



Fig. 3. Smaller primate species, such as the moustached tamarin have become increasingly more abundant in areas where hunting continues (photo by R.E. Bodmer).

Richard E. Bodmer  
Department of Zoology  
Large Animal Research Group  
34A Storeys Way  
Cambridge CB3 0DT  
U.K.  
and  
Dept. Zoologia  
Museu Paraense Emílio Goeldi  
C.P. 399  
66.040 Belém-Pará  
BRAZIL



Fig. 4. Overhunting has greatly reduced woolly monkey populations throughout South America (photo by J. Penn).

Tula G. Fang  
Universidad Nacional de la Amazonia  
Peruana  
Iquitos, Loreto  
PERU

Luis Moya Ibanez  
Ministerio de Agricultura  
Region Agraria — XXII Loreto  
Apt. 621  
Iquitos, Loreto  
PERU

#### Acknowledgements

Special thanks is given to the Peruvian Ministry of Agriculture for their assistance and suggestions throughout the project. We thank G.B. Rabb, T.H. Clutton-Brock, N. Leader-Williams, and P. Soini for their guidance and encouragement. Helpful aid was given by J. Moro, C. Malaga, F. Encarnacion, the Peruvian Primate Project, and I.V.I.T.A. N. Leader-Williams, M. Hiraiwa-Hasegawa, J.M. Ayres, and R. Gill are thanked for their constructive comments on the manuscript. This study was supported by grants from the Chicago Zoological Society and the G.B. Harris Foundation.

#### Literature Cited

- Ayres, J.M. 1986. Uakaris and Amazonian Flooded Forest. Ph.D. thesis. Univ. Cambridge.
- Bodmer, R.E., T.G. Fang, and L. Moya. 1988. Ungulate management and conservation in the Peruvian Amazon. *Biol. Cons.* 45: 303-10.
- Buchanan, D.B., R.A. Mittermeier and M.G.M. van Roosmalen. 1981. The saki monkeys, genus *Pithecia*. In: *Ecology and Behavior of Neotropical Primates*, A.F. Coimbra-Filho and R.A. Mittermeier, eds. Academia Brasileira de Ciencias, Rio de Janeiro, pp. 391-417.
- Burnham, K.P., D.R. Anderson, and J.L. Laake. 1980. Estimation of density from line transect sampling of biological populations. *Wildl. Mono.* 72, pp. 202.
- Caldecott, J. 1988. *Hunting and Wildlife Management in Sarawak*. IUCN, Cambridge.
- Clutton-Brock, T.H., F.E. Guinness, and S.D. Albon. 1982. *Red Deer: Behavior and Ecology of Two Sexes*. Univ. Chicago Press, Chicago.
- Eisenberg, J.F. 1981. *The Mammalian Radiations: An Analysis of Trends in Evolution, Adaptation, and Behaviour*. The Athlone Press, London.
- Eisenberg, J.F. and R.W. Thorington. 1973. A preliminary analysis of a Neotropical mammal fauna. *Biotropica* 5: 150-61.
- Eisenberg, J.F. and G.M. McKay. 1974. Comparison of ungulate adaptations in the New World and the Old World tropical forests with special reference to Ceylon and the rainforests of Central America. In: *The Behaviour of Ungulates and its Relation to Management*, V. Geist and F. Walther, eds. IUCN Publications new series, No. 24.
- Emmons, L.H. 1984. Geographic variation in densities and diversities of non-flying mammals in Amazonia. *Biotropica* 16: 210-22.
- Emmons, L.H. 1987. Comparative feeding ecology of felids in a Neotropical rainforest. *Behav. Ecol. Sociobiol.* 20: 271-83.
- Fang, T.G. 1987. Importancia de los frutos en la dieta de *Saguinus mystax* y *S. fuscicollis* (Primates: Callitrichidae), en el Río Tahuayo, Loreto-Peru. Unpubl. thesis. Univ. Nacional de la Amazonia Peruana.
- Freese, C.H., P.G. Heltne, N. Castro, and G. Whitesides. 1982. Patterns and determinants of monkey densities in Peru and Bolivia, with notes on distributions. *Int. J. Primatol.* 3: 53-89.
- Gill, R.M.A. 1987. Monitoring the status of European and North American Cervids. Unpubl. report, UNEP/GEMS project ST/4101-84-02.

Glanz, W.E. 1982. The terrestrial mammal fauna of Barro Colorado Island: censuses and long-term changes. In: *The Ecology of a Tropical Forest: Seasonal Rhythms and Long-Term Changes*, E.G. Leigh, A.S. Stanley, and D.M. Windsor, eds. Smithsonian Instit. Press, Washington, D.C., pp. 455-68.

McCullough, D.L. 1987. The theory and management of *Odocoileus* populations. In: *Biology and Management of the Cervidae*, C.M. Wemmer, ed. Smithsonian Instit. Press, Washington, D.C.

Mittermeier, R.A. 1986. A global overview of primate conservation. In: *Primate Ecology and Conservation*, J.G. Else and P.C. Lee, eds. Cambridge Univ. Press, Cambridge.

Pierret, P.V. and M.J. Dourojeanni. 1967. Importancia de la caza para alimentacion humana en el curso inferior del Rio Ucayali, Peru. *Revista Forestal del Peru* 1: 10-21.

Robinson, J.G. and J.F. Eisenberg. 1985. Group size and foraging habits of the collared peccary *Tayassu tajacu*. *J. Mammalogy* 66: 153-55.

Robinson, J.G. and K.H. Redford. 1986. Intrinsic rate of natural increase in Neotropical forest mammals: relationship to phylogeny and diet. *Oecologia* 68: 516-20.

Terborgh, J. 1983. *Five New World Primates: A Study in Comparative Ecology*. Princeton Univ. Press, Princeton, New Jersey.

Terborgh, J. 1986. Conserving New World primates: present problems and future solutions. In: *Primate Ecology and Conservation*, J.G. Else and P.C. Lee, eds. Cambridge Univ. Press, Cambridge.

Weckermann, E. 1987. Managing German red deer (*Cervus elaphus* L.) populations. In: *Biology and Management of the Cervidae*, C.M. Wemmer, ed. Smithsonian Instit. Press, Washington, pp. 505-16.

## Primate Community Structure in Western Brazilian Amazonia

by Carlos A. Peres

The richest primate communities identified to date are located in West Africa, where assemblages of up to 16 species may occur in one general area (e.g. Makokou, Gabon: Gautier-Hion, 1978). Several of these species, however, present a patchy distribution, and as many as five may be entirely nocturnal (Charles-Dominique, 1977). Thus, co-existing primate species in these communities are not all microsympatric, and may minimize interference competition through a greater partitioning of temporal niche breadth. A patchy species distribution is also the case with diverse primate communities in upper Amazonia, where small habitat specialists (e.g. *Cebuella pygmaea*, *Callimico goeldii*), as well as larger-bodied frugivores (e.g. *Pithecia monachus*, *Lagothrix lagotricha*), may not occur within a particular, relatively small study site (e.g. Terborgh, 1983). In this article, four high-density primate communities of western Brazilian Amazonia are discussed and compared to those found elsewhere in the Amazon (Ayres, 1986; Johns, 1986a; Soini, 1986; Terborgh and Stern, 1987).

### Population Surveys

Estimates of mean group size, population density, and population biomass were carried out by walking a measured transect several times and noting all encounters that occurred with primate groups or individuals. Two of the four sites surveyed had been abandoned by seismic

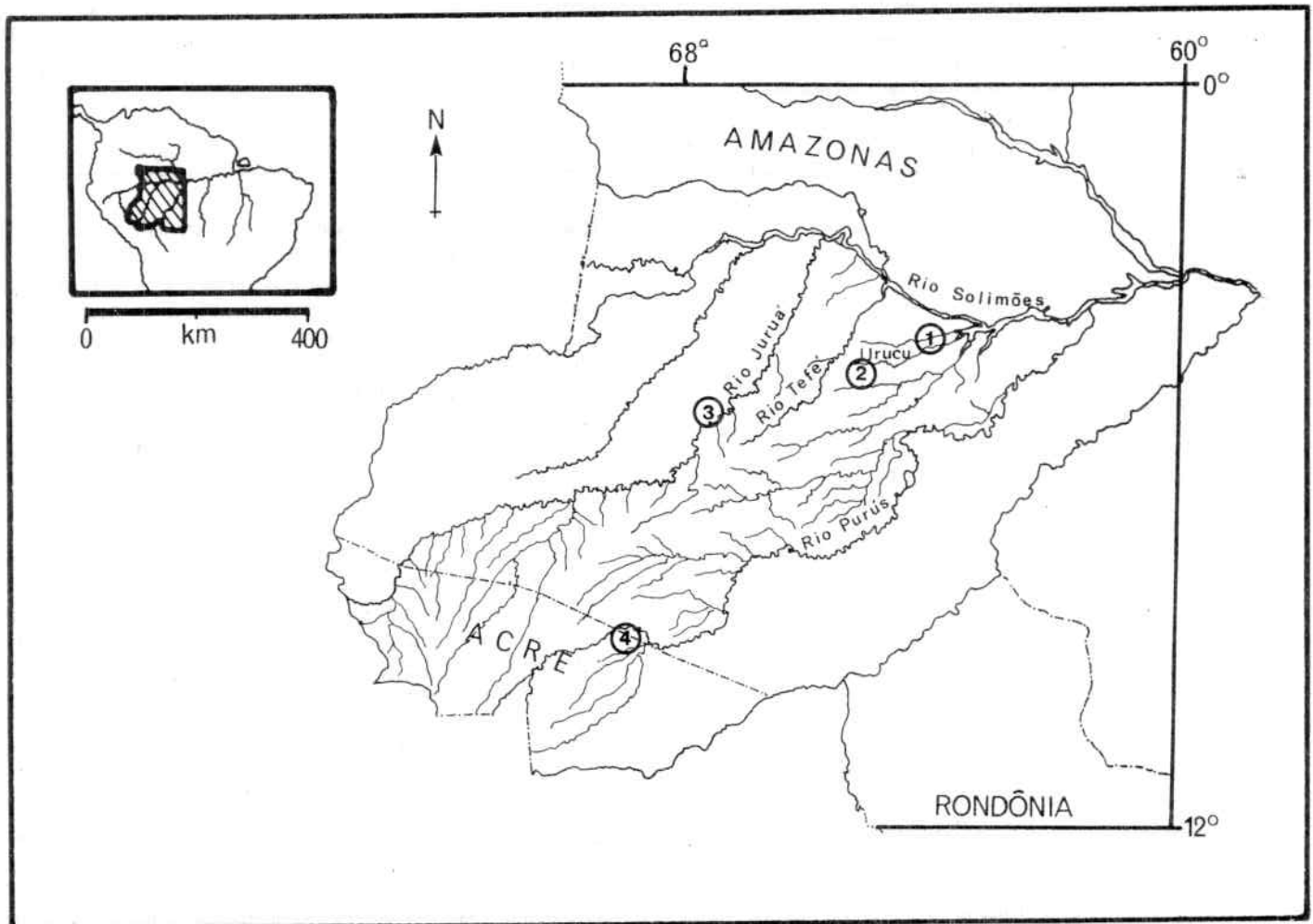


Fig. 1. Map of the Rio Purús and Juruá basins in Brazilian Amazonia, showing the location of the four survey sites: (1) Igarapé-Açu, (2) SM-1 drilling site, (3) Lago da Fortuna, and (4) São Domingos (map provided by author).

surveyers, who left behind hundreds of kilometers of neatly cut seismic transects. These transects had been marked every 50 m with small wooden blocks, which were still visible at least one year after the transects had been established. In survey sites, seismic transects were not available and surveys were conducted along new transects or near-linear *estradas* (rubber-tapping trails).

