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Editors: Anthony B. Rylands and Ernesto Rodríguez-Luna
PSG Chairman: Russell A. Mittermeier
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TAXONOMIC STATUS OF *AOTUS HERSHKOVITZI*: ITS RELATIONSHIP TO *AOTUS LEMURINUS LEMURINUS*

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Abstract

We analyze various taxonomic problems of northern *Aotus* and describe the phenotype and karyotype of specimens, which have been called *Aotus hershkovitzi* since their discovery. Karyotypes from Panama with a diploid number of 2n = 55–56 had been referred to as *Aotus lemurinus lemurinus* but actually belong to *Aotus lemurinus zonalis*, a taxon found throughout the Pacific lowlands of Colombia, extending to Panamá and the Río Sinú on the Caribbean coast of Colombia. *Aotus lemurinus zonalis* is different phenotypically and karyologically from that of the Colombian Andes population (*Aotus lemurinus lemurinus*). We correct Hershkovitz' designation of the Quindío Pass as an amended type locality for *Aotus lemurinus*. There are no solid grounds to reject the vicinity of Santa Fe de Bogotá as type locality, and this should be listed as the correct type locality. We then point out that as the karyotype of *Aotus lemurinus lemurinus* has not been described and as the specimens called *Aotus hershkovitzi* are phenotypically within the range of other *Aotus lemurinus lemurinus,* that *Aotus hershkovitzi* is a synonym for *A. lemurinus lemurinus*, which should now be recognized as having a diploid karyotype of 58 as well as the highest Fundamental Number (76) known for the genus. This interpretation is supported by the discovery of an *Aotus* (the Murrillo specimen) with 2n = 58 from the Cordillera Central. We suggest further that the karyotypes published for *Aotus lemurinus griseimembra* need to be confirmed with specimens from known collection sites and that, in fact, *Aotus* from lowland sites of the Caribbean coast may be another taxon, yet to be described. Furthermore, we clarify the unwarranted assumption that the origin of the "Quindío specimen" described karyologically by Torres *et al.* (1998) is from this region, but may represent an undescribed species from an as yet unidentified locality. Finally we suggest that in fact the "subspecies" of *Aotus lemurinus* may in fact be full species in light of their karyological differences. In order to clarify the *Aotus* species it is important to do specific systematic research, including the collection of specimens from specific localities.

Key words: *Aotus lemurinus lemurinus, Aotus hershkovitzi*, *Aotus* taxonomy, New World monkeys, Platyrrhini, Cebidae, night monkey, owl monkey

Resumen

Se analizan varios problemas taxonómicos de los *Aotus* del norte y se describe el fenotipo y cariotipo de ejemplares que han sido denominados *Aotus hershkovitzi* desde su descubrimiento. Los *Aotus* de Panamá con cariotipos (2n = 56–55) designados como *A. lemurinus lemurinus,* corresponden a *Aotus lemurinus zonalis,* taxon que puede ser diferenciado tanto en fenotipo como en cariotipo de las poblaciones andinas Colombianas de *Aotus lemurinus lemurinus. A. l. zonalis* está presente en las zonas bajas del pacifico desde Panamá hasta Colombia extendiéndose hasta el valle del río Sinú en la costa Caribe de Colombia. Proponemos una corrección de la localidad típica de *A. lemurinus.* Para Hershkovitz, la localidad tipo de esta especie fue restringida a el "Paso de Quindio." Nosotros sugerimos que no hay argumentos solidos para efectuar esta restrición en la localidad tipo de esta especie por lo cual proponemos que la localidad tipo correcta para este taxo debe ser "Santa fe de Bogotá." Según nuestro criterio, el cariotipo del verdadero *Aotus lemurinus lemurinus* aun no ha sido descrito, y los ejemplares conocidos como *Aotus hershkovitzi* corresponden en fenotipo y en rango de distribución a los *Aotus lemurinus lemurinus,* por lo cual *Aotus hershkovitzi* es un sinónimo de *Aotus lemurinus lemurinus,* que debe ser reconocido por el numero cromosómico (N = 58) y numero fundamental (NF = 76), los mas altos para el genero entre los cariotipos hasta hoy descritos. Esta interpretación esta basada en el hallazgo de un ejemplar (espécimen de Murillo) de 2N = 58 en la cordillera Central de los Andes. Es necesario determinar el numero cromosómico de *Aotus lemurinus griseimembra* a partir de ejemplares colectados en lugares cercanos a su localidad tipo, en la costa Caribe, que pueden conformar una entidad taxonómica diferente aun no evaluada. Con respecto al ejemplar del "Quindio" descrito cariológicamente por Torres *el al.* (1998) creemos que sin duda corresponde a un nuevo taxon que debe ser descrito, y definida su distribución. Finalmente, sostenemos que las "subespecies" *de Aotus lemurinus*, por sus diferencias carilógicas y fenotipicas, corresponden a especies. Es indispensable para clarificar el estado real de la diferenciación especifica de los *Aotus*, realizar un estudio sistemático, con colecciones de ejemplares en localidades especificas.

Palabras claves: *Aotus lemurinus lemurinus, Aotus hershkovitzi,* Taxonomía *de Aotus,* Primates del nuevo mundo, Platyrrhini, Cebidae, Mico de noche.

Introduction

Hershkovitz (1949: 400) first considered *Aotus* as a monotypic genus in his account of northern Colombian Primates, although he recognized several subspecies for *A. trivirgatus* (Humboldt, 1812). This scheme was followed by many authors (for example, Hill, 1960: 169–179; Cabrera, 1958). Thorington and Vorek (1976), however, pointed out that the subspecific classification of night monkeys had probably hampered any understanding of the complex geographic variation in *Aotus*. The discovery of karyotypic polymorphism in *Aotus* by Brumback *et al.* (1971) has made it necessary, during the past few years, to recognize several species of *Aotus*. Brumback (1973) recognized *Aotus griseimembra* Elliot (1912: 36; type locality, Hacienda Cincinnati [also known as Valparaíso] southeast of Santa Marta, on the northwestern slope of the massif of Sierra Nevada de Santa Marta, Magdalena, Colombia; 1,480 ft.) as a full species from northern Colombia, and he treated night monkeys from Perú as *A. trivirgatus*, although this definition of *Aotus trivirgatus* is no longer preserved in present day taxonomy according to Hershkovitz (1983). Later, Brumback (1974) distinguished a third karyotype, which he assigned to *A. azarae* (Humboldt, 1812; type locality: right bank of Río Paraguay in north-east of Argentina). However, Hershkovitz (1983: 217–223) later described this taxon as a new species *Aotus brumbacki,* and redetermined the type locality as the Villavicencio region, Department of Meta, eastern Colombia.

Work by Ma *et al.* (1976a, 1976b, 1977, 1978, 1980) described various other karyotypes of captive *Aotus*, resulting in the recognition of the polymorphic 2n = 55, 56 for animals said to be "Panamanian" and 2n = 46 for upper Amazonian specimens. They clarified the karyotype of *Aotus nigriceps* Dollman (1909: 200; type locality: Chanchamayo, Peru, 3000 ft) and *Aotus boliviensis* Elliot (1907: 189; type locality: Provincia of Sara, Bolivia), which had been described by de Boer (1974), although they continued using *Aotus trivirgatus* as a species including all members of the genus (Ma *et al.*, 1976b, 1980).

Hershkovitz (1983) described two new species, *A. brumbacki* and *A. nancymai*, and he attempted to bring order out of the chaos that had been *Aotus* taxonomy by proposing a scheme whereby a total of nine species were recognized. These were represented by the so-called "red-necked" species group, distributed almost entirely south of the Amazon River and including *A. azarae*, *A. infulatus*, *A. miconax* and *A. nancymai,* and the "gray-necked" species group, occurring almost entirely north of the Amazon River and including the species *A. brumbacki, A. lemurinus* (which he defined as including populations from Panamá and northern and Andean Colombia)*, A. trivirgatus* and *A. vociferans.*

Ford (1994) published an extensive morphometric study of the skulls of 193 *Aotus* specimens and pelage characteristics of 105 adult *Aotus*. This analysis showed "mixed variation" across almost the entire range of *Aotus.* She interpreted the cline of northern Colombian *Aotus lemurinus* (which Hershkovitz [1983] defined as including populations from Panamá as well as northern and central Colombia), *A. brumbacki* and *A. vociferans* as one clinal species, with *A. trivirgatus* being strongly separable from this clinal "*Aotus lemurinus"* (*sensu* Ford, 1994).

In 1981 Jairo Ramírez-Cerquera and Jaime Umaña collected four specimens of *Aotus* in the upper valley of the Río Cusiana (*vereda* [1, notes at end of paper] of Corinto in the Cusiana river valley, Departament of Boyacá), Colombia, in the putative geographic range of *Aotus lemurinus* (*sensu* Hershkovitz**,** 1949: 408, fig 58; *sensu* Hernández-Camacho & Cooper, 1976:46, fig. 6) or *Aotus brumbacki* (cf. Hershkovitz, 1983: 218, Fig. 2) [2]. Ramírez-Cerquera and his collaborator Marta L. Bueno studied the four specimens for karyotype. Ramírez-Cerquera (1983) reported the diploid number (2n = 58) for all of the four animals, the highest number yet reported for the genus, and he referred to these animals as *Aotus hershkovitzi* for the first time in the literature.

Giraldo *et al.* (1986) included *Aotus hershkovitzi* in their study of northern Colombian *Aotus* karyotypes, which they referred to as *Aotus* sp. They showed that all but four of the chromosomes were homologous with *A. lemurinus* (KII, KIII & KIV, *sensu* Ma *et al.*, 1976a, which correspond to populations of *A. l. griseimembra*). Hershkovitz (*verbatim*) initially thought that the four Cusiana animals represented a new karyotype for *Aotus lemurinus griseimembra.* Later, Hershkovitz (*verbatim*) changed his mind and suggested that this material represented a new species and urged the publication of a description of the new species, which Jairo Ramírez-Cerquera (1983:146) proposed be named *Aotus hershkovitzi* in a paper read at the Primate Symposium of the IX Latin American Congress of Zoology at Arequipa, Perú. Ramírez-Cerquera briefly recorded the origin of the original four specimens, giving as distinguishing characters long hair, low sensibility to experimental infection with *Plasmodium falciparum* as compared to *Aotus brumbacki* and *Aotus vociferans* and a unique diploid number. Only the diploid number of 58 was diagnostic, distinguishing the taxon from any other known karyotypic number for the genus. He mentioned, furthermore, the possibility that the species seemed to be phylogenetically closer to the populations of *Aotus* from the lowlands of eastern Colombia than to *Aotus lemurinus* from the highlands and inter-Andean valleys of Colombia, perhaps based on *Aotus hershkovitzis* lack of sensibility to *Plasmodium falciparum.*

The name *Aotus hershkovitzi* has become generally recognized by the scientific community (Rylands *et al.*, 1995, 2000) and was listed in the taxonomic reference book *Mammal Species of the World: A Taxonomic and Geographic Reference* by the author of "The Primates" (Groves, 1993: 256; type locality, department of Meta, east side of Cordillera Oriental) [3] as a full species, *Aotus hershkovitzi* Ramírez-Cerquera 1983. In this article we analyze the validity of *A. hershkovitzi* from a nomenclatural and taxonomic point of view, and its relationship with the Andean population of *Aotus* (*Aotus lemurinus lemurinus, sensu stricto*) and *Aotus brumbacki.*

Methods

We analyzed the nomenclatural and taxonomic aspects of Andean populations of *Aotus lemurinus* and *Aotus hershkovitzi* including phenotypic and karyotypic variation. In the description of pelage coloration particular attention was given to *Aotus hershkovitzi*, and we used the color nomenclature of Ridgway ("1912"=1913), capitalizing the initial letters. Standard measurements based on fresh material were taken from the specimen label.

Chromosome preparations were obtained by M. L. Bueno using standard methods for lymphocyte culture (Moorhead *et al.*, 1960). Blood samples were taken with heparinized syringes (Liquemine, Roche). Peripheral blood was cultured in Minimal Essential Medium (MEM, Sigma) with 20% of bovine fetal serum, 10% of Penicillin-streptomycin, Sigma. As mitogens, 0.35 mls P-Phytohemaglutinin (Difco, at 1:16 dilution) were used. A duplicate culture with a crude extract of *Vicia faba* lectin (the procedure of Arango and Moreno, 1977) gave the best preparations. Optimum culture time was 66 hours.

QFQ, GTG and CBG banding were carried out as described by Capersson *et al.* (1970), Seabright (1971) and Summer (1972) respectively. Late DNA replication patterns (RBG) were observed after a 5-bromodeoxyuridine (Budr) terminal pulse (see Camargo and Cervenka, 1980). CBG banding was accomplished using preparations previously analyzed with QFQ banding. Nucleolar organizer regions (NORs) were located by the procedure of Goodpasture and Bloom (1975).

The following acronyms have been used:

AMNH - American Museum of Natural History, New York.
BMNH - British Museum (Natural History) London.
FMNH - Field Museum of Natural History, Chicago.
ICN - Instituto de Ciencias Naturales, Museo de Historia Natural, la Universidad Nacional de Colombia, Santa Fé de Bogotá.
INDERENA - Instituto Nacional de los Recursos Naturales Renovables y del Medio Ambiente, Ministerio de Agricultura, Santa Fé Bogotá.
IVH - Instituto de Investigaciones de Biodiversidad Alexander von Humboldt, Ministerio del Medio Ambiente, Villa de Leyva, Boyacá, Colombia.
MCZ - Museum of Comparative Zoology, University of Harvard, Cambridge, Massachusetts.
MNHP - Muséum National d'Histoire Naturelle, Paris.
UNIFEM - Unidad Investigativa Federico Medem (INDERENA), Santa Fé de Bogotá.
USNM - National Museum of Natural History, Smithsonian Institution, Washington, DC.

Aotus lemurinus lemurinus
(I. Geoffroy-St. Hilaire, 1843)

Synonymic history: *N[yctipithecus] lemurinus* I. Geoffroy-Saint Hilaire, 1843: *Comptes Rendus Acad. Sci., Paris* 16: 1151 (original description of taxon).

Nyctipithecus lemurinus I. Geoffroy-Saint Hilaire, 1844: *Arch. Mus. Hist. Nat., Paris* 4: 24, pl.2.

Nyctipithecus villosus J. E. Gray, 1847: 6 (original description; type locality: Santa Fé de Bogotá).

Nyctipithecus hirsutus J. E. Gray, 1870: 58 (*nomen nudum*; *lapsus colanit for hirsutus*).

Aotus lanius G. Dollman, 1909: 202 (original description; holotype BMNH 1890.2.22.4, adult female, skin and skull, collected by White, "Tolima Mountains," 2°20'N, 6000 feet, now Department of Huila, Colombia). D. G. Elliot, 1913: 12-13 (type locality: "Tolima Mountains," Río Toche, 7000 feet).

Aotus aversus D. G. Elliot, 1912: 251 (original description; Fusagasugá, Cundinamarca, Colombia).

Aotus pervigilis D. G. Elliot, 1912 (La Candela, Huila, Colombia).

Aotus vociferans (*non Nyctipithecus vociferans* Spix, 1823) D. G. Elliot, "1912"[=1913]: 15-16 (*partim*; "mountains of Tolima"; *Nyctipithecus lemurinus* (original series examined; regarded as synonym).

Aotus lemurinus J. A. Allen, 1916, *Bull. Amer. Mus. Nat. Hist.* 35: 234 (Fusagasugá, type and topotype of *aversus* D. G. Elliot; *A. vociferans* Elliot, *non Nyctipithecus vociferans* von Spix, 1823, = *lemurinus* I. Geoffroy-St. Hilaire, 1843). Groves, 1993, *Primates*, in *Mammal Species of the World: A Taxonomic and Geographic Reference*, p.25 (listed type locality as Department of Caldas, Quindio, Colombia).

Aotus trivirgatus Groves and Pulido, 1982: 226 (*partim*).

Aotus lemurinus lemurinus Hershkovitz, 1983, *Am. J. Primatol.* 4(3): 209, 211, 214 (fig. 2), 233 (*partim*; Andean Colombian populations, comparisons with other taxa of *Aotus*). Rylands *et al.*, 1995, *Neotrop. Primates* 3(suppl.): 119, 122, 127, 132, 138, 149 (*partim*; Andes, Colombian populations; Neotropical primate classification and conservation). Rylands *et al.*, 2000, *Neotrop. Primates* 8(2): 62, 65, 69, 75 (*partim*; Andean Colombian populations Neotropical diversity).

Aotus trivirgatus lemurinus Hershkovitz, 1949, *Proc. U. S. Natl. Mus.* 98(3232): 405 (taxonomic revision). Hernández-Camacho and Cooper, 1976, *Neotropical Primate Field Studies and Conservation,* pp.35–69. Thorington and Vorek, 1976, *Lab. Anim. Sci.* 26(6): 1006–1021 (review of skeletal development and pelage color and patterns).

Aotus hershkovitzi Ramírez-Cerquera, 1883, *IX Congr. Latinoamer. Zool* (abstracts): 146 (first published mention of intention to name the taxon; brief diagnosis). Groves, 1993, *Mammal Species of the World,* Primates: 256 (reference to species; type locality incorrectly recorded as "Department of Meta"). Rylands *et al.*, 1995, *Neotrop. Primates* 3(suppl.): 119, 122, 127, 138, 149 (species listed according to conservation status and IUCN Mace-Lande system). Torres *et al.*, 1998, *Am. J. Primatol.* 44(4): 268, figs. 8a-b (recognize a different karyotype group for this species). Rylands *et al.*, 2000, *Neotrop. Primates* 8(2): 62, 65, 69, 75 (Neotropical diversity). Groves, 2001, *Primate Taxonomy*, p.164.

Aotus "hershkovitzi", Defler, 1994, *Trianea,* 5: 265 (species conservation). Defler, 1996, *Neotrop. Primates* 4(3): 77 (IUCN classification of Colombian primates).

[*Aotus* sp.] L1, L2, L3 and L4, Espinal *et al.*, 1984, *Amer. J. Trop. Med. and Hyg.* 33: 777–781, Table 1-2, Fig. 1-2 (report on serology and malariology of this species as compared to *A. lemurinus* and *A. vociferans*). Giraldo *et al.*, 1986, *Biomedica* 6(1-2): 11–12, fig. 6 (brief description of karyotype, included in a new group "X" following the system of Ma *et al.*, 1976a, 1978).

[*Aotus sp.*] Mittermeier *et al.*, 1988, *Ecology and Behavior of Neotropical Primates*, Vol. 2: 34 (reference to Ramirez's desire to name a new species of *Aotus* for Philip Hershkovitz).

Type locality: A problem with *Aotus lemurinus* is the lack of precision of the type locality for the species, which was first listed as "Nouvelle Grénade" by I. Geoffroy-St. Hilaire (1843: 1151), who did not designate a type specimen. In the following year the same author listed the type locality as "Santa Fé de Bogotá" (I. Geoffroy-St. Hilaire, 1844: 58). Rode (1938: 38) selected as "holotype" (= lectotype) an adult (?) male skin (mounted with skull no. 102a), purchased from Parzudaki, and another specimen designated as allotype (= lectoparatype), also purchased from Parzudaki in 1842. Designations made by Rode are fully valid, according to the International Code of Zoological Nomenclature. I. Geoffroy-St. Hilaire's (1844: 58) restriction of the type locality to "Santa Fé de Bogotá" did not take into consideration the material collected by Justine Goudot in the "Quindiu" [= Quindio region] already existing in the Paris Natural History Museum. This strengthens the case for I. Geoffroy-St. Hilaire's choice of the Bogotá region as specimens for the type series [4]. For further details about the lectotype see Hershkovitz (1949: 406).

Despite Geoffroy-St. Hilaire's designation of Santa Fé de Bogotá as type locality, Hershkovitz (1949: 407) restricted the type locality to the Quindío Pass (Cordillera Central), remarking that "this is the only authentic locality for specimens of the original series" and, further, "as *Aotus* does not occur in the Bogotá region proper, which is savanna, the type locality is here restricted to that of the Goudot specimens." Obviously the "Bogotá region proper" should include an area surrounding the city of Santa Fé de Bogotá in the Eastern Cordillera of the Andes. In a comparatively short distance from this city a wide variety of ecological conditions occur, including humid subtropical [sub-Andean] and temperate forest, as well as edaphically and climatically determined semi-arid conditions [5], so that the Bogotá region cannot be regarded as natural savanna as a whole. At the time, Hershkovitz (1949) was not acquainted personally with the Bogotá region. He probably was influenced by the fact that Chapman (1917) had classified the Bogotá plateau in the "arid temperate zone." He did not consider the fact that most of the mountains surrounding the so-called "savanna de Bogotá" actually were originally covered by humid forest where *Aotus* occurred. Furthermore, available precise records for this species include localities such as the forest adjoining the Pedro Palo lake (about 2,100 m.), Subía (*ca.* 1,700–2,500 m.), Cuchilla de Cruz Grande above Fusagasugá (2,000 m.) and the Fusagasugá type locality of *Aotus aversus* Elliot (a synonym for *A. lemurinus*). Consequently, since the original restriction "Santa Fé de Bogotá" as type locality for *A. lemurinus* and localities such as those mentioned are separated by distances that were covered in a 1–2 day mule ride, we believe that the authenticity of Santa Fé de Bogotá interpreted in a broad sense can be regarded as a valid designation of the type locality, and could be restricted even more precisely to the neighborhood of Fusagasugá (1,700–2,000 m.).

Specimens examined: Phenotypic analysis for *Aotus lemurinus* is based on an examination by JIH-C of almost all Colombian specimens held within the country (ICN, IVH = INDERENA), the United States of America (AMNH, FMNH, MCZ and USNM) as well as from the MNH (Museum National d'Histoire Naturelle, Paris) and the BMNH (British Museum of Natural History, London) totaling about 130 specimens of geographically referenced *Aotus lemurinus* collected from sites spread throughout the northern part of Colombia. A map of the origins of these specimens can be seen in Defler (in press).

Characters: According to Hershkovitz (1949: 407) distinctive characters are the following: (1) on average this is the darkest of the subspecies and (2) pelage of *Aotus lemurinus lemurinus* is extremely coarse [6], long and lax and "the majority of the specimens from the interior of Colombia are of higher altitudes than those of the coast and show, consequently, larger, coarser and laxer pelage. Beyond this, no single character serves to unite individuals here held to represent *lemurinus* in an assemblage distinct from all others. Variability in color and character of pelage is so great among these night monkeys that two discrete family groups of the same locality are apt to differ more from each other than either of them from a series of any other locality in the Colombian Andes." Thorington and Vorek (1976: 1013–1014) concur that phenotypic variation is so great as to not be useful for subspecific differentiation and that among northwestern South American *Aotus* "there is greater east-west differentiation than there is north-south."

There are two types of phenotypic variation within the area inhabited by *Aotus lemurinus lemurinus*. The first type is intrapopulational and involves more grey and less reddish and the opposite, and the development of a dark, middorsal stripe is quite variable. The second character is clinal and involves a progressive lightening of the dorsal surface of the hands and the feet and begins on the west slopes of the Cordillera Occidental and on the west slope of the Cordillera Central in the upper Magdalena valley, where the hands and feet are darkest, while on the east slope of the Cordillera Central a tendency is seen which continues south along the slope to the western slopes of the Cordillera Oriental and involves a gradual change of the hands and feet from darker to lighter. This culminates on the western slopes of the Cordillera Oriental and is due to the increasing width of the un-pigmented basal hair band.

Distribution: Hershkovitz (1949: 407; fig. 58) defined the distribution of *Aotus lemurinus lemurinus* as "forested parts of the Colombian Andes, exclusive of the northern half of the Sierra de Perijá." This distribution included the lowlands of the middle and upper Magdalena river valley and parts of the departments of Antioquia, Santander, Boyacá, Caldes, Cundinamarca, Tolima and Huila. Hershkovitz (1983: 214; fig. 2) amended this distribution to include the lowlands of the middle and upper Magdalena river valley as the distribution for *Aotus lemurinus griseimembra*. Although material is scarce for the area, phenotypes tend to support this interpretation (despite his assertion that the two subspecies were not separable phenotypically). In reality, it should be pointed out that there are no valid specimens from the highlands of the department of Norte de Santander, Santander, Boyacá or western Arauca, even though these areas were included by Hershkovitz (1949: 407, fig. 58; 1983: fig. 2) in the geographic distribution of lemurinus. Hershkovitz (1949: 407) included the eastern slope of the Cordillera Oriental in the range of his *Aotus trivirgatus lemurinus*, but in 1983, the discovery of *A. brumbacki* modified his original view. Finally, it is important to note that Hershkovitz (1949: fig. 58) included the highlands of the department of Nariño in the range of *Aotus lemurinus lemurinus*, despite the fact that there are no records for that region or for that matter for the entire department.

Hill (1960: 174) gives the distribution of this taxon precisely the same as Hershkovitz (1949: 407), but Hill (1960: map 2 between p.166–167), in his much more inaccurate map, included not only the highlands of the Andes of Nariño but also those of northern Ecuador and the piedmont on the eastern slope of the Ecuadorian Andes. Curiously there is no evidence whatsoever for the presence of *Aotus* in the Ecuadorian Andes. In this article we maintain that *A. l. lemurinus* is basically restricted to the Andean highlands of Colombia. Lowland Pacific coastal *Aotus* as well as the Panamanian and Urabá populations are *Aotus lemurinus zonalis* (see map, Defler, in press).

