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Articles

MIMICRY IN PRIMATES: IMPLICATIONS FOR HETEROGENEOUS CONDITIONS

Unrelated organisms may sometimes look alike. Mimicry (convergence due to exploitation or mutual advantage) is a Darwinian mechanism which may explain such similarities. In 1974, Cody concluded that, for mammals, virtually nothing is known of character convergence to facilitate aggressive spacing or of social mimicry to facilitate gregariousness (see also Pough, 1988; Vencel, 1977), although both forms of mimicry are well documented for birds (see Wickler, 1968; Moynihan, 1968, 1981; Cody, 1969, 1974). These studies concluded that different organisms in the same populations, guilds or communities may exhibit similar structures as conventional mechanisms to promote mutual recognition in predator-prey, competitive, mutualistic or social interactions. Convergent features may help to explain certain patterns of exclusion, coexistence, social parasitism, hyperparasitism, co-operation or "interpersonal attraction" within and between species (see Moynihan, 1968), and this note reviews for the primates traits that may represent convergence to facilitate recognition.

Table 1 summarizes preliminary evidence for the Order Primates. In brief, 20 species or genera exhibit characters that are likely candidates for the above interpretations. Eight of the 21 species or genera are Neotropical, 13 (62%) are Paleotropical. Each example involves some apparent type of mimicry among potential competitors for food, mates or space: five apparent examples of intraspecific modeling to a pregnant morphology (prominent abdomens) by one or both sexes: six of intraspecific mimicry of genitalia (four of six cases exhibit female mimicry of male sexual structures; Fig. 1); one of interspecific mimicry of genitalia; nine of interspecific vocal mimicry; two of interspecific mimicry of facial signals; two of generic morphological mimicry; two of pedomorphosis and neoteny which may involve convergence to juvenile forms; and three of mimicry of an estrus model ("pseudoestrus").

Convergence may entail a one-way (e.g., *Cercocebus* to *Macaca* and *Papio*) or a two-way (e.g., prominent abdomens in both sexes of *Ateles*) change whereby mutant organism B may become more similar to the phenotype of organism A (one-way) or both may model each other more or less mutually (two-way). In order to demonstrate one-way or two-way dominance, despotism or competition in a two-organism

dyad, it would be necessary to test the effects of clinal variation and to show deleterious effects for one or both interactants in the absence of the modeled trait. Subsequent measures of the effects of interactions in the presence of the modeled trait would be expected to demonstrate less deleterious consequences, no deleterious consequences or facilitation by one or both interactants. It is unlikely that rigorous tests meeting these criteria can be conducted in the field. However, the examples of modeled structures displayed in Table 1 may provide rich tests of hypotheses concerning the evolution or proximate advantage of obligatory relationships in general and competitive and social mechanisms in particular (see Jones, 1985a; West Eberhard, 1979; Briand and Cohen, 1984), especially where investigators employ the tools of game theoretical analysis, removal experiments, or comparative approaches (see Axelrod and Hamilton, 1981; Jones, 1982).

For example, imagine a hypothetical set of interactions between two organisms, A and B (a "payoff matrix", see Axelrod and Hamilton, 1981) and the relative costs and benefits (genetic or other) in each of four conditions: (1) A mimics B; (2) B mimics A (both one-way mimicry); (3) A and B mimic each other or a third model (two-way mimicry); and (4) neither A nor B mimic the other. Assuming that A and B use some limiting resource in common, the competitively inferior organism will experience the lowest relative payoff across conditions. These four conditions may correspond, respectively, to social parasitism (W. C. Dilger, pers. comm; see also West-Eberhard, 1979) or hyperparasitism; to mutualism or co-operation (see Moynihan, 1968, 1976); and to "active competition" (see Emlen, 1973, Chapter 12) where B or A may competitively exclude the other in certain environmental regimes. Features that are mimicked or modeled are assumed to be morphological, physiological (including chemical), behavioral, or developmental.

The frequency of mimicry may be much higher than Table 1 indicates since the subject has rarely been investigated systematically. Pseudoestrus provides a good example. Hrdy (1981) is of the opinion that pseudoestrus facilitates the female's ability to "manipulate" potential mates, and adult female howler monkeys (*Alouatta palliata* Gray) provide a rich example of such manipulation among Neotropical primates (Jones, 1985b). A recent report by Zucker *et al.* (1994) suggests that genital swelling may not be a reliable measure of estrus stage in mantled howlers. Males employ visual and olfactory cues to assess female condition and may in part base decisions to copulate upon these cues (Jones, 1985b). Although the

methods for evaluating genital swelling employed by Zucker *et al.* may require refinement, this study suggests that females may deceive males about their true estrus condition by mimicking an unreliable estrus stage. Studies of the confidence of estrus signals need to be undertaken in other primates.

Most primates are obligately social, and systems of mimicry assume potential or ongoing interactions among coexisting individuals or populations within or between species. These systems of cues, signals, and signs represent mechanisms of social regulation and symmetry which facilitate interpersonal organi-

Table 1. Mimicry in primates and its possible origins. A = adult(s), AF = adult females, AM = adult males; RC = resource competition (including food, mates and/or space); MP = mimicry of pregnancy; MM = mimicry of males; MY mimicry of young.

Genus or Species	Trait	Origins	Source
<i>Alouatta</i>	Prominent abdomens (AF)	RC; MP	Jones, 1985b
	Genital hypertrophy (AF)	RC; MM	Pers.obs., Coelho, pers. comm.
	Neotenus vocalizations (AM)	RC; MY	Jones, 1980
<i>Aotus</i>	Morphological convergence ^a (A)	RC	Pers.obs.
	Pseudoestrus (AF)	RC	Jones, 1985b
	Vocalizations adapted to nocturnal life	RC (bats?)	Napier & Napier, 1967; pers.obs.
<i>Ateles</i>	Prominent abdomens (A)	RC ^b ; MP	Napier & Napier, 1967; pers. obs.
<i>Brachyteles</i> <i>Callicebus</i>	Prominent abdomens (A)	RC ^b ; MP	Napier & Napier, 1967
	"Howler-like" and/or bird-like vocalizations	RC	Napier & Napier, 1967; Vencel, 1977; pers.obs.
<i>Callimico</i> <i>Cebus</i>	Tamarin-like vocalizations	RC	Napier & Napier, 1967
	Genital hypertrophy (AF)	RC ^b (<i>Alouatta?</i> ; <i>Ateles?</i>); MM	Napier & Napier, 1967; pers. obs.
	Scrotum sessile (AM)	RC ^b ; MF	Napier & Napier, 1967; pers.obs.
<i>Cercocebus</i>	Vocal mimicry (A)	RC ^b ; (birds?; <i>Alouatta?</i>)	Napier & Napier, 1967; pers.obs.
	<i>Macaca</i> & <i>Papio</i> -like facial signals (A)	RC	Napier & Napier, 1967
	<i>Papio</i> -like vocalizations	RC	Napier & Napier, 1967
<i>Cercopithecus</i>	Bird-like vocalizations (A)	RC	Napier & Napier, 1967
<i>Cynopithecus</i>	<i>Macaca</i> -like facial signals (A)	RC	Napier & Napier, 1967
<i>Hapalemur</i>	<i>Lemur</i> -like vocalizations (A)	RC	Napier & Napier, 1967
<i>Homo</i>	Prominent abdomens (A)	RC	Bjerre, 1958
<i>Macaca</i>	Pseudoestrus (AF)	RC	Hrdy, 1981
<i>Microcebus</i>	"High-pitched", possibly "supersonic" vocalizations	RC (bats?)	Napier & Napier, 1967
<i>Pan paniscus</i>	Paedomorphosis & neoteny (A)	RC; SM	Shea, 1983
<i>Papio</i>	Pseudoestrus (AF)	RC	Hrdy, 1981
<i>Papio papio</i>	Perianal area of male mimics estrus	RC	Napier & Napier, 1967
<i>Papio leucophaeus</i>	Estrus female resembles <i>Cercocebus</i> in estrus	RC	Napier & Napier, 1967
<i>Perodicticus</i>	Genital hypertrophy (AF)	RC; MM	Napier & Napier, 1967
<i>Presbytis</i>	Prominent abdomen (A)	RC; MP	Napier & Napier, 1967
<i>Saguinus</i>	Ultrasonic vocalizations (A)	RC (bats?)	Napier & Napier, 1967
<i>Simias concolor</i>	Morphological convergence to <i>Macaca nemestrina</i>	RC	Napier & Napier, 1967

^a Striking morphological similarity apparent for *Alouatta* physiognomy (single adult at rest), *Cathartes* physiognomy (single vulture at rest), *Nasutitermes* nests and *Sciurus* nests.

^b Possibly an adaptation to mixed-species feeding aggregations (see Klein and Klein, 1973; also pers. obs.; pers. comm. from D. Boucher, C. Freese, and A. Coelho).

zation. These systems of mimicry may enhance species integrity in disturbed habitats where patchy conditions prevail, and the organization of communication is expected to impose a conservative homeostatic force under heterogeneous conditions caused by habitat degradation and other factors. Such features may contribute to the optimization of survival and reproductive success in distressed regimes. Other examples of "stereotyped" or "ritualized" characteristics may be interpreted as traits functioning homeostatically to promote individual recognition within or between species (see, for example, Smuts and Watanabe, 1990; Wickler, 1968).

Is mimicry inherently more common in the Paleotropics than in the Neotropics, or are the present trends a result of sampling error? Some observations are suggestive. First Paleotropical species are more terrestrial than Neotropical, possibly favoring the expression of visual features. Most of the examples in Table 1 are signs of visual communication, possibly biasing the results in favor of Old World taxa. Second, for arboreal species, studies are needed of the differential architecture of forests inhabited by primates since such studies may reveal the selective pressures associated with mimicry in primates in Paleotropical and Neotropical forests (see Richards, 1973). Third, it may be productive to study interspecific mimicry in modalities other than the visual, in particular the potential for vocal mimicry with birds. Species with which primates compete for food and space are likely candidates for mimicry. Finally, most studies of "coalitions and alliances" in primates have been conducted on Paleotropical species. Nonetheless, it seems clear that mimicry in both Old and New World primates can be viewed in the context of symmetrical communication and can be related to the growing literature on reciprocal relationships in primates (e.g., de Waal and Luttrell, 1988).

Research on convergent features in primates has the potential to unify this literature with that of other taxa (e.g., Mason and Crews, 1985; Pietsch and Grobecker, 1978; Bawa, 1980; references for birds cited above). In particular, the morphometric quality of traits exhibited in Table 1 allows a high degree of quantitative precision in measurement and empirical evaluation permitting analysis relative to variations in size, sex, and vital parameters (e.g., age, fecundity, and survivorship) as well as aggressive and non-aggressive behaviors, structures, signals, and displays. Where populations are polymorphic for convergent traits, as Bushmen and Australian aborigines may be for prominent abdomens (see Bjerre, 1958; E. Haggmann, pers. comm.), studies may be undertaken

to reveal the heritability of convergent features as well as their biogeographical distribution and possible relationship to population differentiation (W. C. Dilger, pers. comm.; Cody, 1974). Future investigations of mimicry in primates and other mammals may produce more than "anecdotal" results (Cody, 1974, p.260).

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- far as the state of Amapá on the basis of four specimens collected at Carmo do Macacoari, Itauba, eastern Amapá, and on the island of Caviana in the Marajó archipelago, Pará (Fernandes, 1993). In 1994, fieldwork at these two sites resulted in the collection of a further two specimens of *Aotus* from the former (Museu Paraense Emílio Goeldi MPEG 24035 and Instituto de Pesquisas do Estado do Amapá IEPA 041) and three from the latter (MPEG 24130, 24131 and 24132).
- All ten specimens now collected at these two sites were analyzed using the diagnostic characteristics used by Hershkovitz (1983). According to Hershkovitz, *Aotus trivirgatus* and *Aotus infulatus* Olfers 1818 belong to the gray-necked and red-necked groups, respectively. His phenetic key to the *Aotus* species and subspecies (1983, p.213), showed that *A. trivirgatus* and *A. infulatus* may be distinguished by just two characteristics: the coloration of the side of the neck, and the presence (or absence) of a whitish band at the lateral corner of the eye. The remaining characters cannot be considered diagnostic. The entire side of the neck behind and below the ear is grayish agouti or brownish agouti in *A. trivirgatus*, as are the flank or the outer side of the arm, and whitish bands are found at the lateral corners of the eyes. In *A. infulatus*, the neck is partially or entirely orange or buff, and two small whitish patches are found above the eyes.
- All ten specimens exhibit the diagnostic characters of *A. infulatus*. The animals from Carmo do Macacoari were indistinguishable from those of Caviana Island, and the Goeldi Museum specimens of *A. infulatus* from Marajó Island and the Rio Tocantins. All these thus represent a single species, *A. infulatus*, the geographic distribution of which is extended to the left (north) bank of the lower Amazon, in Amapá (Fig. 1). Consequently, the known eastern limit of the geographic distribution of *A. trivirgatus* is still the Rio Trombetas, as described by Hershkovitz (1983). Contrary to Fernandes (1993), then, the occurrence of night monkeys in the remainder of Amapá, west of the Rio Trombetas in Pará remains to be confirmed, especially as the genus was not reported from previous primate surveys in Amapá (Carvalho, 1962), Suriname (Mittermeier and van Roosmalen, 1981), and French Guiana (Roussillon, 1988).