Given the time and personnel limitations of these surveys, insufficient data were generated to apply species-specific detection functions to determine transect width. Thus I lumped sighting records of all species in any given community and used Emlen's (1971) 'most effective sighting distance' to estimate survey strip width. This method, though mathematically less robust than Fourier series analysis (Burnham *et al.*, 1980), is appropriate for relatively small data sets and produces density estimates comparable to those of other primate surveys recently conducted in Brazilian Amazonia (*e.g.* Johns, 1986a; Ayres, 1986; Peres, 1987).

### The Survey Sites

Surveys were conducted during the late dry season in four *terra firme* (upland) forest sites (Fig. 1). An additional survey was carried out within *várzea* (seasonally flooded) forest, while the water level was dropping at approximately 11 cm/day. Two of the *terra firme* sites, Igarapé-Açú and SM-1, were entirely undisturbed and primates in them had never been hunted. The other two survey sites, Lago da Fortuna and São Domingos, had been subject to moderate hunting or light selective-logging for at least 15 years prior to the surveys. Here I provide a brief description of each survey site and make a few points about the taxonomy and distribution of primates occurring in them.

Table 1. Characteristics of the Primate Community in non-*Várzea* Forests at Lago da Fortuna

Species	Mean Group		Density			Biomass kg/km <sup>2</sup>
	Size	N <sup>1</sup>	Enc./ 10 km	grp/km <sup>2</sup>	ind/km <sup>2</sup>	
<i>Cebuella pygmaea</i>	4.0	1	0.36	1.79	7.14	1.1
<i>Saguinus m. mystax</i>	4.3	6	2.50	5.00	21.65	13.0
<i>S. f. fuscicollis</i>	3.9	3	1.07	3.50	13.65	8.19
<i>Callicebus moloch cupreus</i>	2.9	9	5.71	9.52	26.48	31.8
<i>C. t. torquatus</i>	3.0	1	0.36	0.89	2.68	4.0
<i>Aotus nigriceps</i> <sup>2,3</sup>	—	—	—	—	—	—
<i>Saimiri sciureus macrodon</i>	31.0	1	0.71	1.43	44.29	44.3
<i>Cebus apella</i>	6.7	4	2.14	3.57	24.11	53.0
<i>Cebus albifrons unicolor</i>	11.0	1	0.36	0.71	7.81	20.3
<i>Pithecia i. irrorata</i> <sup>3</sup>	3.0	2	0.71	0.89	2.68	5.1
<i>Cacajao calvus novaesi</i>	21.7	3	0.71	2.14	46.44	139.3
<i>Alouatta seniculus</i> <sup>2,3</sup>	6.0	1	0.36	0.89	5.34	34.7
<i>Lagothrix lagotricha</i> spp. <sup>2,3</sup>	—	—	—	—	—	—
<i>Ateles paniscus chamek</i> <sup>2,3</sup>	—	—	—	—	—	—

Total distance surveyed = 28.0 km Total number of groups sighted = 41

#### Key:

<sup>1</sup> number of accurate group counts

<sup>2</sup> presently occur at Lago da Fortuna, but were not seen during surveys

<sup>3</sup> abundance probably affected by hunting

**Lago da Fortuna.** This site is located on the fringes of Lago da Fortuna, Carauari, Amazonas (5°5' S, 67°10' W), an oxbow lake long isolated from the main stream of the white water Rio Juruá. One of the survey transects intersected a small portion of dry floodplain forest, but most surveys were conducted in forest which is not regularly flooded. Numerous families of rubber tappers lived in the *várzea* forest along the lake, but human disturbance in natural rubber (*Hevea brasiliensis*) stands was almost entirely restricted to light selective hunting during the tapping season.

A minimum of 14 sympatric primate species (Table 1) occur at Lago da Fortuna, the maximum number reported from any surveyed locality in the Neotropics. In addition, two chromatic forms of Humboldt's woolly monkey (*Lagothrix lagotricha*) were sighted, only one matching the description of *L. l. poeppigii* known to occur west of the Rio Juruá (Fooden, 1963). A recently described subspecies of white uakari (*Cacajao calvus novaesi* Hershkovitz, 1987a), known only from the south bank of the upper Rio Juruá, occurs at the site and downriver, at least until Carauari, thus extending its range to the west bank of the Rio Juruá by almost 500 km.

In addition to walking surveys, I carried out a series of dugout canoe surveys in a 1.5 km transect within flooded forest at Lago da Fortuna. This survey was repeated only seven times, covering a total distance of 12 km. Density estimates generated by this survey were calculated in a similar way to those in terrestrial habitats, and are presented in Table 2.

Table 2. Characteristics of the Primate Community in *Várzea* Forests at Lago da Fortuna

Species	Mean Group		Density			Biomass kg/km <sup>2</sup>
	Size	N <sup>1</sup>	Enc./ 10 km	grp/km <sup>2</sup>	ind/km <sup>2</sup>	
<i>Saimiri sciureus macrodon</i>	31.0	1	5.00	8.33	258.3	232.5
<i>Callicebus moloch cupreus</i>	3.0	1	1.25	2.08	6.2	7.5
<i>Aotus nigriceps</i> <sup>2</sup>	4.0	1	—	—	—	—
<i>Cebus apella</i>	7.0	1	1.25	2.08	14.6	32.0
<i>Cebus albifrons unicolor</i>	11.0	1	2.50	4.17	45.8	119.2
<i>Cacajao calvus novaesi</i>	21.7	2	1.25	2.08	45.1	135.4
<i>Alouatta seniculus</i>	6.0	1	1.25	2.08	12.5	75.0

Total distance surveyed = 12 km Total number of groups sighted = 18

#### Key:

<sup>1</sup> number of accurate group counts

<sup>2</sup> occur in *várzea* forests at Lago da Fortuna, but were not sighted during surveys

**Igarapé-Açú.** This site is located on the north side of the lower Rio Urucú, Coarí, Amazonas (4°30' S, 64°29' W). Prior to the surveys, seismic operations had been conducted on the site by small prospecting teams hired by the Brazilian oil monopoly, Petrobras. Access to remote *terra firme* sites, such as Igarapé-Açú, was restricted to small helicopters which landed on a 1 ha man-made clearing. Local human residents were conspicuously absent, and I assume that primates had not been subject to hunting before the surveys. Seismic transects ran across entirely undisturbed *terra firme* forest of medium stature (25–30 m) on undulating terrain. Small, clear-water forest streams were relatively common, generating moderate levels of habitat heterogeneity.

**SM-1.** This site is located 110 km from Igarapé-Açú, on the southern bank of the upper Rio Urucú, Tefé, Amazonas (4°50' S, 65°16' W). The forest at SM-1 consists of taller (30–35 m), undisturbed *terra firme* forest growing on slightly smoother terrain. At the time of the survey, a Petrobras oil drilling operation was being conducted in a 20 ha clearing, 500 m from the nearest seismic transect surveyed. The operation was entirely restricted to this clearing, however, and human disturbance in the surrounding forest was limited to noise produced by drilling machinery and helicopter traffic.

A minimum of 11 species of sympatric primates occur in Igarapé-Açú and SM-1, although I only observed nine of these while conducting surveys in Igarapé-Açú (Tables 3 and 4). Primate communities in the Rio Urucú basin are thus slightly less diverse than those west of the Rio Tefé (Johns, 1986a; 1986b). Pygmy marmosets (*Cebuella pygmaea*) and white uakaris (*Cacajao calvus*) are not known to occur east of the Rio Tefé, and were absent in the Rio Urucú sites. I did not observe

*Callicebus t. torquatus*, described by local residents as present at both sites, presumably because of its habitat specialization and local rarity (Kinzey and Gentry, 1979). The taxonomic status of squirrel monkeys (*Saimiri* spp.) along the Rio Urucú várzea remains questionable. The range of *S. ustus* (= *madeira*: Thorington, 1985), which appears to be limited to the west side of the Rio Purús (Hershkovitz, 1984), possibly extends westwards to the Rio Tefé (cf. Ayres, 1985; Johns, 1986a). Hershkovitz (1984) and Thorington (1985) agree to the extent that they assigned *S. b. boliviensis* and *S. sciureus boliviensis*, respectively, to the lower Purús-Juruá Basin. However, both of these refer to a blackish-capped form of squirrel monkey, which is not supported by my observations along the Rio Urucú várzeas.

Two tamarins, *Saguinus mystax pileatus* and *S. fuscicollis avilapiresi*, are endemic to the Purús-Tefé Basin (Hershkovitz, 1977), and have more restricted distributions than related subspecies. The range of *S. f. avilapiresi* extends eastwards at least to the west bank of the Rio Coarí. White (or gray) sakis, *Pithecia albicans*, are restricted to the lower Purús-Juruá Basin (Hershkovitz, 1979; 1987b), although they may well hybridize with, or be replaced by, *P. i. irrorata* south of the 6th parallel.