Supposed *Aotus lemurinus lemurinus* karyotype: An additional problem having to do with the source of the *Aotus lemurinus* karyotype is that Hershkovitz (1983: 211, Table I) chose karyotypes determined from specimens maintained in Panamá, that were collected from two known Panamanian sites and one unknown site (see Ma *et al.*, 1978: 147), as representative of *Aotus lemurinus lemurinus*. We believe that material definitely from Panamá represents another, generally unrecognized taxon *Aotus lemurinus zonalis* (Goldman, 1914) (cf. Hernández-Camacho and Cooper, 1976: 45–46) which Hershkovitz (1949) decided not to recognize. *Aotus lemurinus zonalis* is made up of populations of the Colombian Pacific coast, NW Antioquia and Córdoba as well as Panamanian animals, all of which show darker dorsal hands and feet than *griseimembra* in northern localities. The dark dorsal surface of the hands and feet is an agouti effect due to the brownish tips and light bases of the hairs (Hernández-Camacho and Cooper, 1976: 47). These are the animals which Hershkovitz (1983: 211, Table I; 214, fig. 2) decided to include with *Aotus lemurinus lemurinus*. Karyotypes for authentic Andean *Aotus lemurinus lemurinus* were unknown until now.

***Aotus lemurinus griseimembra* karyotype:** The problem of the karyotype of *Aotus lemurinus griseimembra* is that the karyotypes ascribed to this taxon came from a group of animals of uncertain origin imported from Barranquilla (department of Atlántico, Caribbean coast, Colombia) and studied by Ma *et al.* (1976b). Barranquilla at the time was a center of a widespread animal trade which gathered together primates from a wide area of northern Colombia, most coming from Magange in northern Bolívar, which also traded in animals from many regions of southern Bolívar and southern Magdalena. However, primates came from as far away as Leticia in Amazonas. Photographs were taken of all of these "Barranquilla" primates and their designated "phenotype B" was identified by Hershkovitz as coming from northern Colombia from a population ascribed by him to *griseimembra* Elliot (1912: 33; type locality Hacienda Cincinatti, formerly known as Valparaiso, on the west slope of the Sierra Nevada de Santa Marta, department of Magdalena, Colombia, 1,480 m). As we pointed out earlier, Hershkovitz (1983: 215) stated that the then recognized subspecies of *A. lemurinus* could only be distinguished "by karyotype alone," contradicting his action of identifying *griseimembra* by photo, as reported by Ma *et al.* (1976).

Since the karyotyped animals ascribed to *Aotus lemurinus griseimembra* were imported into the United States from Baranquilla, where *Aotus* specimens from many parts of Colombia arrived for the animal trade (cf. Cooper and Hernández-Camacho, 1975; Thorington and Vorek, 1976), there is no reason to accept that these animals necessarily correspond to this taxon, nor to accept that lowland *Aotus* of north central and northwestern Colombia have the same karyotype as highland forms, as suggested by Hershkovitz

(1983: 215). The lowland and highland populations are referable to several separate taxa, and Hershkovitz (1983: 215) himself has stated, "there is no certainty that the specific name *lemurinus,* based on a high-Andean night monkey of unknown karyotype, is also applicable to the Panamanian *Aotus* with known karyotype, and the holotype of *griseimembra* and its representatives from the type region in the Sierra Nevada de Santa Marta region of northern Colombia."

From the above analysis we have concluded that *Aotus lemurinus lemurinus* is distributed only throughout the Andean region of Colombia (and perhaps Venezuela) and that the *Aotus* karyotypes used by Hershkovitz (1983) to define *Aotus lemurinus lemurinus* actually are karyotypes for *Aotus lemurinus zonalis.* This conclusion has important implications for the following description of *Aotus hershkovitzi.*

Aotus hershkovitzi Ramirez-Cerquera, 1983

Holotype: Adult female, skin and skull, ICN no. 8880 (original field numbers L-2 of the Instituto Nacional de Salud and conforming to the probable mother of L-3 and L-4); collected December, 1981, by Jairo Ramírez Cerquera and Jaime Umaña from a family group of four individuals. The skull of this specimen has fully erupted third molars, the basilar suture is closed (but not obliterated) and the skin exhibits staining of the hairs of the post-anal glands, all of which indicate that the specimen is an adult.

Type locality: Right bank of Cusiana River, upper Cusiana River valley, district (*vereda*) of Corinto, municipality of Pajarito, Boyacá department, east slope of the Cordillera Oriental de los Andes, Colombia, 5°25'35"N, 72°42'45"W, 1750 m (Fig. 1). Groves (1993: 256) incorrectly lists the type locality as "Department of Meta, east side of Cordillera Oriental."

Paratopotype: Subadult female, skin and skull, INDERENA 4140 (No. L-4 Instituto Nacional de Salud), deposited in collection of Instituto de Investigación de Recursos Biológicos "Alexander von Humboldt" with same number as INDERENA, collected December, 1981, by Jairo Ramírez-Cerquera and Jaime Umaña from the same family group as the holotype. Entire body with stomach preserved separately from skin in 70% alchohol.

Distribution: Known with certainty only from the type locality. Karyotypes 2n = 58 have been found from two other unpreserved specimens, one of them from an unspecified locality in the department of Casanare (possibly the Cusiana river valley) and the other said to be a captive animal from Murillo on the eastern slope of the Cordillera Central de los Andes, Tolima. If the latter locality is indeed correct, this would imply sympatry of *A. hershkovitzi* with *A. lemurinus.*

Etymology: The name *Aotus hershkovitzi* first was suggested by Jairo Ramírez Cerquera to honor Philip Hershkovitz for his many contributions to Colombian and Neotropical primatology and mammalogy and for the support and friendship which he offered to many of us during his lifetime.

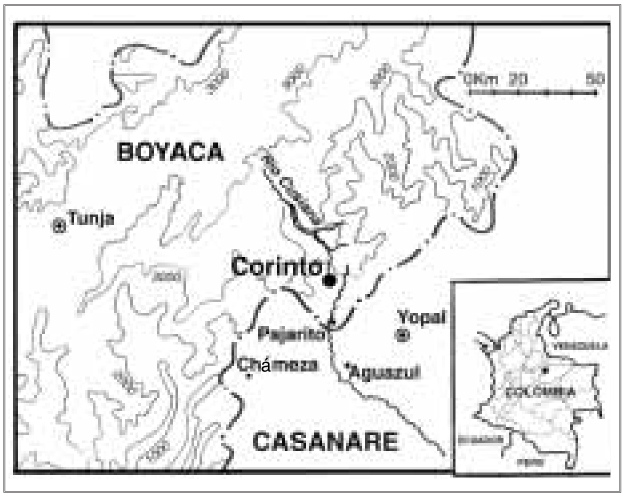

Figure 1. Map of type locality of *Aotus hershkovitzi.*

Diagnosis: A highland *Aotus* belonging to the gray-necked species group (*sensu* Hershkovitz, 1983: 211–212); white orbital ring of hairs interrupted by the temporal dark stripe, continuous with the lateral canthus of the eye (as in *A. lemurinus lemurinus*); broad stripe of agouti-patterned hairs below; malar stripe absent (as in *A. lemurinus lemurinus*); dark temporal stripes faintly convergent posteriorly without merging; sagittal stripe widened and fan-shaped behind and mixed with agouti-patterned hairs (as in *A. lemurinus lemurinus*); mid-dorsal stripe absent; hands and feet agouti mixed with some black hairs; buffy-yellow of throat extends to chin (in contrast to *A. lemurinus lemurinis*, which is duller and lighter with less yellow and with dark hair tips); diploid number 58 and fundamental number 76, higher than any other known for the genus.

Description of holotype: (Figs. 2, 3 a–e, 4) Dorsum with rich reddish brown (*Cinnamon Rufous*) wash extending halfway down tail; typical agouti pattern (Hershkovitz**,** 1977: 90–91) hairs proximal 2/3 (19 mm) dark brown (*Light Grayish Olive*), distal 1/3 as follows (8 mm *Cinnamon Buff* bands, 5–6 mm dark *Benzo Brown* bands, 2–3 mm *Cinnamon Rufous* bands) mixed with some black (*Sepia*) guard hairs giving overall appearance of *Cinnamon Rufous*; sides of neck and body *Cinnamon Buff* to *Cinnamon Rufous* agouti, paler than back; upper arms paler *Pinkish Buff* agouti than sides of body; upper legs agouti *Pale Pinkish Buff* and slightly more reddish than arms; dorsum of hands slightly more reddish than arms with black hairs throughout; dorsum of feet slight reddish wash on brown agouti with long black hairs throughout; neck and chest like belly dull; *Pinkish Buff*; hairs proximal half *Pinkish Buff*, distal half *Pinkish Buff*; throat becomes slightly darkened due to admixture *Sepia* tipped *Pale Pinkish* hairs (vibrissae); ventrum of arms slightly lighter agouti *Pale Pinkish Buff*; skin of hands dark pink

(*Salmon Buffy-Seashell Pink*) with blackened digits; ventrum of legs dull *Pale Pinkish Buff* and *White* on upper thighs with shorter and sparser hair than other parts of body; longer and darker agouti *Pinkish Buff* around ankles, although the base of the hairs are *Light Grayish Olive*; skin of feet dark blackish pink; digits generally darker; ventrum of tail with *Fuscous-Black* distal hair extending closer to body (1/2 tail) than on dorsum of tail; proximal half ventrum of tail rich *Ochraceous-Orange* with *Fuscous Black*-tipped hairs mixed, giving black wash effect; dark tar-like staining of hairs by post-anal glands in ellipsoid 19 mm by 10 mm; head with narrow distinct temporal stripe on right side, extending convergent towards midline of crown to position over ear; left convergent temporal stripe less distinct, more diffuse; doesn't reach ear and the two don't unite; crown same rich *Cinnamon Rufous* as back; two distinct supraocular patches of cream-colored hair with greatest length 17 mm tending towards *Pale Pinkish Buff* at outer points so that patch turns into wedge of lighter *Cartridge Buff* fur between temporal stripe and the forehead patch of basally (*Light Grayish Olive*), dark-tipped agouti hair showing black (*Fuscous Black*) patch, which extends in narrow thread down between the eyes; malar stripe absent; pelage at mid-back 26 mm length; pelage upper tail dorsum 23–24 mm length; pelage midway on sides 34 mm length; no interscapular whorl or crest.

Comparisons: Distinguished from all other known *Aotus* karyotypes by 2n = 58 (Table 1 shows two such comparisons); differentiated from all members of red-necked group by side of neck brownish agouti like side of trunk; from *A. vociferans* of the gray-necked group by absence of interscapular crest or whorl of hairs; from *A. trivirgatus* (which has no interscapular crest or whorl) by an absence of a strongly contrasting mid-dorsal stripe; from *A. lemurinus* mainly by 2n = 58 and FN = 76 although in specimens examined, in contrast to *A. lemurinus,* the *hershkovitzi* have virtually no admixture of dark hairs in gular region. Phenotypic differences between the holotype and the paratopotype are generally slightly lighter tonalities in the paratopotype as compared to the holotype. Length of hair of holotype and paratopotype are within the ranges of that measured from specimens of *A. lemurinus* (ICN 01, 02, 03, and 04) so that two color phases are identifiable (light and dark). The *hershkovitzi,* which is the dark phase, is quite comparable to the darker *A. lemurinus* de Fusagasugá. Measurements included sternum (32 mm/33 mm), interscapular (36 mm/36 mm), dorsum of tail (23–23 mm/unmeasured because of poor state), end of tail (51 mm/unmeasured because of poor state) and flanks (43 mm/44 mm); listed here with first measurement for ICN 8880 and second measurement INDERENA 4140.

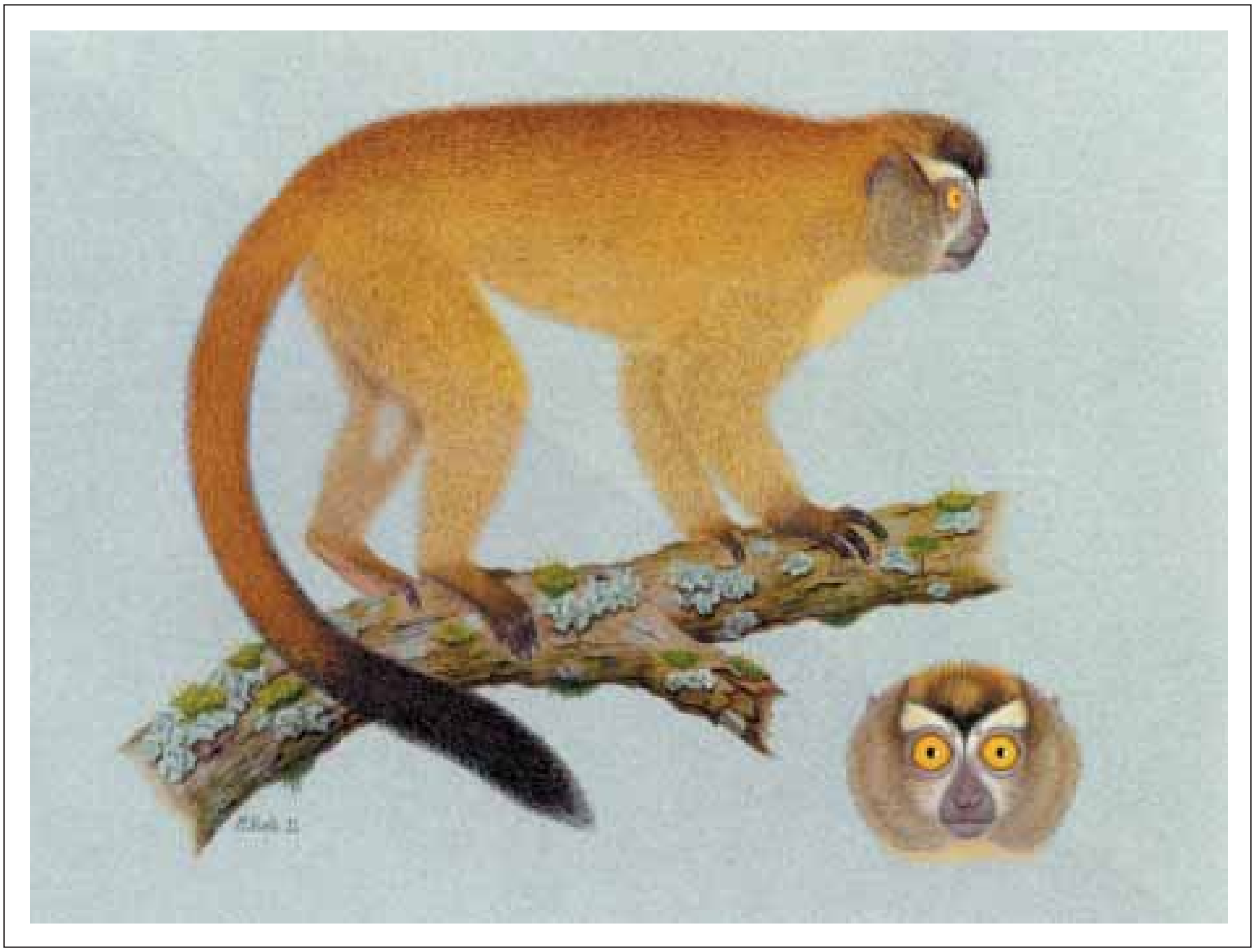

Figure 2. Holotype, lateral and frontal views of *A. hershkovitzi*, Ramírez-Cerquera, 1983.

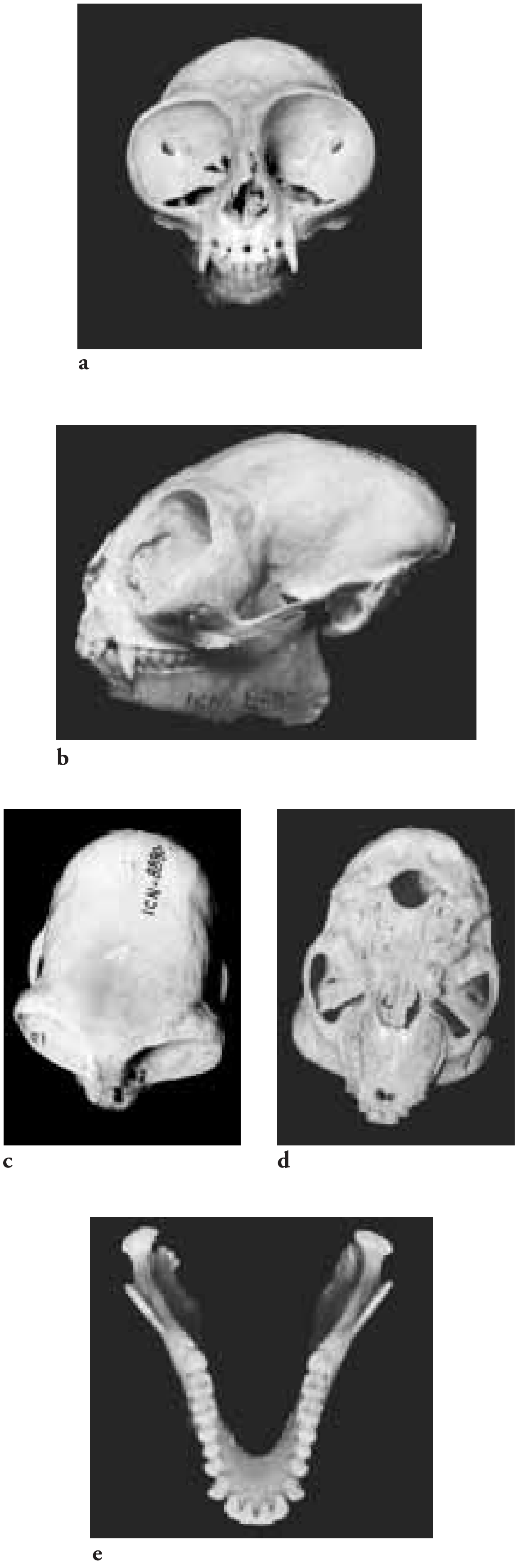

Figure 3. Holotype skull: a) frontal view; b) lateral view; c) dorsal; d) ventral view of the holotype skull; e) dorsal view of lower mandible.

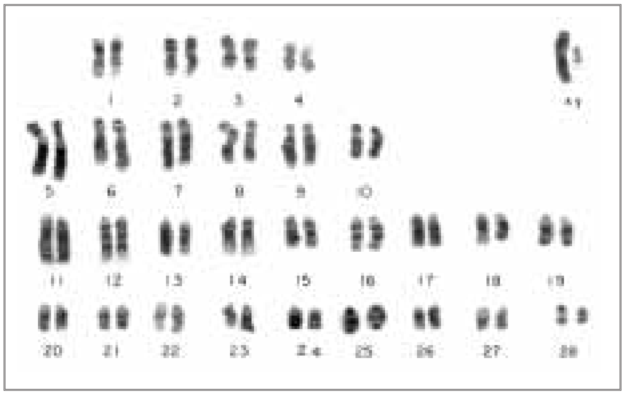

Figure 4. GTG band karyotype of L1, a male Aotus (2n = 58) from the Cusiana River, Boyacá, Colombia.

Description of paratopotype: Dorsum rich *Cinnamon Rufous* wash extending halfway down tail but slightly lighter than holotype; interscapular hairs 21 mm *Light Grayish Olive* + 8 mm *Cinnamon Buffy* band + 4 mm dark *Light Grayish Olive* band + 2–3 mm *Cinnamon Rufous* band = 36 mm in length; overall impression of *Cinnamon Rufous*; intensifying down the tail to mid-tail; side of neck and body *Cinnamon Buffy*, paler than dorsum; upper arms paler *Pinkish Buff* agouti than sides of body; upper legs agouti brown about same tone as arms; dorsum of hands slightly more reddish than arms with black hairs throughout; dorsum of feet slight *Pinkish Buff* wash on brown agouti with black hairs throughout; neck and chest like belly dull *Pinkish Buff*; color hairs half *Pale Pinkish Buff* proximally, half *Pinkish Buff* distally; throat same color throughout; ventrum of arms lighter than dorsal of arms; dried skin of hands *Salmon Buffy-Seashell Pink* with blackened digits; ventrum of legs lighter than dorsal of legs; upper thighs naked of hair (perhaps due to preparation), skin yellowish cast; feet dark yellowish skin coloration; digits black; some dark hairs around ankles; ventrum of tail *Fuscous Black* distal hair extends two-thirds up; proximal hair one-third tail rich *Ochraceous Orange*; no staining of the hairs of the post-anal gland evident and no admixture of black-tipped hairs; head with very faint temporal stripes, darker at corner of eyes and more evident fading out to slight wash and convergent to midline with left stripe slightly more pronounced; crown mixture of agouti brown and black-tipped hairs filling in area between temporal stripes with slight reddish wash; base of hairs same *Light Grayish Olive* color as black hairs + *Cinnamon Buffy* + *Cinnamon Rufous* or alternatively blackish band; two distinct supraocular patches of creamy white hairs tending slightly to more buff posteriorly; dark hairs extend down from forehead to more pronounced black between supraocular patches, no dark malar patch on either cheek; pelage at mid-back 33–35 mm length; pelage upper tail dorsum 22 mm length; pelage midway on sides 30–33 mm length; no interscapular whorl or crest evident.

Crests and whorls: No crests or whorls were detected on the two specimens (*sensu* Hershkovitz, 1977: 81; 1983: 213).

Measurements: See Table 1 for measurements.

Table 1. Homologous chromosomes in 3 taxa of *Aotus.*

Aotus l. lemurinus **2n=58**	***Aotus l. griseimembra*** **2n= 54**		***Aotus brumbacki*** **2n=50**
P.R.	**Ma *et al.* (1976)**	**Yunis *et al.* (1977)**	**Yunis *et al.* (1977)**
1	A4	9	13
2	A5	10p-	-
4	A6	11	-
5	B7	1	1
6	B12	4	3
7	B9	3	2
9	B11	6	6
11	-	-	14p+
12	B13	23	15
13	B14	24	-
14t	B10	12p+	10q
15	B16	16p+	19p+
16	B18	14	17
17	B17	15p+	18p+
18	B15	13	16
19t	A2q	8q	21
20t	A3q	5q	5q
21	B24	19	22
22	B21	20	-
23	B19	18	9
25t	A2p	8p	10p
27	B26	26	-
28t	A3p	5p	5p
X	X	X	X

P.R.: Present report.
t = Chromosomes involved in different Robertsonian translocations in other *Aotus* species.
+/-: Differences between homologues due to additions or deletions of heterochromatin.
p, q : short and long arm of chromosome, respectively. Spaces are left empty whenever chromosome homology cannot be recognized.

Karyology: The karyotype was previously superficially described by Giraldo *et al.* (1983) and placed in a new "karyotype 10 or X" according to a system defined by Ma *et al.* (1976a, 1978, 1980). Torres *et al.* (1998: 298–270) on the other hand referred to this karyotype as "karyomorph 8" (KM) of their own system and further described some of its characteristics.

In both members of the series we found a diploid number of 58 chromosomes and fundamental number (FN) of 76 (Figs. 4–8 a and b). This is the highest diploid number and fundamental number known for the genus (see Hershkovitz, 1983: 211, Table 1). The autosomes were arranged in order of decreasing size (Figs. 4, 5) according to the large groups (A and B) defined by Ma *et al.* (1976). Group A is composed of four pairs of metacentric chromosomes (Pairs 1-4). Chromosome 1 is a marker chromosome with an achromatic region in the long arm, a common finding in *Aotus* and a frequent one in many Cebidae, being the only chromosome containing a NOR (Fig. 6). Group B with pairs 5–10 is conformed of six pairs of submetacentric chromosomes. Short arms of pairs 8 and 10 are entirely heterochromatic. Pairs 11–28 are acrocentric and include a range of size from large to small. Chromosome X is metacentric and very similar to those found in other species of the genus. The holotype female (L2) showed a large telomeric block at the short arm of both X chromosomes; this region is absent in the X chromosome of male L1 but present in L3 (a male juvenile specimen) and confirms the mother-son relationship (Fig. 7).

The distribution of constitutive heterochromatin is essentially centromeric. A distinct heteromorphism in the centromeric region of chromosome 3 was observed in one specimen (L1) (Fig. 7). In addition to centromeric heterochromatin, telomeric heterochromatin blocks were observed at the short arm of chromosomes 2, 5, 7, 9 and at the long arm of chromosome 25, while the short arm of pairs 8 and 10 were

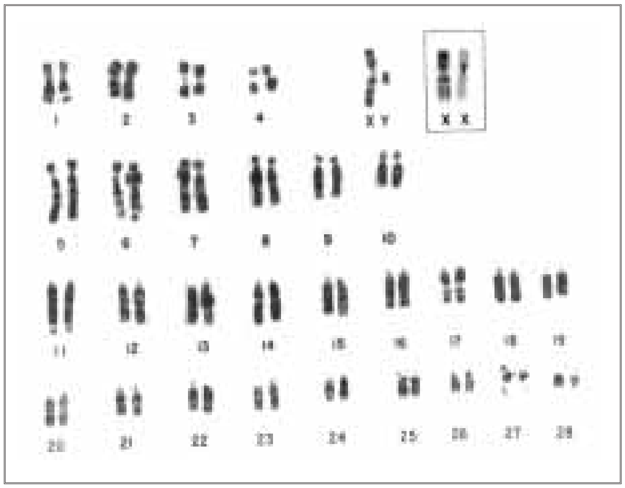

Figure 5. RBG band karyotype of a male Aotus (2n = 58) from the Cusiana River, Boyacá, Colombia. The two X chromosomes from a female specimen are shown inside the box; one X chromosome (right) shows a late replication pattern.