GEOGRAPHIC DISTRIBUTION OF NIGHT MONKEYS, *AOTUS*, IN NORTHERN BRAZIL: NEW DATA AND A CORRECTION

The geographic distribution of *Aotus trivirgatus* Humboldt, 1812 was recently extended eastwards as

The presence of *A. infulatus* north of the Amazon is consistent with the occurrence of other closely related taxa on both sides of the lower reaches of the river: *Cebus apella apella*, *Cebus nigrivittatus/kaapori*, *Chiropotes satanas* ssp., *Saguinus midas* ssp. and

Saimiri sciureus sciureus (see Torres de Assumpção, 1988; Hershkovitz, 1977, 1985; Queiroz, 1992; Silva Jr., 1992; Harada, 1994). Of the primate genera that occur on both banks, only *Alouatta* is clearly represented by distinct species; *A. belzebul* to the south and *A. seniculus* to the north. The apparently limited distribution of *Aotus infulatus* in Amapá clearly indicates the need for further investigation, especially given the recent

observation of enclave populations of *A. belzebul* north of the Amazon (Fernandes, 1993; A. Nunes, pers. obs.). Like *Alouatta belzebul*, the presence of an enclave of *Aotus infulatus* north of the Rio Amazonas may be related to shifts in the course of the river, resulting in the passive transfer of populations between banks, as probably occurred with *Aotus nancymai* and *A. vociferans* further west (Hershkovitz, 1983). Alternatively, if *Aotus infulatus* is found to be more widespread in Amapá, it would seem reasonable to conclude that species occurred throughout the area prior to the formation of the Amazon delta (Frailey *et al.*, 1988), as seems to have been the case for *Cebus*, *Chiropotes*, *Saguinus* and *Saimiri*. The collection of additional data from Amapá, northern Pará, and the Guianas will thus not only help define the distribution of *Aotus* in northeastern Amazonia, but also provide new insights into the role of river barriers in the recent biogeography of Amazonian primates.

Specimens examined: *Aotus infulatus*: Pará: Vila Brabo, right bank of Rio Tocantins (MPEG 12177, 12178); Sítio Calandrinho, left bank of Rio Tocantins (MPEG 8869, 8870); Timbozal, left bank of Rio Tocantins (MPEG 1185, 11853); Saúde, left bank of Rio Tocantins (MPEG 12179); Cocal, right bank of Rio Tocantins (MPEG 11851); Conceição do Araguaia (MPEG 1321); Lago Arari, Marajó Island (MPEG 99, 100); Ponta de Pedras, Marajó Island (MPEG 8875, 8876, 8877); Fazenda Santana, Caviana Island (MPEG 23058, 23059, 24130, 24131, 24132). Amapá: Carmo do Macacoari, Itaubal (MPEG 225223, 22523, 24035, IEPA 0040, 0041, and specimen with field number 837).

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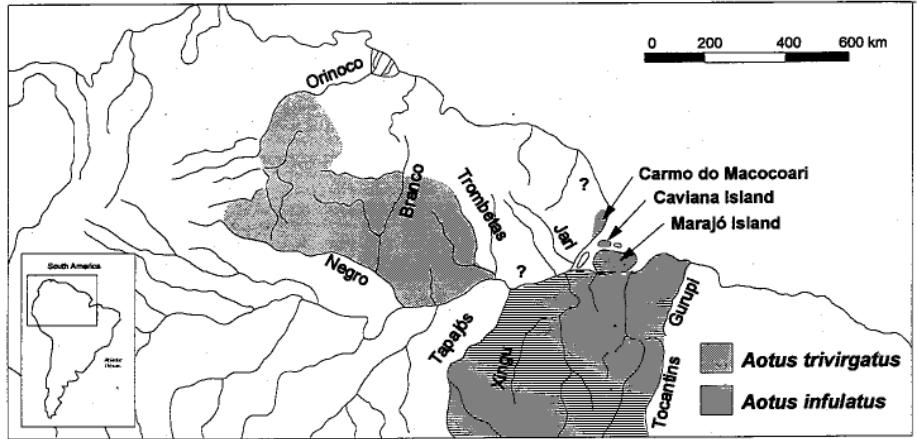


Figure 1. Geographic distribution of *Aotus infulatus* in Pará (part) and Amapá, and of *Aotus trivirgatus*. Map by José de Sousa e Silva Jr.

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POLE BRIDGES TO AVOID PRIMATE KILLS: A SEQUEL TO VALLADARES-PADUA ET AL.

Roads can interrupt habitat continuity and reduce the chances of survival of some species by fragmenting their populations (Beier, 1995; Oxley *et al.*, 1974; Wilkins, 1982). Additionally, roads may have a negative impact on wildlife populations by increasing mortality through road deaths (Beier, 1995; Comita, 1984; O'Gara and Harris, 1988; Polaco and Guzmán, 1993; Wilkins and Schmidly, 1980). Road accidents with wildlife also have an important economic and social cost (Hansen, 1983). These are likely to be important and increasing problems as roads are constructed in wilderness areas and where they cross regions inhabited by threatened species and populations. Several solutions have been proposed and implemented, including the use of warning signs, road fencing, illumination, reflectors, and road underpasses and overpasses for wildlife (Feldhamer *et al.*, 1986; Gibson, 1980; Reed, 1981; Reed and Woodward, 1981; Schafer and Penland, 1985). These solutions - which have met with mixed success - may be useful for terrestrial fauna, but their utility for arboreal animals is uncertain.

Valladares-Padua *et al.* (1995) demonstrated a simple and imaginative way of avoiding primate road kills and connecting isolated areas of their habitat by placing a pole bridge above a road. They have observed black lion tamarins (*Leontopithecus chrysopygus*) and

capuchin monkeys (*Cebus apella*) using the bridge. Valladares-Padua *et al.* (1995) mentioned the successful implementation of the bridge (although not systematically assessed), and made no reference to any negative effects.

The use of pole bridges in open areas (such as in many roads) may, however, have a potentially serious side-effect: primates, particularly callitrichids, may be more exposed to predators, mainly raptors. To make the design of the pole bridge constructed by Valladares-Padua *et al.* more effective in open areas, it would be necessary to provide some sort of shelter while they cross the bridge. This could be achieved in a number of ways, and using local materials, by simply building a roof or providing some other protection such as a web of ropes. By promoting the growth of creeping vines and other plants, bridges and their 'roofs' could be camouflaged to disguise them or make them more appealing aesthetically. However, care has to be taken to avoid creating in this way places for other predators to hide (for example, snakes). Another issue to consider is that raptors may use poles and other artificial platforms to nest (Steenhof *et al.*, 1993). In fact, it is a common management practice to increase raptor populations by providing them with artificial nesting structures (Lefranc and Millsap, 1984). Thus, in regions where this may be a concern, it may be necessary to build the bridges in such a way as to minimize this problem, and to monitor them to remove undesired raptor nests. Finally, having a single pole bridge may create a bottleneck and make the monkeys (and their travel routes) predictable, hence increasing their risk of predation or of being captured by humans. Having several bridges would help solve these problems. The implementation of these proposals would increase the cost of bridges, but it would be minimal compared to the costs of losing individuals of seriously depleted populations. Of course, as in most management programs, decision of what is appropriate for one site will need to be determined case-by-case.

It is of great importance to make an objective assessment of the effectiveness and cost of different bridge designs under various road conditions (for example, road type - paved or dirt - and width, intensity and speed of traffic flow, noise levels, distance to primate habitats). These evaluations are fundamental in order to convince governments and road constructors and operators of their value. If effective, as current evidence and common sense suggest, the establishment of wildlife tunnels and bridges, as well as other means to mitigate population fragmentation and wildlife mortality, should become a standard practice.

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HABITAT AND DISTRIBUTION OF THE BUFFY-TUFTED-EAR MARMOSET *CALLITHRIX AURITA* IN SÃO PAULO STATE, BRAZIL, WITH NOTES ON ITS NATURAL HISTORY

The buffy-tufted-ear marmoset, *Callithrix aurita* is an endangered primate endemic to the states of Minas Gerais, Rio de Janeiro and São Paulo, in southeastern Brazil (Coimbra-Filho, 1991), living in forests between 500 and 800 m altitude (Rylands, 1994). The species has only recently been studied in the field (Torres de Assumpção, 1983; Muskin, 1984; Bueno, 1989; Corrêa, 1995). Here we discuss the former and present-day distribution of the species in the state of São Paulo in the southern limit of its distribution, and also its habitat and ecology.

Distribution

Rylands (1994), following Hershkovitz (1977), considered the species' distribution in São Paulo to be limited by the Rio Ribeira de Iguape to the south, stretching west between the upper courses of the Rios Tietê/Piracicaba and Paranapanema, and north to the border with Minas Gerais. Overall, in São Paulo the species has actually been recorded from 16 localities (Hershkovitz, 1977; Coimbra-Filho, 1991; Vivo, 1991; Centro de Monitoramento Ambiental da Serra do Itapety - Mogi das Cruzes). Except for Boracéia (22°10'S, 48°45'W; Hershkovitz, 1977) there is no locality south of the Rio Tietê at the latitude of São Paulo city, and none east of the ridge of the Serra do Mar. The species is absent from the eastern slopes of the Serra do Mar and lowland forests. Four new localities for the species have been recently discovered: Mairiporã (23°19'S, 46°35'W), where two individuals were observed in August 1981; Atibaia (23°07'S, 46°33'W), a recently prepared specimen in the Atibaia Natural History Museum; Santa Isabel (23°15'W, 40°19'W), based on several observations (see below); and Fazenda Lagoa, São Luis do Paraitinga (c. 23°15'S, 45°20'W), an adult male collected in 1984, in the Zoology Museum of the Universidade Federal de Mato Grosso. The species also apparently occurs in the Serra do Japi (23°14'S, 46°57'W; see Marinho-Filho, 1992), where suitable habitat exists, but as other *Callithrix* species have been released there the record has still to be confirmed, despite several trips we have

made to the area.

Extensive fieldwork from 1982 to 1995 in the putative range of *Callithrix aurita* in the mountains of the Ribeira de Iguape valley and in southeastern São Paulo, including such well-protected areas as Fazenda Intervales, the State Parks of Alto Ribeira, Ilha do Cardoso and Carlos Botelho, and the Juréia Ecological Station, and also in the municipalities of Juquitiba and Miracatú in the Serra de Paranapiacaba, has consistently failed to find evidence for the presence of the species. The only callitrichids occurring in southern São Paulo are the black-faced lion tamarin, *Leontopithecus caissara* (lowlands and isolated mountain ranges from Cananéia to Guaraqueçaba, Paraná; see Martuscelli and Rodrigues, 1992), and the introduced black-tufted-ear marmoset *Callithrix penicillata* (Fazenda Serrana, municipality of Cajati, and the Serra de Miracatu, municipality of Miracatu).

We believe the actual southern limit of the species' distribution is located around the present-day city of São Paulo, north of the junction of the Rios Pinheiros and Tietê, the last forming the southern boundary of the species' distribution. The only anomalous locality would be Hershkovitz's "Boracéia", apparently located south of the Rio Tietê north-west of present-day Bauru (Rylands, 1994). Nevertheless, Hershkovitz described the locality as in the upper river Tietê, which would be unlikely. In fact, it is more probable that the locality refers to the Boracéia Biological Station, a well-known collecting locality near the headwaters of the Tietê, and not to the town of Boracéia, which is near Bauru.