Table 3. Characteristics of the Primate Community in Igarapé-Açú

Species	Mean Group		Density			Biomass kg/km <sup>2</sup>
	Size	N <sup>1</sup>	Enc./ 10 km	grp/km <sup>2</sup>	ind/km <sup>2</sup>	
<i>Saguinus mystax pileatus</i>	5.0	2	0.36	1.78	8.90	5.3
<i>S. fuscicollis avilapiresi</i> <sup>2</sup>	—	—	—	—	—	—
<i>Callicebus moloch cupreus</i>	3.7	4	0.71	1.65	6.17	7.4
<i>C. t. torquatus</i> <sup>2</sup>	—	—	—	—	—	—
<i>Aotus nigriceps</i> <sup>2</sup>	4.0	1	—	—	—	—
<i>Cebus apella</i>	8.0	3	0.71	1.88	15.01	30.0
<i>Cebus albifrons unicolor</i>	13.0	1	0.36	1.19	15.47	40.2
<i>Pithecia albicans</i>	3.0	2	0.36	1.78	5.35	16.1
<i>Alouatta seniculus</i>	6.0	1	0.18	0.45	2.70	17.6
<i>Lagothrix lagotricha cana</i>	22.5	2	0.36	1.34	30.15	241.2

Total distance surveyed = 50.6 km Total number of groups sighted = 19

Key:

<sup>1</sup> number of accurate group counts

<sup>2</sup> occur at Igarapé-Açú, but were not sighted during surveys

Table 4. Characteristics of the Primate Community in SM-1

Species	Mean Group		Density			Biomass kg/km <sup>2</sup>
	Size	N <sup>1</sup>	Enc./ 10 km	grp/km <sup>2</sup>	ind/km <sup>2</sup>	
<i>Saguinus mystax pileatus</i>	5.7	4	1.47	2.72	15.66	9.4
<i>S. fuscicollis avilapiresi</i>	6.0	2	0.59	2.72	14.08	8.5
<i>Callicebus moloch cupreus</i>	2.5	2	0.59	2.93	7.33	9.5
<i>C. t. torquatus</i> <sup>2</sup>	4.0	1	—	—	—	—
<i>Aotus nigriceps</i> <sup>3</sup>	3.0	1	—	—	—	—
<i>Cebus apella</i>	7.0	1	0.59	0.98	6.84	15.2
<i>Cebus albifrons unicolor</i>	13.0	1	0.29	0.73	9.50	24.7
<i>Pithecia albicans</i>	5.0	2	0.59	1.96	9.80	18.6
<i>Alouatta seniculus</i>	8.0	1	0.29	0.49	3.92	25.5
<i>Lagothrix lagotricha cana</i>	20.0	1	0.59	1.31	26.2	209.6

Total distance surveyed = 34.1 km Total number of groups sighted = 21

Key:

<sup>1</sup> number of accurate group counts

<sup>2</sup> records of both species of *Callicebus* were combined because of insufficient data

<sup>3</sup> occur at SM-1, but were not sighted during surveys

**São Domingos.** This site is located in Sena Madureira, Acre (8°55' S, 68°20' W), near an extension of the Trans-Amazon Highway (BR-364). Prior to my surveys, several families of landless peasants had been resettled around the survey area as part of a large-scale program of land colonization. The human population density at São Domingos was thus far greater than typical Amazonian *terra firme* forests could support on a purely extractive basis (e.g., Denevan, 1976).

Of the four primate communities surveyed, the one at São Domingos was the most impoverished. This was not a consequence of the local source-fauna, since only large-bodied species (i.e. *Alouatta seniculus* and *Ateles paniscus*) were very rare or locally extinct, probably due to overhunting and habitat disturbance, whereas small omnivores, such as the black-chinned emperor tamarin (*Saguinus i. imperator*) and Weddell's saddle-backs (*S. fuscicollis weddelli*), were extremely common. Bald face sakis (*Pithecia i. irrorata*) and woollies (*Lagothrix lagotricha*) do not occur between the upper Rio Purús and Iaco (Peres, 1987), and thus were not present at São Domingos.

Table 5. Characteristics of the Primate Community at São Domingos

Species	Mean Group		Density			Biomass kg/km <sup>2</sup>
	Size	N <sup>1</sup>	Enc./ 10 km	grp/km <sup>2</sup>	ind/km <sup>2</sup>	
<i>Saguinus i. imperator</i>	5.5	7	2.69	6.73	37.02	22.2
<i>S. fuscicollis weddelli</i>	6.4	7	2.69	6.73	43.08	25.8
<i>Callimico goeldi</i> <sup>2</sup>	—	—	—	—	—	—
<i>Callicebus moloch cupreus</i>	3.0	2	1.54	3.00	9.30	11.2
<i>Aotus nigriceps</i> <sup>3</sup>	4.5	2	2.00	5.49	24.73	24.7
<i>Saimiri b. boliviensis</i>	32.0	2	0.77	1.92	61.54	61.5
<i>Cebus apella</i>	7.0	1	0.38	0.96	6.73	14.8
<i>Cebus albifrons unicolor</i>	21.0	2	0.77	1.28	25.64	66.7
<i>Alouatta seniculus</i> <sup>4</sup>	—	—	—	—	—	—
<i>Ateles paniscus chamek</i> <sup>5</sup>	—	—	—	—	—	—

Total distance surveyed = 26.0 km Total number of groups sighted = 22

Key:

<sup>1</sup> number of accurate group counts

<sup>2</sup> occur at BR-364/km 20, but were not seen during surveys

<sup>3</sup> density underestimated because it is partially nocturnal at this site

<sup>4</sup> very rare due to hunting

<sup>5</sup> locally extinct due to hunting

The Primate Communities

Density estimates were obtained for all primate species observed during the surveys (Tables 1-5). In Igarapé-Açú and SM-1, where primates had not been hunted, population biomass showed a close direct relationship with species body mass ( $r=0.84$ ,  $df=13$ ,  $p<0.001$ ,  $t=5.58$ ). Large-bodied frugivores, particularly those in large groups (e.g., *Lagothrix l. cana*), were among the most numerically abundant primates, accounting for the bulk of the total primate biomass in these sites. This trend is often skewed in hunted sites (e.g. Johns, 1986a); in the hunted or disturbed sites I surveyed, such as Lago da Fortuna and São Domingos, primates weighing 5 kg or more were extremely rare or locally extinct (Peres, in press). On the other hand, small-sized species (< 2 kg) suffered few negative consequences from hunting. In fact, small primates living in small groups (e.g., *Saguinus* spp., *Callicebus moloch*) were found in considerably higher densities in hunted sites. This, however, need not be a form of density compensation as a consequence of competitive release from larger, heavily-hunted primates, but instead the result of moderate levels of habitat disturbance favoring small-sized primates (see Johns and Skorupa, 1987).

On the other hand, small-bodied primates were not the most numerically representative in communities occurring in undisturbed sites, as might be expected within trophic levels (Clutton-Brock and Harvey, 1977). In Igarapé-Açu, for instance, the individual density of *Saguinus m. pileatus* was less than a third of the combined densities of the two *Cebus* species, despite the fact that all three share the same major categories of food items (Terborgh, 1983). In Manu, another undisturbed site in western Amazonia, the two sympatric tamarins (*S. fuscicollis* and *S. imperator*) rank lowest in terms of numeric abundance and biomass out of ten primate species with known population densities (Terborgh and Stern, 1987), including an even smaller and rarer species, the pygmy marmoset (*Cebuella pygmaea*). Again, body mass alone explains most of the variation in population biomass for the primate community ( $r=0.97$ ,  $t=11.2$ ,  $df=8$ ,  $p < 0.001$ ; calculated from Terborgh and Stern, 1987).

Recent estimates of total primate biomass (*Aotus* excluded) in western Amazonian sites vary considerably, though this can partly be attributed to sampling artifact. Primates in São Domingos, a *terra firme* site subject to moderate selective-logging and intensive hunting, accounted for 226.9 kg/km<sup>2</sup>, just over one third of the estimates made for Cosha Cashu, an undisturbed site in both *várzea* and *terra firme* forests (662.5 kg/km<sup>2</sup>; derived from Terborgh and Stern, 1987). The lowest estimate for any site in Brazilian Amazonia, however, comes from a six-species community in a continuous primary forest in extremely nutrient-poor, yellow latosols near Manaus. Here, primate biomass does not exceed 100 kg/km<sup>2</sup> (derived from Rylands and Keuroghlian, 1986). Community composition, habitat type, type and degree of habitat disturbance, and degree and selectivity of hunting all influence these estimates (Peres, in press). The ways these factors interact to determine the biomass of any given community is not easy to predict. In the non-hunted *várzeas* of Lago Mamirauá, for instance, biomass estimates for a four-species community in primary forest (250.8 kg/km<sup>2</sup>; Johns, 1986a) is considerably lower than estimates for forests logged selectively and moderately (336.6 kg/km<sup>2</sup>; Johns, 1986a; and 352 kg/km<sup>2</sup>; Ayres, 1986), primarily because logging was associated with an increased density of folivores (*i.e.* *Alouatta seniculus*). Those estimates, however, are comparable to those of species-rich communities in undisturbed *terra firmes*, such as Lago da Fortuna, Igarapé-Açu, and SM-1 (Peres, 1987), but considerably lower than those of undisturbed *várzeas* at Lago da Fortuna (Table 2), and Cahuana Island (Soini, 1986).

This study suggests that many more population surveys and detailed studies are needed to establish how primate community structure in western Amazonia is affected by natural and anthropogenic patterns of disturbance. Increasing access to remote river basins, as the booming oil industry in Brazilian Amazonia is doing (Peres, 1987), will soon reduce the possibilities for studies in entirely undisturbed sites. Hunters, loggers, farmers and ranchers are quicker and more numerous than field primatologists.

Carlos A. Peres  
Sub-Dept. Veterinary Anatomy  
University of Cambridge  
Cambridge CB2 1QS  
U.K.

#### Acknowledgements

I am grateful to A. Apoluceno and O. Monte for permitting me to take advantage of the logistical support offered by the Brazilian oil company, Petrobras, during three of the four surveys conducted in this study. Access to such remote sites would not have been possible without the helicopter transportation Petrobras offered. The work at Sena Madureira was partially supported by the Federal University of Acre, Rio Branco. I thank R. Angelim for his valuable contacts. Financial support

throughout this study was provided by the WWF-US Primate Program. My studies at Cambridge University are supported by an Overseas Graduate Fellowship from the Brazilian Council of Science and Technology (CNPq).