Figure 6. Nucleolar Organizing Region (NOR) in Aotus (2n = 58) from the Cusiana River, Boyacá, Colombia. Arrows point to silver precipitated regions on chromosome No.1.

Figure 7. Partial karyotype with C-Band (CBG) showing the polymorphism of pair 3 and X Chromosome of mother (L-2) and son (L-3). Arrows point to the heterochromatic polymorphic region on chromosomes X and 3.

completely heterochromatic. Interstitial heterochromatin regions were found in the long arm of chromosomes 20 and 27. The Y chromosome was metacentric and the smallest of the chromosome complement but was the longest Y of the karyomorphs described by Torres *et al.* (1998). All chromosomes show an exact homology of complete chromosomes and chromosome arms to karyotypes known for *Aotus lemurinus griseimembra* except for the 4 pairs of extra chromosomes which had no apparent homology (Giraldo *et al.*, 1986).

Q-and G-band karyological comparisons between the specimens studied and two other previously described species of Colombian *Aotus* are shown in Table 2. Comparison is limited to euchromatic regions of karyotype II (K-II) of *A. l. griseimembra* (2n = 54; Ma *et al.*, 1976), which agrees with the one described by Yunis *et al.* (1977) for the same taxon and the karyotype assigned to *A. t. trivirgatus* (2n = 50) by Yunis *et al.*, (1977), later recognized as *A. brumbacki* (Hershkovitz, 1983).

Specimens examined: 2. COLOMBIA. Holotype ICN no. 8880 (skin and skull); paratype IVH (INDERENA) no. 4140 (stuffed skin; body preserved apart in 70% alcohol). Two other specimens from the original series, the adult male and the infant male were not preserved. Also examined for *Aotus lemurinus* 4. COLOMBIA. ICN 001, 002, 003, 004 from Fusagasugá and from Pedro Palo.

Serology: Electrophoretic analysis of the serum proteins shows a single "fast" type of albumin band not seen in other *Aotus lemurinus* specimens. Additionally a demarcated band 2 made up of three well-marked alpha-globulin bands was detected. Although three types including this type of albumin band have been identified for *A. l. griseimembra* by Reardon *et al.* (1979), three well-marked alpha-globulin bands have not been observed in any other taxon. Beta- and gamma-globulin were found as an undifferentiated wide stripe in both these specimens and *Aotus lemurinus*.

Malariology: The specimens exhibited low susceptibility to *Plasmodium falciparum*. This resulted in parasitemias of less than 5% after 14–18 days of infection. Animals referred to *Aotus lemurinus griseimembra* showed high susceptibility. Six specimens from the middle Magdalena River and referred to *Aotus lemurinus lemurinus* showed mixed susceptibility: two had low susceptibility and four had high susceptibility (Espinal *et al.*, 1984).

The systematics of *Aotus* is still far from being resolved, and Colombia is particularly difficult because of its topographic complexity, which has surely influenced the genus' evolution. The first confirmed appearance of the genus in the fossil record of La Venta (Huila, Colombia, described as *Aotus dindensis*) dates back to at least the Middle Miocene of 11.8-13.5 million years B. P. (Setoguchi and Rosenberger, 1987), although Kay (1990) has suggested synonymy with *Mohanimico hershkovitzi* described by Luchtehand, Kay and Madden (1986); Rosenberger *et al.* (1990) continue to maintain the fossil to be *Aotus.*

Not only are contemporary phenotypes unusually complicated to distinguish, but variation within populations is high, including two color phases in *A. lemurinus* (dark and light) (Hershkovitz, 1949, 1983; Hernández-Camacho and Cooper, 1976; Thorington and Vorek, 1976). Actually coat color has already proven to be unreliable as a diagnostic tool, as there are many differences which probably are not good genetic markers, as observed by Thorington and Vorek (1976). This does not seem surprising - since the species is nocturnal, there are no strong selective pressures for

Table 2. *Aotus lemurinus lemurinus (=A. hershkovitzi).* Measurements in millimeters.

Specimen No.	Head & body	Tail	Hind foot	Ear	Greatest skull length	Condylo-basal length	Zygomatic width	Biorbital breadth	Postorbital constriction
No. 8880	286	325	88	31	60.8	47.5	40.5	43.3	30.0
No. 4140	302	320	86	29					
	Braincase width	Mastoid breadth	I^1-M^3	C–M^3	PM–M^3	$I1^{-1}$	$I2^{-2}$	C-C	M^{1-1}
No. 8880	33.8	35.5	21.7	17.2	13.8	6.4	10.7	16.8	20.3
	M^{3-3}	Mandibular length	Coronoidal height	Symphyseal angle	Weight*				
No. 8880	18.9	38.1	22.7	49	615				

*Datum for the weight of the adult female ICN 8880 written on the ticket of the specimen chosen as the holotype (ICN 8880) seems to be incorrect, since the weight is given as 615 g, far below the weight of a typical adult female. It seems likely that either the weight was not registered correctly or the weight belongs to the subadult female INDERENA(IVH) 4140 and was incorrectly ascribed to ICN.

differences in coat color. We should look to vocalizations, behaviors and pheromones to provide isolating mechanisms. Complicating all of this, we describe here how the taxonomic descriptions defining *Aotus lemurinus lemurinus*, *Aotus lemurinus griseimembra* and *Aotus brumbacki* (see below) have historic problems relating to the adequacy of the type specimens and associated karyotypes (which were described independently) to define the taxon.

In the case of this genus, karyology has become an indispensable tool for defining each species group, and it is particularly disappointing that so little is being done from that viewpoint to address the issues that need to be resolved. Since karyotypes used to define *Aotus l. lemurinus* and *Aotus l. griseimembra* were taken from animals obtained independently and matched by Hershkovitz to phenotypes representing the taxa, there is no certainty that high altitude *Aotus lemurinus* and the population of the holotype (if it still exists) exhibits this karyotype number (Hershkovitz, 1983: 215; Ma *et al.*, 1976a, 1978). Part of the importance of the *hershkovitzi* material is that here we have a karyotype from a known geographic locality associated with a known phenotype, a situation which has been quite rare in the history of this genus.

Other "local" karyotypes: A karyotype prepared by MLB from an animal in captivity in Armero and said to be from Murillo from the eastern slopes of Nevado de Ruíz (Tolima) also had 2n = 58. The animal perished with the village of Armero when the eruption of the Nevado de Ruíz Volcano caused the death of 20,000 inhabitants, including Jairo Ramírez-Cerquera. Another karyotype prepared by MLB from an animal in the Cali Zoo and said to have come from the department of Casanare had 2n = 58 and a phenotype resembling the two *hershkovitzi*. It could have come from the Cusiana valley in eastern Casanare. The animal died and the skin was discarded. Neither of these karyotypes was further analyzed, but if these animals were of the same taxon then the geographic distribution of *hershkovitzi* might eventually prove to be throughout the eastern and Central Cordillera of the Andes, sympatric with *Aotus lemurinus*, and probably at a higher altitude than that of *Aotus brumbacki* on the east slope of the Eastern Cordillera.

***Aotus brumbacki* karyotype:** *Aotus brumbacki* is well-founded, since Yunis *et al.* (1977) described a karyotype from animals purportedly from the Villavicencio area, which Hershkovitz (1983: 217) referred to *Aotus brumbacki.* Brumback (1974) had described the karyotype 2n = 50 as being from a Paraguayan animal and identified as *A. azarae*, but this was amended by Hershkovitz (1983: 218) as being from the area around Villavicencio (Meta, Colombia), due to the phenotype which was "gray-necked" and his assertion that "The paratype, a member of the gray-neck groups (AMNH 143756) from the Villavicencio region, Colombia, resembles the photograph of the holotype closely enough to serve equally well as phenotypic model of the species. It cannot be identified with any other species of *Aotus.*" Nevertheless, we still need additional verifying karyotypes and phenotypes from known geographic collection sites for this species as well.

Ford's (1994) conclusion that northern taxa in the gray-necked group are represented by the well-differentiated species *Aotus trivirgatus* and a clinally variable *Aotus vociferans* (including *A. lemurinus*, *A. brumbacki* and *A. vociferans*, *sensu* Hershkovitz, 1983) while provocative, seems to us to be premature in view of the extensive variability in karyomorphs and karyotypes that would be involved in such a "species," varying from 2n = 46 to 2n = 58 and FN = 58 to FN = 76. Additionally, besides chromosome variability, *Aotus* social groups and behaviors seem more likely to result in closed populations than in broad gene flow across great distances. The added factor of a complexly formed topography consisting of lowlands separated by various high mountain ranges and wide rivers would have provided many opportunities for isolation of populations with subsequent speciation. Lack of mobility in a small organism distributed across a mountainous terrain is not a situation that would lend itself to a clinal population of such magnitude as suggested by Ford (1994). And yet, her results of several clinal cranial and pelage characteristics require some explanation and future analysis.

One partial explanation might be that the clinal variation that homogenized all of the specimens analyzed for Colombia may have an uncertain origin, as Ford herself recognized. In her analysis, 33 of the specimens were clumped as being from "Baranquilla," the principal port of exportation for animal traffic for Colombia for many years. Extensive experience of one of us (JIH-C) in animal traffic control in Colombia allows us to confirm that *Aotus* from many parts of Colombia could easily have been included in this group, since it was common for animals even from as far away as Leticia, Amazonas, to arrive in Barranquilla, where they were sent by Leticia's leading animal trafficker. Nevertheless, the problem of clinal characteristics bears further analysis in the future, given that the karyotypic differences are so pronounced.

Some of the karyotypic problems mitigating against the recognition of Ford's (1994) clinal species are the five different karyomorphs described from the elements which would make up Ford's *Aotus vociferans.* These karyomorphs, four of which were previously known and which correspond to the four species lumped into Ford's clinal *A. vociferans,* and a fifth karyomorph taken from the Pereira Zoo (department of Quindío) called "Quindío" with 2n = 50, strongly suggest that reproductive barriers would exist between each of these populations of *Aotus* due to their ample karyomorphic differences (Torres *et al.*, 1998). The "Quindío" specimen actually may represent a new Colombian species, since its fundamental number (FN = 72), number of metacentric (9), submetacentric, and acrocentric (12) chromosomes are so different from *A. brumbacki,* the other northern species with a diploid number of 50. Unfortunately the location of the "Quindío" specimen's capture is unknown, so that further study will have to await the discovery of its range. The skin and skull were preserved in the Instituto de Ciencias Naturales of the Universidad Nacional de Colombia (specimen no. ICN 14023), but a recent search for this material revealed it to be missing from the collection.

Relationship of karyotype to different species: Marks (1987) makes the interesting case that to some extent, chromosome divergence among species may be a reflection of the social system and demographic characteristics of the group. A more closed type of social group, including monogamous relationships and territorial defense, would tend to favor random inbreeding and should favor elevated genetic drift. He used the case of the six species of gibbons (*Hylobates*), which illustrate an elevated cytogenetic diversity with 2n = 38, 44, 50, 52 and exhibit a more closed social system, including territorial defense, reduced vagility and monogamy as compared to 26 papionine monkey species (macaques [*Macaca* 12 spp.], baboons [*Papio* 5 spp.; *Theropithecus* 1 spp.], mandrills [*Mandrillus* 2 spp.] and mangabays [*Cercocebus* 4 spp.; *Lophocebus* 2 spp.]), which generally exhibit a comparably more open social system including large and mobile groups that are not pair-bonded and are usually polygynous with a very uniform karyotype (2n = 42) throughout the group (Napier and Napier, 1967: 409-410). The example using *Hylobates* spp. could have been *Aotus*, with their elevated cytogenetic diversity. Furthermore, although we do not know many of the details of their social system, it is apparently more socially closed and philopatric, with pair monogamy where members of a small group do not move far and defend a small territory (Wright**,** 1978, 1981; Mittermeier *et al.*, 1999).

Callicebus would also fit into this model of elevated chromosome diversity and small, semi-closed, monogamous, philopatric groups. Although we know less about chromosome diversity in *Callicebus*, it is evident that there are wide differences. For example, *Callicebus torquatus* (2n = 20) has the lowest diploid number known for primates as compared to *Callicebus moloch* (2n = 48), *Calliceus cupreus* (2n = 46) and *Callicebus donacophilus* (2n = 50) (Hershkovitz**,** 1990: 37).

Relation of *A. hershkovitzi* karyotype to other congeneric species: The *A. hershkovitzi* karyotype shows the highest diploid number (2n = 58) so far recorded in the genus. It contains a high number of acrocentric chromosomes (nos. 14, 19, 20, 25, 28), which, in other *Aotus* species, correspond to arms of biarmed chromosomes of different Robertsonian translocations. Table 1 shows the homology between the chromosomes of *A. hershkovitzi* and the karyotypes of KII. Chromosome A-2 from KII is derived from *A. hershkovitzi* nos. 25 and 19 (Fig. 8b) and KII chromosome A-3 from *A. hershkovitzi* nos. 20 and 28. *A. hershkovitzi* and *A. brumbacki* share 15 pairs of similar chromosomes, but differ by the presence of two Robertsonian translocations. The first one involves *Aotus hershkovitzi* nos. 14 and 25 to form the chromosome 10 of *A. brumbacki*. The second one involves *Aotus hershkovitzi* nos. 20 and 28, to form chromosome 5 in *A. brumbacki*. Interestingly, *A. hershkovitzi* chromosome no. 25 is involved in two different types of Robertsonian translocations (Figs. 8a and b), either with chromosome 14 (resulting in chromosome 10 of *A. brumbacki*) or with chromosome 19, resulting in chromosome A2 in the KII, KIII and KIV karyotypes (see Ma *et al.*, 1976). This type of translocation is characteristic of *Aotus* from northern Colombia.

Comparisons between chromosomes 2, 11, 14, 15 and 17 of the *A. hershkovitzi* karyotype and their counterparts in the other species of *Aotus* (Table 1) show differences in short arm size, probably resulting from variable amounts of constitutive heterochromatin. These variations have been found to occur in different groups that have undergone drastic chromosome shuffling during radiation (Sousa Barros *et al.*, 1990). Two different types of polymorphic variation have been found by us in this taxon affecting pair no. 3 and the X chromosome. When comparing the *A. hershkovitzi* karyotype with the K-IX karyotype of "Panama" (Ma *et al.*, 1978), 24 pairs were shared between them. This finding indicated that the *A. hershkovitzi* and "Panamanian" *Aotus (A. l. zonalis)* are karyotypically more similar to each other than to the other Colombian *Aotus* suggesting a close relationship of *A. hershkovitzi* to the Panamanian *Aotus* material studied by Ma *et al.* (1978).

Our findings also indicate that fusions have been prominent in the karyotypic evolution of *Aotus,* resulting in reduction of diploid number. The alternative mechanism, *viz* fission, has been postulated by other authors (Galbreath, 1983) to

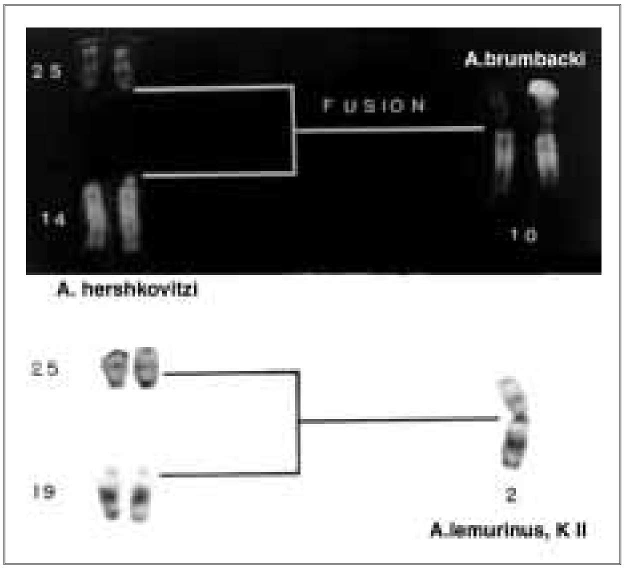

Figure 8. Presumptive chromosome rearrangements involving chromosome no. 25 of Cusiana specimens a) Robertsonian translocation between chromosome 25 and 14 of Cusiana *Aotus* resulting in chromosome 10 in *A. brumbacki* (QFQ banding); b) Robertsonian translocation between chromosomes 25 and 19 of Cusiana *Aotus* resulting in chromosome A2 of *Aotus lemurinus griseimembra* (karyotype KII). (GTG banding).

explain the occurrence of diploid numbers higher than 54, a diploid number considered by these authors to have been present in the common ancestor of the group. We suggest that the *Aotus hershkovitzi* karyotype is likely to be more similar to the ancestral karyotype because it contains at least one acrocentric chromosome that is involved in two different rearrangements, each of them being present in different species.

The sympatry of 2n = 58 individuals with *Aotus lemurinus* and their phenotypic similarity strongly suggests that the *A. hershkovitzi* described here represent Andean *Aotus lemurinus lemurinus* and not a separate species. Additionally, we believe that karyological differences between the *hershkovitzi* specimens or autocthonous *Aotus lemurinus lemurinus* and the other two *Aotus lemurinus* subspecies to which it was compared here may produce reproductive barriers between them, and that any potential hybrids may be infertile. The implication here is that the three subspecies of *Aotus lemurinus* may actually more correctly be considered separate species. More detailed cytogenetic analyses with high resolution banding, hybridization *in situ* and other molecular markers might also be needed for detecting complex rearrangements of sinteny groups which might allow us to recognize the real homology between these karyomorphs. Further karyological studies and analyses of other *Aotus lemurinus* are urgently needed to confirm these views.

In memoriam

We wish to dedicate this paper to two people, Philip Hershkovitz and Jairo Ramírez Cerquera. A first attempt at describing *A. hershkovitzi* was begun by Ramírez C. *et al.* (*mss.*) in an effort to name the taxon after Philip Hershkovitz. The effort was abandoned by the authors when Jairo was killed by the Nevado de Ruíz Volcano disaster. The present manuscript is a completely new paper, written with the desire to finally clarify the new taxon's position.

Philip Hershkovitz was well-known to many Colombians including the authors of this paper. He began field-work in Colombia with a two-year collecting trip to the Santa Marta region from 1941 to 1943. In 1948, after the Second World War, while employed by the Field Museum of Natural History in Chicago, he moved his family to Bogotá and worked in Colombia until he was obliged by his museum duties to return to Chicago in 1952. All of these collections became the heart of his subsequent work at the Field Museum, where he worked with most mammalian orders, describing many species and revising many groups of Neotropical mammals, focusing his work on their evolutionary origin, dispersal, classification, nomenclature and systematics. His impact on primatology was immense, resulting in many important revisions such as those for *Chiropotes, Pithecia, Saimiri* and *Callicebus*. Other notable achievements include his classic volume 1 of *New World Monkeys (Platyrrhini)* on the Callitrichidae and his effort to make sense out of the difficult genus *Aotus* (Hershkovitz, 1949, 1977, 1979, 1982, 1983, 1984, 1985, 1987a, 1987b, 1988, 1990). Because of Philip Hershkovitz' readiness to help and encourage all of us who work on some aspect of Neotropical mammalogy, Jairo Ramirez wanted to honor him using Hershkovitz's name as a species name for this taxon.

Jairo Ramirez-Cerquera first studied biology at the Universidad Nacional de Colombia, where he was a companion of one of us (MLB). He began his studies in primatology when he was hired as biologist of the *Aotus* colony of the Colombian National Institute of Health in Bogotá. Because of his interest in beginning a reproductive program with the animals, part of the colony was moved to the Biology Station of INS in Armero, Tolima, necessitating his move to Armero. Tragically he, along with his wife and children, were among the more than 20,000 missing in the avalanche of lahar which enveloped the town of Armero in 1985. We close this *memoria* with a quote from Russell Mittermeier and Adelmar Coimbra-Filho (1988: 34): "Jairo Ramirez, a rising star in Colombian primatology, had apparently discovered yet another species in the Colombian Andes, which because of his untimely death was never described. Ramirez' intention was to name the species after Hershkovitz in recognition of his many contributions to Neotropical primate taxonomy." It was the intention of the authors of this paper to complete Jairo's wish and at the same time honor the memory of these two men, but further analysis of the problem obliged us instead to synonymize the taxon with *Aotus lemurinus lemurinus.*

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We would like to acknowledge all those who have been interested in this problem previously, particularly the authors of the first manuscript written in the effort to formally describe *Aotus hershkovitzi*, especially Jaime A. Umaña, Marleney Montilla M., Carlos A. Espinal T. and Alejandro Giraldo. We would also like to thank Alberto Cadena (Instituto de Ciencias Naturales, Museo de Historia Natural, Universidad Nacional de Colombia) and Yaneth Muñoz (Instituto para la Investigación de la Biodiversidad "Alexander von Humboldt") for lending us the holotype and paratopotype for this hypothetical species and for other support they have given over the years towards the solution of this and other taxonomic problems. We would also like to thank Juan Manuel Renjifo for the photography of skin and skull and the National Institute of Health where the collection and preparation of the material was supported. We are grateful to Margarita Nieto for the color plate of the holotype.

Notes

[1] Subdivision of municipality in Colombia.

[2] Hill (1960: map 2) locates *A. lemurinus* throughout the region, which includes *A. hershkovitzi* and part of *A. brumbacki* and also includes northern Ecuador. We have found, however, that in general his distribution maps are

so full of distributional and geographic errors that they are practically useless for any detailed consideration of Neotropical primates.

[3] The type location identified by Groves (1993: 256) is in error, since it is located in the Department of Boyacá and not Meta.

[4] From a series of animals preserved in the MNHP. Elliot (1913: 14) did not fix a lectotype but commented that "The type of *N[yctipithecus] lemurinus* I. Geoffroy in the Paris Museum has been examined [by the author], but it is so faded from exposure to light that it is impossible to recognize its original coloring and I could only guess at it."

[5] On the plateau.

[6] Apparently a *lapsus,* since all *Aotus lemurinus* of the Cordilleras are fine-haired and not course.

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SHORT ARTICLES

STANDARD ERRORS OF SURVEY ESTIMATES: WHAT DO THEY MEAN?

William E. Magnusson

Few journals would accept an estimate of density or population size without a corresponding measure of variability, and most computer programs that provide estimates of population size also provide estimates of standard errors. It is part of the prevailing scientific culture to demand "error" estimates even when they do not aid communication (Magnusson, 2000a). In my experience, most students and many professionals do not understand what those "errors" represent or the relationship between the question and the sampling design. Primatologists often use "standardized" survey techniques that depend on repeated sampling of the same transect and the use of line transect methods to estimate population size (Peres, 1999). I will show below that these provide standard errors with extremely limited utility. Wildlife courses should spend more time explaining what standard errors mean and less time showing how to calculate them.

The terms "standard error" (SE) and "standard deviation" (SD) were originally synonymous. However, SE is currently used to indicate an estimate of the standard deviation of a parameter such as the mean, or total population size, and SD is used to describe the primary data. The SE gives an estimate of the variability expected if many independent estimates of the parameter were made using the same methodology. Usually, only one estimate of the parameter is made, and the SE estimated from statistical theory based on variability among the observations.

In the simplest case, the SE relates to the expected variability caused by sampling only a small proportion of the area occupied by the population. Sampling units are spread randomly over the area and all of the target organisms are counted within each sampling unit (Pielou, 1984). If some of the targets in each unit are counted, the SE may give a useful index of the variability expected if the methodology is repeated, but the SE does not relate to the uncertainty in the estimate of population size. In many cases, the trend in population size, rather than the absolute value of population size, is not of interest, and it may be more efficient to use regularly spaced sampling units. This results in smaller SEs (Caughley and Sinclair, 1994).

Alternatively, the whole area may be surveyed and corrections made for the number of animals not seen. This is the basis of the mark-recapture and line-transect methods. Line-transect methods depend on the construction of a sighting function that estimates the relationship between the number of targets recorded and the distance from the transect line. Mark-recapture methods estimate the mean proportion of targets registered over the whole area. The SE of these methods relates to the uncertainty in the proportion of targets seen.

The two types of methods can be combined with incomplete sampling of individual sampling units that do not cover the whole area of interest. If the correction for targets missed within the sampling units is unbiased, then the SE of the estimate based on geographical variation effectively includes the variability due to incomplete counts within the sampling units. It is best to seek help from a statistician before using these hybrid methods because the standard errors for density corrections may not be symmetrical (Caughley and Sinclair, 1994). Students often do not realize that the "expected value" of a parameter for a statistician is the mean of a very large number of estimates of that parameter. If the distribution of estimates is asymmetrical, then the "expected value" may be far from the values you expect to obtain from most samples. Other sources of variability, such as seasonal or random fluctuations in population density, may contribute to variability, but our model is already sufficiently complicated.

Let us consider the standard method suggested by Peres (1999), which is similar to standard methods recommended by many primatologists. Two 4.5 km transects are placed at 90° to each other, forming an "L" shape. Each transect is surveyed many times until a minimum number of primate groups is recorded, or a minimum distance covered. Peres (1999) suggested that more than 300 km should be walked. A computer program such as DISTANCE (Buckland *et al.*, 1993) is used to estimate population density and its SE. This estimate relates to the area effectively sampled by the transects, which depends on vegetation density. However, in most forests, it is unlikely that mammals can be detected at more than 50 m from the transect line. Therefore, the area effectively surveyed would be of the order of 90 ha or less.