The southern limit of the distribution of *C. aurita* is close to Ipanema (23°26'S, 47°36'W), today Araçoiaba da Serra, the type locality of the black lion tamarin, *Leontopithecus chrysopygus*, a species originally widespread south of the Tietê and north of the Paranapanema rivers, and formerly found in the low forests characteristic of the hills behind the Serra do Mar. It is possible that ecological interactions between this species and the marmoset, probably competitive as both favor the same viny, tangled microhabitat for foraging (pers. obs.), rather than geographical barriers, limited the distribution of the latter to the south. The low forests characteristic of the transitional hilly area between the Serra do Mar ridge and the inland highlands would not offer enough habitat complexity to allow two callitrichids to co-exist, as occurs with *Callithrix kuhli* and *Leontopithecus chrysomelas* in the taller forests of southern Bahia (Rylands, 1989).

The western limits of the species' distribution are un-

clear. The junction of the Rios Piracicaba and Tietê seems to be an important natural limit, but further north the limits between the distribution of *aurita* and *penicillata* have still to be determined. In the westernmost locality, the Mogi Guaçu Ecological Station (adjacent to the best-known Fazenda Campininha), on the right bank of the Rio Mogi-Guaçu, *Callithrix aurita* lives in *cerradão* and riverine forest habitat quite similar to that used by *C. penicillata* at the Jataí Ecological Station, about 130 km downstream, also on the right bank of the Mogi. The intermediate area would be worth researching.

Habitat

We have been able to visit most of the localities where *Callithrix aurita* has been recorded in São Paulo. *Callithrix aurita* has been found, currently, to live in montane forest and in gallery forest and *cerradão*, in altitudes ranging from 600 to at least 1,200 m. Although there are specimens from Ubatuba, a lowland locality by the sea (Vivo, 1991), recent fieldwork failed to find the species there. We believe the specimens were probably collected somewhere on the hilly country along the old road from Taubaté to Ubatuba, perhaps close to São Luis do Paraitinga (a known locality) or Natividade da Serra, rather than in the lowlands around Ubatuba itself. The forest in the area is similar to that found at known localities such as Cunha, not too far away.

Montane forests inhabited by the species are both evergreen and semideciduous, usually with a low (around 15 m) and even canopy with few or no emergents and mostly slender trees, sometimes with multiple trunks. The common denominator of all localities where *C. aurita* is known to live is a dense understorey of tangled vines (in drier forests) or bamboo (in montane areas). Localities where *C. aurita* has been found share a seasonal climate with dry, cold winters when frosts and mist are common due to altitude or proximity to river bottomlands. Most localities are under the influence of the rain-shadow of the Serra do Mar or other mountain ranges, which evidently explains the more seasonal climate and differences in vegetation structure and successional dynamics (see below).

Marmosets have been recorded in habitat patches found mostly on hilltops where the effects of the shallow soil, wind, frost and mist result in a stunted, viny or bamboo-rich forest (contrary to the conditions in the valleys) and, in localities farther inland such as Barreiro Rico and Mogi-Guaçu, in second-growth and edge areas where vines are dominant. *Callithrix aurita*

seems dependent on disturbed areas where some edge effect, resulting in a growth of vines or bamboo, is occurring.

During fieldwork conducted in June 1995 (see below) in a montane site in the Serra da Mantiqueira massif (Santa Isabel) and another located in the planalto (Mogi-Guaçu), we located groups of *C. aurita* only in patches of forest or *cerradão* where tangled vines were common. It is interesting to note that the abundance of vines in the *cerradão* studied is apparently due to the lack of fires for several years, which has allowed a build-up of dead vines. Torres de Assumpção (1983) and Muskin (1984) also found the species to favor vine-tangled areas, spending more time in bamboo and vine-covered trees, where it found most of its food.

The patchy habitat favored by *C. aurita* is similar to that preferred by other species of *Callithrix*, a group favoring, successional, disturbed and edge habitats (Stevenson and Rylands, 1988; Rylands, 1995). Such a preference is probably due to the greater availability of invertebrate prey in such habitats (Janzen, 1973), a result of the low prevalence of plants with chemical defenses against herbivory (see Marquis and Braker, 1994 for an overview). Also many of the gum-producing trees and vines used by the marmosets are edge or early successional species, including legumes.

The dependence on tangled, successional or edge habitats probably explains the absence of *C. aurita* from lower slopes (under 500 m) of the Serra do Mar and of the coastal plain forests. In São Paulo, a dense undergrowth of bamboo (mainly *Guadua*, *Chusquea* and *Merostachys* spp.) only begins to become common in forest above 500 m altitude. Also the "edge effect" that results in a dense cover of vines sharply marking the forest edge or completely dominating small woodlots observed inland, where there is a marked dry season, is mostly absent from forests in the Serra do Mar and the coastal plain of São Paulo.

Natural History

Population densities of *Callithrix aurita* were obtained in two localities, the montane Santa Isabel and planalto at Mogi-Guaçu (Fig. 1). Santa Isabel is in a 2,200 ha private property, at the southern tip of the Serra da Mantiqueira at an altitude of 700-1,200m. Most (752 ha) of the remaining forested area is covered by montane broadleaved perennial forest (Eiten, 1970), located on the valley bottoms and lower slopes of the hills, while 162 ha of hilltops are covered by montane mesophytic semideciduous forest (Leitão-

Filho, 1992). The remaining area is covered by *Eucalyptus*. Mogi-Guaçu covers part of the Mogi-Guaçu Ecological Station and Experimental Station, and the adjoining Mogi-Guaçu Biological Reserve (Fazenda Campininha), with a patchwork of mostly disturbed gallery forest along the Rio Mogi-Guaçu (362 ha), *cerradão* or low sclerophyllic forest (619 ha) and old *Pinus* and *Eucalyptus* plantings with an undergrowth of native species (137 ha). The area has been described by Vuono *et al.* (1982), Mantovani (1984, 1987) and Mantovani *et al.* (1989). The only other primate found both at Santa Isabel and Mogi-Guaçu was the black-fronted titi, *Callicebus personatus nigrifrons*.

Both areas were visited in June 1995, a few weeks apart, and censused by strip transects. A total of 85 km was walked in Santa Isabel during six days (10 km in riverine forest, 12 in forest bordering a water reservoir, 29.5 in montane forest, 25.5 in hilltop forest and eight in planted forest with native undergrowth). At Mogi-Guaçu 48.1 km were walked during four days (26 km in gallery forest, 19.6 in *cerradão* and 2.5 in planted forest with native undergrowth). Long distance and contact calls made by marmosets could be detected from a distance of at least 100 m, and the means by which most groups were located involved the use of "playback" of recorded vocalizations. Whenever possible the marmosets were followed, but only at Santa Isabel were they tame enough.

Eight different groups were contacted 12 times at Santa Isabel. Eight contacts were made in hilltop forest, two in valley forest and two in the transition between them, suggesting a selection for the hilltop habitat. At Mogi-Guaçu, three groups were located four times, once in *cerradão* and three times in gallery forest. In this case, we consider the sample size too small to characterize any habitat preference. Overall density at Santa Isabel was 1 group/142 ha and 1 group/240 ha at Mogi-Guaçu, but the latter is probably an underestimate. A low population was also estimated for Barreiro Rico (Milton and Lucca, 1984).

In a previous visit to Mogi-Guaçu on 29 April 1988, three different groups were located, one in gallery forest and two in planted forest with native undergrowth. One of the groups was crossing a road from an old *Eucalyptus* grove to native forest. From this observation it is clear that *C. aurita* can use planted forest at least as corridors for moving between habitat patches and, probably, for foraging when there is enough native vegetation growing in the undergrowth.

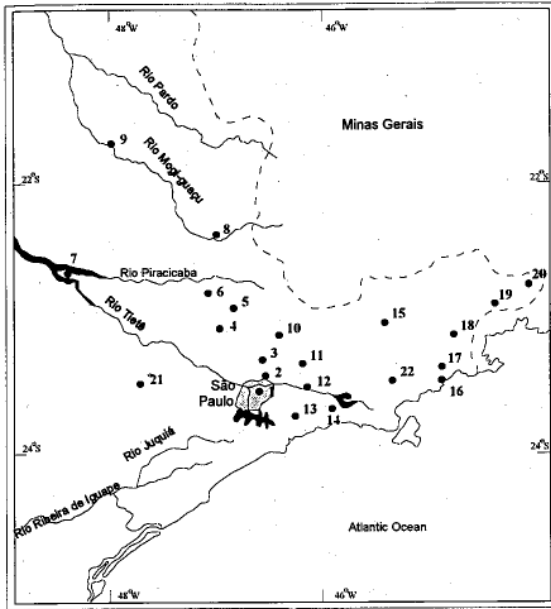


Figure 1. Distribution of *Callithrix aurita* in São Paulo state, Brazil, and other localities cited in the text. 1 - São Paulo city (e), 2 - Serra da Cantareira (c), 3 - Mairiporã (c), 4 - Serra do Japi (?), 5 - Itatiba (?), 6 - Campinas (e), 7 - Fazenda Barreiro Rico (c), 8 - Mogi-Guaçu (c), 9 - Jataí (*C. penicillata* present), 10 - Atibaia (c ?), 11 - Santa Isabel (c), 12 - Mogi das Cruzes (c), 13 - Alto da Serra (c), 14 - Boracéia (c ?), 15 - Taubaté (?), 16 - Ubatuba (?), 17 - Serra do Mar (?), 18 - Cunha (c), 19 - Posse (c ?), 20 - Bananal (c), 21 - Araçoiaba da Serra (type locality of *Leontopithecus chrysopygus*), 22 - São Luis de Paraitinga (c). c - currently found in the area, e - locally extinct. ? - status uncertain.

Group sizes at Santa Isabel were 4, 5, 5, 5, 6, 7, 8 and 11. Five groups observed at Mogi-Guaçu in 1988 and 1995 had 4, 5, 5, 6 and 8 individuals. Group composition could not be assessed. No dependent infants were seen at Mogi Guaçu. At Santa Isabel two groups had infants beginning to move independently, one in a group of five, and two in a group of eight.

At Santa Isabel, the marmosets were observed probing for invertebrates in mounds of leaves in vine tangles and among the roots of an epiphytic Araceae. They were also observed feeding on the fruits of *Protium cf. widgrenii* (Burseraceae), *Ficus organensis* (Moraceae), *Myrcia rostrata* (Myrtaceae), *Prunus sellowii* (Rosaceae) and *Matayba oleaginoides* (Sapindaceae). Two trees of the gum-producing legume *Piptadenia gonoacantha* were found in an area used by a marmoset group with holes probably produced by marmosets, but gum-eating was not actually observed. Crescent-shaped holes and scars were also found to cover most of the trunk of two *Tapirira guianensis* in a riverine forest patch at Mogi-Guaçu. These observations suggest that *C. aurita* feed on gums, as indicated by Torres de Assumpção (1983).

Conservation

Callithrix aurita is presently known from five protected areas in São Paulo: Cantareira State Park, Mogi Guaçu Ecological Station (including the contiguous Biological Reserve), Bananal Ecological Station, Núcleo Cunha of the Serra do Mar State Park and Serra do Itapety Municipal Park. Of these, the largest is Cantareira, with 5,800 ha.

The largest continuous forest fragment where the species is known to occur in São Paulo is a 50 km stretch along the southern Serra da Mantiqueira, from Santa Isabel west to the Serra da Cantareira, and north to Atibaia. The habitat is best preserved along the Cantareira-Santa Isabel axis, where the forest is still continuous, but it is fragmented towards Atibaia and in the peripheral areas. Both Mogi-Guaçu and Barreiro Rico are small and isolated, and may not have viable populations.

The main threat to the survival of the species is habitat fragmentation by real estate enterprises, mainly weekend and small holiday estates, and closed condominiums, and the introduction of other *Callithrix* species from releases made by wildlife officers. Parts of the Cantareira park have also been occupied by shantytowns, and invasions by homeless people are common. Despite the fact that most of the area has some degree of legal protection as an Environmental Protection Area, effective protection and management of the forested areas is wanting. Introduced marmosets occur both at Cantareira and Serra do Japi, threatening the native species with competition and hybridization.

With continuous pressure from people wanting to live in more pleasant locations than São Paulo city, and the growth of the now 12 million inhabitant-megalopolis toward the Serra da Cantareira, long-term viability of the best *Callithrix aurita* habitat so far known in the state, and of most of the known populations, remains uncertain.