#### Literature cited

- Ayres, J.M. 1985. On a new species of squirrel monkey, genus *Saimiri*, from Brazilian Amazonia (Primates: Cebidae). *Papeis Avulsos Zool., S. Paulo* 36: 147-64.
- Ayres, J.M. 1986. Uakaris and Amazonian flooded forest. Unpubl. Ph.D. dissertation, Univ. of Cambridge, Cambridge.
- Burnham, K.P., D.R. Anderson, and J.L. Laake. 1980. Estimation of density from line transect sampling of biological populations. *Wildl. Monogr.* 72.
- Charles-Dominique, P. 1977. *Ecology and Behaviour of Nocturnal Prosimians*. Duckworth, London.
- Clutton-Brock, T.H. and P.H. Harvey. 1977. Species differences in feeding and ranging behavior in primates. In: *Primate Ecology: Studies of Feeding and Ranging Behaviour in Lemurs, Monkeys, and Apes*. T.H. Clutton-Brock, ed. Academic Press, London, pp. 557-84.
- Denevan, W.M. 1976. The aboriginal populations of Amazonia. In: *The Native Populations of the Americas in 1492*. W.M. Denevan, ed., Univ. of Wisconsin Press, Madison, pp. 205-33.
- Emlen, J.T. 1971. Population studies of birds derived from transect counts. *Auk* 88: 323-42.
- Fooden, J. 1963. A revision of the woolly monkeys (genus *Lagothrix*). *J. Mammal.* 44: 213-17.
- Gautier-Hion, A. 1978. Food niches and coexistence in sympatric primates in Gabon. In: *Recent Advances in Primatology*, Vol. 1. D.J. Chivers and J. Herbert, eds. Academic Press, New York.
- Hershkovitz, P. 1977. *Living New World Monkeys (Platyrrhini)*. Univ. of Chicago Press, Chicago.
- Hershkovitz, P. 1979. The species of sakis, genus *Pithecia* (Cebidae, Primates), with notes on sexual dichromatism. *Folia Primatol.* 31: 1-22.
- Hershkovitz, P. 1984. Taxonomy of squirrel monkeys, genus *Saimiri* (Cebidae, Platyrrhini): a preliminary report with description of a hitherto unnamed form. *Am. J. Primatol.* 6: 257-312.
- Hershkovitz, P. 1987a. Uakaris, New World monkeys of the genus *Cacajao* (Cebidae, Platyrrhini), a preliminary taxonomic review with description of a new subspecies. *Am. J. Primatol.* 12: 1-53.
- Hershkovitz, P. 1987b. The taxonomy of the South American sakis, genus *Pithecia* (Cebidae: Platyrrhini): a preliminary report and critical review with the description of a new species and a new subspecies. *Int. J. Primatol.* 12: 387-468.
- Johns, A.D. 1986a. Effects of habitat disturbance on rainforest wildlife in Brazilian Amazonia. Unpubl. report to WWF-US.
- Johns, A.D. 1986b. Primates and forest exploitation at Tefe, Brazilian Amazonia. *Primate Conservation* 6: 27-29.
- Johns, A.D. and J. Skorupa. 1987. Responses of rain-forest primates to habitat disturbance: a review. *Int. J. Primatol.* 8: 157-91.
- Kinzey, W.G. and A.H. Gentry. 1979. Habitat utilization in two species of *Callicebus*. In: *Primate Ecology: Problem-Oriented Field Studies*. R.W. Sussman, ed. John Wiley, New York.
- Peres, C.A. 1987. Conservation of primates in western Brazilian Amazonia. Unpubl. report to the WWF-US.
- Peres, C.A. in press. Effects of hunting on western Amazonian primate communities. *Biol. Cons.*
- Rylands, A.B. and A. Keuroghlian. 1986. Primate survival in forest fragments in central Amazonia: preliminary results. In: *A Primatologia no Brasil*, Vol. 2. M.T. de Mello, ed. Universidade Federal de Minas Gerais, Belo Horizonte, pp. 213-14.

- Soini, P. 1986. A synecological study of a primate community in the Pacaya-Saimiria National Reserve, Peru. *Primate Conservation* 7: 63-71.
- Terborgh, J. 1983. *Five New World Primates: A Study in Comparative Ecology*. Princeton Univ. Press, Princeton.
- Terborgh, J. and M. Stern. 1987. The surreptitious life of the saddle-backed tamarin. *Am. Scientist* 75: 260-69.
- Thorington, R.W., Jr. 1985. The taxonomy and distribution of squirrel monkeys (*Saimiri*). In: *Handbook of Squirrel Monkey Research*. L.A. Rosenblum and C.L. Coe, eds. Plenum Publishers, New York, pp. 1-33.

## On the Status of *Ateles belzebuth marginatus* with Notes on Other Primates of the Iri River Basin

by Eduardo S. Martins, José Márcio Ayres and Maria Beatriz Ribeiro do Valle

According to a recent review of the spider monkeys, the white-whiskered form, *Ateles belzebuth marginatus* (E. Geoffroy, 1809), is considered the most endangered of all the South American spider monkeys (Konstant *et al.*, 1985). This primate has the smallest geographical distribution of all of the *Ateles* in Brazil, its range being located in the southeastern portion of Amazonia, an area which has been subject to much habitat destruction in the last decade. The distribution of this primate, as defined by Kellogg and Goldman (1944) and followed by other authors (Napier, 1976; Thornback and Jenkins, 1982), comprises the forests south of the Amazon between the Tapajós and Tocantins rivers in the state of Pará, Brazil. The southern limits are not defined by these authors, but probably extend at least as far as the Curua and Cururu rivers (8° S), a left bank tributary of the Iri and an east bank tributary of the Tapajós respectively (Fig. 1), as suggested by the German naturalist Emilie Sneath's observations in 1913 and by a specimen collected by José Hidasi in 1953.

A number of recent surveys in the Tocantins-Araguaia River basin have failed to confirm the existence of this subspecies in this area (Ayres, 1983; Kingston, 1984; Johns, 1986). Rescue operations conducted during the filling of the Tucuruí Dam reservoir on the lower Tocantins River recorded the capture of 29,257 monkeys of seven species but none belonged to this genus (see article, "Nonvolant mammals rescued at the Tucuruí dam in the Brazilian Amazon" by Mascarenhas and Puerto, on p. 91 of this issue). The only record of *Ateles belzebuth marginatus* east of the Xingú River was made by Friederich W. Sieber in the early nineteenth century in Cameté, the type locality for this subspecies (Geoffroy, 1809).

Table 1. Primate Densities at Iri River\*

Species	No. groups/ 10 km Surveyed	Absol. Freq.
<i>Alouatta belzebul</i>	**	0
<i>Ateles belzebuth marginatus</i>	0.4	4
<i>Aotus infulatus</i>	**	0
<i>Callicebus moloch</i>	0.9	9
<i>Callithrix argentata</i>	**	0
<i>Cebus apella</i>	2.1	20
<i>Chiropotes albinasus</i>	0.2	2
<i>Saimiri ustus</i>	0.2	2
<b>Total</b>	<b>3.8</b>	<b>37</b>

\*Densities are based on 96 km of diurnal transect surveys.

\*\*These monkeys were not seen during surveys, but they were found as pets in an Indian village (Araras/Laranjal).

In April and early May 1987, we conducted a preliminary 14-day survey in the forests along both margins of the middle and lower Iri River, the main tributary of the Xingú River (Fig. 2). There are few mammal collections from this area (Hershkovitz, 1977, 1984, 1985), probably because of difficult access due to a great number of rapids and the existence of numerous Indian tribes.

During this period we observed 43 groups of eight species along both margins of the Iri River (Table 1 and Appendix). Standardized transect censuses were done along 96 km of *terra firme* forest, during which 37 groups of five species were observed. These surveys were conducted on trails previously opened for geological prospecting.

The most common species was the black-capped capuchin (*Cebus apella*), which represented more than half of all sightings. This may be associated with the high densities of *babaçu* palm (*Orbygnia cf. phalerata*) (87 adult ind/ha), an important food source for this primate (Terborgh, 1983; Tables 1 and 2).

Table 2. Physiognomic Vegetation Types and Monkey Sightings on the Iri and Xingú Rivers

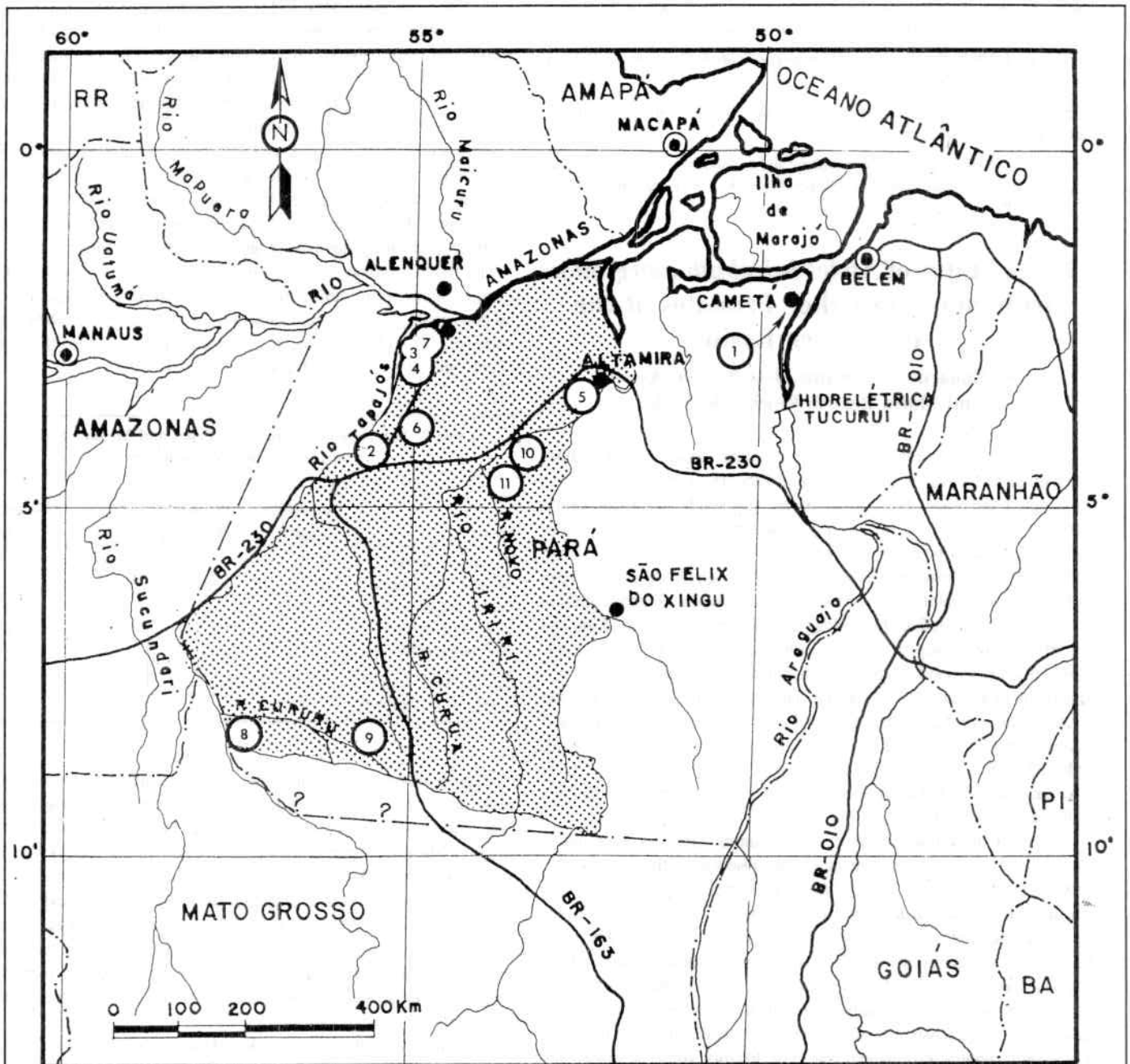
Species	Clear-water			
	Floodplain (igapo)	Primary Forest	Liana Patches	Secondary Vegetation
<i>Alouatta belzebul</i>	5	-	-	-
<i>Ateles b. marginatus</i>	-	4	-	-
<i>Cebus apella</i>	2	8	6	4
<i>Callicebus moloch</i>	1	2	6	1
<i>Chiropotes albinasus</i>	-	2	-	-
<i>Saimiri ustus</i>	-	1	-	1
<b>Total (of 43 sightings)</b>	<b>8</b>	<b>17</b>	<b>12</b>	<b>6</b>