Population estimates obtained by line-transect methods are greatly affected by the sighting function. The distribution of primates around a 300 km transect should give a reasonably precise idea of the sighting function for that region. However, if the sighting function is based only on repetitions of the same 9 km, then it may depend on the behavior of a few groups of monkeys. A large fruiting tree near the transect line that regularly attracts primates will result in a very different sighting function than a similar large tree further from the transect line. When no large trees are fruiting, the sighting function for the same area will change again as the same monkeys do not accumulate in the same place on different days. Line-transect methods were designed for analyzing independent observations. Sampling 100 km of transects (e.g., 10 separate 10 km or 20 separate 5 km transects) once would give a much more accurate estimate of primate density and its SE than repeatedly walking along the same 9 km of trails until a total of 300 km is attained. It is very unlikely that the time gained by not cutting extra transects compensates for the uncertainty in what the SEs represent.

Densities are used to compare sites, habitats or areas subject to different disturbances, such as hunting. If the units being compared are of similar size to the transects, then the SEs are meaningful and can be used to calculate 95% confidence intervals (95% CI). If the areas are much larger, as they usually are, it is impossible to estimate the SE of the density based on a single dog-leg transect; there is no replication. The SE calculated, which may relate to uncertainty in the absolute density in that transect, gives no information as to likely variation in other transects. However, given that the line-transect methods give unbiased density estimates for transects, the SE based on between-transect variability would effectively include variability due to incomplete sampling within transects. Therefore, it is not usually necessary to calculate the SEs for densities in individual transects, and meaningful conclusions can be made without consideration of the within transect uncertainty (e.g., Peres, 1997).

Hurlbert (1984) alerted biologists to the dangers of pseudoreplication decades ago. However, university courses do not prepare students to deal with practical sampling problems. At the most basic level, this just means stating clearly what is being sampled. Editors should require that authors clearly state what is being studied on three distinct scales. The *first scale* is the universe of interest. A researcher may be interested in "big" questions such as the mortality patterns of a species over its entire range, or the physiology of all species within a family. The reader should know this, but it is almost always impractical to carry out studies at that scale. Therefore, authors should state their sampling universe, the *second scale*, which will generally be something smaller, such as mortality patterns in Wisconsin or all species in the family that occur in Mexico. The greater the overlap between the sampling universe and the universe of interest, the greater the generality, but only a pedant with no field experience would require that the whole universe of interest be sampled in every study.

The level of interest in relation to pseudoreplication is the sampling universe. Sampling units (the *third scale*) are usually best distributed randomly (or at least uniformly or arbitrarily) over the whole sampling universe. The greater the coverage of the sampling universe, the greater the generality. Variability among sampling units affects the accuracy of parameter estimates for the sampling universe, and this is reflected in the SEs. Variability within sampling units (as given by line-transect SEs) does not allow evaluation of accuracy or precision of parameters.

I have focussed on problems in surveying primates, but the same problems of linking the questions to the analyses and avoiding pseudoreplication are general for wildlife studies (e.g., Magnusson, 1999). Courses in wildlife management, and biology in general, need to give more emphasis on the basic concepts of sampling design, and less on the mathematical manipulations (Magnusson, 2000b).

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PRIMATAS DA REGIÃO DO RIO TAPAJÓS, PARÁ, BRASIL

Sergio Maia Vaz

Introdução

Vários naturalistas visitaram o Tapajós, porém, foi Henry W. Bates, no século XIX, quem melhor descreveu a região. Na obra *The Naturalist on the River Amazons* (Bates, 1863), ele dedicou um capítulo inteiro a descrição de uma excursão que fez ao local, entre junho e outubro de 1852.

Alfonso M. Olalla continua sendo o responsável pela maior e mais importante coleção de mamíferos já formada na área de Tapajós. As coletas feitas, entre 1931 e 1971, reúnem exemplares de diversas localidades de ambas as margens, principalmente, Santarém (junho-julho de 1934), Caxiricatuba (maio de 1931; janeiro-setembro de 1935; março, maio, novembro e dezembro de 1936; janeiro, fevereiro, setembro, novembro e dezembro de 1937), Piquiatuba (maio de 1931; maio-agosto e dezembro de 1936; março de 1937), Marai, Tapaiuna, Aveiro e Fordlândia, entre outras. No Brasil, o material colecionado pelo Sr. Olalla encontra-se depositado no Museu Nacional/Universidade Federal do Rio de Janeiro (UFRJ) e no Museu de Zoologia/Universidade de São Paulo (USP).

Em 1938, aproveitando a abertura de áreas para a implantação de seringais pela Companhia Ford Industrial do Brasil, em Belterra e Fordlândia, o Ministério da Educação e Saúde, através do Serviço de Estudos e Pesquisas sobre a Febre Amarela (SEPSFA), com a cooperação da Divisão de Saúde da Fundação Rockefeller, realizou investigações envolvendo a coleta de mamíferos. Os espécimes obtidos em Belterra foram colecionados por A. Rebello, entre maio e outubro. Esse material está depositado no Museu Nacional/UFRJ.

Além das coleções do Sr. Olalla e do Serviço da Febre Amarela, é digno de nota o material reunido pelo Instituto Evandro Chagas, em Belterra, no ano de 1978. Os espécimes estão conservados no Museu Paraense Emílio Goeldi.

Material e Métodos

Área de Estudo

Este estudo foi desenvolvido, em parte, na área da antiga concessão da Companhia Ford Industrial do Brasil (Ford Motor Company), localizada na margem direita do rio Tapajós, município de Belterra, estado do Pará, delimitada pela Ponta do Pindobal (02°34'S, 54°58'W) e a Ponta São João, na enseada de "cachiriquituba" (= Caxiricatuba) (03°02'S, 55°06'W) (Fig. 1).

Atualmente a quase totalidade dessa área encontra-se inserida nos limites da Floresta Nacional do Tapajós, administrada pelo Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis (IBAMA). A região estudada abrange dois planaltos: o Planalto Rebaixado da Amazônia (Médio Amazonas) e o Planalto Tapajós-Xingu, cuja altitude varia de 120 a 170 metros ao nível do mar (Brasil, Projeto RADAMBRASIL, 1975). O clima é quente e úmido, enquadrando-se no tipo Amw da classificação de Köppen. Na região de Belterra, tomando-se como referência a estação meteorológica local e os dados referentes ao período de 1980 a 1993, a temperatura média mensal varia de 23.6 a 27.8°C. As temperaturas máximas e mínimas mensais variam de 28.3° a 33.9°C e 17.8° a 23.8°C, respectivamente. Setembro, outubro e novembro são os meses mais quentes e junho e julho correspondem aos mais amenos. A estação chuvosa vai de fevereiro a maio e o período de menor precipitação ocorre de agosto a novembro. A precipitação pluviométrica apresenta um total anual que varia de 1113.8 a 2232.4 mm. A umidade relativa é sempre superior a 80%.

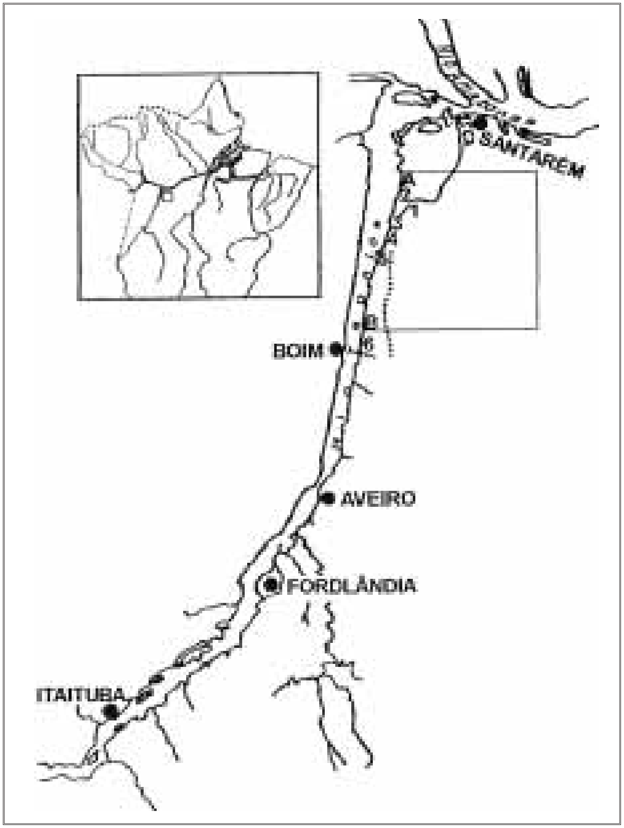

Figura 1. Localização da área estudada. A - Ponta do Pindobal, B - Ponta S. João; 1 - Belterra, 2 - Iruçanga, 3 - Cajutuba, 4 - Aramanaí, 5 - Maguarí, 6 - Piquiatuba.

A vegetação predominante é a Floresta Ombrófila Densa que reveste a região desde os locais mais altos até a margem do Tapajós. São comuns espécies como a seringueira *Hevea brasiliensis*, a castanheira *Bertholletia excelsa*, o cumaru *Dipteryx odorata*, a itaúba *Silvia itauba*, o tachi *Sclerobium* sp., o pau-jacaré *Laetia procera*, o freijó *Cordia goldiana*, o piquiá *Caryocar villosum*, a jarana *Holopyxidium jarana*, entre outras. Há também manchas da Floresta Ombrófila Aberta, com a presença de palmeiras, notadamente do babaçu *Orbignya martiana*. Desmatamentos e queimadas são freqüentes para a formação de roças de subsistência.

Metodologia

Durante dois períodos, compreendidos entre dezembro de 1991 e janeiro de 1992 e dezembro desse mesmo ano e janeiro de 1993, foram realizados levantamentos de campo objetivando verificar a ocorrência de mamíferos, especialmente primatas, nas localidades de Belterra (02°35'S, 54°58'W), Cajutuba (02°40'S, 55°00'W), Aramanaí (02°43'S, 55°00'W), Maguarí (02°47'S, 55°01'W) e Piquiatuba (03°03'S, 55°06'W). A identificação das espécies foi conseguida através de observação pessoal e contou com o auxílio de moradores locais. Com a finalidade de complementar as informações obtidas foram examinados espécimes conservados no Museu Nacional/UFRJ (MNRJ), no Museu de Zoologia/USP (MZUSP) e no Museu Paraense Emílio Goeldi (MPEG).

Resultados

As pesquisas permitiram constatar a ocorrência de oito espécies de primatas na área estudada: *Callitrix argentata* (Linnaeus, 1771), *Alouatta belzebul discolor* (Spix, 1823), *Aotus infulatus* (Olfers, 1818), *Ateles marginatus* E. Geoffroy, 1809, *Callicebus moloch* (Hoffmannsegg, 1807), *Cebus apella* (Linnaeus, 1758), *Chiropotes albinasus* (I. Geoffroy e Deville, 1848) e *Saimiri ustus* I. Geoffroy, 1843 (Tabela 1).

Essas mesmas espécies foram encontradas na região do rio Iriri, afluente da margem esquerda do rio Xingú, por Martins *et al.* (1988). Pesquisas de campo envolvendo primatas na área do Tapajós foram realizadas por Ayres e Milton (1981), Branch (1983) e George *et al.* (1988), no Parque Nacional da Amazônia (03°41'-4°50'S; 56°00'-57°21'W). Das oito espécies de macacos que ocorrem na área, uma (*Chiropotes albinasus*) figura na *Lista Oficial de Espécies da Fauna*

Tabela 1. Lista das espécies de primatas que ocorrem na área estudada.

Espécie/Localidade	Belterra	Iruçanga	Cajutuba	Aramanaí	Maguarí	Caxiricatuba	Piquiatuba
Callithrix argentata	(41)	x	x	a	x	(28)	(8)
Alouatta b. discolor	x	x	x	x	x	(11)	(5)
Aotus infulatus	x	x	x	x	x	(1)	(1)
Ateles marginatus	Extinto, b	Extinto	x	Extinto	x	(7)	(7)
Callicebus moloch	(1)	x	x	x	x	(16)	(9)
Cebus apella	x	x	x	x	x	(13)	(1)
Chiropotes albinasus	Extinto	Extinto	x	Extinto	x	(3)	(1)
Saimiri ustus	x	x	x	x	x	(8)	(2)

x = presente, (n) = número de espécimes examinados; MNRJ, MPEG, MZUSP

Brasileira Ameaçadas de Extinção (Brasil, IBAMA, 1989). O coatá ou coamba, *Ateles marginatus*, e o cuxiú, *C. albinasus*, já foram bastante frequentes na região do Tapajós. De Santarém ao Rio Cururú (07°45'S, 57°30'W) existem diversos registros de coletas. Atualmente é admitida a extinção de ambos nos arredores de Belterra, Iruçanga, Cajutuba e Aramanaí. Informações de moradores locais dão conta da ocorrência dessas espécies no trecho compreendido entre Maguarí e Piquiatuba.

As demais formas são relativamente comuns. O sauim *Callithrix argentata* e o macaco prego *Cebus apella* foram observados diversas vezes sendo criados como animais de estimação. Os bandos avistados de *C. argentata* eram normalmente compostos de 2 a 3 indivíduos. O guariba *Alouatta belzebul discolor* é um animal bem conhecido, principalmente devido ao som característico produzido pelos machos. A suposta raridade do macaco da noite *Aotus infulatus* se deve ao fato de se tratar de uma espécie com hábitos noturnos. O Sr. Ollala teve a oportunidade de coletar espécimes em Marai e Aveiro, além de Caxiricatuba e Piquiatuba (Lonnberg, 1941), como também em Fordlândia (MZUSP).

Durante as pesquisas foi possível observar que a caça é uma atividade bastante frequente na área estudada. Entrevistas com moradores locais possibilitaram levantar que existe consciência que a falta de critério para o abate dos animais silvestres (idade prematura dos espécimes, não respeito à época de reprodução ou amamentação, etc.) e a quase ausência de fiscalização estão contribuindo para diminuir ou mesmo extinguir as populações de várias espécies. Nesse particular se inclui não só primatas (*Ateles marginatus, Chiropotes albinasus*), mas formas como o tatu-canastra *Priodontes maximus*, o queixada *Tayassu pecari*, a anta *Tapirus terrestris*, entre outros.

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BODY WEIGHTS BEFORE AND AFTER FIRST PREGNANCIES OF IMMIGRANT ADULT FEMALE MANTLED HOWLING MONKEYS (*ALOUATTA PALLIATA*) IN COSTA RICA

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Margaret R. Clarke
Kenneth E. Glander

Introduction

For female primates, as in other mammals, successful reproduction depends upon the proper sequencing of endocrine events (e.g., hypothalamic, pituitary, and ovarian hormone secretions), as well as the physical capacity to support, energetically, the developing fetus (or fetuses) through gestation and lactation (see Bercovitch, 1987; Bercovitch *et al.*, 1998; Serio-Silva *et al.*, 1999; Tardif and Jaquish, 1997). Ontogenetically, one physical requirement for viable first pregnancies appears to be the attainment of a minimum total body weight (Bercovitch and Berard, 1993) or amount of body fat (Schwartz *et al.*, 1988). For mantled howling monkeys (*Alouatta palliata*), these ontogenetic, physical requirements for successful reproduction are in addition to the social challenges facing females, who emigrate from their natal groups as juveniles, and following a period of time as solitary individuals (one month to two years), immigrate into other groups as young adults (Clarke and Glander, 1984; Glander, 1980, 1992; Jones, 1980; Scott *et al.*, 1978). In order to remain as permanent members in new groups, these immigrant females must become dominant to resident females, a process that can take up to one year (Jones, 1980; Zucker and Clarke, 1998).

Immigrant female howling monkeys give birth to their first offspring, on average, after 19.7 months of residency in a new group (Zucker *et al.*, submitted), meaning they do not conceive their first infant until they are in the group for nearly 14 months (gestation length = 186 days; Glander, 1980). One hypothesized explanation for this apparent delay in reproduction is that they are not fully physically mature at the time of immigration. To assess this hypothesis, we present here (a) the body weights of immigrant female mantled howling monkeys, (b) comparisons of immigrants' weights with the weights of adult female residents, and (c) the body weights of immigrants before and after their first pregnancies. As immigrants are younger than residents, their weights were expected to be less, initially, than the residents. Thus, we are examining the body weights of female mantled howling monkeys from soon after their immigrations (pre-pregnancy) until after their first births (post-pregnancy).

Methods

Data Set

Howlers were weighed after capture for morphometric, physiological and dental microwear studies at Hacienda La Pacifica, Guanacaste Province, Costa Rica (see Glander *et al.*, 1991; Teaford and Glander, 1996). Body weights for 13 immigrant females, who entered Groups 2, 7 and 19 between 1978 and 1992, were extracted from these records. Group 2 inhabits upland forests, while Groups 7 and 19 inhabit riverine forest. Group 2 has been observed since 1985 (Zucker and Clarke, 1998), Group 7 since 1970 (Glander, 1980), and Group 19 since 1980 (referred to as "Cabina" group by Clarke *et al.*, 1986; see Figure 1 in Glander, 1992, for the locations of these groups on the ranch). Body weights for 36 females resident in these groups were obtained at approximately the same time as were the weights for these immigrants. While secondary dispersal occurs, it is rare (see Glander, 1992). Thus, it can be assumed that nearly all immigrant females are nulliparous. During this time span, three pregnant females entered these groups and another entered with a dependent infant (Zucker *et al.*, submitted); data for these females are not included here.

Body weights for 8 of these 13 females were obtained after the births of their first infants, approximately two years after their capture and weighing as immigrants. Changes in weight were assessed with a correlated samples t-test. Comparison of immigrants' weights with residents' weights was done with an independent groups t-test. Changes in body weights also are expressed in terms of percent increase or decrease.

Results

Immigrants vs. Residents

The 13 immigrants had a mean weight of 4.22 kg (s.d. = 0.30), whereas the 36 resident females of these groups had a mean weight of 5.00 kg (s.d. = 0.65). The immigrants were significantly lighter than the residents ($t = 4.16$, $df = 47$, $p<0.001$). Their weights were approximately 85% of those of the older residents. The weights of immigrants and residents are presented in Table 1. For nine of the 13 immigrants, the body weights of all other adult females in the group were available. In 7 of these 9 cases, the immigrant female was lighter than all other females in the group.

Pre- and Post-Pregnancy Weights of Immigrants

Body weights were obtained for eight of the immigrants soon after they gave birth to their first infants, approximately two years after joining their respective groups. These females showed a significant increase over their pre-pregnancy weights (mean = 4.99 kg; $t = 3.84$, $df = 7$, $p = 0.003$, one-tailed test; see Table 1). Post-pregnancy weights were 16.25% higher than pre-pregnancy weights (range 11% to 32%). One of the eight females, however, weighed less after her first pregnancy than before, losing 5% of her pre-pregnancy weight (see Table 1). This was the only pregnancy and birth this female was known to have. Comparison of the post-pregnancy weights of the eight immigrant females with the weights of resident females indicated no significant difference (t = 0.18, df = 43, p>0.05).

Discussion

These data show that soon after the time of their immigration, female mantled howling monkeys were significantly lighter than resident females, supporting the hypothesis that they were not fully mature, physically, at this stage of their lives, and that they were competing for group membership at a physical disadvantage. However, within two years, and after their first infants were born, females who had competed successfully for group membership increased their body weights by approximately 16%, and their weights were no longer significantly different from those of resident females. Post-partum female Anubis baboons (*Papio anubis*) lose weight during lactation, weighing 7% less than cycling females (Bercovitch, 1987). If mantled howlers experience patterns of weight changes similar to the baboons, then the post-pregnancy weights reported here for howlers would actually be lower than what these females would weigh when lactation ceases and estrous cycles resume. Bercovitch (1987) further suggested that females might need to surpass a post-lactational weight threshold before estrous cycles resumed and subsequent pregnancies occurred.

Bercovitch *et al.* (1998), in their study of captive, provisioned rhesus monkeys (*Macaca mulatta*), found that body weights of young, nulliparous females were predictive of first conceptions: those that conceived weighed significantly more than those that did not. This difference in body weight persisted for at least another year, until these females were four years old, although their subsequent weight did not differ as a function of parity; primiparous females increased their weight by an average of 31% over the next year, while nulliparous females increased their weight by an average of 25% (Bercovitch *et al.*, 1998). The average weight gains by both subsets of rhesus females were greater than those noted for mantled howlers at La Pacifica (16%), but the overall patterns of weight gain were similar. The difference in the amount (or percentage) of weight gained likely reflects species and ecological (management) differences. Rhesus monkeys are seasonal breeders, unlike mantled howlers, so nulliparous females would have until the onset of the next breeding season to increase their weights before the energetic demands of gestation occurred. Primiparous females, likewise, would have longer to reach the weight needed for post-lactational ovulation. Low estrogen levels during periods of acyclicity would also contribute to higher body weights in these rhesus (e.g., Kemnitz *et al.*, 1989). The magnitude of the difference between mantled howlers and rhesus monkeys might also stem from ecological differences; while conceptions could occur at any time of the year for howlers, they face greater seasonal variations in food and nutrient availability than would the provisioned rhesus monkeys studied by Bercovitch *et al.* (1993). The howler body weight data obtained and used here were not controlled for possible seasonal differences (wet vs. dry).

Comparative growth and development data for New World monkeys are not as readily available as they are for Old World monkeys. Pre- to post-pregnancy body weights of captive, primiparous squirrel monkeys (*Saimiri sciureus*; N = 16), a New World species, also increased significantly (L. Williams, unpubl. data), although the magnitude of the average increase (6.6 %) was not as large as seen in mantled howlers or rhesus monkeys. For this sample of squirrel monkeys, the range of increase was 3.7% to 23.9%, but four of the monkeys showed decreases in their pre- to post-pregnancy weights (losses of 0.5% to 6.0%). While a decrease was noted in one howling monkey, these limited data indicate that post-lactational

Table 1. Immigrant females' body weights, weight gains and residents' mean weights

Female	Group	Entry year	Pre-pregnancy weight (kg)	Post-pregnancy weight (kg)	% change	Group mean weight (kg)	Group s.d.	No. of resident females
APRICOT	7	1978	4.05	4.74	17	4.34	0.99	5
LILAC	7	1989	4.50	5.00	11	5.40	0.28	2
FIONA	7	1990	4.00	5.25	32	4.85	0.58	6
CLEO	7	1990	4.40	4.20	-5	4.75	0.64	6
ARUBA	7	1992	4.80	5.00	4	5.25	0.73	9
OREG	2	1986	3.80	N/A	N/A	4.15	0.16	4
JQ	2	1989	4.00	N/A	N/A	4.60	0.46	3
WISTERIA	2	1991	4.30	N/A	N/A	4.60	0.49	2
SAGE	2	1991	4.20	N/A	N/A	4.60	0.42	2
AZALEA	2	1992	3.90	N/A	N/A	4.80	-----	1
RUBY	19	1980	4.06	5.11	26	4.22	-----	1
GARNET	19	1989	4.70	5.90	26	5.20	0.89	3
LAPIS	19	1989	4.20	5.00	19	5.40	0.61	3
Mean			4.22	4.99	16.25			
S.d.			0.30	0.44	12.40			

Notes: Group mean weight refers to the resident females' mean weights obtained at the same time as the immigrants' weights; number of residents contributing to this mean is indicated in the right-most column. "N/A" denotes "not available."

weight loss in squirrel monkeys might be a more common phenomenon.

Successful reproduction is obviously necessary for sustaining wild populations of nonhuman primates. While the conservation status of howlers is "low risk" (Crockett, 1998), the structure of the La Pacifica population of howlers has changed over the past decade. The total number of monkeys has remained essentially unchanged, but the number of groups has increased; thus, average group size has declined (Clarke and Zucker, 1994; Clarke *et al*., submitted). In contrast, the protected mantled howler population at Santa Rosa National Park (also in Guanacaste Province) has increased over the comparable time period (Fedigan *et al*., 1998). For several groups at La Pacifica, emigration and immigration routes appear to have been affected by deforestation and associated canal construction. In one group that has been studied extensively (Group 2), and whose immigrants were included in the present study, the incidence of immigration has decreased (Clarke *et al*., in press). With the habitat changes, it might take immigrating howler females longer to reach the necessary minimum weight for successful reproduction (or threshold for resumption of cycling post-partum), thus decreasing their potential lifetime reproductive success and reducing the actual number of offspring produced by lengthening interbirth intervals. Applying this scenario to any primate species, decreased habitat quantity or quality could have detrimental effects on reproduction by slowing the rates at which females attain threshold weights necessary for reproduction.

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FOOD RESOURCES AND THE SURVIVAL OF A GROUP OF HOWLER MONKEYS (*ALOUATTA PALLIATA MEXICANA*) IN DISTURBED AND RESTRICTED HABITAT AT LOS TUXTLAS, VERACRUZ, MEXICO.

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Introduction

In recent decades, a gradual transformation and disappearance of primate habitat has taken place worldwide, placing an increasing number of species in danger of extinction. Mexico, at the northern limit of Neotropical primate distribution, is one of the areas where primates are potentially under the greatest threat. At present, researchers have only a very general idea of the distribution, biology and ecology of the Mexican primates *Ateles geoffroyi vellerosus, A. g. yucatanensis, Alouatta palliata mexicana* and *A. pigra*. There is still a great deal to be learnt (Rodríguez-Luna *et al.*, 1996a).