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A NEW RECORD FOR *CALLITHRIX MAUESI* MITTERMEIER, SCHWARZ & AYRES, 1992

The Rio Maués marmoset (*Callithrix mauesi*) was recently described by Mittermeier *et al.* (1992), based on one specimen deposited in the scientific collection of the Museu Paraense Emílio Goeldi (holotype:

MPEG-22177) and two social groups in the wild, including seven live animals captured and the birth in captivity of two infants in the collection of Marco Schwarz. The new species was placed in the tasseled subgroup of the *Callithrix argentata* species group (Hershkovitz, 1977; Vivo, 1991; Mittermeier *et al.*, 1992). This was due to it being considered a close relative of *C. humeralifera* and *C. chrysoleuca*, and presenting as diagnostic features the shape and placement of the ear tufts and their erect, "neatly trimmed" appearance, the dark fur coloration, the absence of the characteristic light mantle of *C. humeralifera*, and the light orange tint to the underparts.

All specimens cited by Mittermeier *et al.* (1992) originated from the type locality, on the left bank of the Rio Maués-Açu (a widening of the Rio Maués), opposite the town of Maués, Amazonas state, Brazil (0323°S, 5746°W). Based on information from local people in 1985, the authors presumed that the species occurred in the area between the Rios Maués, Paraná Urariá, and Abacaxis. During a recent expedition to the region, a new locality record was obtained for this species, confirming in part the proposed range (Fig. 1). Three adult specimens, a male and two females (MPEG-23962, 23963, 23964), were collected at the locality of Santa Maria, right bank of the lower Rio Abacaxis, municipality of Nova Olinda do Norte, Amazonas state (0354°S, 5846°W). The material included skins and skulls, skeletons, endoparasites, and blood and liver samples for genetic

studies, as well as stomach and intestinal contents. The gut measurements were also taken. The marmosets were in a small patch of secondary forest, near a guaraná (*Paulinia cupana*) plantation. *C. mauesi* was particularly abundant in this area (Silva Jr. and Noronha, in prep.). Although it was not possible to visit the area, local people also reported the occurrence of *C. mauesi* in the vicinity of the town of Abacaxis, right bank of the Rio Abacaxis (0355°S, 5845°W), a few kilometers below Santa Maria. Locals, including a hunter, reported its absence however, from São João, left bank of the Rio Marimari, near its confluence with the Rio Abacaxis (0357°S, 5848°W), and two other places on the left bank of the Rio Abacaxis, opposite Santa Maria. This suggests that the Rio Abacaxis is the limit to its range in the southwest. *C. mauesi* may be partially sympatric with a newly described species of bare-eared marmoset (Silva Jr. and Noronha, in press) on the right bank of the Rio Abacaxis, according to information obtained from the localities of Abacaxis and Santa Maria cited above, and also based on the data available for the paratypes of the new species (MPEG-23959, 23960), originating from the locality of Terra Preta, right bank of the middle Rio Abacaxis (0449°S, 5826°W). However, this remains to be demonstrated.

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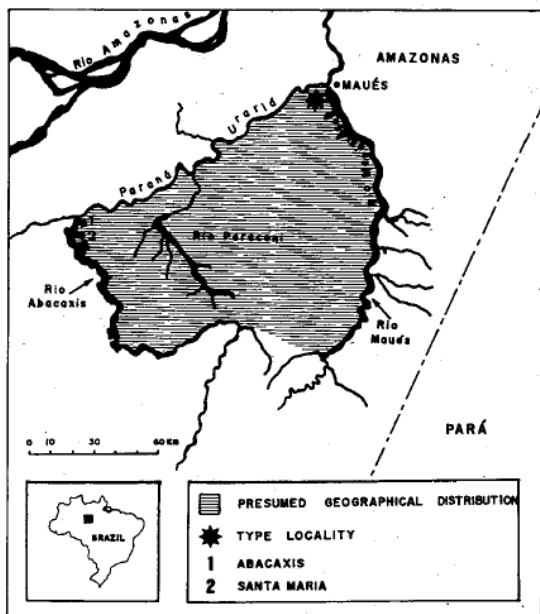


Figure 1. Available data on the geographic distribution of *Callithrix mauesi*, based on Mittermeier *et al.* (1992) and the new records.

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PRIMATES AND CONSERVATION IN THE GUAJARÁ-MIRIM STATE PARK, RONDÔNIA, BRAZIL

Located in western Rondônia (Fig. 1), the 258,000 ha Guajará-Mirim State Park was decreed in 1990. The Park is just over 200 km south-west of the Samuel Ecological Station, the primate fauna of which is well-known from the rescue operation during the construction of the Samuel Hydroelectric Reservoir (Schneider *et al.*, 1990). Seven diurnal primates are found at Samuel, including *Saguinus fuscicollis* which has a distribution otherwise restricted to the west of the Rio Madeira (Hershkovitz, 1977), but excluding howler monkeys, *Alouatta*.

An equivalent primate community was encountered on the west or left bank of the Rio Jiparaná at Calama, 100 km northwest of Samuel (Fig. 1), but not east of this river, which plays a role in the zoogeography of at least five platyrrhine genera (Ferrari and Lopes, 1992). As no major river or other geographic barrier apparently separates these two sites from Guajará-Mirim, an equivalent primate community would be expected at this site. However, while seven diurnal monkeys were also observed during the preliminary survey at Guajará-Mirim in August 1995 reported here (Table 1), the composition of the primate community was different from that at the two sites described above, with the addition of howler monkeys, *Alouatta seniculus*, and omission of marmosets, *Callithrix emiliae*. The absence of *Callithrix* was confirmed in

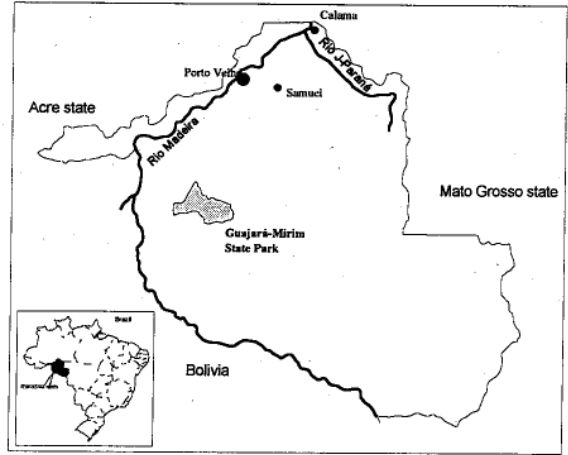


Figure 1. Location of the Guajará-Mirim State Park, Rondônia, Brazil.

interviews with local residents, although the possibility of marmosets occurring in areas of the Park not visited during the survey cannot be ruled out altogether.

The differences between these communities raise a number of interesting questions with regard to the ecology and zoogeography of primates in southwestern Amazonia, in particular because both *Alouatta* and *Callithrix* are among the most ecologically versatile of the platyrrhines.

One factor that may be important in the case of *Callithrix* is competition with a second callitrichine, *S. fuscicollis* (see Lopes and Ferrari, 1994), combined with differences in habitat quality, similar to those that may determine the distribution of *Callithrix argentata* east of the Rio Xingu (Ferrari and Lopes, 1990). Primary forest habitat observed at Guajará-Mirim appeared, qualitatively, to be of lower stature, more open, and more deciduous than that at Samuel, as might be expected from respective differences in latitude, altitude, and precipitation. However, while competition with a second ateline (*Ateles chamek*) may - at least potentially - be a factor, it is unclear how these same differences in habitat quality might have the opposite effect on the distribution of *Alouatta seniculus*.

Far more data are needed before a more definitive analysis of such factors will be possible, but the present study does indicate that *Callithrix* is less widely distributed in western Amazonia than was previously thought (Rylands *et al.*, 1993), and that *S. fuscicollis* is more widespread.

The Guajará-Mirim State Park has, until very recently, been isolated from areas of human colonization, but

Table 1. Diurnal primates observed in the Guajará-Mirim State Park Rondônia.

- Alouatta seniculus*
- Ateles chamek*
- Callicebus brunneus*
- Cebus apella*
- Pithecia irrorata*
- Saguinus fuscicollis weddelli*
- Saimiri (sciureus) ustus*

logging roads and land clearance are now encroaching on its western limits, and the state government is planning the construction of a highway that will bisect the Park, with predictable consequences (Fearnside and Ferreira, 1984). For the time being, at least, there appears to little habitat disturbance or hunting within the Park's boundaries. Spider monkeys (*A. chamek*) were in fact the most frequently-observed primates, and large-bodied frugivorous birds such as cracids (*Mitu, Penelope*) and macaws (*Ara ararauna, Ara macao*) were apparently abundant. *S. fuscicollis*, on the other hand, was sighted less than half as often as *Ateles*, and mainly in disturbed forest adjacent to the Park's accommodation.

The fieldwork reported here was supported by the United Nations Development Program (PNUD) and the Secretaria de Estado do Desenvolvimento Ambiental (SEDAM), Rondônia. We would also like to thank Izael F. da Silva and Juvenal D. Fernandes.

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REINTRODUÇÃO: UMA FERRAMENTA CONSERVACIONISTA OU BRINQUEDO PERIGOSO?

Minha resposta a questão proposta no título é "ambos". A reintrodução já salvou várias espécies da extinção (Conway, 1989) e seu valor como uma ferramenta conservacionista é indiscutível. No entanto, neste artigo, gostaria de enfatizar o lado negro das reintroduções para evitar que elas se tornem uma atividade rotineira (por exemplo, Agoramoorthy, 1995). Nada do que será discutido aqui é novo. A União Mundial de Conservação (IUCN) tem diretrizes explícitas sobre as situações em que as reintroduções devem ou não ser utilizadas (IUCN, 1987). Neste artigo, uso "reintrodução" no sentido amplo que inclui aumento de estoques já existentes.

Existem vários aspectos negativos sobre a soltura de animais em áreas em que a espécie já existe. Estes incluem a ruptura de relações sociais já existentes, a exclusão de indivíduos quando a população está próxima à capacidade de suporte do ambiente, e a degradação do habitat por populações mantidas artificialmente densas. No entanto, gostaria de focar o problema das doenças, porque este tem a maior chance de provocar catástrofes (Viggers *et al.*, 1993).

Somente agora as doenças transmitidas ao ser humano por primatas estão chamando atenção do público. É importante lembrar que as doenças podem ser transmitidas também em sentido inverso, como é o caso de tuberculose em chimpanzés (Viggers *et al.*, 1993). Doenças que normalmente não causam conseqüências sérias para as populações (mas não necessariamente para indivíduos) podem ser críticas quando a população também está sendo impactada pela destruição de seu habitat.

As pessoas que estão soltando os animais alegam que eles são *aparentemente* saudáveis. Porém, muitas doenças que podem ser fatais sob condições naturais de stress climático e nutricional, podem não apresentar sintomas em cativeiro. A tuberculose no homem é um caso clássico. Estima-se que 30% da população seja portadora do bacilo sem apresentar sintomas. No entanto, sob condições de desnutrição, como acontece em épocas de guerra, epidemias assustadoras são desencadeadas.

A declaração de que o animal foi submetido a um exame veterinário prévio à soltura não invalida este argumento. Potencialmente, estamos tratando de doenças cujos sintomas são desconhecidos. Nenhum médico do mundo poderia ter identificado o vírus HIV nos primeiros portadores assintomáticos. Mesmo depois do aparecimento de milhares de pessoas com sintomas de AIDS, passaram-se anos até o vírus ser isolado. Exames veterinários são artificios utilizados para *reduzir* o risco quando nós já julgamos que os benefícios da introdução são potencialmente muito maiores que o risco de causar a extinção da população/espécie.

O fato de a espécie ser comum e de ampla distribuição não indica que a doença não afetará a população. Os coais da Austrália são dizimados regularmente por epidemias em vastas áreas e os efeitos da "rinderpest" nos ungulados africanos é bem conhecido. Na pior das hipóteses, uma espécie comum pode se recuperar mas, ao longo do processo, transmite a doença para espécies raras e ameaçadas.

Qual é a possibilidade de uma dada introdução desencadear uma epidemia catastrófica? Certamente é menor que um em vários milhares. Isto justificaria a soltura? Somente se ignoramos a estatística. A realidade é que, a cada ano, milhares de animais estão sendo presos e doados. Individualmente, a soltura de cada um representa pouco risco. Em conjunto, elas representam um dos maiores perigos para as populações silvestres de primatas. Os primatólogos neotropicais deveriam assumir as diretrizes da UICN para tentar reduzir os riscos.