*Ateles b. marginatus* was the third most frequently encountered primate in the area. It was seen only in the tall primary *terra firme* forests at two right bank localities of the Iri River. The first sighting was in Mundo Novo, on the middle portion of the river; three other sightings were made along the right bank of the Novo River, a small tributary of the Iri. We observed small parties, ranging in size from 3-5 individuals and were once able to define the composition of a single subgroup as consisting of an adult male, two adult females, and a young individual. In the season we visited, the spider monkeys were feeding on, among other things, the juicy pulp of *Maximiliana* palm fruits and the immature seeds of the liana *Hippocratea ovata*.

Since *Ateles* and the black howler (*Alouatta belzebul*) are the largest primates in the area, one may suppose that they are also the most hunted monkey species. The *caboclo* (peasant) population in the area, however, is still quite low, and subsistence hunting does not appear to have a severe impact. Some Indian tribes in the region may use primates as food, but judging from their pet collections, black-capped capuchins appear to be the preferred primate game species (Fig. 3).

The main threat to the wild populations of *Ateles b. marginatus* is the establishment of hydroelectric projects. On the Xingú and Iri rivers, at least three dams are planned which will inundate an area of 700,000 ha. The main cause of habitat disturbance will not be the flooding itself, but rather the associated establishment of an infrastructure which increases the value of the lands around the artificial lakes and attracts colonists, ranchers, and timber interest. These dams are planned for the new decade and land speculation may already be in progress.

An important piece of information gathered during this survey is the fact that, according to reliable local residents, there is no *Ateles* on the right bank of the Xingú River. All the people interviewed in the region unanimously confirmed this. It is very unlikely even in the Xingú River, an area of low human disturbance, that this species has been extinguished

Gazeteer for Some Collecting Localities of *Ateles belzebuth marginatus*

## Key:

- |   |  |
|---|--|
| (1) Cametá, lower Tocantins River, left bank<br>F. Sieber, 1808 (holotype; Kellogg and Goldman, 1944)                               | (7) Taperinha, east of the Tapajós River<br>Hagmann. Specimens preserved at the Goeldi Museum (collection nos. 5027, 5029-48, 5050-51, 5143-50, 5683, 5686-87) |
| (2) Cupari River, eastern tributary of the Tapajós River<br>W. Bates, 1863  | (8) Missão Cururu, Cururu River<br>Hagmann, 1934 (MPEG, collection no. 5028)   |
| (3) Caxiricatuba, eastern bank of the Tapajós River<br>(Kellogg and Goldman, 1944)  | (9) Cururu, upper Cururu River<br>Hidasi, 1958 (MPEG, collection no. 7254)   |
| (4) Marafá, right bank of the Tapajós River<br>Lönnerberg, 1940   | (10) Mundo Novo, right bank of the Iriri River<br>(sighting locality during this study)  |
| (5) Altamira, left bank of the Xingú River<br>Specimens preserved at the Goeldi Museum (MPEG, collection no. 18)                    | (11) Novo River, right bank tributary of the Iriri River<br>(sighting locality during this study)  |
| (6) Km 212 on the Santarém - Cuiabá highway<br>Specimens preserved at the Goeldi Museum (collection nos. 8121, 8471, 8474 and 8498) |  |

Fig. 1. Map showing geographical range of *A. belzebuth marginatus* based on Kellogg and Goldman (1944). Collecting localities since 1944 are numbered (map by S.D. Nash based on author's original).

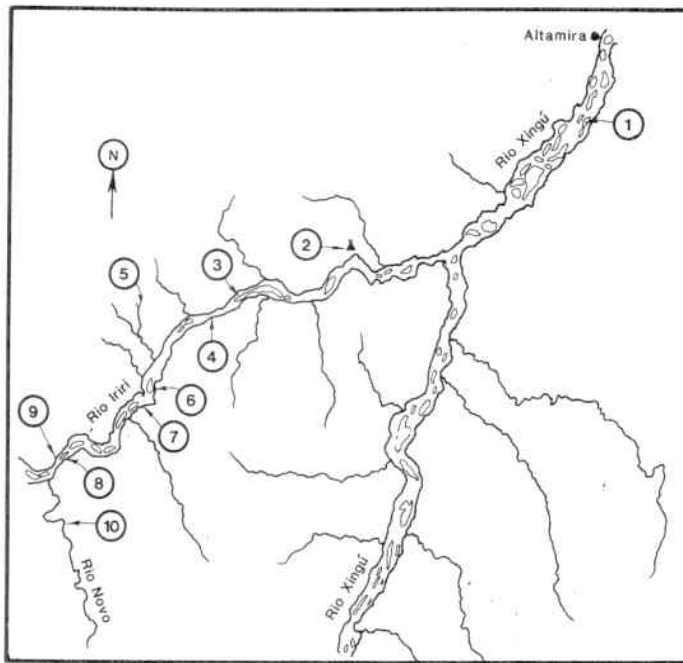


Fig. 2. Map showing localities of sightings in transect censuses. See appendix for explanation (map by S.D. Nash based on authors' original).



Fig. 3. Primates (e.g. *Cebus*, *Aotus*, *Callithrix* and *Saimiri*) are kept as pets by Araras Indians (photo by authors).

due to subsistence hunting, as has been suggested in the literature. Perhaps the holotype was a captive animal brought to Cametá from the west, and this led to an incorrect extension of the subspecies range. If this is true, the geographical range is only about half of that originally supposed. This increases the necessity of establishing a protected area for this primate west of the Xingú River. In addition, the western portion of the geographical range of *A. b. marginatus* (Tapajós River) is already being disturbed by colonization projects, timber exploitation, and mining; and, therefore, may be unsuitable for the kind of large conservation unit required for the genus. Based on these preliminary surveys, we have proposed to the electric company, Eletronorte, that further surveys be conducted in the area for the purpose of establishing a conservation unit. The area initially proposed is located between the Xingú, Iriri, and Novo rivers, adjacent to the borders of the Kayapó and Araras Indian reserves.

Another species listed as vulnerable in the official lists is the white-nosed saki, *Chiropotes albinus* (Thornback and Jenkins, 1982), which was seen in two locations on the left bank of the Iriri River. Our sample

size was too small to exclude its presence on the opposite bank of the Iriri, and many locals interviewed were not sure about its presence there. Some reliable informants, however, have seen this species on both margins of the upper portion of this river. If this is true, the proposed conservation area should be extended southwards or to the left bank in order to include viable populations of this species (Fig. 4).

Eduardo S. Martins  
 José Márcio Ayres  
 Maria Beatrice Ribeiro do Valle  
 Núcleo de Primatologia  
 Museum Paraense Emílio Goeldi  
 Caixa Postal 399  
 66.000 Belém-Pará  
 BRAZIL

Appendix  
 Species Sightings and Key to Localities in Fig. 2

Species	Localities
<i>Alouatta belzebul</i>	Tapiranga Island (1) Grande Island (3) Bem-Bom Island (6) Mundo Novo, right bank Iriri River (7)
<i>Aotus infulatus</i>	Laranjal, Arara Indian Tribe (2)
<i>Ateles belzebuth marginatus</i>	Mundo Novo, right bank Iriri River (7) Novo River, right bank tributary Iriri River (10)
<i>Cebus apella</i>	Morro do Gado, right bank Iriri River (4) João Ribeiro ( <i>igarapé</i> ), left bank Iriri River (5) Mundo Novo, right bank Iriri River (7) Novo River, right bank tributary Iriri River (10) Jatobá Island (8) Secondary road off highway PA-180 (9)
<i>Callicebus moloch</i>	João Ribeiro ( <i>igarapé</i> ) (5) Mundo Novo (7)
<i>Callithrix argentata</i>	Laranjal, Arara Indian Tribe (2)
<i>Chiropotes albinus</i>	Mundo Novo (7) Secondary road off highway PA-180 (9)
<i>Saimiri ustus</i>	Secondary road off highway PA-180 (9)

Acknowledgments

This survey was supported with a grant from Academia Brasileira de Ciências through an agreement with CNEC/Eletronorte. The authors wish to thank P.E. Vanzolini, coordinator of the project, and D. Oren for editorial comments.

Literature Cited

- Ayres, J.M. 1983. Levantamento de aves e mamíferos no rio Araguaia. Unpubl. report to Eletronorte, MME. 30 pp.
- Geoffroy Saint-Hilaire, É. 1809. *Ann. Mus. Hist. Nat. Paris*. Vol. XIII. 92 pp.
- Hershkovitz, P. 1977. *Living New World Monkeys (Platyrrhini) with an Introduction to the Primates*. Vol. 1. Univ. of Chicago Press, Chicago.
- Hershkovitz, P. 1984. Taxonomy of squirrel monkeys genus *Saimiri* (Cebidae, Platyrrhini): A preliminary report with description of a hitherto unnamed form. *Am. J. Primatol.* 7: 155-210.
- Hershkovitz, P. 1985. A preliminary taxonomic review of the South American bearded saki monkeys genus *Chiropotes* (Cebidae, Platyrrhini) with description of a new subspecies. *Fieldiana*, n.s. 27: 1-46.