Primates are profoundly affected by growing pressure from human activity, as well as the implementation of inappropriate development policies that largely ignore environmental consequences. The main pressures affecting the primates and their habitat in south-eastern Mexico are “slash and burn” farming techniques to create cattle pasture (Guevara *et al.*, 1997) or agricultural land for crops (for example, sugar cane and maize), fires, logging and the construction of rural and urban infrastructure (such as dams and highways). The hunting of primates for food and their capture for sale as pets also threaten groups surviving in increasingly small forest fragments (Paré *et al.*, 1992; Peres, 1997). These small groups remaining in forest patches may also be more susceptible to disease and genetic problems. These threats have led to a recent reassessment of the conservation status of the four Mexican primate taxa, prompting the World Conservation Union (IUCN) to list two of them (*Alouatta palliata mexicana*, *Ateles geoffroyi yucatanensis*) as threatened species (Hilton-Taylor, 2000). As new field studies are developed, it will be necessary to revaluate the Mexican primates to determine their conservation status more accurately.

In the Los Tuxtlas region *A. palliata* is found in San Martín Tuxtla Volcano, in Sierra Santa Marta, in San Martín Pajapan and in the fragments of forest surrounding these three areas (Fig. 1). These areas make up the core of the recently established Los Tuxtlas Biosphere Reserve (Presidential Decree in *Diario Oficial de la Federación*, 23 November 1998). The *A. palliata* population is in numerous isolated groups in this area. Besides the destruction and fragmentation of their habitat, the main threat is hunting, and although still surviving, there is an urgent need for plans and conservation measures to ensure the long-term survival of these groups (Rylands *et al.*, 1996/1997). To address this, a Conservation Assessment Management Plan (CAMP) workshop was held (Rodríguez-Luna *et al.*, 1996a) at Puebla (México). Its recommendations led to a Population and Habitat Viability Assessment (PHVA) for *Alouatta palliata mexicana*, which included a simulation of the survival of populations using ecological and demographic parameters (Rodríguez-Luna *et al.*, 1996b).

Factors which must be considered in the conservation and management of primates in fragmented habitats include population densities, home range boundaries and foraging strategies (e.g., minimum foraging area required to maintain a group). A number of estimates for the minimal forest area required have been suggested for both continuous and fragmented habitat (Estrada and Coates Estrada, 1996). These data are useful when estimating the carrying capacity of a particular habitat, but values may vary according to the characteristics of each and the pressures from indirect and direct human activities such as hunting (Neville *et al.*, 1988). These variations explain the different estimates obtained in this study, and it is therefore difficult to define the carrying capacity of any given habitat and/or the minimum area required by a group of this species, as small changes in environmental conditions and anthropogenic pressure can cause significant differences in the demography of primate groups. The incidence of illness and other factors (injuries, loss of variability, genetic defects, behavioral abnormalities) in population regulation also remains unclear, especially in fragmented habitats (Jones, 1994).

Estrada and Coates Estrada (1994) showed the negative effects of habitat fragmentation on the viability and size of the monkey groups living in areas of dense vegetation in Los Tuxtlas. The distance between fragments and the time they have been isolated has a negative effect on the survival chances of monkeys and other groups of animals. Estrada and Coates Estrada (1994) give an estimate of the requirements for a group of 10 howler monkeys as between 30 and 60 hectares of rainforest.

In a demography study of howler monkeys in the San Martín Volcano area carried out in 1995 (Garcia-Orduña, in prep.), the sizes of the forests where monkeys were found ranged from 15 ha (not including the fragment in the present study) to 300 ha, with the one exception being the fragment or central core of the San Martín Volcano of approximately 4,000 ha where several groups were observed. There was no correlation (r = 0.5, p = 0.1749) between the number or density of individuals and the area of the fragment, and therefore its particular history, which would make ecological differences between the fragments less significant. There was an approximate mean ecological density of 8.48 howlers/km^2 (SD 6.76, n = 10) for the fragments occupied by *A. palliata*, an average group size of 3.36 animals (SD 2.38; range 1-8), and an average composition, following Clarke's (1990) classification, of 1.27 adult males, 1.45 adult females, 0.09 young and 0.53 infants. Another case observed by the authors that demonstrates a capacity to adapt to restricted habitats was in the Sierra de Santa Marta, where groups of howler and spider monkeys numbering more than 10 individuals each were found in a fragment of less than 10 ha (Garcia-Orduña, 1996). Further examples of the howler monkey's ability to survive in very disturbed or small areas are given by Rodríguez Luna *et al.* (1987), Silva-López *et al.* (1988) and Estrada *et al.* (1996). Estimates of the minimum area required resulting from these studies range from 30-60 ha for a group of 10 howlers (Estrada and Coates Estrada 1984). However, howler monkeys can survive in the long-term in even smaller areas. Perhaps the most striking example of this is a troop of howlers released on Agaltepec Island in Lake Catemaco, which is only 8.3 ha. At the beginning of 1998 the island had a population of over 70 howler monkeys, originating from a group of 10, introduced during 1988-89 (Rodríguez-Luna and Cortés-Ortiz, 1994; Rodríguez-Luna, unpubl. data). The resources on the island seem not only to be sufficient for present needs, but it is also probable that they have yet to be fully exploited (Serio-Silva, 1992). It remains to be seen, however, how these groups fare in the long term.

Here we present an extreme case of survival of a group of seven howler monkeys (one male, five females and one juvenile) in an area of 1.3 ha near Arroyo Liza, north of the San Martín Tuxtla Volcano. This group was of interest for three reasons: 1) it was probably not introduced and is at the northernmost limit of the species' original distribution, proposed by Hall (1981); 2) it has adapted to an extremely small and isolated area; and 3) it has remained in the area for at least eight years.

Study Site

The forest fragment near Arroyo Liza is located at 18° 41' 16" N; 952 pt 11' 12" W, altitude 60–100 m above sea level. It is

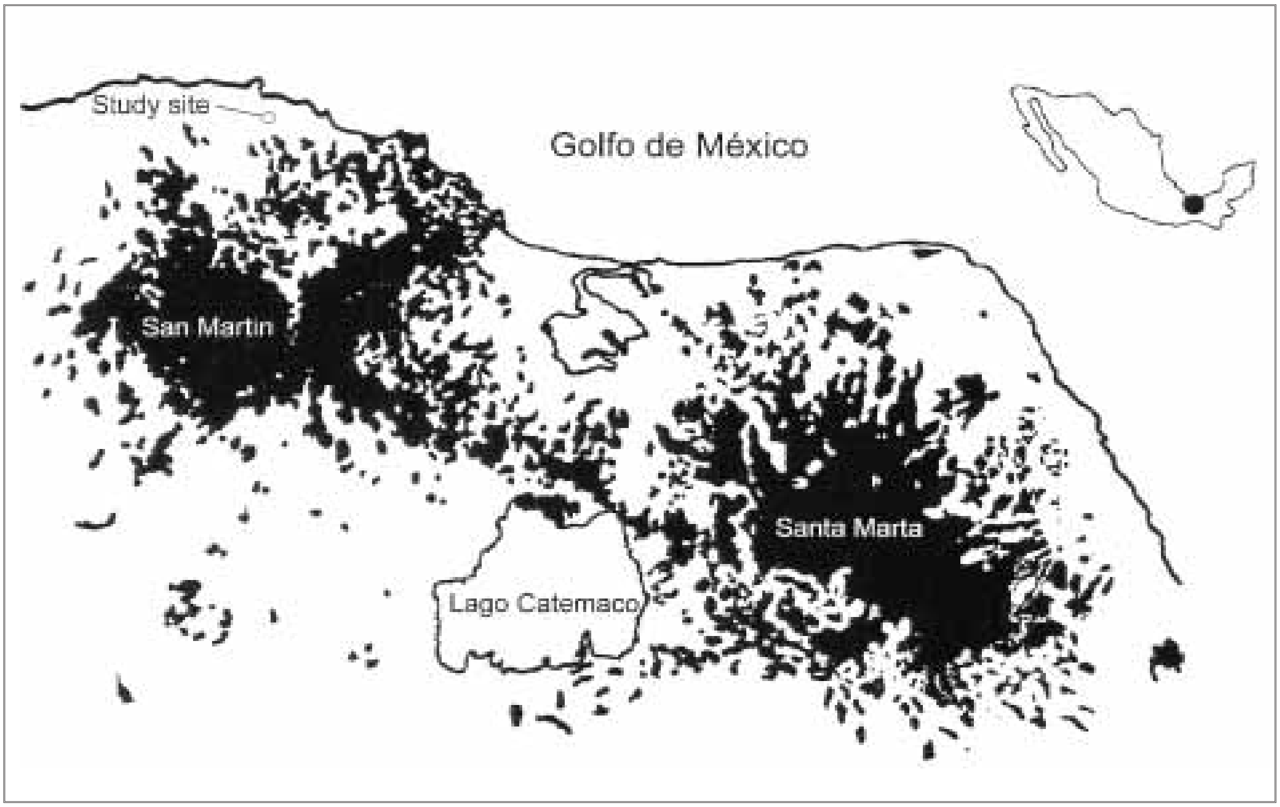

Figure 1. Region of Los Tuxtlas. Dark areas represent remaining forest. Forest fragment near, is located at 18° 41' 16" N, 95° 11' 12" W.

within the buffer zone of the Los Tuxtlas Biosphere Reserve (Fig. 1). The climate is of type Am: warm and humid, with summer rains and monsoon influence, a mean annual temperature of 24–26° C and a mean annual precipitation of 3,000–4,000 mm, distributed seasonally, with a relatively dry period from March to May. The maximum temperature is 36° C and the minimum is 16°C (Soto, 1997). The soil is volcanic in origin and made up of plioquaternary volcanic rocks (Martín-del Pozo, 1997). The original vegetation was predominantly evergreen rainforest, although it has for the most part been degraded and fragmented by human activities, particularly the creation of pasture for extensive cattle farming. Land ownership in the Arroyo Liza area consists of private ranches and the communal properties of sharecroppers, parcels of which have been recently privatized. Most is given over to extensive cattle farming and some small areas are used for maize (*milpas*) and chili, among other cash crops.

Vegetation

Although the original vegetation was evergreen rainforest, today there is only a small corridor left of 350 m in length bordering a permanent stream (Fig. 2). The maximum width is around 100 m at the highest point of the fragment in the south-west. The forest there, although disturbed, is the most conserved and has the highest species diversity, with trees between 15 and 25 m tall. Further downhill there is a strip of trees bordering grassland (*Bursera simaruba, Ficus* sp. and *Sapium* sp.) which contains a small area of secondary growth. This area in turn extends to a patch of trees, mainly *Bursera simaruba*, ending in a group of six large trees in the pasture, with 10 coconut palms and three other trees near by. The nearest woodland is over 100 m away; it is a fragment totally surrounded by meadows used for pasture, with only herbaceous vegetation.

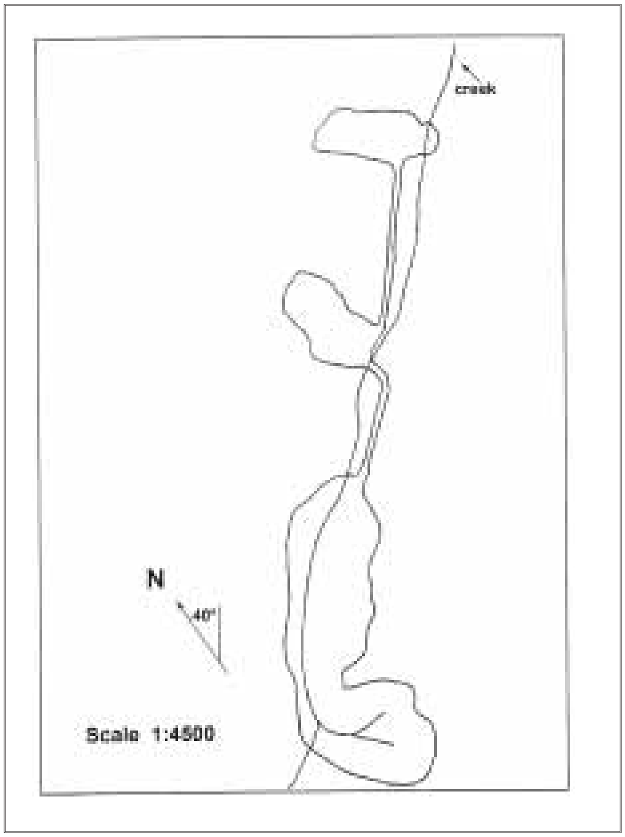

Figure 2. Map of the Arroyo Liza forest fragment.

Potential Food Resources for Howlers in the Fragment

We observed a group of seven *A. palliata*, at what is probably the northernmost limit of their distribution, in conditions of extreme habitat reduction and disturbance. According to local people, the group has lived in these conditions for at least eight years. The monkeys appeared physically normal and healthy when we first observed them (1 December 1997). The group is occasionally harassed by the locals, and individuals are occasionally captured (probably infants) for the pet trade. On our second visit (2 December 1998) nine individuals were found - two adult males, five adult females and two juveniles - demonstrating the group's capacity for survival and reproduction.

The forest is approximately 1.3 ha. The vegetation is disturbed both in terms of species composition and forest layers. Lists of the plant species identified can be found in Tables 1 and 2. One hundred ninety-eight trees were registered; 182 were identified as belonging to 43 genera and 48 different species. As can be seen in Table 1, 37 to 39 of the species identified (77.7% to 81.25%,) provide food for *Alouatta palliata* in other places where the species has been studied (see references in the table). As such, 81.32% to 83.52% (n = 152-162) of the trees in the Arroyo Liza fragment are potentially edible for the howlers. A total of 86 of these trees are important in the howlers' diet (marked Yes* in Table 1); this category includes species (n = 13) reported by other authors as among the ten most important in their studies, and those that in our view may make significant seasonal contributions to their diet. These account for 47.25% of the total number of identified trees in the fragment.

Little attention has been paid to lianas and vines in most studies on the diet and foraging of *A. palliata.* Few are identified or even observed. However, Rodríguez-Luna (2000) showed that the number of species consumed is comparable to tree species and some may even be more important in the diet. Habitat disturbance favors growth of vines and lianas, owing to their greater proliferation in areas of light and at the edges of the rainforest or on slopes. This potentially increases the diversity of species available as a resource for the howlers and possibly the biomass (although it may diminish the resource potential of the trees supporting them due to competition for nutrients, light and space). Tree species that are not a potential food source for the howlers may support vines or creepers they use, thus increasing the food sources available. For example, an increase in the howler population on Agaltepec Island was correlated with an increase in the use of lianas and vines as food sources. In 1990, lianas and vines comprised 12.2% of the time a group

Table 1. Potential feeding resources for *A. palliata* at the Arroyo Liza, Los Tuxtlas, Mexico.

Species	**Number of individuals**	**Habit**	**Potential resource**	**References**	**Family**
Albizia purpusii	1	Tree	Yes	8	Mimosaceae
Alchornea latifolia	1	Tree			Euphorbiaceae
Annona glabra	3	Tree	Yes	8	Annonaceae
Aspidosperma megalocarpon	1	Tree	Yes*	10	Apocynaceae
Brosimum alicastrum	2	Tree	Yes*	2,3,4,5,6,8,9,10,12,13	Moraceae
Bursera simaruba	45	Tree	Yes*	1,2,3,5,6,7,8,9,11,12,13	Burseraceae
Castilla elastica	1	Tree	Yes	3	Moraceae
Cecropia obtusifolia	2	Tree	Yes*	1,2,4,5,6,8,9,11,12,13	Cecropiaceae
Citrus sinensis	2	Tree	Yes	8	Rutaceae
Coccoloba hondurensis	3	Tree	Yes	1,6,8,12	Polygonaceae
Cocos nucifera	10	Palm			Arecaceae
Conostegia xalapensis	1	Shrub	Yes	8,9	Melastomataceae
Cordia alliodora	1	Tree	Yes	6, 7, 8, 10	Boraginaceae
Crataeva tapia	2	Tree	Yes	6,13	Capparaceae
Croton pyramidale	1	Tree	Yes	4	Euphorbiaceae
Croton schiedanus	5	Tree	Yes	4 ,8	Euphorbiaceae
Cupania glabra	2	Tree	Yes	6,11	Sapindaceae
Dendropanax arboreus	1	Tree	Yes	2,3,11	Araliaceae
Eugenia acapulcensis	1	Tree	Yes	1,6,8	Myrtaceae
Ficus lundellii	2	Tree	Yes*	8	Moraceae
Ficus petenensis	2	Tree	Yes*	8	Moraceae
Ficus sp.	14	Tree	Yes*	All references	Moraceae
Ficus yoponensis	3	Tree	Yes*	8,10	Moraceae
Gliricidia sepium	1	Tree	Yes	1,7,11	Fabaceae
Guarea grandifolia	1	Tree	Yes	7	Meliaceae
Hampea nutricia	1	Tree			Malvaceae
Bernoullia flammea	2	Tree			Bombacaceae
Nectandra colorata	11	Tree	Yes		Lauraceae
Omphalea oleifera	2	Tree	Yes	6	Euphorbiaceae
Pimienta dioica	1	Tree			Myrtaceae
Piper sanctum	1	Shrub	Yes	13	Piperaceae
Pleuranthodendron lindenii	2	Tree			Flacourtiaceae
Posoqueria latifolia	1	Tree			Rubiaceae
Poulsenia armata	4	Tree	Yes*	6,8,9,10	Moraceae
Pouteria sp.	1	Tree	Yes	2,5,6,8,13	Sapotaceae
Psychotria flava	1	Tree			Rubiaceae
Pterocarpus rohrii	3	Tree	Yes*	6,8,9,10	Fabaceae
Robinsonella mirandae	1	Tree	Yes	6	Malvaceae
Rollinia mucosa	5	Tree	Yes	6,8	Annonaceae
Sapium sp.	13	Tree	Yes	6	Euphorbiaceae
Spondias radlkoferi	4	Tree	Yes*	1,2,6,8,10,12,13	Anacardiaceae
Tabernaemontana arborea	3	Tree	Yes	10	Apocynaceae
Tetrorchidium rotundatum	6	Tree	Yes	6	Euphorbiaceae
Trichilia martiana	1	Tree	Yes?	1,7,10	Meliaceae
Trichospermum galeottii	7	Tree	Yes	9	Tiliaceae
Trophis mexicana	1	Tree	Yes	10,11	Moraceae
Zanthoxylum caribaeum	1	Tree	Yes*	1,2,6,11,13	Rutaceae
Zanthoxylum kellermanii	2	Tree	Yes	6, 8	Rutaceae
Other unidentified species	16	Tree			
Total: 49 Species	**198 trees**		**37-39 species**		**27 Families**

References: 1. Glander (1981); 2. Gaulin *et al.* (1980); 3. Chapman (1987); 4. Silva-López (1982); 5. Estrada & Coates-Estrada (1984); 6. Estrada (1984); 7. Glander (1975); 8. Gómez-Marin (in prep.); 9. Jiménez (1992): 10. Milton (1980); 11. Serio (1992); 12. Estrada *et al.*(1984); 13. Estrada & Coates-Estrada (1986). See text for explanation.

Table 2. Potential food resources (vines and lianas).

Species	Habit	Potential Resource	References	Family
Salacia megistophylla	Vine	?		Hippocrataceae
Ipomoea phillomega	Vine/climber	Yes	2	Convolvulaceae
Philodendron radiatum	Climber	Yes	2, 3	Araceae
Philodendron scandens	Climber	Yes	2	Araceae
Pisonia aculeata	Vine	?		Nyctaginaceae
Syngonium podophyllum	Climber	Yes	2	Araceae
Smilax aristolochiifolia	Vine	Yes	1	Smilacaceae

References. 1. Estrada (1984); 2. Gómez-Marin (in prep.); 3. Milton (1980).

of 10 howlers spent feeding (Serio 1992). In 1997 this had increased to 22% in a group of 57 (Rodríguez-Luna 2000). At Arroyo Liza we noted seven species of vines and lianas, all potentially eaten by howlers, but we were not able to compile a more complete list (Table 2).

Forest loss and fragmentation lead to a greater proportion of trees being located on the forest edge where they are more exposed to wind, solar radiation and dry microclimates, increasing tree mortality and causing changes in fruit and leaf production. (Gascon *et. al.*, 2000). This may be disadvantageous, but more leaves falling due to wind and/or drying may be followed by the production of new shoots and young leaves which howlers favor (as we have observed in other fragments of the region). The majority of these trees are shorter and have less foliage than trees found in less disturbed areas, and it is possible that the trees in this fragment provide fewer resources (when available) than taller trees of mature undisturbed forests.

Discussion

Estrada and Coates-Estrada (1994) and Estrada *et al.* (1994) showed that there is a positive correlation between the size of a forest fragment and the number of monkeys that live there. This is reasonable due to the greater quantity and diversity of food sources in larger fragments, greater opportunities to escape from humans (which increases the difficulty of hunting the monkeys), greater chances of surviving occurrences such as fires and a reduced incidence of genetic or demographic problems, among others. However, according to Garcia-Orduña (in prep.), no such correlation was observed in the San Martín Volcano area, and we did not observe this correlation with the Arroyo Liza group of nine in 1.3 ha. This indicates that the amount of direct or indirect human activity in a forest fragment, such as monkey harrassment or fire setting, may influence the presence and number of monkeys more decisively than ecological characteristics and the size of the fragment.

On the other hand, the presence or absence of monkeys in a fragment depends on whether or not they were already there at the time of isolation. Undoubtedly, a large fragment will have a better probability of containing monkeys than a small fragment. Estrada *et al.* (1994) found that the distance to the nearest fragment is negatively correlated to the number of monkeys that can inhabit it because of fewer opportunities for migration and fewer opportunities for escape from catastrophes such as fires and large-scale disturbances. Howler monkeys appear reluctant to cross pasture and areas with little vegetation - local people reported seeing monkeys moving from one fragment to another, crossing up to 150 m of pasture. There are also instances where males have been seen to remain isolated for long periods of time while only 150 m away from other monkeys in another fragment (authors' observation). Factors contributing to why monkeys remain in a fragment or decide to leave include: resource availability in both fragments; health of the individuals; knowledge of the destination (acquired prior to isolation); distance and availability of trees for locomotion; presence and composition of other groups at the destination; and degree of attachment to the home range. To date, we do not know if the Arroyo Liza group has ever left their fragment.

Howler monkeys appear to adapt well to adverse conditions. These and other examples in the region (Rodríguez-Luna *et. al.*, 1987, Garcia-Orduña, 1996) prompt us to question whether fragmentation, disturbance, isolation and reduction and loss of habitat diversity are the most influential factors affecting the disappearance of howler monkeys within a fragment (Estrada *et al.*, 1994, 1996). Milton (1985) suggested that seasonal factors or weather conditions can restrict the availability and abundance of resources, and may be causal factors in nutritional stress, contributing to mortality. According to Milton, the most probable mortality factor is parasitism, especially botfly infestation (*Alouattamya baer* and *Dermatobia hominis*). In Los Tuxtlas, mortality and/or poor health, especially in infants, has been observed as a result of these infestations (Gómez-Marín, pers. obs.; Stuart *et. al.*, 1998; Canales-Espinosa, 1992). However, Coelho *et al.* (1976), in their study of resource availability and nutritional requirements of *Alouatta pigra* in Tikal, indicated a superabundance of available resources and suggested that the concept of resource limitation is a myth among primatologists. However, we believe the results and conclusions of Coelho *et. al.* to be premature, as the study was limited to a mere three months (June-August 1973), and a seasonal and/or annual superabundance of resources cannot be ruled out. In other years or during certain times, there are limited resources which affect the size of the population, as seen at Barro Colorado, Panama (Milton, 1985).

This study and others of monkeys living at high densities in small rainforest fragments demonstrate that the values obtained for ecological density in less restricted areas are not universally suitable for estimating survival and densities in fragments. Habitat carrying-capacity parameters used in the PHVA simulations (Rodríguez-Luna *et al.*, 1995), which give only short-term viability for groups in very fragmented habitats, need to be reviewed.

Priority measures for the conservation of howler monkeys, as in other species (Laborde, 1996, Guevara, 1997), should take account of small areas (often the only available), such as gallery forests, forest patches and remnant hillside forests. The establishment of corridors and the maintenance of appropriate habitat mosaics which can allow for dispersal could create conditions for a functional demographic connection for otherwise isolated groups (Forman and Godron, 1986). In the llanos, red howlers (*A. seniculus*) occupy and regularly move through grassland and swamps between very small forest patches (Braza *et al.*, 1983), and there is no reason to suppose that *A. palliata* could not do the same. We would argue that the key factor influencing the survival of primates in fragmented habitats is hunting. This obviates the need for environmental awareness campaigns and measures which can reduce the pressure on the primate populations. Future projects need to comply with the recommendations of the CAMP workshop (Rodríguez-Luna *et al.,* 1995) which recommend integrated rural development, alternatives and improvements in land use and natural resources and a strengthening of legal and penal measures on the hunting, capture, trafficking and ownership of primates.