As reintroduções e o aumento de estoques de algumas espécies, como os micos-leões, precisa continuar. Em alguns casos, a soltura de uma espécie comum para testar a metodologia antes de tentar com a espécie ameaçada é aconselhável. No entanto, a soltura rotineira de indivíduos em desacordo com as diretrizes da UICN deveria ser desestimulada.

Ninguém quer sacrificar um indivíduo, especialmente um primata. Porém, muitas vezes, do ponto de vista da conservação de espécies e a manutenção da biodiversidade, esta é a atitude mais apropriada. Até do ponto de vista educacional, sacrificar o animal pode ser recomendável. A pessoa que tira um animal da natureza ou estimula a prática através do comércio nas feiras deveria sentir o gosto amargo de ter acabado com a vida biológico do indivíduo. Soltar o animal na natureza para ameaçar os estoques selvagens não deve substituir esse gosto amargo pela sensação de ser um herói que está ajudando a espécie sobreviver.

O aparecimento de animais nas ruas dos bairros da periferia da cidades é sinal de que seus habitats naturais estão sendo destruídos. Levá-los para outras áreas e soltá-los talvez resolva problemas políticos e emocionais mas a ação é neutra ou negativa em termos de conservação.

As seguintes prioridades são recomendadas para pessoas e órgãos que recebem primatas ou outros animais silvestres:

- 1) Tentar alojar o animal num zoológico que participe de um programa de reprodução em cativeiro. Isto é fácil para todos as espécies ameaçadas de extinção.
- 2) Entregar o animal para um grupo que está tentando recuperar a espécie através de um plano de manejo que esteja de acordo com as recomendações da UICN. O Instituto Brasileiro do Meio Ambiente (Ibama) pode indicar estes grupos.
- 3) Doar o animal para um instituto de pesquisa para estudos comportamentais, fisiológicos, morfológicos ou taxonômicos.
- 4) Sacrificar o animal e se descartar do cadáver sob orientação veterinária.

Quando a soltura do animal é realizada por razões emocionais ou políticos do tipo "para inglês ver", os praticantes devem ser explícitos sobre seus motivos e não tentar implicar valor conservacionista na ação. Inclusive, eles deveriam ter a coragem de admitir que preferem que o animal morra na natureza com os riscos concomitantes para a espécie, ao invés de assumir a real responsabilidade pelo manejo da vida silvestre.

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News

BEHAVIORAL ECOLOGY STUDY OF RED UAKARI, *CACAJAO CALVUS UCAYALII*, IN NORTHEASTERN PERU

A long-term behavioral ecology study of red uakari (*Cacajao calvus ucayalii*) was begun in April 1993 in northeastern Peru, approximately 110 km south of Iquitos, along the Quebrada Blanco and adjacent to the Reserva Comunal Tamshiyacu-Tahuayo (see Aquino, 1995). The principal investigator of this project, Suzi Leonard, works under the auspices of the Detroit Zoological Institute, and under the direction of Cynthia Bennett, Research Zoologist at the Dallas Zoo. The project was initiated in cooperation with I.V.I.T.A./The Peruvian Primate Project, and continues in conjunction with the biological science departments of the Universidad Nacional de La Amazonia Peruana in Iquitos.

This subspecies of uakari has been little studied in the wild. The critical information on the species comes from the work of Ayres (1986) with the white uakari (*C.c.calvus*) in Brazil. Ayres' long-term uakari work gives this species as a flooded-forest specialist. Our findings indicate that the red subspecies in our study area spend at least part of their time in terra firme forests. During the 1500+ hours searching for and following red uakari, we have totaled 270+ contact hours with the animals over 14 months (April 1993 - December 1995). All of these contact hours were in terra firme forests (following Encarnación, 1985). The approximately 90 km study area abuts flooded forest on the west, and possibly on the south, and the uakari may be spending time out of the study area in these locations. Based on search time versus contact time, we know these groups use immense ranges. Day range lengths averaged 7.3 km.

During four months in 1994, we totaled 151.5 hours of behavioral scans on red uakari groups, taken at 15-minute intervals (Altmann, 1974). Interestingly, almost 30% of those scans caught the uakari in association with other species of primates; and 76% of their associative time was with woolly monkeys (*Lagothrix lagotricha*). During the next two years, we will be concentrating on the food selection of both the uakari and the woollies, in and out of polyspecific groups, in an attempt to determine whether there is a resource advantage to association for one or both species. We also predict that, in an area where large

eagles, including the harpy eagle (*Harpia harpyja*) still prey on primates (pers. obs.), avian predator protection (Struhsaker, 1981) may prove influential in uakari-woolly monkey decisions to associate.

In July 1995, with the aid of Kenneth Glander (Duke University Primate Center), Fred Koontz (Wildlife Conservation Society), and Wendy Westrom (DVM), we will be radio-collaring several uakari. Hopefully, telemetry will improve our contact time, help us to define home range boundaries, and identify individuals for edification of social systems.

Acknowledgments: This project would have been impossible without the strong encouragement of Dr Ron Kagan, Director of the Detroit Zoological Institute. We thank Filomeno Encarnación for his botanical expertise, and Rolando Aquino for his strong field work. Both are experienced biologists with IVITA, Peru. In the field, we would have been lost without the help of three outstanding assistants, Jeisen Shahuano, Hugo Huanacquiri, and Robert Piñedo.

Suzi Leonard, Apartado 668, Iquitos, Peru, and **Cynthia Bennett**, The Dallas Zoo, 621 East Clarendon Drive, Dallas, Texas 75203-2996, USA.

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BLACK LION TAMARINS IN THE CENTRAL PARK WILDLIFE CENTER, NEW YORK



Four black lion tamarins, *Leontopithecus chrysopygus*, are settling into their new home in the Central Park Wildlife Center, New York, USA. They are the first to be imported into North America. Efforts have been made to provide a varied and stimulating environment for both pairs, one of which is on exhibit, while the second pair remains behind the scenes. The black

lion tamarin exhibit, located in the Tropic Building, features trees with special feeding holes. Keepers place fruit, meal worms, and other foods into different combinations of holes each day to stimulate the tamarins to search for their meals. The exhibit also includes vines for climbing which can be moved around for variety. Similar environmental enrichments are also provided to the pair off exhibit.

In addition to providing the black lion tamarins with a stimulating environment, the Central Park Wildlife Center aims to educate the public about the threats to this species. Graphics explain that the endangered status of the black lion tamarin is due to the destruction of their rain forest home. The Wildlife Center also has two other types of tamarins, the cotton-top, *Saguinus oedipus*, and the golden-headed lion tamarin, *L. chrysomelas*, which also provide opportunities for education. In addition, a stage show presented for zoo visitors uses cotton-top tamarin puppets to educate children about the destruction of the forest, and the importance of saving this environment for tamarins and other animals which live there.

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1994 INTERNATIONAL STUDBOOK FOR THE GOLDEN-HEADED LION TAMARIN

The 1994 Studbook for the golden-headed lion tamarin, *Leontopithecus chrysomelas*, was recently published by the Royal Zoological Society of Antwerp on behalf of the International Recovery and Management Committee for the species. This, the 7th International Studbook, prepared by Helga De Bois, Antwerp Zoo, covers the period 1 January 1994 to 31 December 1994. It contains information on animal identities and locations, sex, parentage, and causes of deaths. In addition, it includes a list of addresses of holders, data on the current demographic and genetic status of the population, and a bibliography. It is maintained in SPARKS, developed by the International Species Information System (ISIS), and is available free of charge from the studbook keeper.

On 31 December 1994, the number of living animals in captivity was 616, distributed through Brazil (245 in 13 institutions), North America (99 in 19 institutions), Europe (233 in 25 institutions) and Asia (39 in two institutions). The number of founders increased from 108 to 160 (33 without living descendants). The percentage growth of the population during 1994 was

6%.

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De Bois, H. 1995. *1994 International Studbook for the Golden-Headed Lion Tamarin* *Leontopithecus chrysomelas*. Royal Zoological Society of Antwerp, Antwerp. 81pp.

EEP STUDBOOK FOR THE EMPEROR TAMARIN

The first international studbook for *Saguinus imperator imperator* and *S. i. subgrisescens* (1991) was compiled by Lee Nesler, Pittsburgh Zoo (Nesler, 1993). The first studbook for the European population of emperor tamarins has now been compiled by the Studbook keeper and EEP Coordinator for the species, Eric Bairrão Ruivo, with assistance from Cristiane Silveira, both of the Lisbon Zoo, Portugal. It was sponsored by Compaq, and covers the entire history of the species in Europe up to 31st December 1994. The emperor tamarin EEP was first approved by the Executive Office of the European Endangered Species Program (EEP) in 1990, and, till 1994, Rob Colley, Pencynor Wildlife Park, was coordinator. Eric Bairrão Ruivo took over in 1994. The Studbook is divided into five sections: A summary of some taxonomic and biological aspects of the species; a full historical listing of the European population; a listing of the living population of the two subspecies by location; a studbook analysis; and an evaluation of the progress, status, and future action of the program for the species in European zoos and animal collections.

The European captive population of *S. i. imperator* has never been sizable. It began in 1962 with just one female, and only in 1976 were three more imported, and in 1977 a further four animals. The population grew to a maximum of 15 individuals in 1983, and declined from there on. On 31 December 1994, there were believed to be four animals (3.1) in Europe, although only one male (in the Frankfurt Zoo) is officially registered. *S. i. subgrisescens* was first registered for Europe in 1964, but no records were kept until 1978. Since then the population has increased to 128 (63.61.4) animals in 35 European institutions. The main problem with this captive population, however, is infant and juvenile mortality (45% mortality in the first year); the reason for a lack of increase in

growth rate since 1978. The founder population is 34 (11 are still alive), and all except three have contributed descendants. The Studbook concludes that the population is still too small for an adequate breeding program. Some founders are over represented, but the coordination recommend that none should have their breeding curbed, although emphasis will be given to encouraging breeding in the under represented lines. The studbook keepers would be most grateful for information on any research projects on captive or wild populations of this species.

Eric Bairrão Ruivo and Cristiane Silveira, Jardim Zoológico de Lisboa, Estrada de Benfica 158-160, 1500 Lisboa, Portugal.

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A STUDY ON THE BEHAVIOR OF ADOLESCENT FEMALE MURIQUIS

Research is being carried out on the migration of adolescent female murequins, *Brachyteles arachnoides*, at the Caratinga Biological Station, Minas Gerais. In murequi groups the proportion of adult females remains nearly constant as a result of the migration of the adolescents, an important feature of the sociodemography of this species (Strier, 1991). The study aims to clarify why females emigrate, and the social mechanisms involved. Data have been collected to answer these, and other related questions, using the observation technique of "focal-animal" (10 minute observation periods), possible due to the tameness of the group under study (see Strier, 1992). Data was collected over 12 months, from August 1994 to July 1995, and has resulted in 1555 focal animal samples. Dr Karen Strier of the Anthropology Department, University of Wisconsin, Madison, USA, and Sandra Hartz, Federal University of Rio Grande do Sul, Porto Alegre, Brazil, are supervising the research, which is supported by a U. S. National Science Foundation Grant (BNS958298), the Liz Clayborne and Art Ortenberg Foundation, the Chicago Zoological Society, and the Lincoln Park Zoo, Chicago.

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VARIABILITY IN CONSTITUTIVE HETEROCHROMATIN IN SOUTH AMERICAN PRIMATES

In March 1995, Júlio César Pieczarka defended his thesis on the nature and variability of constitutive heterochromatin in South American primates. The thesis formed part of the requirements for a doctoral degree in Genetics and Molecular Biology at the Federal University of Rio Grande do Sul, Porto Alegre, Brazil. His supervisor was Dr. Margarete Suñe Mattevi, and the study was supported by the Universidade Federal do Pará (UFPA), the Universidade Federal do Rio Grande do Norte (UFRGS), the Fundação de Amparo à Pesquisa do Rio Grande do Sul (FAPERGS), the Financiadora de Estudos e Projetos (FINEP), the Brazil Science Council (CNPq), the Brazilian Higher Education Authority (CAPES), and Eletronorte (Centrais Eléctricas do Norte SA). The following is a summary of the thesis.