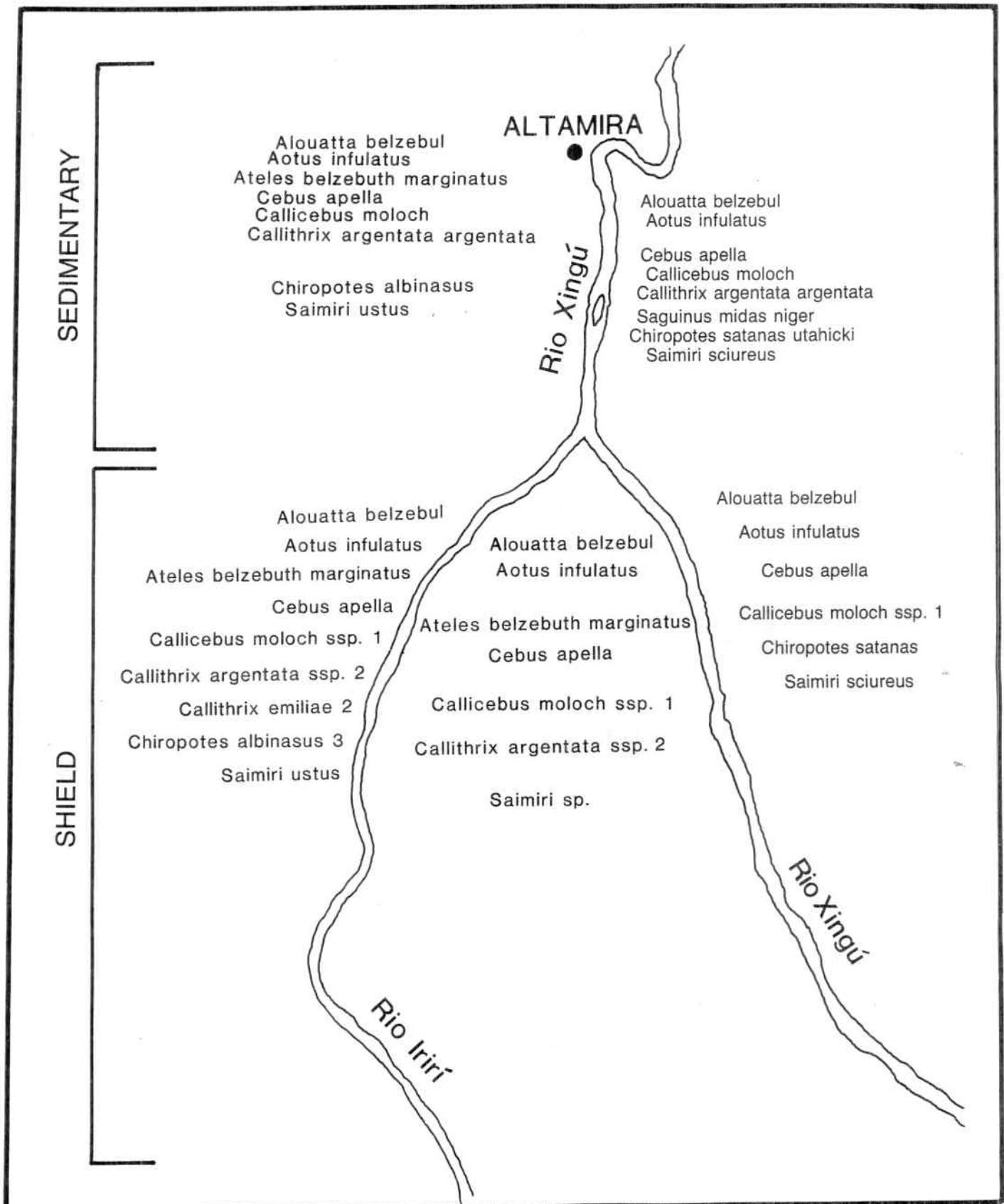


Fig. 4. Probable distribution of primates along the Xingú-Iriri River (1) *C. moloch* observed showing distinctive hair color; (2) individual *Callithrix argentata* ssp. observed on the left bank of the Iriri River by an Araras Indian — other *Callithrix* were collected by Sneath on the southwestern bank of the Curúa River (Vivo 1985) and described by Thomas (1920) as *Callithrix emiliae*; (3) distribution is based on sightings and reports (map by S.D. Nash based on authors' original).

- Hill, W.C.O. 1962. *Primates: Comparative Anatomy and Taxonomy*. Vol. 5, Part B. Interscience, New York. 537 pp.
- Johns, A. 1986. Effects of habitat disturbance on rainforest wildlife in Brazilian Amazonia. Unpubl. report to WWF. 111 pp
- Kellogg, R. and E.A. Goldman. 1944. Review of the spider monkeys. *Proc. U.S. Nat. Mus.* 96: 1-45.
- Kingston, W.R. 1984. Tucuruí hydro-electric project. *Primate Eye* 23: 20-3.
- Konstant, W., R.A. Mittermeier, and S.D. Nash. 1985. Spider monkeys in captivity and in the wild. *Primate Conservation* 5: 82-109.
- Napier, P.M. 1976. *Families Callitrichidae and Cebidae*. Part 1 of *Catalogue of Primates in the British Museum (Natural History)*, British Museum (Natural History), London.
- Snethlage, E. 1913. A travessia entre de Xingú e Tapajós. *Bol. Mus. Goeldi.* 7: 7-99.
- Terborgh, J. 1983. *Five New World Primates: A Study in Comparative Ecology*. Princeton Univ. Press, New Jersey.
- Thornback, J. and M. Jenkins. 1982. *The IUCN Mammal Red Data Book, Part I: Threatened Mammalian Taxa of the American and the Australian Zoogeographic Region (excluding Cetacea)*. IUCN, Gland.
- de Vivo, M. 1985. On some monkeys from Rondônia, Brasil (Primates: Callitrichidae, Cebidae). *Papéis Avulsos de Zoologia* 36(11): 103-10.

## Nonvolant Mammals Rescued at the Tucuruí Dam in the Brazilian Amazon

by Bento Melo Mascarenhas and Giuseppe Puerto

The filling of the Tucuruí Dam reservoir on the Tocantins River in eastern Brazilian Amazonia ( $3^{\circ}43'5''-5^{\circ}15' S$ ,  $49^{\circ}00'-50^{\circ}00' W$ ; Fig. 1), began in September 1984. The operation lasted until April 1985, when the water reached its expected maximum level. As a result, a lake 170 km in length and 14.3 km in mean width was formed, covering an area of approximately 2,430 km<sup>2</sup> and reaching a mean depth of 18.9 m (Valerio, 1986). During the filling the water rose 72 m, and Operation Curupira was developed to rescue animals from the flooding (Fig. 2). In all, 284,211 wild animals were caught, of which 103,143 were mammals (Table 1), 100,822 reptiles and 3,951 birds (Mascarenhas, 1985; Eletronorte, 1985). The rescue team consisted of approximately 470 people, who were divided among six field bases and used about 100 speed boats.

Capture statistics generally reflect the relative numbers of different species of the former forests. They are, however, biased due to several variable factors. For one thing, the capture of any individual was influenced by its size, mobility, and swimming ability, as well as other logistical problems encountered during the effort. Some larger mammals able to subsist for an extended time in the isolated conditions caused by the inundation are over-represented. In addition, since captures and releases were handled as quickly as possible in order to avoid transport and housing hazards, it was not possible to make species-level identification of some groups such as smaller rodents and marsupials.

Recapture may also have biased the figures. Animals were always released at the borders of the lake, but, since the water level kept rising, most areas where animals had been released were later inundated. As a result, some individuals may have been recaptured. The extent to which this process favored certain taxa is unknown because only 355 individual mammals (mostly primates) were marked during the operation, none of which were recaptured. We recommend future rescue operations mark a greater number of individuals so this error can be accounted for.

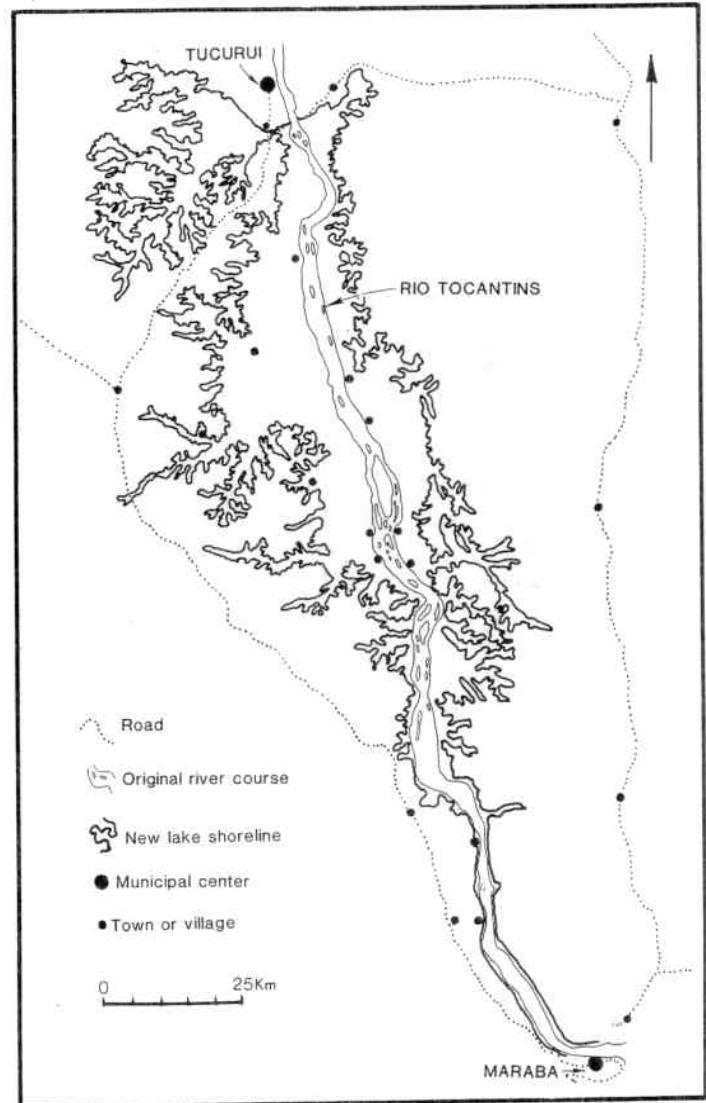


Fig. 1. Map of the Tocantins River showing area inundated by the Tucuruí Dam reservoir (map by S.D. Nash).