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MULTIPLE BREEDING FEMALES AND ALLO-NURSING IN A WILD GROUP OF MOUSTACHED TAMARINS (*SAGUINUS MYSTAX*)

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Introduction

Callitrichines show flexible social organization and mating patterns (Goldizen, 1988; Ferrari and Lopes Ferrari, 1989). Instances of multiple breeding females have been reported in all genera (Table 1) except *Cebuella* and seem to be the rule in *Callimico* (Christen, 1998; Encarnación and Heymann, 1998). Except for *Callimico*, this circumstance has been observed to result in reduced offspring survival or live births for one of the breeding females. However, allo-nursing, a highly co-operative behavior, has also been reported in *Callithrix jacchus*, *C. aurita* and *C. flaviceps* groups with multiple breeding females (Table 1). Here, we present observations of two female *Saguinus mystax* breeding simultaneously and the subsequent allo-nursing of the surviving offspring.

Methods

Data were collected *ad libitum* on a group of *S. mystax* during on-going studies at the Estación Biológica Quebrada Blanco (4°21'S, 73°09'W) in northeastern Peru (for details see Heymann and Hartmann, 1991). The tamarins were observed for 14–20 days each month from 14 February to 28 June 2000. The group consisted of two adult females (labeled 1 & 2), two adult males and a subadult male. The group was never trapped and was fully habituated to the presence of humans. Individuals were recognized by natural distinguishing characteristics. The group was first seen in the area in May 1999, without the second adult male who immigrated in late August/early September 1999 (Tirado Herrera, pers. obs.).

Results

On the morning of 21 February, 2000, a single male infant was seen (born to female 1). He fell to the ground shortly after the group left its sleeping site, and was later recovered by a member of the group, only to fall again shortly thereafter. He was not retrieved the second time and died at 10:10 hrs. That night, female 2 gave birth to male twins and the following morning they were observed being carried separately. Female 1 repeatedly tried to take an infant from his mother's back, but the mother resisted. Later in February the infants of female 2 were seen being nursed on five occasions by their mother and twice by female 1. The mother nursed only with her left nipple. Her right nipple did not produce milk and her breast remained unswollen and unmarked by any effects of suckling. Female 1 nursed with both nipples normally. Their swollen breast(s) indicated that both females continued to lactate until the end of May. Both infants survived to at least one year of age.

Discussion

Factors underlying the occurrence of multiple breeding females in callitrichines are largely unknown. High population density and limited opportunities for dispersal have been suggested as influencing factors in *C. jacchus* and *Leontopithecus rosalia* (De Vleeschouwer *et al.*, 2001; Digby and Ferrari, 1994; Dietz and Baker, 1993). However, in *C. aurita* polygyny occurred despite much lower population densities (Coutinho and Corrêa, 1995). Dietz and Baker (1993) found a correlation between the occurrence of polygyny and some habitat parameters in *L. rosalia*, but nevertheless excluded the polygyny threshold model as an explanation. They suggested that the balance of costs and benefits to the dominant female determines whether or not she allows a subordinate female (daughter) to breed (see also Rylands, 1996). The presence of males unrelated to the daughter may play a key role in this decision. This agrees with Savage *et al.*'s (1996) findings that incidences of two pregnant female *S. oedipus* in the same group were associated with the immigration of a novel male. It is also consistent with a greater success of multiple breeding females in captive groups of *L. chrysomelas* with unrelated males (De Vleeschouwer *et al.*, 2001).

In our case, population density and habitat quality have not changed noticeably since 1994, and hence are unlikely

Table 1. Polygynous breeding in wild callitrichines (except *Callimico goeldii*).

Species	Observations	Reference
Callithrix aurita	3/4 infants of dominant female survived, 2/3 infants of subordinate female survived; no allo-nursing observed.	Coutinho & Corrêa (1995)
Callithrix flaviceps	4/4 infants of dominant female survived, 3/5 infants of subordinate female survived; allo-nursing by all females.	Guimarães (1998)
Callithrix jacchus	8/13 infants of dominant females survived, 2/6 infants of subordinate females survived; one infanticide observed; allo-nursing by subordinate females of dominant females' infants.	Digby (1995)
	13 infants (six births) born to 2 females, 6 survived, 6 died or disappeared, 1 infanticide; allo-nursing by subordinate female.	Roda & Mendes Pontes (1998)
Leontopithecus rosalia	Polygyny in 20 of 211 group samples (10.6%); lower infant survival for offspring of subordinate females.	Dietz & Baker (1993)
Saguinus fuscicollis	One set of twins born to each of 2 females, all infants survived.	Calegaro-Marques *et al.* (1995)
	Twins born to each of 2 females in 5 groups: all infants survived in four cases, 1 set of twins probably died immediately after birth in one case.	Goldizen *et al.* (1996)
	2 simultaneously pregnant females in each of 2 groups; in 1 group, only 1 female gave birth; in the other group, 1 female gave birth to a single offspring which she killed on the day of birth; second female gave birth to twins, one of which disappeared at age 5 months.	Tirado *et al.* (2000), Tirado Herrera (pers. obs.)
Saguinus mystax	Twins born to each of 2 females, 1 set survived, 1 female died and her infants disappeared.	Ramirez (1989)
	2 pregnant females or 1 pregnant and 1 lactating female in 3 out of 13 groups, but only 1 female reared and nursed infants.	Garber *et al.* (1993)
Saguinus oedipus	2 simultaneously pregnant females in each of 2 groups; in 1 case, only 1 female delivered live offspring; in the second case, no live births were observed.	Savage *et al.* (1996)
	Pregnancy, but no subsequent offspring, observed in a daughter of a regularly reproducing female.	Savage *et al.* (1997)

to be factors. However, the coincidence of polygynous breeding observed since 1997 in *S. fuscicollis* groups living in the same area (Tirado Herrara *et al.* 2000; Tirado Herrera, pers. obs.) suggests some causal environmental factor. In addition, the immigration of the second adult male one month earlier may have provided a situation similar to those under which multiple females breed in *S. oedipus*, *L. rosalia* and *L. chrysomelas*. However, mounts by male 1 of female 2 had been observed on 10 September (Heymann, pers. obs.), suggesting that immigration of male 2 may only have been additional to environmental factors. At the same time there was tension between the two females (repeated head-grasping of female 2 by female 1, and squealing of female 2 towards female 1) (Heymann, pers. obs.). Such tension may be expected, given that in callitrichines, except *Callimico*, reproduction is usually monopolized by a single female (French, 1997).

In callitrichines, allo-nursing has only previously been observed in *Callithrix* spp. However, whether their tendency to live in larger groups than other genera (Ferrari and Lopes Ferrari, 1989; Rylands, 1993) affects the incidence of allo-nursing is unclear. One would predict that female relatedness plays a critical role in whether allo-nursing occurs, but the kinship between the two females in our study was not known. In *C. jacchus*, it is frequently the mother and daughter who breed simultaneously (Coutinho and Corrêa, 1995; Digby, 1995). All callitrichine group members are involved in infant care (Tardif *et al.*, 1993) and, at least in captivity, they will carry non-related infants (Box, 1977) and, in mixed-species groups, congeneric infants (Buchanan-Smith, pers. obs.). In the *S. mystax* group, female 1, the allo-nurse, had lost an infant, and the fact that the mother female 2 was only nursing with one nipple may have increased her willingness to let female 1 allo-nurse her infants. In *Callithrix,* females have been seen to allo-nurse while they had their own infants and also after the death or disappearance of their infants.

This is the first reported incidence of allo-nursing in a *Saguinus* spp. Although the factors affecting multiple breeding females and allo-nursing are still unclear, it is only as cases emerge and are reported that the underlying conditions will become clear. These observations provide further evidence for the high degree of flexibility and co-operation in tamarin sociality and mating patterns (Caine, 1993).

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DENSIDADE E CONSERVAÇÃO DO BUGIO (*ALOUATTA FUSCA*) NO PARQUE ESTADUAL INTERVALES

Sandra Steinmetz

Introdução

A Mata Atlântica originalmente ocupava cerca de 1.200.000 km^2 ou 12% do território nacional. Com a colonização do Brasil, que se deu justamente através da costa Atlântica, houve em muitos lugares uma rápida depauperação deste ecossistema. A crescente concentração humana, com a consequente expansão das áreas urbanas e o desenvolvimento da agropecuária e da indústria madeireira no meio rural são os principais fatores que causaram a destruição da Mata Atlântica (Mittermeier *et al.*, 1982; Fonseca, 1985). Atualmente, resta 7% da Mata Atlântica, estando a maior parte dispersa em remanescentes isolados e uma ínfima parte protegida por unidades de conservação (Consórcio Mata Atlântica, 1992; CI do Brasil *et al.*, 2000). Levantamentos revelaram que das 18 espécies de primatas endêmicas da Mata Atlântica, 16 estão ameaçadas de extinção (Rylands e Rodrígues-Luna, 2000). Entre estas está *Alouatta fusca* (= *guariba*), citada no Anexo II da CITES (Convention of International Threatened and Endangered Species) e enquadrada na categoria de "Vulnerável" pela IUCN (World Conservatin Union) (Hilton-Taylor, 2000).

Atualmente, se conhece muito pouco a respeito da demografia das populações de *A. fusca*. Como a destruição de habitats na Mata Atlântica continua em um ritmo acelerado, a sobrevivência desta espécie nas próximas décadas está sob sério risco, ficando condenada a viver em remanescentes cada vez menores. O Parque Estadual Intervales representa um dos últimos grandes remanescentes de Mata Atlântica contínua e bem preservada, abrigando uma importante população de bugios. Mendes (1985) alertou que, apesar de algumas áreas menores, como a Reserva Estadual da Cantareira, apresentarem grande densidade de bugios, é muito questionável que áreas em torno de 5.000 ha sejam suficientes para a preservação de uma espécie com o porte de *Alouatta*, especialmente quando se consideram os riscos de endocruzamentos a longo prazo e de incêndios florestais.

Material e Métodos

O comportamento e a ecologia do bugio, *Alouatta fusca*, foram estudados de outubro 1997 a novembro 1999, no Parque Estadual Intervales (24°12' a 24°25' S e 48°03'a 48°30' W), localizado na Serra de Paranapiacaba (SP), com 49.888 ha de área. O trabalho de campo totalizou 1.799 horas, sendo 1.118 horas em observação de diversos grupos de bugios. O padrão de atividades e dieta de um grupo de seis indivíduos foram registrados através de amostragem instantânea. As observações diretas do grupo totalizaram 92 dias ou 918:30 horas. A área de uso dos bugios foi quantificada através da plotagem de seus percursos diários em mapa (Steinmetz, 2000).

A cada avistamento de um grupo de bugios em Intervales, foram anotados: data; localização; horário inicial e final de contato com o grupo; características físicas de cada animal (tais como, ferimentos, marcas naturais, características faciais, e pelagem) e classe sexo etária de cada indivíduo.

A densidade foi estimada dividindo-se o tamanho médio dos grupos de bugios encontrados em Intervales pela área de uso do grupo de estudo, sendo esta calculada pelo método do esquadrinhamento (Steinmetz, 2000). A população foi calculada multiplicando-se a densidade pela área total do Parque Intervales.

Resultados e Discussão

Composição dos grupos

A organização social é resultado das respostas comportamentais às condições ambientais e aos eventos demográficos recentes e limitada pela filogenia (Crockett, 1996). Um aspecto da organização social de uma espécie é o tamanho e a composição dos grupos. O tamanho dos grupos varia inter e intra-especificamente, mas geralmente é maior quando as densidades populacionais são altas (*A. palliata*: 6-23, Crockett e Eisenberg, 1987; *A. pigra*: 4-6, Horwich e Johnson, 1986; *A. seniculus*: 3-16, Crockett e Eisenberg, 1987; *A. caraya*: 2-19, Rumiz, 1990). No entanto, a composição e o tamanho dos grupos das diferentes espécies de bugios são significativamente diferentes, mesmo quando as densidades são semelhantes. Os grupos de *A. palliata* contêm mais fêmeas adultas por macho do que os grupos de *A. pigra*, *A. seniculus* e *A. caraya* (Crockett e Eisenberg, 1987; Rumiz, 1990). Durante o trabalho de campo, foram avistados 12 grupos de bugios, incluindo o grupo de estudo. A composição destes encontra-se na Tabela 1.

A média de indivíduos por grupo encontrada em Intervales foi de 5,83 (variando de 4 à 8 indivíduos). Os grupos de *Alouatta fusca* tendem a serem pequenos, mesmo em locais com altas densidades (Tabela 2). Em seus estudos na Serra da Cantareira, Silva (1981) encontrou uma média de 5,76 ind./grupo para *A. fusca* enquanto que Torres (1983), na Fazenda Barreiro Rico, encontrou 6,4 ind./grupo. Em Caratinga, Minas Gerais, Young (1983) observou 6 ind./grupo e Mendes (1985) 6,79 ind./grupo.

A maioria dos grupos encontrados em Intervales é formada por um macho adulto e duas fêmeas adultas. Na Serra da Cantareira a maioria dos grupos de *A. fusca* observados tinha mais de um macho adulto (Silva, 1981), já em Barreiro Rico (Torres 1983) e Caratinga (Mendes, 1985; Young, 1983), os grupos encontrados tinham apenas um macho adulto.

Geralmente os grupos de *Alouatta* têm um número maior de fêmeas que de machos adultos (Altmann, 1959; Carpenter, 1934; Chivers, 1969; Mittermeier, 1973; Neville, 1972a; Rudran, 1979). A organização social dos bugios tem sido descrita como macho único ("unimale"), machos múltiplos ("multimale") e gradação de idade ("age-graded") (Eisenberg, 1979). O sistema de gradação de idade, como proposto originalmente por Eisenberg, Muckenhirn e Rudran (1972), difere do sistema de machos múltiplos, pois apenas um macho adulto, geralmente o mais velho, realiza a maioria das cópulas e, provavelmente, tem parentesco com os outros machos do seu grupo (Crockett e Eisenberg, 1987). Mas

Tabela 1: Composição dos grupos de bugios observados no Parque Estadual Intervales, São Paulo, de junho 98 a novembro 99.

Referência	Número de Indivíduos	Machos adultos	Machos subadultos	Fêmeas	Jovens	Infantes
Grupo estudo	5	2	(1)	1	1	1
Laranjão	6	1	-	2	2	1
Bochecha	5	1	-	3	1	-
TRQ	5	1	-	2	1	1
TRQ2	6	1	1	2	1	1
Bananeira	5	1	-	2	2	-
Estrada	6	2	-	2	1	1
CD 2	7	1	1	2	2	1
T. Fig.	6	1	1	2	1	1
Fig. branca	8	1	-	3	3	1
Araçá-branco	4	1	-	2	1	-
Parcela	7	1	1	3	1	1
Média	5,83	1,17	0,42	2,17	1,42	0,75

Tabela 2: Tamanho do grupo, densidade e população estimada em alguns estudos sobre *Alouatta fusca*, com referências sobre a área em que o estudo foi realizado e seu tamanho.

Área de estudo	Tamanho do grupo	Densidade (ind./ha)	População estimada	Método	Área de estudo (ha)	Referência
Reserva de Santa Genebra - SP	4,9	1,77	274 –407	Esquadrinhamento e Censo	250	Chiarello (1993)
Estação Biológica de Caratinga - MG	6,79	1,1	667	Esquadrinhamento e Censo	569	Mendes (1985)
Estação Biológica de Caratinga - MG	5,7	0,92-1,49	793 –1.284	Censo	860	Hirsch (1995)
Fazenda Barreiro Rico - SP	6,4	0,22		Censo	"115"	Torres (1983)
Floresta Nacional de Três Barras - SC	5-7	0,64	60	Esquadrinhamento	"93,6"	Peres (1997)
Parque Estadual da Cantareira - SP	5,76	0,81	4.369	Censo	5.400	Silva 1981
Parque Estadual do Rio Doce - MG	2,8	0,02-0,49	586 – 16.129	Censo	32.583,9	Hirsch (1995)

nem todos os grupos de bugios seguem esse sistema, sendo que em alguns casos os machos jovens são dominantes (Crockett e Eisenberg, 1987; Jones, 1980). Mesmo que alguns grupos de bugios tenham mais de um macho adulto, a organização social dos bugios tem semelhanças com os sistemas de harém (Crockett e Eisenberg, 1987). No grupo de estudo, apenas o macho 1, mais velho, foi observado copulando com a fêmea e, no período fértil desta, o macho 2 se manteve mais afastado do grupo. Parece que o padrão, em Intervales, é de um macho adulto por grupo e, quando existe um número maior, estes devem ter parentesco.

Densidade e população

A densidade foi estimada com base na área de uso do grupo de estudo, calculada pelo método do esquadrinhamento e no tamanho médio dos grupos de bugios encontrados em Intervales. Se considerarmos a área total do grupo de estudo (33 ha), a densidade é de 0,18 ind./ha. No entanto, se considerarmos apenas a área de uso restrita ao grupo (27 ha), a densidade é de 0,22 ind./ha.

As populações de *Alouatta* possuem densidades variáveis, dependendo do habitat e do estado de conservação deste (Mendes, 1985). Os métodos utilizados e o tempo despendido nos vários estudos também devem influenciar as densidades encontradas (Tabela 2). Os bugios passam a maior parte do tempo descansando em árvores altas e, em geral, sua reação ao perigo é se esconder, o que torna sua observação bastante difícil em censos, principalmente, em áreas de floresta madura e onde os animais têm pouco ou nenhum contato com humanos.

Já que o tamanho dos grupos de *A. fusca* parece não variar tanto entre as diferentes localidades estudadas, a densidade deve variar junto com o tamanho da área de uso ocupada pelos grupos. Em fragmentos florestais pequenos, os bugios têm áreas de uso restritas e, portanto a densidade tende a ser maior (Tabela 2) (Crockett, 1996). Os bugios parecem ser bastante flexíveis quanto ao tamanho de suas áreas de uso e isso deve ser reflexo da sua considerável plasticidade de dieta (Rylands e Keuroghlian, 1988). Os grupos de bugios parecem lidar com as variações de densidade aumentando ou diminuindo suas áreas de uso.

Se a densidade for homogênea por todo o Parque Estadual Intervales (49.888 ha), uma população total de 10.975 bugios pode ser estimada, com base na densidade. No entanto, essa deve ser uma super estimativa, já que a vegetação do Parque é heterogênea e em alguns pontos nunca foram observados bugios. Contudo, parece razoável afirmar que em torno de 10.000 bugios habitam Intervales, uma população bastante representativa para esta espécie.

Por se tratar de uma área extensa, a maior parte do Parque Intervales se encontra isolada do contato com humanos e animais domésticos, o que evita pressão de caça, desmatamentos, incêndios provocados e contagio por doenças. As florestas do Parque estão se regenerando e provavelmente as populações de animais estão aumentando, ao menos isso foi descrito por Petroni (2000) para um grupo de monos-carvoeiro. Ao longo deste estudo, nunca se presenciou animais feridos, com cicatrizes ou algum tipo de berne, pelo contrário, os bugios em Intervales parecem sadios e, em todos os grupos observados, havia a presença de jovens e/ou infantes (Tabela 2).

Conservação

Os primatas neotropicais, por serem arborícolas, são especialmente vulneráveis à fragmentação do habitat. Mesmo as espécies maiores parecem incapazes de atravessar as distâncias que separam os fragmentos florestais. Isso ocasiona dois grandes problemas: a incapacidade de recolonizar fragmentos florestais onde a população foi eliminada e a ausência de fluxo gênico entre as populações existentes (Ferrari e Diego, 1995).

Em geral, as reservas extensas são melhores do que as pequenas porque suportam populações mais completas e viáveis de fauna e flora de uma região (Ferrari e Diego, 1995). Devido à grande fragmentação da Mata Atlântica, áreas como Intervales são raras e, portanto, devem ser mantidas e preservadas.

Intervales se encontra numa região muito pobre e sofre uma grande pressão dos mineradores e palmiteiros. Deveria-se dar alternativas de renda para a população local, como o ecoturismo e o manejo sustentável do palmito, junto com o desenvolvimento de programas de educação ambiental e controle populacional. Além disso, o Parque necessita de mais recursos para a preservação, os vigias e as viaturas são insuficientes para um monitoramento constante ao longo de toda sua extensão. A infra-estrutura para pesquisa também deveria ser ampliada e melhorada (Fundação Florestal, 1997).

De um modo geral, seria necessário identificar a distribuição e as populações de *A. fusca* existentes nas áreas de conservação, para se ter uma idéia mais precisa do estado de conservação desta espécie. É indispensável preservar o que ainda sobrou de Mata Atlântica, principalmente em regiões extensas, onde existem populações grandes que vão garantir uma maior variabilidade genética.

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NEWS

THE "NEOTROPICAL APE" - *AMER-ANTHROPOIDES LOYSI*

A recent publication by Bernardo Urbani, Ángel L. Viloria and Franco Urbani, 'La creación de un primate: El "simio americano" de François de Loys (*Amer-anthropoides loysi* Montandon, 1929) o la historia de un fraude', examines in great detail the story, the facts and the misconceptions surrounding the controversy of the "discovery" of an alleged Neotropical ape by the Swiss geologist François de Loys in 1917–1918 during an oil prospecting expedition in the forests of the Río Tarra, southwestern Lake Maracaibo, state of Zulia, Venezuela.

The authors provide short biographies of three of the principal players: François de Loys (1892–1935), a geologist who attained considerable respect and position, which made it impossible for him to admit it was all a joke; George Montandon (1879–1944?), physician, and racist, who used the "discovery" as ammunition for the theory of human hologenesis (the argument that species are "programmed" in their extinction, and that new and similar species arise simultaneously in different places), a proposition heinously used by the nazis to justify their persecution of the Jews; and Enrique Tejera (1899–1980), who came to be the most distinguished of the three, a decorated tropical physician and pathologist, ambassador and minister in the Venezuelan government who was a friend of de Loys in the field. The expedition members were supposedly attacked by a group of apes, one of which was killed. The cadaver, given to the cook to look after, was lost during the expedition, and the controversy was subsequently based on a photograph of what would appear to be a spider monkey, perched on a wooden crate. According to de Loys it was a female, 1.57 m tall, tailless and with 32 teeth.

The story of the "man-ape" is complex; over the years inspiring much comment, analysis and controversy (Urbani *et al.* 2001 list 247 bibliographic references!) not least by

eminent mammalogists such as Ángel Cabrera (1930), Philip Hershkovitz (1960), Ivan Sanderson (1962), W. C. Osman Hill (1962) and G. H. H. Tate (1951). It was immortalized by Heuvelmanns (1958). The inevitable conclusion is that *Amer-anthropoides loysi* is a synonym of *Ateles hybridus* (see Kellogg and Goldman, 1944), but the coup de grace, reported for the first time in Urbani *et al.* (2001), is a letter, reproduced in full in the appendix, written by Enrique Tejera in 1962 to Guillermo J. Schael, who had published a report that same year of another encounter with the supposed "man-ape" of de Loys, again in the vicinity of the Río Tarra. In this letter Tejera explained that the tail had been cut off, that it was nothing more than a joke, the "ape" was a *marimonda* and de Loys's field pet, and stated simply at the end that Montandon was an evil person who was shot after the war as a traitor to France. A good read, a fascinating story.

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SOCIAL BEHAVIOR AND DIET OF THE SPIDER MONKEY, *ATELES BELZEBUTH*, IN THE YASUNÍ NATIONAL PARK, ECUADOR

In July 2001, Wilmer E. Pozo, R. defended his doctoral thesis entitled "Social Behavior and Feeding Habits of the Eastern Spider Monkey in the Yasuni National Park, Ecuador" at the School of Biology, Universidad Central del Ecuador. The study was supervised by John G. H. Cant, Peter Rodman, Luis Albuja V. and Oswaldo Baez. Financial support was provided by the National Science Foundation and the Department of Anatomy of the University of Puerto Rico. Logistical support was provided by the Yasuní Research Station of the Universidad Católica of Quito and by the Ecuadorian Primates Project. The following is a summary of the thesis, translated kindly by Cris Canaday of CECIA.

This thesis is the result of a study of the social behavior and feeding behavior of a group of eastern spider monkeys (*Ateles belzebuth belzebuth*), a component of the Ecuadorian Primates Project's study area in Yasuní National Park, Amazonian Ecuador. It is one of the first long-term studies conducted in Ecuador on a naturally occurring primate population. *Ateles belzebuth* has been studied previously in Colombia and Brazil, but without achieving an adequate understanding of the relationship between the spatial distributions of resources used by *Ateles* and their social behavior. I addressed this question and looked for differences among other wild *Ateles* populations.

The objectives were to study the natural behavior of eastern spider monkeys, their social grouping patterns and the plants they eat, and to contribute to an understanding of the community ecology of the primate species present at the site. I habituated and followed a group at Km 47 of the Pompeya Sur-Iro road, inside Yasuní National Park, in eastern Ecuador. I collected data on activity budgets, habitat use, composition of social groups and diet. This information was compared to results from existing studies of this and other species of *Ateles*. Behavioral data were correlated with climatic variation, available habitat and fruit production.

The group spent 30% of their time resting, 25% feeding, 32% moving, and 13% socializing. Forest types were used by the spider monkeys in proportion to availability. In terms of topography, valleys and slopes were preferred, and the monkeys tended to stay about 15 to 20 m above the ground. The group consisted of 25 individuals (including infants) and used a home range of about 469 ha. They often broke into subgroups of 1 to 13 individuals (mean = 3.24). A quarter of the group tended to be solitary, while the rest formed subgroups of only males or females, or mixed groups. Fruit, usually eaten whole and ripe, constituted 70% of their diet, and 60% of plant foods eaten came from trees. Eleven species of plants were the most important in the diet in each month.