The aim of the work was to assess the distribution and variability of constitutive heterochromatin in 10 platyrrhine primate species, and examine the digestion mechanism of DNA by *in situ* restriction enzymes, in a broad study of the reaction of heterochromatin to these enzymes. The following callitrichids were studied: *Cebuella pygmaea*, *Callithrix geoffroyi*, *C. argentata*, *C. humeralifera*, *C. emiliae*, *Saguinus fuscicollis fuscicollis*, *S. mystax*, and *Leontopithecus rosalia*. These species show constitutive heterochromatin with very different patterns of distribution, despite the similarity of their karyotypes in terms of chromosome number and morphology. Two cebid species were studied: *Aotus* and *Ateles paniscus paniscus*, both of which have considerable quantities of heterochromatin. The determination of correct chromosomal pairs in each karyotype was made by sequenced G/C-banding. The constitutive heterochromatin was analyzed by determining the *in situ* digestion pattern using seven restriction enzymes (*Hinfl*, *Mbol*, *AluI*, *RsaI*, *DdeI*, *HaeIII* and *MspI*), sequenced RE/C-banding, and fluorochrome banding (Chromomicyn A³ and DAPI). This study permitted the following conclusions:

Concerning constitutive heterochromatin in the callitrichids:

a) There are at least four distinct types of constitutive heterochromatin in *Callithrix geoffroyi*; three in *C. argentata*, *C. humeralifera*, and *C. emiliae*; four in *Cebuella pygmaea*; five in *Saguinus f. fuscicollis*; three in *S. mystax*; three in *Leontopithecus rosalia*; and three in *Ateles paniscus* and *Aotus*.

b) The comparative study of bands in the callitrichid genera shows that their size and position remain unaltered during the evolution of the groups, but not their composition.

c) Chromosomes with rearrangements that some taxa have different heterochromatic compositions in their alternative forms.

d) The composition of distal heterochromatin in callitrichids suggests a unique origin. It is possible that this constitutive heterochromatin was originally accumulated in the distal band of the short arm of chromosome 6.

Comparing the performance of each enzyme in the digestion of the heterochromatin in callitrichids;

a) The *AluI* enzyme showed more intensive digestion than the others in the study of the centromeric heterochromatins in banded chromosomes.

b) None of the restriction enzymes used in this study showed significant digestion of the centromeric heterochromatins of acrocentrics.

c) The enzyme *RsaI* digested the distal constitutive heterochromatin found in all four callitrichid genera, showing a common origin for the heterochromatin.

d) The differential sensitivity to the other enzymes of the distal heterochromatin of the various taxa indicated that homogeneity is not complete in callitrichids.

The heterochromatin observed in some of the cebid taxa (*Ateles p. paniscus* and *Aotus* studied here, as well as *Saimiri*, *Cebus*, *Alouatta*, and *Chiropotes*) is equilocally distributed as it is in the callitrichids.

Analyzing the heterochromatin of Platyrrhini in a phylogenetic perspective, it was found that sensitivity to *AluI* is a characteristic common to the constitutive heterochromatin of all. The callitrichids are still sensitive to *RsaI*, whereas the cebids are sensitive to *HinfI* and resistant to *RsaI*. Amongst the callitrichids, *Saguinus* shares with the cebids the largest amount of the various types of constitutive heterochromatin.

The following was observed comparing the banding patterns, obtained with restriction enzymes, to C-banding produced by Barium hydroxide:

a) Variation in both the size of the band and its position.

b) There are bands observed only with *AluI*, with no correspondence in C-banding: cryptic bands.

c) There are C-bands with no correspondence to traditional heterochromatin regions.

Relating the structure of a given heterochromatin and its localization in the karyotype:

a) In most species the heterochromatic bands can be separated into four types, each with distinct characteristics: centromeric bands in banded chromosomes; centromeric bands in acrocentric bands; distal bands; and interstitial bands.

b) The centromeric bands of banded chromosomes are distinguishable from the centromeric bands of acrocentrics with regard to their composition. The former show heterogeneity, and the latter homogeneity.

c) As a rule, the distal bands are homogeneous, or at least show a clear common origin, whereas the interstitial bands are heterogeneous.

d) The degree of homogeneity of some bands must be produced by concerted evolution.

e) The destination of a specific constitutive heterochromatin will be defined by its localization in the karyotype. There are different chromosomal domains where the heterochromatins remain isolated from each other.

By comparing the data obtained in this study to the current hypothesis on equilocality, it is possible to conclude that the existence of nearly identical karyotypes with radically different distributions of heterochromatin eliminates some models that attempt to explain these distributions on the basis of interphase chromosomal configuration or on the types of rearrangements that would have occurred in the chromosomal evolution of the taxa.

Regarding the banding mechanisms by restriction enzymes:

a) *In situ* differential digestion of a given chromosome segment by a restriction enzyme is due to the distribution of cutting sites and to molecular interactions between DNA and the chromosomal components.

b) The use of sequenced C-banding made it possible to distinguish situations where a region was effectively digested by the enzyme from those where it merely produced a negative G-banding pattern.

Júlio César Pieczarka, Departamento de Genética, Centro de Ciências Biológicas, Universidade Federal do Pará, Campus do Guamá, 66075-110 Belém, Pará,

Brazil.

Reference

Pieczarka, J. C. 1995. A Natureza e a Variabilidade de Heterocromatina Constitutiva em Primatas Sul-Americanas. Unpublished Doctoral Thesis, Universidade Federal do Rio Grande do Sul, Porto Alegre. 202pp.

CHROMOSOMAL RELATIONS AND PHYLOGENETIC AND PHENETIC ANALYSES IN THE CALLITRICHIDAE

In March 1995, Cleusa Yoshiko Nagamachi defended her thesis on chromosomal relations and the phylogeny of the Family Callitrichidae. It formed part of the requirements for a doctoral degree in Genetics and Molecular Biology at the Federal University of Rio Grande do Sul, Porto Alegre, Brazil. The study was supervised by Dr. Margarete Suñe Mattevi, and supported by the Universidade Federal do Pará (UFPA), the Universidade Federal do Rio Grande do Norte (UFRGS), the Fundação de Amparo à Pesquisa do Rio Grande do Sul (FAPERGS), the Financiadora de Estudos e Projetos (FINEP), the Brazil Science Council (CNPq), the Brazilian Higher Education Authority (CAPES), and Eletronorte (Centrais Elétricas do Norte SA). The following is a summary of the thesis.

This study comprised the first broad inter- and intragenetic cytogenetic (G, C, G/C and NOR banding) and cytotaxonomic study of the family Callitrichidae, including representatives of all four genera: *Cebuella pygmaea*; *Callithrix argentata* group (*C. argentata*, *C. emiliae*, *C. chrysoleuca*, *C. humeralifera*, and *C. mauesi*); *Callithrix jacchus* group (*C. aurita*, *C. geoffroyi*, *C. jacchus*, *C. kuhli*, and *C. penicillata*); *Leontopithecus* (*L. chrysomelas*, *L. rosalia*); and *Saguinus* (*S. midas midas*, *S. m. niger*). The aim was to characterize each species, group, and genus in terms of their chromosomes, as well as to determine the types of chromosomal rearrangements that have occurred in the karyotypic differentiation of the members of the family. The results were converted to numeric data and submitted to phenetic and cladistic analyses to determine phylogenetic relationships and clusters among the callitrichids. The phenetic analysis was performed using the NTSYS-pc program (UPGMA method) and the cladistic analysis with the NTSYS-pc (NJ method) and PAUP programs. *Cebus apella* was used as an outgroup in the cladistic analysis. The results obtained allow for the following conclusions.

- 1) Callitrichids share nearly all the euchromatic chromosome segments.
- 2) Considering only the euchromatic portion, within species groups and genera were all found to be homosequential, with no chromosome rearrangement differentiating their karyotypes.
- 3) Chromosomal rearrangements were found which differentiated groups and genera, with five distinct karyotypes as follows: a) a reciprocal translocation differentiates *Cebuella* ($2n = 44$) from the *Callithrix argentata* group ($2n = 44$); b) a centric fusion/fission rearrangement and a paracentric inversion differentiate both *Cebuella* and the *C. argentata* group from the *Callithrix jacchus* group ($2n = 46$); c) a reciprocal translocation and a paracentric inversion differentiate *Leontopithecus* ($2n = 46$) and *Saguinus* ($2n = 46$) from the *C. jacchus* group; and d) *Saguinus* diverges from all others by a paracentric inversion and pericentric inversions in at least three pairs of acrocentric autosomes.
- 4) The variations in the content of chromosomal material are due to differences in the amount of noncentromeric constitutive heterochromatin, the distribution patterns of which are characteristic in each group or genus. This suggests that the accumulation mechanisms of these constitutive heterochromatins might have occurred after the differentiation of the distinct group comprising the callitrichids.
- 5) The phenetic and cladistic analyses separate the genus *Cebus* from the callitrichids, which form a clade. In the callitrichids, the results show that the marmosets (*Cebuella* and *Callithrix*) form a subclade: *Cebuella* and the *C. argentata* group being more closely related to each other than to the *C. jacchus* group. *Leontopithecus* and *Saguinus* are also very closely related, indicating that, if not derived from each other, they share a close common ancestor. *Leontopithecus* are karyotypically closer to the marmosets (*C. jacchus* group) than is *Saguinus*.
- 6) On the basis of information obtained from chromosomes, and taking into account the evolutionary pathways, it was possible to suggest the karyotype of an ancestor, as well as proposals for the origin, differentiation and dispersion of the callitrichids. If evolution occurred in the direction of a body size increase (primitive hypothesis), the ancestral form would have a karyotype similar to those of marmosets. If, on the other hand, evolution was in the direction of a body size decrease (phyletic dwarfism), the karyotype of the ancestor would be similar to those of tamarins. Both are chromosomally plausible. However, when taking into account the current distributions of the callitrichids, the proposal involving phyletic dwarf-

ism is the more probable.

Cleusa Yoshiko Nagamachi, Departamento de Genética, Centro de Ciências Biológicas, Universidade Federal do Pará, Campus do Guamá, 66075-110 Belém, Pará, Brazil.

Reference

Nagamachi, C. Y. 1995. Relações Cromossômicas e Análises Filogenética e de Agrupamento na Família Callitrichidae (Platyrrhini, Primates). Unpublished Doctoral Thesis, Universidade Federal do Rio Grande do Sul, Porto Alegre. 181pp.

CYTOGENETICS, CHROMOSOMAL EVOLUTION, RADIATION AND SPECIATION IN SPIDER MONKEYS

In 1994, Manuel Alfredo Araujo Medeiros completed his Master's thesis on cytogenetics, chromosomal evolution, radiation and speciation in *Ateles*, for the Postgraduate Course in Biological Sciences (specialization in Genetics) of the Federal University of Pará and the Emilio Goeldi Museum, Belém, Pará, Brazil. It was supervised by Dr. Regina Maria de Souza Barros, and supported by the Brazil Science Council (CNPq), the Brazilian Higher Education Authority (CAPES), and the Universidad Autonoma de Barcelona (UAB), Spain. The Emilio Goeldi Museum, Belém, The Center for Forest Warfare Instruction (CIGS), Manaus, the National Primate Center, Belém, the Teresina Zoo, Piauí, and the Barcelona Zoo, Spain, kindly provided material for the cytogenetic study of the spider monkeys. The following is a summary of the thesis.

The karyotypes were studied of 22 spider monkeys of four subspecies: *Ateles paniscus paniscus*, *A. p. chamek*, *A. belzebuth hybridus*, and *A. b. marginatus* (following the taxonomy of Kellogg and Goldman, 1944). Four cytogenetic techniques were used: conventional staining, G and C banding, and NOR staining. The data obtained concerning karyotype structure and chromosomal variation were compared to that available in the literature. The results of the analyses, and in particular the geographic variation in chromosomes 6, 7, and 4/12, indicate that *A. p. chamek* represents the most primitive form of the genus, which would have originated in the southwestern Amazon basin and spread eastwards, founding the ancestral population of *A. b. marginatus*, and northwest, giving rise to *A. b. belzebuth*. The taxa found to the west of the Andes would in this case have been derived

from the ancestral populations of *A. b. belzebuth*. *A. p. paniscus* is almost certainly derived from the ancestral populations of *A. b. hybridus*.

The peripheral radiation of *Ateles* in the Amazon basin can be partially accounted for by a number of different models of biogeographic evolution, although the relative distribution of the northernmost taxa and the phylogenetic relationships between them, based on cytogenetic data, indicate that significant changes occurred in the distribution of forests during the Pleistocene.

It was not possible to define the taxonomic status of the *Ateles* forms studied here, although *A. p. paniscus* appears to be a monotypic and reproductively isolated from all other populations. The results of this study nevertheless confirm the need for a taxonomic revision of the genus, given that at least four karyotypically distinct groups were identified: 1) *A. geoffroyi* and *A. belzebuth hybridus*; 2) *A. fusciceps rufiventris* and possibly *A. f. fusciceps*; 3) *A. belzebuth belzebuth*, *A. paniscus chamek*, and *A. belzebuth marginatus*; and 4) *A. paniscus paniscus*.

