Short articles. These 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 which 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 which occur in them. Texts should not exceed 10 pages in length (1.5 spaced, including the references).

Figures and maps. Articles may include small black-and-white photographs, high-quality figures, and high-quality maps and tables. Please keep these to a minimum. We stress the importance of providing maps which are **publishable.**

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

References. Examples of house style may be found throughout this journal. 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.

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

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