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Reference

Pozo R., W. E. 2001. Composición social y costumbres alimenticias del "mono araña oriental" en el Parque Nacional Yasuní, Ecuador. Tesis Doctoral, Escuela de Biología, Universidad Central del Ecuador, Quito, Ecuador. 205pp.

SPIDER MONKEYS IN CAPTIVITY - THE NORTH AMERICAN REGIONAL STUDBOOK

The North American Regional Studbook for spider monkeys is maintained by Kristi Newland, Population Manager of the

Memphis Zoo, Tennessee. The 1999 update (through 31st December 1999) records the births, deaths and movements of *Ateles belzebuth* (unknown subspecies, one male in Ralph Mitchell Zoo, Kansas), the white bellied spider monkey, *Ateles belzebuth belzebuth* (one female in the Bramble Park Zoo, South Dakota), the black-faced black spider monkey, *Ateles chamek* (1.5.2 in two institutions), the endangered robust black spider monkey, *Ateles fusciceps robustus* (44.78.9 [131] in 37 institutions: two births, 15 transferred, and 4 deaths), the variegated spider monkey, *Ateles hybridus* (12.17.0 [29] in 11 institutions: one birth, four transferred and two deaths), and the Guiana black spider monkey, *Ateles paniscus* (2.3.0 in five institutions: no births, transfers or deaths). There are no white-whiskered spider monkeys, *Ateles marginatus,* in North America, and there are no records of the critically endangered brown-headed spider monkey, *A. fusciceps fusciceps,* ever having been kept in captivity in the region. Population Management Plans (PMP) have been recommended for *A. fusciceps robustus* and *A. hybridus* by the AZA's New World Primate Taxon Advisory Group (TAG). The New World Primate TAG has also recommended phasing out the small North American populations of *A. belzebuth belzebuth* and *A. chamek.* Due the problem of hybridization in the past, Newland recommends that all spider monkeys in captivity be karyotyped, and instructions as to how to do this are given in the studbook.

To maintain an accurate record of the North American populations, vital for the recommended PMPs, Kristi Newland requests information on all births and deaths (including stillborns and fetuses), sales, transfers and acquisitions as soon as they occur to allow the studbook records to be current throughout the year, rather than only just prior to publication.

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Reference

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THE OCCURRENCE OF MURIQUIS (*BRACHYTELES ARACHNOIDES*) IN THE ITATIAIA NATIONAL PARK, BRAZIL

Brachyteles arachnoides is the largest living new world monkey and one of the most threatened species of the platyrrhines (Fonseca, 1994). Having knowledge of any remaining forest areas containing muriquis is important for conservation efforts. The Itatiaia National Park of 30,000 ha, located in the Atlantic Forest, close to the borders of the states of São Paulo, Rio de Janeiro and Minas Gerais, was created in 1937 as the first federally protected area in Brazil. The occurrence of *Brachyteles* in the Itatiaia Park in the past was confirmed by an adult male specimen collected by J. Lima in 1950 and deposited at the Museu de Zoologia of the University of São Paulo (MZUSP), museum register number 9962. Câmara (1995) pointed out that *Brachyteles* may still occur in the Itatiaia National Park based on a complete skeleton of an individual which was electrocuted while crossing power transmission lines near to the park's headquarters. Unable to ascertain when exactly the animal died, Câmara (1995) suggested that it was sometime between 1990 and 1995. The complete skeleton of the animal is now in the Centro Universitário de Barra Mansa (number six in the collection register). The register indicates that the animal was found dead on February 22, 1992, at Mont Serrat, close to the park's headquarters.

During a field trip to Itatiaia Park in November of 1993, an adult muriqui was sighted crossing a hiking trail called "Três Picos," which begins at the Simon Hotel and ends at the Três Picos in the Serra do Palmital, within the boundaries of the Itatiaia Park. The animal was sighted at approximately 22°26' S, 44°35'N, at an altitude between 1,000 and 1,400 m. The observation of this individual indicates that a muriqui population still occupies the park, which is contiguous with other forested areas in the region and undoubtedly serves as a significant refuge for this threatened species.

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SPECIES AND SUBSPECIES OF PRIMATES DESCRIBED SINCE 1990

Thirty-six primates (species and subspecies), have been described in the last ten years: ten from Madagascar, eight from Africa, seven from South-east Asia, eight from the Brazilian Amazon (seven of them marmosets) and three from the Brazilian Atlantic forest. Froehlich *et al.* (1998) record the existence of a new macaque species occurring in the Central Sulawesi peninsula, Indonesia, but its formal description has yet to be published (see also Supriatna and Hendras, 2000). Please note that this list is presented without any judgement as to the validity or otherwise of the various primates described.

Acknowledgments: The authors thank Ardith Eudey, Jörg Ganzhorn, Thomas Butynski, Douglas Brandon Jones, Jatna Supriatna and Jeffrey Froehlich for help in compiling this list.

Anthony B. Rylands, Center for Applied Biodiversity Science at Conservation International, **Russell A. Mittermeier** and

Prosimians	
Pseudopotto martini Schwartz, 1996	False potto
Tarsius dianae Niemitz, Nietsch, Warter & Rumpler 1991	Dian's tarsier
Galagoides rondoensis Honess 1996	Rondo dwarf galago*
Galagoides udzungwensis Honess 1996	Matundu dwarf galago*
Microcebus ravelobensis Zimmerman, Cepok, Rakotoarison, Zietemann & Radespiel, 1998	Lac Ravelobe mouse lemur
Microcebus tavaratra Rasoloarison, Goodman & Ganzhorn, 2000	Northern rufous mouse lemur
Microcebus sambiranensis Rasoloarison, Goodman & Ganzhorn, 2000	Sambirano mouse lemur
Microcebus berthae Rasoloarison, Goodman & Ganzhorn, 2000	Berthe's mouse lemur
Cheirogaleus ravus Groves, 2000	Large iron-grey dwarf lemur
Cheirogaleus minusculus Groves, 2000	Lesser iron-grey dwarf lemur
Phaner furcifer pallescens Groves & Tattersall, 1991	Western fork-crowned lemur
Phaner furcifer parienti Groves & Tattersall, 1991	Sambirano fork-crowned lemur
Phaner furcifer electromontis Groves & Tattersall, 1991	Amber mountain fork-crowned lemur
Avahi unicolor Thalmann & Geissmann, 2000	Unicolor avahi

*The first descriptions were in "Honess, P. E. 1996. Speciation Among Galagos (Primates: Galagidae) in Tanzanian Forests. Ph.D thesis, Oxford Brookes University, Oxford, UK." While here attributed to Honess (1996), both forms were described and illustrated in Kingdon (1997). Not accepting the validity of a doctoral thesis as a formal published description, the authorship is also attributed to "Honess, 1997" by Groves (2001), referring to the descriptions in Kingdon (1997). Honess and Bearder (1996) also published the descriptions of these species, but issue 2(2), 1996, of *African Primates* was in fact published after Kingdon (1997).

Old World monkeys	
Miopithecus ogouensis Kingdon, 1997	Northern talapoin
Cercopithecus cephus ngottoensis Colyn, 1999	Ngotto moustached monkey
Cercopithecus erythrogaster pococki Grubb, Lernould & Oates, 1999	Nigerian white-throated guenon
Macaca pagensis siberu Fuentes & Olson, 1995	Siberut macaque
Colobus badius semlikiensis Colyn, 1991	Semliki red colobus
Procolobus badius epieni Grubb & Powell, 1999	Niger Delta red colobus
Presbytis melalophos bicolor Aimi & Bakar, 1992	Sumatran sureli
Semnopithecus auratus ebenus Brandon-Jones, 1995	Wulsin's ebony leaf monkey
Pygathrix nemaeus cinerea Nadler, 1997	Grey-shanked douc langur
Rhinopithecus roxellana hubeiensis Wang, Jiang & Li, 1998	Hubei golden snub-nosed monkey
Rhinopithecus roxellana qinlingensis Wang, Jiang & Li, 1998	Qinling golden snub-nosed monkey

New World monkeys	
Callithrix nigriceps Ferrari & Lopes, 1992	Black-headed marmoset
Callithrix mauesi Mittermeier, Ayres & Schwarz, 1992	Maués marmoset
Callithrix argentata marcai Alperin, 1993	Marca's marmoset
Callithrix saterei Souse e Silva Jr & Noronha, 1998	Sateré marmoset
Callithrix humilis Van Roosmalen, Van Roosmalen, Mittermeier & Fonseca, 1998	Black-crowned dwarf marmoset
Callithrix manicorensis Van Roosmalen, Van Roosmalen, Mittermeier & Rylands, 2000	Manicoré marmoset
Callithrix acariensis Van Roosmalen, Van Roosmalen, Mittermeier & Rylands, 2000	Rio Acarí marmoset
Leontopithecus caissara Lorini & Persson, 1990	Black-faced lion tamarin
Callicebus personatus barbarabrownae Hershkovitz, 1990	Blond titi
Callicebus coimbrai Kobayashi & Langguth, 1999	Coimbra-Filho's titi monkey
Cebus kaapori Queiroz, 1992	Ka'apor capuchin

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PLANNED 2000 REVISION OF DIRECTORY OF GRADUATE PROGRAMS IN PRIMATOLOGY AND PRIMATE RESEARCH

An updated Directory will be published in the January, 2002, issue of the *Laboratory Primate Newsletter*. If you wish your program to be represented in this Directory or to revise your present entry, please send us the necessary information, following the format shown here as closely as possible. Return the information as soon as possible, but not later than 1st December, 2001, to the *Laboratory Primate Newsletter*, Psychology Department, Box 1853, Brown University, Providence, RI 02912 e-mail: <primate@brown.edu>. Please note that the Directory is not intended for postdoctoral programs, though any such sent to us will be listed separately. For examples, see the 2000 Directory in the *Lab. Prim. Newsl.* 2000, 39[1], 37-44, or see <www.brown.edu/Research/Primate/dir00.html>.

Recommended format: 1. State: 2. Institution: 3. Division, Section, or Department: 4. Program Name and/or Description: 5. Faculty and Their Specialties: 6. Address for further information: **Judith E. Schrier**, Editor *Laboratory Primate Newsletter*, Box 1853, Brown University, Providence, RI 02912, USA, Tel: 401-863-2511, Fax: 401-863-1300, e-mail: <primate@brown.edu>.

NEW HEAD ANNOUNCED FOR THE IUCN/SSC SPECIES PROGRAMME

Dr. Sue Mainka has been appointed as the new Coordinator for IUCN's Species Program, responsible for supporting an increasingly active 7,000-member Species Survival Commission. Dr. Mainka is already familiar with the role, having served as Acting Coordinator for the past four months while her predecessor, Dr. Simon Stuart, served as IUCN’s Acting Director General. He is being seconded by IUCN to a new position at the Center for Applied Biodiversity Science (CABS) at Conservation International, Washington, DC, where he will help expand the activities of the IUCN/SSC Red List Program.

In 1997 Dr. Mainka joined SSC as Deputy Coordinator of the Program and since then, has been involved in all aspects of SSC’s work. She also served as Acting Coordinator for part of 1998. She will work closely with SSC’s Chair, Mr. David Brackett, and the Commission’s Executive and Steering Committees in implementing SSC’s new Strategic Plan.

A veterinarian with 16 years experience in wildlife conservation, Dr. Mainka has worked on giant panda conservation in China and captive management of wildlife in several countries. Her particular field of interest is species conservation related to traditional medicine. She has written several reports on the effectiveness of CITES (the Convention on International Trade in Endangered Species of Wild Fauna and Flora) submitted to previous Conferences of the Parties, and headed the IUCN delegation at the 11th CITES Conference of the Parties in April 2000.

New Deputy Coordinator for IUCN’s Species Programme

Dr. Jean-Christophe Vié has been appointed as the new Deputy Coordinator of the IUCN Species Programme and will be starting work in Gland, Switzerland, on 15 October 2001. Jean-Christophe is French, a qualified veterinarian, and has a Ph.D in evolutionary biology and ecology. He has worked for IUCN as the Programme Coordinator of the Guinea-Bissau office, and his broad-ranging expertise includes coastal planning, protected area management, and translocation of species. Jean-Christophe’s experience includes the directorship of an NGO dedicated to the study and conservation of Guianan wildlife. His career has also taken him to Saudi Arabia, Gabon and the USA, and he speaks French, English and Portuguese. Jean-Christophe will be responsible for general operations and management of the Species Programme and network support. *From: IUCN Species Survival Commission (SSC) E-Bulletin - August 2001, Editor, Anna Knee.*

Curso de Monitoramento e Manejo de Fauna em Unidades de Conservação

O Curso de Monitoramento e Manejo de Fauna em Unidades de Conservação, será ministrado pelo Laboratório de Biologia da Conservação do Departamento de Ecologia da UNESP, Rio Claro, nos dias 19–23 fevereiro de 2002**.** O curso (tanto a parte teórica quanto a prática) será oferecido no Parque Estadual da Ilha Anchieta (PEIA), em Ubatuba, no litoral norte de São Paulo, Brasil. Pesquisadores com experiência em manejo de aves e mamíferos conduzirão aulas teóricas e exercícios de campo em aspectos relevantes `a ecologia de aves e mamíferos. No final do curso o aluno terá subsídeos para realizar levantamentos e censos de aves e mamíferos de Mata Atlântica, e identificar e avaliar o impacto de turistas nas trilhas. *Vagas:* 20 vagas. *Prazo de inscrição*: 30 Janeiro 2002. *Candidatos:* Profissionais relacionados à pesquisa com dispersão de sementes, biólogos, ecólogos, engenheiros florestais, agrônomos, turismo e de áreas afins.

O curso será ministrado por: Dr. Mauro Galetti (censo de mamíferos, frugivoria), e Dr. Marcos Rodrigues (censo de aves). *Monitores*: Denis Briani (pequenos mamíferos), Renato Marques (censos de mamíferos, cameras automáticas) e Mercival Francisco (genética de aves). *O que você irá aprender*: Censo de mamíferos por transectos lineares; Levantamento de mamíferos por cameras automáticas e rastros; Levantamento de pequenos mamíferos; Captura e anilhamento de aves; e Georeferrenciamento das trilhas. *Inscrição/Seleção*: Os interessados em se candidatar deverão enviar Curriculum Vitae e carta de intenção para Dr. Mauro Galetti. A seleção será baseada no CV do candidato. *Custo total*: R$350,00 (inclui quatro dias de alojamento com diária completa no Parque Estadual da Ilha Anchieta, e transporte Ubatuba-PEIA). *Equipamento obrigatório***:** Roupa de cama e banho, perneiras (contra cobras), 01 binóculo, 01 bússola, 01 prancheta, cadernos de campo, papel milimetrado, calculadora, lanterna e capa de chuva.

Mauro Galetti, Laboratório de Biologia da Conservação, Departamento de Ecologia, UNESP, C.P. 199, 13506-900 Rio Claro, São Paulo, Brasil. E-mail: <mgaletti@rc.unesp.br>.

Draft Guidelines for Non-Human Primate Re-Introductions

A draft document prepared by the SSC Re-introduction Specialist Group, “Guidelines for Non-Human Primate Re-Introductions,” is available for comment on the SSC website at <http://www.iucn.org/themes/ssc/programs/rsg.htm>. These guidelines were developed in response to the increasing number of primate re-introduction projects worldwide. They are based on the *IUCN Guidelines for Re-introductions* (1998), *IUCN Guidelines for the Placement of Confiscated Animals* (2000), a review of case histories and consultation across a range of disciplines. From: *IUCN Species Survival Commission (SSC) E-Bulletin-March 2001. Anna Knee, Communications Officer SSC/IUCN.*

Species Survival Commission (SSC) Publications Catalogue

The Species Survival Commission (SSC) Publications Catalogue (July 2001) is now available. An electronic version (in MS-Word) can be downloaded from: <http://194.158.18.4/intranet/DocLib/Docs/IUCN1062.doc>.

This catalogue provides a comprehensive list of SSC publications, but may not include some of the early titles from the 1950s or ‘60s which are no longer available. It provides a comprehensive list of SSC’s published work and includes short summaries of all Action Plans and Occasional Papers. Throughout the catalogue, publications are listed in chronological order with the most recent first.

SSC Publications can be ordered from: IUCN Publications Services Unit, 219c Huntingdon Road, Cambridge CB3 ODL, UK, Tel: +44 1223 277894, Fax: +44 1223 277175, e-mail: <info@books.iucn.org>, Web site: <http://www.iucn.org/bookstore>. Some of the “Out of Print” titles may be available on CD-ROM or as photocopies. Please contact: Cécile Thiéry, Librarian, IUCN-The World Conservation Union, Rue Mauverney 28, CH-1196 Gland, Switzerland, Tel: +41 22 999 01 35, Fax: +41 22 999 00 10, e-mail: <cet@iucn.org>.

Mariano Gimenez Dixon, Programme Officer/SSC, IUCN–The World Conservation Union, Rue Mauverney 28, CH-1196 Gland, Switzerland. E-mail: <mgd@hq.iucn.org>.

DOMINANCE RELATIONSHIPS AND HIERARCHIES IN NEW WORLD PRIMATES

Jennifer Burns and Andreas Koenig are currently conducting a review of dominance relationships and hierarchies among wild, unprovisioned, nonhuman primate females. Included in this review are *quantitative* approaches only, i.e., data published in the form of dominance matrices or indices (directional consistency, linearity, etc.). They have identified a number of published sources that provide the necessary data (see below). However, they have certainly overlooked some sources. They are appealing for help to identify publications that are not on their list.

They are also aiming at a broad overview of primates, and wish to include as many taxa as possible from different radiations. If you are willing to share unpublished information, they would be happy to include the information in their review (and to run an analysis with MatMan). All information provided will be acknowledged if a publication will follow. Andreas Koenig and Jennifer Burns would be most grateful for your help.

List of publications providing data in the form of matrices or indices:

Barton & Whiten, *Anim. Behav.* 46: 777-789 (1993)
Borries, Sommer & Srivastava, *Int. J. Primatol.* 12: 231–257 (1991)
Cheney, Lee & Seyfarth, *Behav. Ecol. Sociobiol.* 9: 153–161 (1981)
Cords, in *Old World Monkeys*, pp.453–479 (2000)
Furuichi, *Primates* 24: 445–455 (1983)
Hausfater, in *Contributions to Primatology* 7 (1975)
Hausfater, Altmann & Altmann, *Science* 217: 752–755 (1982)
Hill & Okayasu, *Behaviour*, 132: 367–379 (1995)
Hrdy & Hrdy, *Science* 193: 913–915 (1976)
Isbell & Pruetz, *Int. J. Primatol.*19: 837–855 (1998)
Iwaza, *Primates* 21: 443–467 (1980)
Janson, *Behav. Ecol. Sociobiol.* 18: 125–138 (1985)
Jones, *Primates* 21: 389–405 (1980)
Koenig, *Behav. Ecol. Sociobiol.* 48: 93–109 (2000)
Matsumura, *Folia. Primatol.* 69: 346–356 (1998)
Perry, *Am. J. Primatol.* 40: 167–182 (1996)
Poirier, *Folia Primatol.* 12: 161–186 (1970)
Pruetz, Ph.D thesis, Univ of Illinois (1999)
Range & Noe, *Am. J. Primatol.* in press
Robinson, *Anim. Behav.* 29: 1036–1056 (1981)
Seyfarth, *Anim. Behav.* 24: 917–938 (1976)
Smuts, *Sex and Friendship in Baboons* (1985)
Sterck & Steenbeck, *Behaviour* 134: 749–774 (1997)
Watts, *Behav. Ecol. Sociobiol.* 34: 347–358 (1994)
Whitten, *Am. J. Primatol.* 5: 139–159 (1983)
Zucker & Clarke, *Int. J. Primat.* 19: 433–449 (1998)

Please send any information to: **Andreas Koenig,** Assistant Professor, Dept of Anthropology, SUNY at Stony Brook, Stony Brook, NY 11794-4364, USA. E-mail: <akoenig@notes.cc.sunysb.edu>.

WANTED - FIELD ASSISTANT TO STUDY SURINAME PRIMATES

An ongoing field study of monkeys in the pristine Raleighvallen-Voltzberg Nature Preserve in Suriname needs additional assistants. The primary responsibility of field assistants will be to collect behavioral and ecological data on brown capuchins (see Boinski *et al.* 2000. Substrate and tool use by brown capuchins in Suriname: ecological contexts and cognitive bases. *American Anthropologist* 102: 741–761). Data are also collected on food availability, mammal and bird abundance and forest phenology. Assistants will work as part of a team of usually four or more. Accommodations are a field camp with permanent buildings, running water and reasonably reliable electricity. Sue Boinski (University of Florida) directs the project with the close collaboration of Lisa Rose (University of British Columbia, Vancouver) and Susan Cropp (Washington University, Seattle).

One or two assistants are needed to start in February 2002, and at least several others later in the year. High priority will be given to applicants with successful experience collecting detailed social and ecological data from individually recognized mammals, especially primates. Experience in situations demanding rigorous physical exercise in tropical conditions will also be useful. All transport costs to, and living expenses within, Suriname are covered. A moderate stipend is provided from which the assistant is expected to purchase his/her health insurance.

Please note that assistants will not be permitted to collect data for publication independent of the project. For example, graduate students in other programs will not be able to arrange collection of their thesis data while also harvesting data for this monkey study. On the other hand, assistants will be invited to co-author publications and independent exploratory projects will be encouraged. Boinski hopes to recruit successful assistants to pursue (further) graduate studies as her students. In these instances, "redistribution" of data can easily be arranged. In any case, assistants successfully completing their fieldwork commitment will have her utmost support in applications to any graduate or other professional program, etc.

Interested individuals are requested to contact Sue Boinski for further information starting November 2001. After initial communication with Boinski, those still finding these positions enticing will be asked to provide a curriculum vitae and the names, positions and e-mail addresses of at least three references. We hope to reach firm agreements with at least two applicants by the end of December 2001.

Please contact: Dr. Sue Boinski, Department of Anthropology, University of Florida, 1350 Turlington, Gainesville, Florida 32611, USA, e-mail: <boinski@ufl.edu>.

WILDLIFE CONSERVATION SOCIETY-RESEARCH FELLOWSHIP PROGRAM

Mailing address and contact information for the Wildlife Conservation Society-Research Fellowship Program (RFP) are: Program Coordinator, Research Fellowship Program, Wildlife Conservation Society - International, 2300 Southern Blvd., Bronx, NY 10460, USA, Tel: +1 (718) 220-6828, Fax: +1 (718) 364-4275, e-mail: <fellowship@wcs.org>. URL: <http://wcs.org/home/wild/researchfellowship/4596>. *Bi-annual deadlines*: Must be post-marked by 1 January and 1 July of every year. Geographic preferences: Africa, Asia, Latin America and their regional marine areas. Please note that the RFP does not support research in North America (excluding Mexico), Australia or Europe and their territories. The RFP will not limit any individual from applying. However, most of the grantees are: professional conservationists from the country of research and/or post-graduates pursuing a higher degree. There are the following restrictions: Organizations are not eligible for funding; previous research fellows are not eligible for funding for the same project; faculty and/or research advisors should not be listed as principal investigators unless they plan to carry out the majority of the field work; the principal researcher must write the proposal (those written on behalf of another individual will be disallowed). Application information: Interested applicants may download the application from the website (above) or e-mail the Program Coordinator and request an electronic RFP Application. Any queries or further information, please contact: Christina Ojar, Research Fellowship Program (address above).

CITES: A Conservation Tool Updated Edition Available

The IUCN/SSC Wildlife Trade Program has completed the seventh edition of “CITES: A Conservation Tool, a Guide to Amending the Appendices to the Convention on International Trade in Endangered Species of Wild Fauna and Flora.” This publication guides the CITES Parties through the Convention’s articles and resolutions. It covers the process for the submission, presentation and adoption of proposals to amend the Appendices for the 12th CITES Meeting of the Conference of the Parties (CoP), 3–15 November 2002 in Chile. The seventh edition has been produced in a booklet form and on CD for the first time. Both CDs and booklets have been distributed to CITES Parties in time for their preparations for the 12th CoP. The guide is available in pdf version in English, French and Spanish via the IUCN/SSC Wildlife Trade Programme web page at: <http://www.iucn.org/themes/ssc/programs/trade.htm>.

Newly Launched Wildlife Community Website

WildlifeDecisionSupport.com is proud to announce the launch of its online wildlife community website. The site gives access to specialized information for the wildlife professional, including rehabilitators, veterinarians, ranchers, researchers, game capturers, managers and students.

The website, at: <http://WildlifeDecisionSupport.com>, includes the full text of the current edition of the *Capture and Care Manual,* which is out of print. The Manual, a combined effort by 22 specialist authors, has become the definitive reference on the translocation of African wildlife. The site also enables people to share their knowledge and experiences with one another in an interactive, immediate manner. Topics covered in WildlifeDecisionSupport.com include: Capture and care issues (darting, handling, loading, transportation, temporary accommodation, etc.); husbandry in more permanent captivity (zoos, safari parks, etc.); wildlife management issues; rehabilitation; capture and translocation equipment; and telemetry-techniques and technology. Further, a regular newsletter is sent to members which includes: Reviews or lists of recent articles in journals/magazines; notes on updates to the community website; reviews of new products and publications (e.g., book reviews); who’s who - people and NGOs; NGO news (especially serious conservation/management projects); letters to the Editor; toolbox - equipment, electronics, etc.; reports back, symposia, etc.; wildlife diary (meetings and conferences); and other issues of interest to the wildlife professional. For more information, visit <http://WildlifeDecisionSupport.com>, or call Riley O’Brien at 012-991-3083, e-mail: <ranger@ WildlifeDecisionSupport.com>.