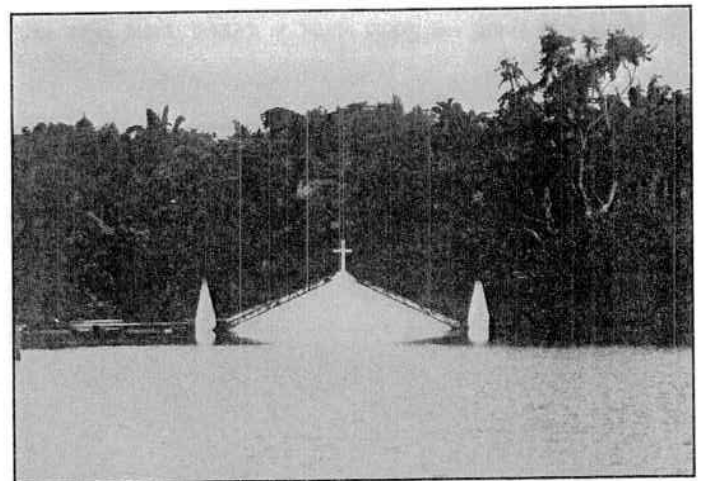


Fig. 2. Animals were not the only mammals displaced by the filling of the Tucuruí Dam (photo provided by authors).

The groups best represented are the edentates and primates, mainly due to the large number of easily recognizable folivores within these groups, such as the three-toed sloth (*Bradypus variegatus*) and the black

howler (*Alouatta belzebul*), which alone represented nearly 47% of the mammals collected (Fig. 3). Among edentates, another folivore, *Choloepus* sp., was quite abundant and represented nearly 22% of the order. Among the armadillos, *Dasybus novemcinctus* was by far the best represented, while, as expected, the rare *Priodontes giganteus* and *Euphractus sexcinctus* were the least represented with a total of 15 individuals.

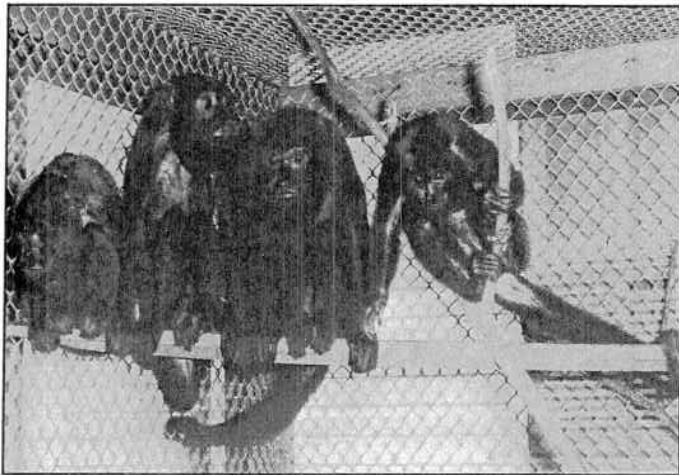


Fig. 3. Four *Alouatta belzebul* rescued during Operation Curupira on the Tocantins River (photo provided by authors).

The omnivorous *Cebus apella* and the insectivore/frugivore *Saimiri sciureus* accounted for more than 15% of all the primates collected. *Chiropotes satanas*, a specialized seed eater, was the least represented primate, as has been the case in surveys in other sites in Amazonia (Ayres, 1981; van Roosmalen *et al.*, 1981). The densities of *Callicebus moloch* (Fig. 4) were low because this species is restricted to the left bank of the river (Hershkovitz, 1963).

Although smaller rodents and marsupials were not identified during their capture, *Coendou* spp. and *Didelphis marsupialis* were, respectively, the best represented taxa. The coatimundi (*Nasua nasua*) was well represented, comprising more than half of the carnivores, followed by the kinkajou (*Potos flavus*). The only puma (*Felis concolor*) captured was a very young individual found on a small island in the center of the reservoir.

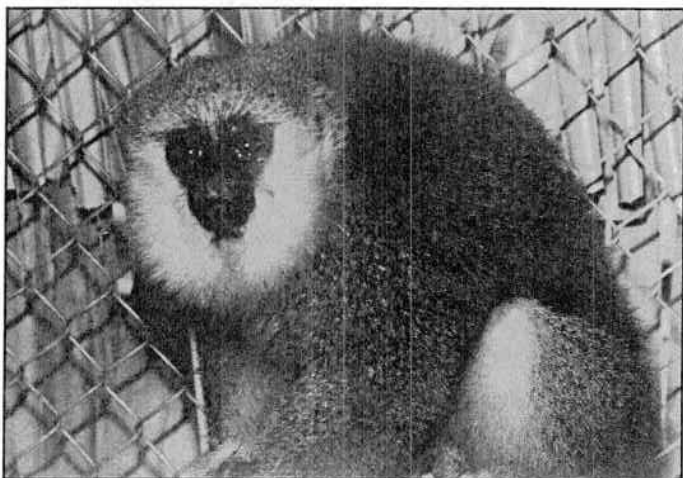


Fig. 4. A *Callicebus moloch* temporarily made captive during Operation Curupira (photo provided by authors).

Table 1. List of Nonvolant Mammals Captured by Operation Curupira

Species	No.	Frequency	
			%*
<b>Edentates</b>	54,263		53.55
<i>Bradypus variegatus</i>	28,771		53.02
<i>Choloepus</i> sp.	11,918		21.96
<i>Dasybus novemcinctus</i>	9,673		17.83
<i>Tamandua tetradactyla</i>	3,688		6.80
<i>Cyclopes didactylus</i>	82		0.15
<i>Cabassous unicinctus</i>	67		0.12
<i>Dasybus kappleri</i>	35		0.06
<i>Myrmecophaga tridactyla</i>	14		0.03
<i>Priodontes maximus</i>	12		0.02
<i>Euphractus sexcinctus</i>	3		0.004
<b>Primates</b>	27,007		26.65
<i>Alouatta belzebul</i>	19,496		72.19
<i>Cebus apella</i>	2,580		9.55
<i>Saimiri sciureus</i>	1,747		6.47
<i>Saguinus midas niger</i>	1,073		3.97
<i>Callicebus moloch</i>	941		3.48
<i>Aotus infulatus</i>	627		2.32
<i>Chiropotes satanas</i>	543		2.01
<b>Rodents</b>	17,709		17.48
<i>Coendou</i> spp.	9,318		52.62
<i>Dasyprocta agouti</i>	5,859		33.08
<i>Agouti paca</i>	810		4.57
<i>Sciurus</i> spp.	84		0.47
<i>Hydrochaeris hydrochaeris</i>	25		0.14
Smaller Rodents ( <i>Rattus</i> spp., <i>Orizomys</i> spp., <i>Proechimys</i> spp., <i>Echimyus</i> spp.)	1,613		9.11
<b>Carnivores</b>	703		0.69
<i>Nasua nasua</i>	384		54.62
<i>Potos flavus</i>	142		20.20
<i>Eira barbara</i>	106		15.08
<i>Felis wiedii</i>	40		5.69
<i>Felis pardalis</i>	15		2.13
<i>Cerdocyon thous</i>	14		1.99
<i>Felis yagouaroundi</i>	1		0.14
<i>Felis concolor</i>	1		0.14
<b>Marsupials</b> (including <i>Marmosa</i> spp., <i>Metachirus</i> spp., <i>Caluromys</i> spp., <i>Didelphis marsupialis</i> )	504		0.49
<b>Artiodactyls</b>	872		0.86
<i>Tayassu tajacu</i>	449		51.49
<i>Mazama gouazoubira</i>	222		25.45
<i>Mazama americana</i>	176		20.18
<i>Tayassu pecari</i>	25		2.87
<b>Lagomorpha</b>	256		0.25
<i>Sylvilagus brasiliensis</i>	256		100.00
<b>Perissodactyla</b>	12		0.01
<i>Tapirus terrestris</i>	12		100.00
<b>Total</b>	101,326		100.00

\*The percentage of each species is relative to its order, while the order's percentage is relative to the class.

*Tayassu tajacu* was the most numerous artiodactyl in the Tocantins River area. *Tayassu pecari*, although locally abundant in several areas of Amazonia, was not well represented in the capture, probably due to its swimming ability. Unlike *T. tajacu*, this species lives in larger troops, usually of more than 20 individuals. Of the 25 individuals collected during

the operation, most came from a single troop captured crossing the reservoir. The others were young individuals found isolated on some islands formed during the filling of the reservoir. Although the tapir (*Tapirus terrestris*) is generally a good swimmer, many found during the operation were in trouble, usually from having been shot and wounded by local hunters.

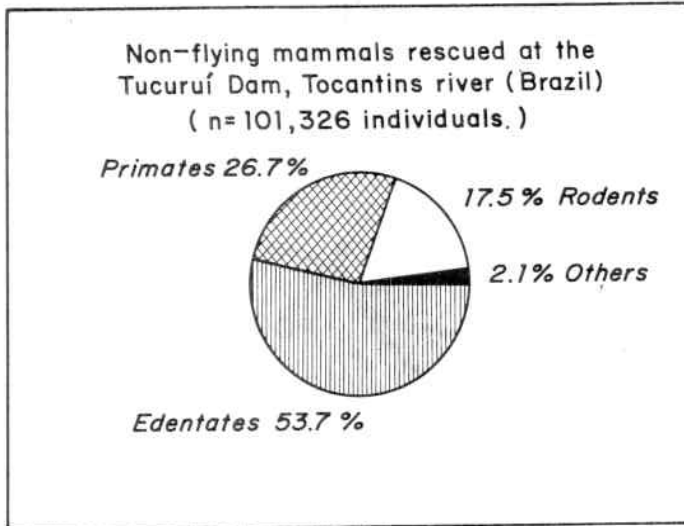


Fig. 5. Graph showing relative representation of different mammalian orders rescued by Operation Curupira (graph provided by authors).

Due to identification problems with small animals, we have not tried to estimate the biomass of each species collected, but there appears to be a predominance of Edentata relative to other mammals (Fig. 5). As expected, there is a clear predominance of folivores over insectivores or frugivores. This supports the idea that edentates comprise the dominant order in the Neotropics, as has been shown by other authors for areas north of the equator (e.g., Eisenberg and Thorington, 1973). The total number of mammals collected on this occasion is quite high compared to the number collected from the Afobaka Dam operation in Suriname (Walsh and Gannon, 1967). Despite the Tucuruí Dam being only twice as big as the Afobaka, the total number of mammals captured was over ten times greater (see Goodland, 1978, for the areas inundated by several dam projects). This difference, however, is probably more due to differences in the scope of the collection efforts than to differences in mammalian density between the forests.

Bento Melo Mascarenhas  
Departamento de Zoologia  
Museu Paraense Emílio Goeldi  
Belém - Pará - 66.00  
BRAZIL

Giuseppe Puerto  
Divisão de Biologia  
Instituto Butantã  
Av. Vital Brasil 1500  
São Paulo - S.P. - 0100  
BRAZIL

#### Acknowledgments

We wish to thank J.M. Ayres and W.L. Overall for their editorial comments on this manuscript. We are also grateful to G.R. Lobo Vasconcelos, General Coordinator of Operation Curupira, for his support throughout the work. The operation was financed by Eletronorte (Centrais Electricas do Norte do Brasil, S.A.). The authors participated in the rescue as technical and scientific coordinators of the operation.