Manuel Alfredo A. Medeiros, Departamento de Biologia, Universidade Federal do Maranhão, Largo dos Amores 21, Centro, 65020-240 São Luis, Maranhão, Brazil.

References

- Kellogg, R. and Goldman, E. A. 1944. Review of the spider monkeys. *Proc. U. S. Nat. Mus.* 96: 1-45.
 Medeiros, M. A. A. 1994. Citogenética, Evolução Cromossômica, Radiação e Especiação dos Macacos-Aranha (*Ateles*, Primates). Unpubl. Master's Thesis, Universidade Federal do Pará, Museu Paraense Emílio Goeldi, Belém, Pará. 137pp.

PUTTING PRIMATES IN THE CLASSROOM

The Primates, a four-part slide set that takes full advantage of young people's interest in monkeys, apes, and the environment, is available for teachers to use in their classrooms. Drawing on the library and resources of the Wisconsin Regional Primate Research Center, this set introduces the topics of primate behavior, primate conservation, primate taxonomy, and field work. Accurate and accessible, each part contains 72 slides with accompanying annotated script, suggestions for classroom activities, bibliographies and other supporting materials. *The Primates* has been tested in schools and revised at the suggestion of middle and high school teachers. The set is also easily adaptable for use in introductory classes at the

undergraduate level, and can be used for staff training in zoological gardens and primate facilities. The four parts are:

Behavior of Social Animals examines the social lives of primates (including humans). Topics covered include the interactions of infants with their mothers; the kinds of social groups in which primates live; how primates communicate; friendly and unfriendly behavior; and how infants become part of a social group. Examples are drawn from more than 20 species of primates.

Conservation of Endangered Species explores how primates use their habitat, and how threats to the habitat have caused most primate species to become threatened or endangered. Two conservation projects which successfully incorporate education, benefits for the local population, and habitat preservation, are examined in detail.

Taxonomic Classification introduces the common features that characterize the Order Primates. Included in the set are photos of members of each major group of primates: Prosimians (eight species), New World monkeys (12 species), Old World Monkeys (14 species), and Apes (six species). Maps and graphics illustrate the geographic distribution and classification of group.

Field Work - Integrating Research and Conservation focuses on selected topics in conservation biology, illustrating the ways which three primatologists doing field work with lemurs, marmosets, and gorillas integrate their research studies with species conservation needs.

The Primates was developed through a grant from the Center for Biology Education, University of Wisconsin, Madison, and with additional support from the American Society of Primatologists. Due to copyright restrictions, *The Primates* is not currently for sale, but is available on loan from the Wisconsin Regional Primate Research Center Library Audiovisual Service. Each part is available for a 14-day loan via mail for a US\$10.00 service fee. *The Primates* may be borrowed at no cost by individuals picking it up on site. For more information, or to request these materials, contact Ray Hamel, Special Collections Librarian, Wisconsin Regional Primate Research Center, University of Wisconsin, 1220 Capitol Court, Madison, Wisconsin 53715-1299, USA. Tel: (608) 263-3512, e-mail: hamel@primate.wisc.edu.

FUNDAÇÃO FLORESTA AMAZÔNICA

A Fundação Floresta Amazônica, com sede em Manaus, implantou com a colaboração do Instituto



Brasi-leiro do Meio Ambiente e dos Recursos Naturais (Ibama), o Centro de Reabilitação de Primatas da Amazônia

(CRPAM). Este Centro é destinado a canalizar esforços para preservar, proteger e estudar os primatas da região. Atualmente trabalha como uma entidade maximizadora de pesquisas multidisciplinares na área da primatologia (genética, parasitologia, comportamento, inventários faunísticos). O programa principal trata do desenvolvimento de técnicas para reabilitação e reintrodução de primatas apreendidos do comércio ilegal de fauna, assim como para os nascidos no Programa de Reprodução em Semicativeiro de Primatas Ameaçados de Extinção (PRSCPAE).

A meta a ser alcançada com esta iniciativa é ampliar os conhecimentos sobre manejo de populações, através do aperfeiçoamento das técnicas de reabilitação, reintrodução e translocação para primatas neotropicais, o que representará uma esperança de ajuda para as espécies ameaçadas. Atualmente possuímos indivíduos de 18 espécies de primatas, na sua maioria em semi-liberdade. Atenção especial está sendo dada às espécies *Lagothrix lagotricha* e *Cebus apella*.

Projetos que são especialmente pertinentes incluem os seguintes: 1) o desenvolvimento de técnicas para manejo de populações; 2) o estudo do comportamento, servindo como base para avaliação das técnicas de manejo empregadas; e 3) fisiologia reprodutiva. Para maiores informações e propostas de projetos: contatar Maurício de Almeida Noronha, Coordenador do CRPAM.

Maurício de Almeida Noronha, Fundação Floresta Amazônica, Rua dos Jatobás 142, Coroado III, 69085-380, Manaus, Amazonas, Brasil. Tel/Fax: + 55 092 644-4066.

AZA AWARD TO PROYECTO TITÍ

The American Zoo and Aquarium Association (AZA) conferred their Significant Achievement Award to the program "Proyecto Tití: A Multi-disciplinary Ap-

proach to the Conservation of the Cotton-top Tamarin in Colombia", during the AZA 70th Annual Conference in September 1994. The Project Director is Dr. Anne Savage, Research Director at the Roger Williams Park Zoo, Providence, Rhode Island, USA. The Program is examining what factors are causing the decline of wild populations. Information is passed on to government officials in charge of establishing protected reserves, local officials regulating resource use, and local people living in the area who are often competing for the resources needed by the tamarins. Community action programs have been established to involve local people in conservation efforts, including peer-teaching programs where older children lead trips to the forest with younger children, as well as an international exchange of information between school children in Rhode Island and Colombia that examines how water pollution affects the lives of the local community and long-term conservation of natural resources.

PRIMATE CONSERVATION, INC. - 1995 CALL FOR GRANT PROPOSALS

Primate Conservation, Incorporated (PCI), Director Noel Rowe, is a not-for-profit foundation to fund field research that supports conservation programs for wild populations of primates. Priority will be given to projects that study, in their natural habitat, the least known and most endangered species. The involvement of citizens from the country in which the primates are found will be a plus. The intent is to provide support for original research that can be used to formulate and to implement conservation plans for the species studied.

Eligibility: Primate Conservation, Inc. will grant seed moneys or provide matching grants for graduate students, qualified conservationists and primatologists to study rare and endangered primates and their conservation in their natural habitat. Grants have averaged approximately US\$2,500, with a maximum grant of US\$5,000. PCI does not support conferences, travel to scientific meetings, legal actions, tuition, or salaries at institutions, and overhead costs.

Selection Criteria: Proposals are evaluated on a competitive basis. Applications are screened by outside reviewers and the Board of Directors of PCI. All appropriate projects will be considered, but the regions of current interest are Asia and west Africa.

Closing Dates and Notification: Deadlines for all grant application materials are March 1 and September 20.

Awards will be given May 15 and December 15.

Application Procedure: Grant applicants should write for application materials. Please submit five copies of our standard cover sheet and your proposal. Proposals are to be submitted typed, double-spaced, in English. Please send all application material to Primate Conservation, Inc. at the following address: 163 Town Lane, East Hampton, New York 11937-5000, USA. Tel: 516 267-6856, Fax: 516 267-2024.

Please note: The address has changed since the announcement about Primate Conservation, Incorporated, was given in Neotropical Primates 3(1): 23, 1995. The Post Office Box number is no longer valid.

STUDIES ON NEOTROPICAL FAUNA AND ENVIRONMENT - NEW EDITORS

Professor Dr. Ernst-Josef Fittkau recently appointed two new editors-in chief for the journal *Studies on Neotropical Fauna and Environment*: PD Dr. Joachim Adis, Tropical Ecology Working Group, Max-Planck-Institute for Limnology, Plön, and Prof. Dr. Wolf Engels, Tübingen University, Germany. The scope of this journal is research on the biology, ecology and diversity of the Neotropical fauna. This includes taxonomic and zoogeographic surveys, and studies of animal communities and their relationships with biotic and abiotic environmental conditions, including terrestrial and freshwater ecosystems, in the Neotropics. It is published in the Netherlands, by Swets and Zeitlinger, but the official language is English. The first issue under the new editors-in-chief will come out in January 1996.

Studies on Neotropical Fauna and Environment will change to a two-column, A4 format, and the number of articles published in each issue will be increased. Original research contributions and small reviews (not more than 15 pages, including figures and tables) are welcomed. There are no page charges, and authors receive 25 reprints. Field primatologists are encouraged to submit their studies for publication. For further information, please contact: Dr. Anne Zillikens, Managing Editor, Zoologisches Institut der Universität, Auf der Morgenstelle 28, D-72076 Tübingen, Germany. Fax: + 49 (0) 7071-296-950, e-mail: anne.zilliken@uni-tuebingen.de.

BIODIVERSITY AND CONSERVATION

Biodiversity and Conservation is an international

journal published by Chapman and Hall, devoted to the publication of articles on all aspects of biological diversity, its description, analysis and conservation, and its controlled rational use by humankind. Relevant research papers and incisive articles dealing with the practicalities of conservation management, economic, social, and political issues as well as timely case studies are welcomed. The scope is wide and multidisciplinary, and embraces all life-forms. Topics include: assessment and monitoring of biodiversity, captive breeding and relocations, marine biota, genetic diversity, environmental planning and management, and social and economic constraints on conservation. It will be published monthly as from 1996. The editors-in-chief are Alan T. Bull, Biological Laboratory, University of Kent, Canterbury, Kent CT2 7NJ, and Ian R. Swingland, The Durrell Institute of Conservation and Ecology, University of Kent, Canterbury, Kent CT2 7NX, UK, and the editors are Ghilleen T. Prance, Royal Botanic Gardens, UK, and Daniel Simberloff, Florida State University, USA. Subscriptions (personal rate): US\$99.00 (USA & Canada), £99.00 (Europe) and £60.00 (rest of world). Special issues are available: *Wildlife Species for Sustainable Food Production*, Vol.4(3), 1995 (£14.99); *Biodiversity and Conservation in the Gulf of the Guinea Islands* Vol. 3(9), 1994 (£19.99); *Protected Areas* Vol. 3(5), 1994 (£14.99); *Botanic Gardens* Vol. 3(2), 1994 (£14.99); *Peatlands and People*, Vol. 2(5), 1993 (£14.99); *Global Biodiversity and Conservation of Insects*, Vol. 2(3), 1993 (£14.99); and *Biodiversity amongst Microorganisms and Its Relevance*, Vol.1(4), 1992 (£14.99). For order forms and more information: Nancy Fogarty, Journals Promotion Department, Chapman and Hall, 115 Fifth Avenue, New York, NY 10003, USA, Tel: +1 (212) 780 6233, Fax: +1 (212) 260 1363, e-mail: fogarty@chaphall.com, or Terry Sleight, Chapman and Hall, Subscriptions Department, ITPS Ltd., Cheriton House, North Way, Andover, Hants SP10 5BE, UK, Tel: +44 (0)1264 342 713, Fax: +44 (0)1264 342 807, e-mail: chsub@itps.co.uk.

1993. Prices in Spanish pesetas: Spain - 5,500; Europe - 6,500; Other countries - 7,000. Copies of the Abstract book for the conference, and volumes 1 and 2 of *Etologia* are also available. To order, please write to: Sociedad Española de Etologia, Museu de Zoologia, Apartado 593, 08080 Barcelona, Spain.