Primate Societies

Callicam Web Site

The Wisconsin Regional Primate Research Center is pleased to announce the release of the Callicam Web Site, <http://callicam.primate.wisc.edu>, a resource available through Primate Info Net, <http://www.primate.wisc.edu/pin/>. Supported by grants RR15311 and RR00167, the site allows visitors to see a live image from a camera focused on a family of common marmosets (*Callithrix jacchus*) at the WRPRC. By clicking on the image on the screen, users can take control of the Callicam for two minutes at a time and are able to pan, zoom and focus the camera.

A series of informational pages, developed in conjunction with Dr. David Abbott and other members of the Common Marmoset group at the WRPRC, accompanies the web cam window and gives users the opportunity to learn about the species and its behavior as they view the animals live on their screens. Links to the Primate Info Net “Common Marmoset” web site are also available from the Callicam window. The Common Marmoset site offers general information about *Callithrix jacchus*, its behavior, current research, a bibliography of print and AV resources and a link to search for more web sites through PIN. Images from the WRPRC’s Audiovisual Archive <http://www.primate.wisc.edu/pin/av.html> are also included on the site.

Stephen Nash Art Lecture Now on Tape

A video tape of the opening lecture of the 2000 Primate Pathology workshop, held in Madison, Wisconsin, given by Dr. Stephen Nash is now available on loan from the WRPRC. This great presentation, “Primates in Art,” was taped by the American Society of Primatologists. To borrow the tape please contact: Ray Hamel, Reference and Special Collections Librarian, e-mail: <hamel@primate.wisc.edu>. Call number for the tape: vt0674. Title: Primates in Art: Stephen Nash Lecture. Source: Produced by the IMDC, University of Wisconsin-Madison for the Wisconsin Regional Primate Research Center PHYSDES: VHS; col., sd.; 49 min.: 2000.

Primate Behavior and Ecology

From 27 December–18 January 18, 2001, the La Suerte Biological Field Station, Costa Rica, and Ometepe Biological Field Station, Ometepe Island, Nicaragua, are offering a course on primate behavior and ecology. This course covers the behavior and ecology of Old and New World primates from an evolutionary perspective. Emphasis will be given to the three species present at La Suerte: *Cebus capucinus*, *Alouatta palliata* and *Ateles geoffroyi*. The material and topics covered in this course are equivalent to an upper division university course in primate behavior and ecology. A background in biology or physical anthropology is helpful but not required. It is far more important to have a serious interest in learning about primates and a desire to do field work in a tropical rainforest.

Flora and fauna of interest will be pointed out and discussed as they are encountered. Students are encouraged to familiarize themselves in advance with general information about primates, tropical ecosystems and Costa Rica. A list of books of reference for the course is available on the web site <www.studyabroad.com/lasuerte>. For more information and to request an information pack, contact: La Suerte Biological Field Station; Ometepe Biological Field Station, P.O. Box 55-7519, Miami, Fl 33255-7519. Phone: (305) 666-9932, Miami Office (9-5 eastern), e-mail: <lasuerte@safari.net>.

LINCOLN PARK ZOO FUNDS

The Lincoln Park Zoo, Chicago, Illinois, has a Neotropic and Africa/Asia Fund to support field research in conservation biology around the world. The Neotropic Fund focuses on projects undertaken in Latin America and the Caribbean and emphasizes the support of graduate students and other young researchers from those countries. The fund, created in 1986, has awarded over 146 grants in 19 countries.

Usually between five and ten projects are supported annually, including project renewals for a second year. The typical award given falls into the range of $3,000–6,000. Initial support is for up to one year from the date of the award and the maximum duration of support is for two years.

For additional information and application procedures please see: <www.lpzoo.com/conservation>, e-mail: <conservation@lpzoo.org> or write to: Lincoln Park Zoo NF/AA Funds, Department of Conservation and Science, Lincoln Park Zoo, 2001 N. Clark St., Chicago, IL 60614, USA.

ERRATA: POPULATION GROWTH IN THE BELIZEAN BLACK HOWLING MONKEY (*ALOUATTA PIGRA*)

In the paper Population growth in the Belizean black howling monkey (*Alouatta pigra*) by Horwich, Brockett, James and Jones, *Neotropical Primates* 9(1): 1–7, April 2001, please note the following:

On page 5, column 2, paragraph 3, the last sentence of the paragraph should read, "Our finding that proportions of males in populations are negatively and significantly correlated with increasing population density can be viewed as a consequence of increased group size with increases in population density."

On page 6, Acknowledgements, the authors wish to thank one anonymous reviewer for constructive comments that significantly improved the manuscript.

The authors regret any inconvenience these oversights may have caused our readers.

RECENT PUBLICATIONS

THE XIXTH CONGRESS OF THE INTERNATIONAL PRIMATOLOGICAL SOCIETY: "CARING FOR PRIMATES"

The XIXth Congress of the International Primatological Society will be held in Beijing, China, 4–9 August, 2002. It is being organized by The Mammalogical Society of China and The Institute of Zoology of the Chinese Academy of Sciences, and is sponsored by The Chinese Academy of Sciences and The National Natural Science Foundation of China. The following is letter of invitation to the Congress:

We, the Organizing Committee, have the pleasure of inviting you to the XIXth Congress of the International Primatological Society (IPS). The main theme of the event will be "Caring for Primates: Progress in and Prospects for Primatology and the Conservation of Non-human Primates in the 21st Century."

China is one of the most important countries in the world in terms of its culture and biodiversity. Twenty-one primate species, five of them endemic, occur there. Ecological and behavioral research and the conservation of China's non-human primates have received increasing attention in recent years. Some species are now seriously endangered, all are still poorly known, and through this Congress we hope to promote and consolidate national programs and research efforts and international co-operation in our endeavors to protect China's remarkable primates at a time of accelerated development and with the burgeoning needs of the country's large and ever-growing human population.

The 19th IPS Congress in Beijing will be China's first major international primate meeting. We are very enthusiastic about this big event and will do what we can to make this gathering go smoothly and combine a first-class scientific programme with a cultural and social experience which will be enjoyable and memorable to all. Most of all, we hope that it will make a major contribution to the development of primatology and especially to our ongoing efforts to conserve primates in China and around the world. In addition to plenary sessions, a variety of symposia and workshops will be convened during the meeting. The deadline for accepting topics for symposia and workshops is the 31st August, 2001.

We are sure that the great biodiversity, the fascination of China's long history and many unique cultures, and the beautiful countryside will make this Congress an enjoyable and memorable experience for all.

We are looking forward to seeing you in Beijing in 2002. For more details please access the web site at: <http://www.ips.ioz.ac.cn>.

Professor Sung WANG, Chairman of the Organizing Committee, 19th Congress of the International Primatological Society, and **Professor Fuwen WEI,** Secretary General, 19th Congress of the International Primatological Society.

EUROPEAN FEDERATION OF PRIMATOLOGY MEETING 2000, CONFERENCE REPORT

Organized by Hilary Box, Hannah-Buchanan-Smith, Bertrand Deputte, Ann MacLarnon, Phyllis Lee and Regine Vercauteren Dubbel, the European Federation of Primatology 2000 Meeting was hosted by the Primate Society of Great Britain, 30 November – 1 December 2000. It was the first international meeting of a primate society to be held in Europe for several years and took place over three days and three venues: University of Surrey Roehampton, Goldsmiths College and the Zoological Society of London. Of particular siginificance was that a number of post-graduate students were able to attend the conference and workshops due to grants provided by the European Community. Themes for the three days included "Evolution and Biology" and "Reproduction and Mating Systems" on the first day, chaired by Phyllis Lee and Ann MacLarnon; "Cognition and Social Conflict" on the second day, chaired by Hilary Box; and "Ecology and Conservation" on the third day, chaired by Bertrand Deputte.

ASP PRESIDENT'S AWARD

The first President's Award of the American Society of Primatologists was given to Professor Vernon Reynolds. This newly created award is given to individuals or organizations that have made unique and exceptional contributions to primatology. The award was announced in the June issue of the *ASP Bulletin.* At the annual conference in Boulder, Charles Southwick read an acceptance letter from Vernon, who was unable to attend the meeting. The award includes a plaque and $1000.

In September, Janette Wallis, ASP Executive Secretary and Reynolds' frequent collaborator, traveled to Uganda to make a public presentation of the ASP President's Award. Vernon graciously accepted the award and, as is typical, gave all recognition and credit to the hard-working staff of the Budongo Forest Project (BFP), directed by Mr. Fred Babweteera. Vernon split the $1000 award evenly among the staff. Research conducted via BFP has included studies of the forest itself (effects of logging, reforestation, etc.) and many species of animals inhabiting the forest, including various birds, butterflies and, of course, chimpanzees and other primates.

SOCIETY FOR CONSERVATION BIOLOGY - NEOCONS

The *Neotropical Conservation Biology Bulletin - NeoCons* is an electronic bulletin produced and edited by the Society for Conservation Biology (SCB) as a forum for conservation issues in South America, Central America, Mexico and the Caribbean. The first issue Vol. 1(1) was released in February 2001. The Society for Conservation Biology is an international professional organization dedicated to promoting the scientific study of the phenomena that affect the maintenance, loss and restoration of biological diversity <http://www.conservationbiology.org/>. Mac Hunter is the SCB President Elect and Co-chair of the Internationalization Committee.

NeoCons is distributed electronically and free to all interested individuals, regardless of whether they reside or not in the region or are members of the SCB. The purpose of *NeoCons* is to facilitate information exchange in order to help strengthen the discipline of conservation biology in Austral and Neotropical America. *NeoCons* is published every two months and has two main sections. The first includes the table of contents of each issue of the journal *Conservation Biology* in Spanish, and the second is a compilation of information relevant to the practice of conservation biology. Contributions to *NeoCons* can be made in Spanish, English, Portuguese and French. The *NeoCons* website is <http://www.conservationbiology.org/SCB/Publications/NeoCons/>, where you will find the subscription form and further information on how to make contributions for its content. *Additional information*: Jon Paul Rodríguez, Editor NeoCons, Centro de Ecología - IVIC, Apartado 21827, Caracas 1020-A, Venezuela, Tel. +58 212 504 1194, Fax. +58 212 504 1088, e-mail: <jonpaul@ivic.ve>.

ECOLOGY AND SOCIAL ORGANIZATION OF BEARDED SAKIS, *CHIROPOTES SATANAS*

The Society for Tropical Ecology, Germany, has begun a monograph series *Ecotropical Monographs*, associated with their journal *Ecotropica*. The editor is Karl-L. Schuchmann of the Zoological Research Institute and Museum of Zoology, Bonn, Germany. No 1 (20 May, 2001) is "Ecology and Social Organization of the Bearded Saki *Chiropotes satanas chiropotes* (Primates: Pitheciinae) in Venezuela," by Angela Peetz, 170pp. ISBN 3 9807780 0 2. In 1988, Angela Peetz joined the "Proyecto Primatología Ecológica de Guayana" in Estado Bolívar, Venezuela, run by the late Warren G. Kinzey (City University of New York) and Marilyn Norconk (Kent State University). For her MSc thesis (University of Bielefeld, Bielefeld) she studied the behavior of a group of red howler monkeys. Subsequently she continued her research, the subject of this monograph, working on the ecology and behavior of *Chiropotes satanas* for a doctoral dissertation, supervised by Prof. Dr. Roland Sossinka. The study was based on an island of about 180 ha in the 4,300 km^2 Lake Guri formed by the Raúl Leoni Dam, completed in 1986 on the Río Caroní, eastern Bolívar State. Two other species occur on the island, *Alouatta seniculus* and *Cebus olivaceus* (given as the subspecies *apiculatus*). Over 15 months in 1989-1990, Peetz studied the habitat, feeding ecology, activity budget, ranging behavior, social organization and development of infants. The overall aim of the study was to investigate the extent to which ecological parameters influence behavioral strategies at the northern limit to the species' range. This monograph gives a thorough and detailed description of her findings. It is a solid and brilliant contribution to our knowledge of this species, the pitheciines and to New World primates in general.

Copies of *Ecotropical Monographs* may be ordered from: GTOE, Zoological Research Institute and Museum of Zoology, Adenauerallee 160, D-53113 Bonn, Germany. Price of No. 1: EURO 55.00. Add EURO 5.00 for handling and shipping charges outside Europe. Check payable to: GTOE, Bonn.

UM LIVRO VERMELHO PARA O MUNICÍPIO DO RIO DE JANEIRO, BRASIL

Espécies Ameaçadas de Extinção no Município do Rio de Janeiro: Flora e Fauna, editado por Fernando Régis Di Maio e Márcia Botelho R. Silva, 2000, 68pp. Secretaría Municipal de Meio Amboente, Rio de Janeiro. Inclui uma listagem de 50 espécies (27 de plantas e 23 de animais) já extintas no município. A categoria "Criticamente em perigo" inclui 46 espécies (35 de plants e 14 de animais). "Em perigo" e "Vulnerável" somaram mais 345 espécies (274 plantas e 170 animais). No total foram listadas como ameaçadas 274 espécies da flora e 170 espécies da fauna do munícipio. A parte de mamíferos (pp.39-43) foi elaborada por uma equipe coordenada por Carla Fabiane de Vera y Conde e incluiu Cecília Bueno (Universidade Federal do Rio de Janeiro), Cibele Rodrigues Bonvicino (Instituto Nacional do Câncer), Sérgio Maia Vaz (Museu Nacional do Rio de Janeiro) e Carlos Esbérard, especialista em quiróptera (Fundação Rio Zôo). *Alouatta fusca*, *Brachyteles arachnoides* e *Leontopithecus rosalia* foram todas registradas como extintas no município.

Sérgio Maia Vaz, Museu Nacional, Seção de Mamíferos, Quinta da Boa Vista, São Cristóvão, Rio de Janeiro 20940-040, Rio de Janeiro, Brasil.

A NEW ONLINE JOURNAL OF ECOLOGY

BioMed Central (BMC) Ecology covers environmental and population ecology of plants, animals and microbes. The journal is one of the 60 or so published by BioMed Central (http://www.biomedcentral.com/), a recently established online publishing house that is committed to making original research articles in biological and medical science freely available to all.

BMC believes that communication of original research is the single most important part of the scientific process and that the current publishing model is often more of a hindrance than a help to this critical activity because of the limited circulation and high costs of many journals. BioMed Central overcomes this by making papers available online to anyone for no charge, while also having them listed in PubMed. Anybody publishing with BMC Ecology (or with any of the other BMC journals) will have their article: 1) made freely available to anyone with Internet access - more people than ever will have the ability to read the results of your work; 2) peer reviewed in the normal way but using the speed of the Internet to expedite the process - BMC's average time from submission to publication is currently 6.5 weeks and the aim is to reduce this further; 3) cited in PubMed and archived in PubMed Central, the NIH's central research repository - this will make your article easily accessible and securely archived; 4) drawn to the attention of the readers of the two other BioMed Central journals that you deem to be most appropriate, by including it in their tables of contents as "related papers." Once your article is published you will be able to see exactly how many people have accessed it. BioMed Central is guided by an Editorial Directorate, which comprises some of the world's leading scientists and clinicians. Instructions on how to submit a paper are at <http://www.biomedcentral.com/manuscript/checklist.asp>. Some recently published research articles in a variety of BMC journals are at <http://www.biomedcentral.com/biology.asp>. For more information: Peter Newmark, Biology Editorial Director, BioMed Central, e-mail: <editorial@biomedcentral.com>. To receive updates on research, reviews and editorials published by BioMed Central, register at <http://www.biomedcentral.com/registration/>.

SUSTAINABLE FOREST MANAGEMENT

The Center for Applied Biodiversity Science (CABS) at Conservation International (CI), Washington, DC, has published the third issue of the publication series, *Advances in Applied Biodiversity Science*, Series Editor, Philippa Benson. "Sustainable Forest Management: A Review of Conventional Wisdom" (29pp. 2001) was written by Richard E. Rice, Cheri A. Sugal, Shelley M. Ratay and Gustavo A. B. da Fonseca. This monograph argues that almost no logging in the tropics (except plantations) can be considered sustainable, and considers why sustainable forest management has met with such limited success, despite much effort over the past two decades. It begins with a brief overview of the scope and diversity of efforts to support sustainable forest management, and then considers one of the most important obstacles to its broader adoption – its lack of financial attractiveness. In the last chapter the authors discuss the conditions under which sustainable forest management represents an appropriate conservation tool based on its environmental impacts, and include a brief review of its cost effectiveness compared to other options. They conclude that sustainable forest management has limited usefulness as a conservation strategy, and that before it is promoted in a given area it should be carefully evaluated against other conservation options. *Contents*: 1) Introduction; 2) The History of Sustainable Forest Management; 3) The Economics of Sustainable Forest Management; 4) Policies Intended to Encourage Investments in Sustainable Forest Management; 5) The Conservation Effectiveness of Sustainable Forest Management; 6) Conclusion. *Available from*: Nedra Johnstone, Center for Applied Biodiversity Science, Conservation International, 1919 M Street NW, Suite 600, Washington, DC 20036; e-mail: <n.johnstone@conservation.org>.

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BOOKS

Primate Taxonomy, by Colin P. Groves, April 2001. Smithsonian Institution Press, Washington, DC. ISBN 1 56098 872 X (cloth). Price: US$65.00. This is a remarkable book - a landmark in our understanding of primate diversity. It is divided into two parts. The first is a series of chapters on taxonomy in general, using primates as examples - "The Theory of Primate Taxonomy." Chapter 1 - What taxonomy is meant to do and how it should do it, pp.3–14; Chapter 2 - Taxonomic ranking and nomenclature, pp.15–25; Chapter 3 - A brief history of primate taxonomy, pp.39–53; Chapter 4 - Taxonomy of primates above the family level, pp.54–61. As pointed out by Groves in his preface, "…primatology does not stand on its own. Part One of this book could be for mammalogists in general, ornithologists, and any other student of sexually reproducing animals…" The second part is titled "Putting Primate Taxonomy into Practice," and reviews the taxonomy to subspecies level of the Malagasy lemurs, the Loriformes, the Tarsiiformes, the Platyrrhini, the Old World monkeys - Superfamily Cercopithecoidea, and the Hominoidea. There is an appendix "A Word about Fossil Primates," and finally a glossary. For each group of primates, taxonomy is discussed at the family and subfamily level. The genera are divided into species groups where appropriate. Scientific name, author, synonyms, diagnosis, and distribution are given for each species. Similar treatments are given to subspecies except that common names are not provided. As Groves himself points out (p.37), an understanding of primate diversity (and not just species) is vital if we are to conserve it. This book is a must, indispensable for all primatologists, primate ethologists and geneticists, zoo curators and tropical conservation biologists. *Available from*: Smithsonian Institution Press, PO Box 960, Herndon, VA 20172-0960, Tel: 1 800 782 4612.

Tropical Ecosystems and Ecological Concepts, by Patrick L. Osborne, 2000, 468pp, ISBN: 0-521-64251-5 (hardback), price: US$110, or ISBN 0-521-64523-9 (paperback), price US$39.95. An introductory textbook that provides a comprehensive guide to the major tropical biomes, including both aquatic and terrestrial systems, this book covers the human dimension and how it relates to such issues such population growth, urbanization, agriculture and fisheries, natural resource use and pollution. The text contains supplementary material on a range of subjects including organisms, mathematical concepts and calculations, line diagrams, maps and photographs. Available from Cambridge University Press, 110 Midland Avenue, Port Chester, NY, 10573-4930, USA, Fax: (914) 937 4712. Web site: <www.cup.org>.

Genetics, Demography and the Viability of Fragmented Populations, edited by Andrew Young and Geoffrey M. Clark, 2000, 448pp. ISBN: 0-521-78207-4 (hardback), price US$90 or ISBN 0-521-794210-8 (paperback), price US$39.95. Providing a detailed introduction to genetic and demographic issues relevant to conservation, this book presents case studies on plants and animals dealing with demographic stochasticity, genetic erosion, inbreeding, metapopulation biology and population viability analysis of fragmented populations. Available from Cambridge University Press, 110 Midland Avenue, Port Chester, NY, 10573-4930, USA, Fax: (914) 937 4712. Web site: <www.cup.org>.

The Nonhuman Primates, by Phyllis Dolhinow and Agustin Fuentes, 1999, 340pp. Mayfield CITY. Price: £24.95. Introduces students to nonhuman primates through 34 essays written by experts in their research areas. *Available from*: NHBS Ltd, 2-3 Wills Road, Totnes, Devon TQ9 5XN, UK, Tel: +44 (0) 1803 865913, Fax: +44 (0) 1803 865280, e-mail: nhbs.@nhbs.co.uk>. Web site: <www.nhbs.com>.

Primate Behavior: An Exercise Workbook (2nd Edition), edited by J. D. Paterson, 2001. Published by Waveland Press, Inc., Prospect Heights, Illinois, USA. ISBN 157 766 1656. Price: US$23.95. An excellent text for students of primatology or animal behaviour. Much larger than the first edition and deals with a number of new concepts, including a major expansion on the section of field ecology exercises. Contents: Part 1. The Study of Behavior (with seven chapters); Part 2. Exercises (with 23 various research exercises). A CD-ROM accompanies the workbook and should be readable by any Windows or Macintosh computer. *Available from*: Waveland Press, Inc., PO Box 400, Prospect Heights, IL 60070, USA, Tel: +1 847-634-0081. Web site: <www.waveland.com>.

The Conservation Handbook: Research, Management and Policy, by William J. Sutherland, 2000, 278pp. Blackwell Science Publications, Oxford. Price: £21.50. Provides clear guidance on the implementation of conservation techniques. Methods include those used for ecological research, monitoring, planning, education, habitat management and combining conservation with development. 18 case studies illustrate how these methods have actually been applied. *Available from*: NHBS Ltd, 2-3 Wills Road, Totnes, Devon TQ9 5XN, UK, Tel: +44 (0)1803 865913, Fax: +44 (0)1803 865280, e-mail: <nhbs.@nhbs.co.uk>. Web site: <www.nhbs.com>.

Designing Field Studies for Biodiversity Conservation, by Peter Feinsinger, 2001, The Nature Conservancy. 219pp. Price £24.50. A comprehensible, practical guide to using scientific inquiry in conservation related work. A good book for both staff and researchers working with conservation institutions or projects worldwide, as well as for professionals and students in the field of ecology, wildlife biology and conservation areas. *Available from*: NHBS Ltd, 2-3 Wills Road, Totnes, Devon TQ9 5XN, UK, Tel: +44 (0)1803 865913, Fax: +44 (0)1803 865280, e-mail: <nhbs@nhbs.co.uk>. Web site: <www.nhbs.com>.

Costa Rica Mammals, by Eduardo Carillo, Grace Wong and Joel C. Saenz, 2000, INBio, Costa Rica. 248pp. Price £28.50. Covers 100 species of Costa Rican mammals and includes information on where to find them and how to distinguish them. Available in both English and Spanish. *Available from*: NHBS Ltd, 2-3 Wills Road, Totnes, Devon TQ9 5XN, UK, Tel: +44 (0)1803 865913, Fax: +44 (0)1803 865280, e-mail: <nhbs@nhbs.co.uk>. Web site: <www.nhbs.com>.

Wild Mammals of Venezuela, by Rexford D. Lord, 2000, Armitano, Venezuela. 344pp. Price, hardback, £106.00. Provides an authoritative and comprehensive reference to the wide array of mammalian fauna and ecosystems found in Venezuela. *Available from*: NHBS Ltd, 2-3 Wills Road, Totnes, Devon TQ9 5XN, UK, Tel: +44 (0)1803 865913, Fax: +44 (0)1803 865280, e-mail: <nhbs@nhbs.co.uk>. Web site: <www.nhbs.com>.

Defending our Rainforest: A Guide to Community Based Ecotourism in the Ecuadorian Amazon, by Rolf Wesche and Andy Drumm, 216pp., 1999. Ecotourism Society, USA. Price: £15.50. Includes maps and photos with information on more than 40 community-based ecotourism projects in the Amazon. *Available from*: NHBS Ltd, 2-3 Wills Road, Totnes, Devon TQ9 5XN, UK, Tel: +44 (0)1803 865913, Fax: +44 (0)1803 865280, e-mail: <nhbs@nhbs.co.uk>. Web site: <www.nhbs.com>.

The Amazon Rain Forest: An Exploration of Countries, Cultures and Creatures, by James Castner, 104pp., 1999. Feline Press, CITY. Price: £24.95. *Available from*: NHBS Ltd, 2-3 Wills Road, Totnes, Devon TQ9 5XN, UK, Tel: +44 (0)1803 865913, Fax: +44 (0)1803 865280, e-mail: nhbs.@nhbs.co.uk>. Web site: <www.nhbs.com>.

Cryobanking the Genetic Resource - Wildlife Conservation for the Future? edited by P. F. Watson and W. V. Holt, 2001. ISBN 0 748 40814 2. Published by Taylor and Francis, 11 New Fetter Lane, London, EC4P 4EE and Tayor and Francis Inc, 29 West 35th St., New York, NY 10001, USA.

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Notes to Contributors

Scope

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

Submissions

Please send all English and Portuguese contributions to: Jennifer Pervola, 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.pervola@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 can 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.pervola@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, 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 are 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 can 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.

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