AFRICAN PRIMATES - NEWSLETTER OF THE AFRICAN SECTION OF THE PSG

The first issue of *African Primates*, *The Newsletter of the Africa Section of the IUCN/SSC Primate Specialist Group* (36pp.) was published in July 1995. It is edited by Thomas M. Butynski, Vice Chairman for the African Section of the IUCN/SSC Primate Specialist Group, and produced and distributed by Zoo Atlanta's Conservation Action Resource Center (ARC) and the National Museums of Kenya's Institute of Primate Research and Center for Biodiversity, in collaboration with Conservation International and the IUCN Eastern Africa Regional Office. Like *Neotropical Primates*, it includes short articles, news, information on meetings; and recent literature, and also has a section dealing with funding and training. Articles in this first issue include: Status and Conservation of the Chimpanzee *Pan troglodytes verus* in Guinea-Bissau - S. Gippoliti and G. Dell'Omo; The Biodiversity Crisis in Southwestern Ghana - T. T. Struhsaker and J. F. Oates; Good News for *Cercopithecus solatus*, Gabon's Endemic Guenon - L. White and A. Mackanga-Missandzou; Census of Kenya's Endangered Red Colobus and Crested Mangabey - T. M. Butynski and G. Mwangi; Recensement de Gorilles dans la Parc National du Kahuzi-Biega au Zaïre - J. Hall; and Du Statut et de l'Avenir des Primates au Sénégal - A. Galat-Luong. Contributions are welcomed. For further information: Thomas M. Butynski, Editor - *African Primates*, Zoo Atlanta, Africa Biodiversity Conservation Program, P. O. Box 24434, Nairobi, Kenya. Tel: 254-2-745374 or 254-2-884369, Fax: 254-2-890615, e-mail: enw@earo.iucn.ch.

Recent Publications

SPECIAL ISSUE OF *ETOLOGIA*

Etologia is published by the Sociedad Española de Etologia, Barcelona. Volume 3 (1993) of this journal is a special issue of 321 pages containing 21 plenary lectures of the XXIII International Ethological Congress, held in Torremolinos, Spain, in September

BOOKS

Preguiças e Guaribas: Os Mamíferos Folívoros Arborícolas do Mamirauá, por Helder Lima de Queiroz, 1995. Preço: R\$10.00. Ministério de Ciência e Tecnologia (MCT), Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq), Brasília. O segundo volume da série *Estudos do Mamirauá*, apresenta diversos aspectos da ecologia

de dois gêneros de mamíferos da várzea amazônica, comparando suas estratégias para a utilização dos recursos da floresta. É o primeiro estudo onde dados da ecologia de preguiças são publicados com profundidade. Inicia a discussão com as implicações do hábito folívoro em mamíferos de todo o mundo, apresentando, num contexto mundial, os aspectos evolutivos e fisiológicos da folívoría em mamíferos. Continua, apresentando as características do habitat, na Estação Ecológica Mamirauá, da preguiça-comum (*Bradypus variegatus*) e do guariba-vermelho (*Alouatta seniculus*) e discute os aspectos demográficos e o uso do tempo e do espaço por essas duas espécies, demonstrando como guaribas e preguiças, num mesmo ecossistema, compartilhando um mesmo habitat, muitas vezes alimentando se nas mesmas árvores, encontraram soluções ecológicas para evitar a competição e maximizar sua eficiência na utilização dos recursos da floresta. Originado da tese de mestrado do autor, este volume apresenta os métodos e as condições reais em que este estudo foi realizado, no coração da floresta amazônica. Para leitores interessados em ecologia e zoologia, preocupados com o destino da várzea amazônica e, particularmente, da Estação Ecológica Mamirauá, é uma obra altamente recomendável. Ao adquirir seu exemplar você estará ajudando a implantação da Estação Ecológica Mamirauá. Favor escrever para: Projeto Mamirauá, Caixa Postal 038, 69.470-000 Tefé, Amazonas, Brasil. Tel./Fax: (092) 743-2736.

Research and Captive Propagation, edited by J. K. Hodges, W. Kaumanns and U. Ganslosser, approximately 250pp, July 1995. Filander Verlag GmbH, Fürth. Price DM45.00. This volume reviews concepts, approaches and methods from a wide range of biological disciplines, relating aspects of the species' biology to the management of small populations and captive breeding. It is aimed at zoo and wildlife biologists, conservation and population managers, as well as researchers with an interest in small population management. Includes: *Introduction* - zoo biology and the quality of populations; *Genetics* - methods and approaches for systematics and population biology; *Reproduction* - including the use of non-invasive methods for endocrine monitoring, ultrasound and modern reproductive technologies (cryoconservation, artificial insemination and contraception); *Behaviour and ecology*: adaptability and individuality in behavior and life history, physiology of social situations, regulation of behaviour, imprinting, rhythms, welfare aspects and cognitive approaches; *Nutrition* - nutritional physiology and metabolism, functional morphology of the gastric tract, aspects relating to mineral and vitamin metabolism,

as well as ecological approaches and foraging strategies; *Miscellaneous* - problems of microtaxonomy, organismic approaches in veterinary medicine, experimental pathology; and *Selected case studies*. To order, please contact: Dr U. Ganslosser, Institut für Zoologie 1, Universität Erlangen-Nürnberg, Staudtstrasse 5, 91058 Erlangen, Germany. Tel: +9131 858073, Fax: +9131 15249.

Primatas do Brasil, por Paulo Auricchio, 250pp, 105 ilustrações preto-e-branco, 18 pranchas coloridas, 1995. Editora Terra Brasilis, Arujá, São Paulo. Preço: R\$45.00. Informações sobre biologia, ecologia, distribuição geográfica, pranchas coloridas para identificação das espécies, chaves de identificação, e outras informações sobre todos os primatas do Território Brasileiro. Encomendas: Editora Terra Brasilis, Rua Zeferino Barbosa de Souza 502, 07400-000 Arujá, São Paulo, Brasil. Tel./Fax: (011) 466-2731.

Primatologia: Uma Fronteira em Expansão da Veterinária Mundial, by Milton Thiago de Mello, 1995. 59pp. Academia Brasileira de Medicina Veterinária, Rio de Janeiro. Available from the author: Milton Thiago de Mello, SHIN Q1 4, Conjunto 2, Casa 19, Lago Norte, 71510-225 Brasília, D. F.

Oecologia Brasiliensis, Volume 1: Estrutura, Funcionamento e Manejo de Ecossistemas Brasileiros, edited by Francisco de Assis Esteves, 1995, 597pp. Instituto de Biologia, Departamento de Ecologia, Universidade Federal do Rio de Janeiro, Rio de Janeiro. Price R\$30.00 (Brazil), US\$40.00 (elsewhere). This is the first volume in a series initiated by the Postgraduate Program in Ecology, of the Institute of Biology, Federal University of Rio de Janeiro. Following an introduction explaining the philosophy behind this series, the book contains 36 articles divided into the following sections: Nutrient cycles in aquatic and terrestrial ecosystems; Population Ecology; Community Ecology; Consequences of human activities on ecosystems; and Ecosystem management. Available from: Programa de Pós-Graduação em Ecologia, Departamento de Ecologia, Instituto de Biologia, Universidade Federal do Rio de Janeiro, Caixa Postal 68020, 21941-540 Rio de Janeiro, Rio de Janeiro, Brazil. Tel./Fax: +55 (0)21 290-3308.

STUDBOOKS

De Bois, H. 1995. *1994 International Studbook for the Golden-Headed Lion Tamarin* *Leontopithecus*

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Meetings

PRIMATE SOCIETY OF GREAT BRITAIN (PSGB) WINTER MEETING: BIOLOGY AND CONSERVATION OF NEW WORLD PRIMATES, 29 November 1995, The Zoological Society of London, London. Organised by Hilary O. Box and Hannah Buchanan-Smith. Contact: Hilary O. Box, Department of Psychology, University of Reading, Reading RG6 2AL, Berkshire, UK. Tel: +44 1734 318523 ext.6668, Fax: +44 1734 316604, or Hannah Buchanan-Smith, Department of Psychology, University of Stirling, Stirling FK9 4LA, UK. Tel: +44 1786 467674, Fax: +44 1786 467641, e-mail: h.m.buchanan-smith@stirling.ac.uk.

ASAB WINTER MEETING: SPACE, THE FINAL FRONTIER, 30 November to 1 December 1995, Association for the Study of Animal Behaviour (ASAB), Zoological Society of London Meeting Rooms, Regent's Park, London, UK. The theme of this meeting will be spatial representation in animals, covering such topics as long-distance migration, navigation through familiar areas, 'cognitive maps', and the role of the hippocampus. Abstract submission by e-mail or ordinary mail by 7 July 1995 to: Sue Healy, Department of Psychology, University of Newcastle, Newcastle upon Tyne NE1 7RU, UK, Tel 0191-222-5056, Fax: 0191- 222-5622, e-mail: s.d.healy@ncl.ac.uk.

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XXI CONGRESSO BRASILEIRO DE ZOOLOGIA, 5-9 February 1996, Porto Alegre, Rio Grande do Sul. Organized by the Brazilian Zoological Society. Contact: Secretaria Executiva, Departamento de Zoologia, Instituto de Biociências, Universidade Federal do Rio Grande do Sul, Avenida Paulo Gama 40, 90040-060 Porto Alegre, Rio Grande do Sul, Brazil. Tel: (051) 228-1633 x 3108 or 3126, Fax: (051) 226-7191 or (051) 227-5529, e-mail: buckup@vortex.ufrgs.br.

II ENCONTRO DE MASTOZOOLOGIA, 5-9 February 1996, Porto Alegre, Rio Grande do Sul. Organized by the Brazilian Mammal Society, as part of the activities of XXI Congresso Brasileiro de Zoologia. Contact: Thales Renato O. de Freitas, Departamento de Genética Instituto de Biociências, Universidade Federal do Rio Grande do Sul, Caixa Postal 15053, 91501-970 Porto Alegre, Rio Grande do Sul, Brazil. Tel:

(051) 336-8399 x 6733, Fax: (051) 336-2011, e-mail: trof@ifl.if.ufrgs.br.

POPULATION AND COMMUNITY DYNAMICS IN THE TROPICS, 1-3 April 1996, British Ecological Society Annual Symposium, Cambridge University, Cambridge, U. K. Contact: Dr. D. M. Newbery, Unit of Tropical Forest Ecology, Department of Biological and Molecular Sciences, University of Stirling, Stirling FK9 4LA, Scotland, UK. Tel: + 44 (0)1786 467809, Fax: + 44 (0)1786 466893, e-mail: d.m.newbery@stirling.ac.uk.

ASAB GENERAL SPRING MEETING, 2-3 April 1996, Association for the Study of Animal Behaviour, Bolton Institute Primate Research Team, Bolton Institute, UK. Organized by Geoff Hosey and other members of the Primate Research Team. Offers of papers and posters invited, send title plus rough statement of content. Further information: Marie Jacques, Primate Research Team, Division of Psychology and Biology, Bolton Institute, Deane Road, Bolton BL3 5AB, Lancashire, UK, Tel: 01204 528851, ext. 3145, Fax: 01204 399074, e-mail: mjl@bolton.ac.uk.

CHANGING IMAGES OF PRIMATE SOCIETIES: THE ROLE OF THEORY, METHOD, AND GENDER, 15-23 June 1996, Hotel Rosa dos Ventos, Teresópolis, Rio de Janeiro, Brazil. Supported by The Wenner-Gren Foundation for Anthropological Research, Inc., New York. Organized by Shirley C. Strum (University of California, San Diego) and Linda M. Fedigan (University of Alberta). Session topics: Primate studies: influence of theory, method, and gender; Comparative perspective: psychology, animal behavior, cultural anthropology, paleoanthropology, archeology; Larger context: science studies, feminism., and popular culture. For more information, please contact: Shirley C. Strum, at Tel: (619) 944-3453, Fax: (619) 944-2809/534-5946, or Linda M. Fedigan at Tel: (403) 492-5899, Fax: (403) 492-5273, e-mail: Linda.Fedigan@ualberta.ca, or Wenner-Gren Foundation, 220 Fifth Avenue, 16th Floor, New York, NY 10001, USA, Tel: (212) 683-5000, Fax: (212) 683-9151.

XVITH CONGRESS OF THE INTERNATIONAL PRIMATOLOGICAL SOCIETY & 19TH CONFERENCE OF THE AMERICAN SOCIETY OF PRIMATOLOGISTS, 11-16 August 1996, University of Wisconsin, Madison, hosted by the Wisconsin Regional Primate Research Center. Contact: Edith Chan, Coordinator/Information, Wisconsin Regional Primate Research Center, 1220 Capitol Court, Madison, Wisconsin 53715-1299, USA. Tel: (608) 263-3500, Fax: (608) 263 4031, e-mail: ipsasp-info@primate.wisc.edu.

Contributions

We would be most grateful if you could send us information on projects, research groups, events (congresses, symposia, and workshops), recent publications, activities of primatological societies and NGOs, news items or opinions of recent events and suchlike, either in the form of manuscripts (double-spaced) or in diskettes for PC compatible text-editors (MS-Word, Wordperfect, Wordstar). Articles, not exceeding six pages, can include small black-and-white photographs, figures, maps, tables and references, but please keep them to a minimum.

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