#### Literature Cited

- Ayres, J.M. 1981. Observações sobre a ecologia e o comportamento dos cuxiús (*Chiropotes albinus* e *Chiropotes satanas*, Cebidae: Primates). FADESP/GRAFISA, Belém.
- Eisenberg, J.F. and R.W. Thorington, Jr. 1973. A preliminary analysis of a neotropical mammal fauna. *Biotropica* 5(3): 150-61.
- Eletronorte. 1985. Usina Hidroelétrica Tucuruí "Operação Curupira," atividades técnicas. Unpubl. report of Eletronorte, Ref. ATE-015/85. S.A., Brasília.
- Goodland, R. 1978. Environmental assessment of the Tucuruí Hydroproject, Rio Tocantins, Amazonia, Brazil. Eletronorte, S.A., Brasília.
- Hershkovitz, P. 1963. A systematic and zoogeographic account of the monkeys of the genus *Callicebus* (Cebidae) of the Amazonas and Orinoco river basins. *Mammalia* 27: 1-76.
- Mascarenhas, B.M. 1985. "Operação Curupira," Relatório Técnico. Unpubl. report to Eletronorte, S.A., Brasília.
- Valerio, C.B. 1986. Efeitos de grandes barragens sobre a fauna e flora. *Rev. Bras. Eng.* 1(1): 85-9.
- van Roosmalen, M.G.M., R.A. Mittermeier, and K. Milton. 1981. The bearded sakis, genus *Chiropotes*. In: *Ecology and Behavior of Neotropical Primates*. Vol. 1, A.F. Coimbra-Filho and R.A. Mittermeier, eds. Academia Brasileira de Ciências, Rio de Janeiro, pp. 419-42.
- Walsh, J. and R. Gannon. 1967. *Time is Short and the Water Rises*. Thomas Nelson & Sons, Camden, New Jersey.

## Primate Populations in Northern Bolivia

by Ann K. Kohlhaas

This report provides data on the status of primates in the northern Pando region of Bolivia in the summer of 1986. Previous primate censuses in the Pando have indicated a high abundance and diversity of primates. Izawa and Bejarano (1981) reported evidence for 15 species of primates in their 1978-80 field study. Freese *et al.* (1982) reported 13 species during a short-term field study in 1975. Additionally, the only two field studies of the little-known *Callimico goeldii* were in the Pando (Masataka 1981a,b; Pook and Pook, 1981).

The current study was in a site relatively accessible from the town of Cobija, and, as such, provides information on primate population trends during the early stages of human encroachment. The author was a member of a larger group primarily concerned with studying birdlife in the area and the study benefited from the observations of several individuals.

#### Methods

This study was primarily conducted at a site located approximately 8 km west (by road) of Villa Bush, a small settlement 12 km south of Cobija (Fig. 1). Three days were also spent at Porvenir, but no biomass estimates were made there. The general topography at the main study area was low, rolling hills interspersed with many small streams. Well-drained upland tropical forest, with a mixed canopy height level of 20-25 m and occasional emergents to 30-40 m, was the predominant vegetative cover. The study site also included a large area of thick bamboo forest, a couple of small swampy areas, and scattered patches of relatively recent secondary growth with relatively open canopies and frequent patches of *Cecropia*.

The main study area included approximately 310 ha of forest through which 4.3 km of trails were cut for use by researchers. An additional 4 km of rubber collection trails were also used regularly. Approximate-

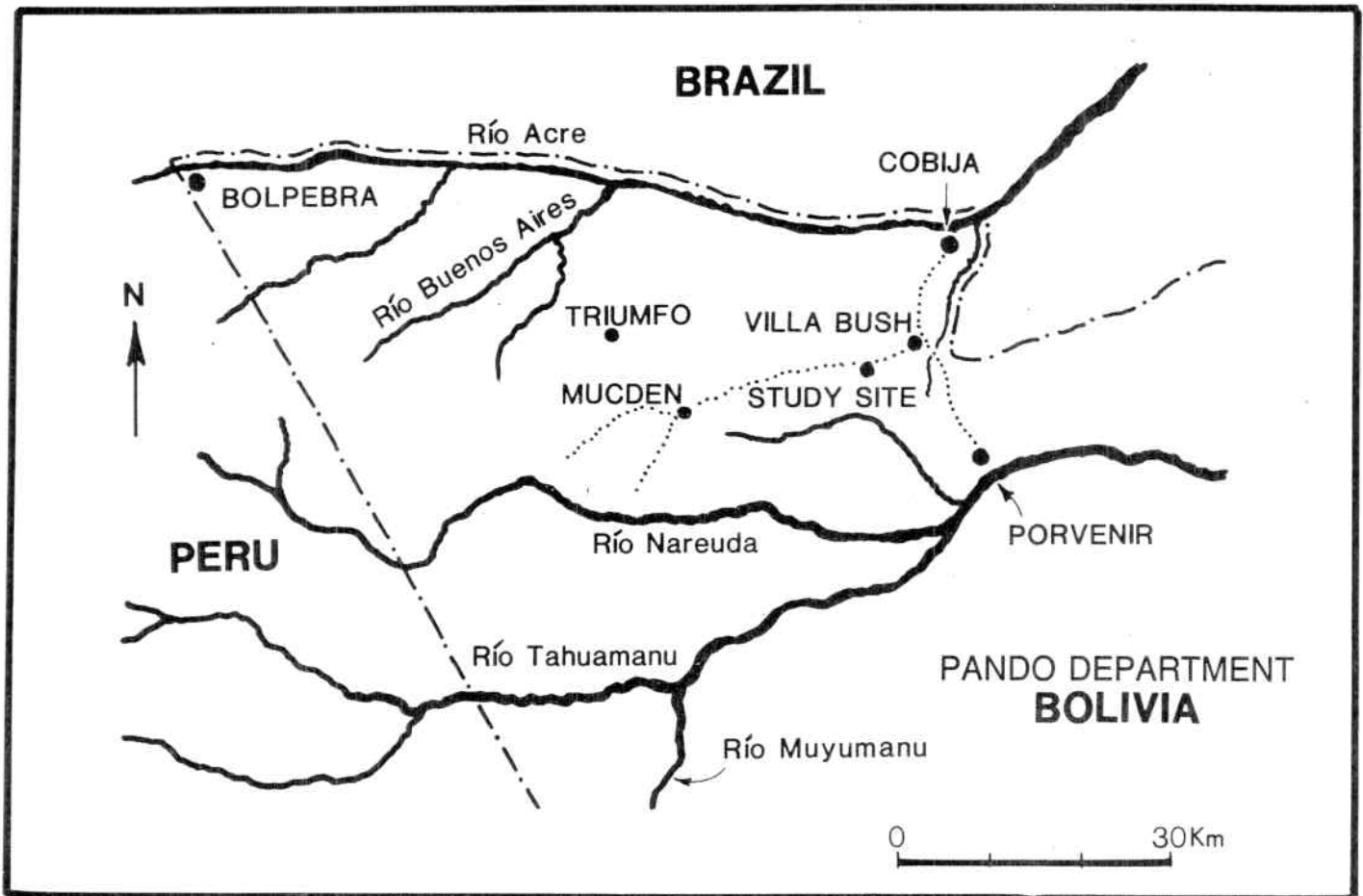


Fig. 1. Map of northwestern Bolivia (by S.D. Nash adapted from Izawa and Yoneda, 1981).

ly 1 km of the trail system went through bamboo forest while the remainder crossed upland forest with occasional streams, swampy areas, and secondary growth.

Daily censuses were conducted from 14 June to 7 August 1986. This is the dry season in northern Bolivia, and only a couple of short showers occurred near the end of the study. Daily temperatures commonly ranged from 18 to 32 °C. Two southern cold fronts (*surazos*) blew through during the study, dropping this temperature range from 13 to 25 °C for about three days. In general, skies were clear or scattered with clouds, there was little or no wind, and relative humidity was high (all unmeasured).

Censuses were conducted by walking along the trails at an average speed of 1 kph. Periods of walking were interspersed with periods of silent "watch and wait" censusing in order to increase the possibility of detecting shy species that might hide or flee upon the approach or movement of a researcher.

Monkey densities were initially calculated as the number of groups encountered per area, according to the recommendations of Eisenberg *et al.* (1981). Area was calculated as the distance traversed (only the first time traversed was counted) multiplied by twice the detection distance. Detection distance was doubled as an estimate of the total detection field for both sides of the trail. Daily estimates calculated as above were averaged to obtain the best estimate for the site. Statistical analyses comparing density estimates obtained from only first daily traverses through trails and from all daily travels (even those areas repeated) revealed no statistically significant differences between the two estimates (Mann-Whitney U test,  $p < 0.05$ ). For each species, the 95% confidence limits overlapped for the two types of estimates, although the means were consistently lower for the estimates including repeated areas. The lowered means were most likely due to repetition of areas invariably

occurring later in the day when fewer groups were usually detected. For this paper, it was decided to include only first daily traverses in the density estimates.

Further calculations involved figuring the average number of individuals per group and, finally, the estimated biomass per area for each species. The counts of individuals per group were made conservatively by only including individuals seen or reliably heard as distinct in the group. Biomass estimates were made in the same manner as Freese *et al.* (1982), as follows:  $\text{ind}/\text{km}^2 \times \text{adult weight (kg/ind)} \times .75 = \text{kg}/\text{km}^2$ . The adult weights used were the same as those used by Freese *et al.* (1982). These were 0.35, 0.35, 0.95, and 1.5 kg for *Saguinus fuscicollis*, *S. labiatus*, *Callicebus moloch*, and *Pithecia irrorata*, respectively.

## Results

Only eight species were positively identified during this study, compared to 13 identified by Freese *et al.* (1982) in 1975, and 15 by Izawa and Bejarano (1981) in 1978-80 (Table 1).

*Alouatta seniculus* was heard roaring at a distance in the early morning on several occasions and were seen three separate times by three different members of the research group during the study period. *Aotus trivirgatus* was seen within the study area, but no attempt was made to determine its abundance. *Cebuella pygmaea* may also occur in the study area. A member of the camp staff reported seeing a small monkey with a description fitting *Cebuella*. This was an isolated sighting and a local youth very familiar with the local wildlife professed no knowledge of the species in the area. However, Izawa and Bejarano (1981) listed a singular sighting of *Cebuella* in the general area. Freese *et al.* (1982) heard reports and saw two captive *Cebuella* along the Río Acre. Thus, it may be a rare species in the area.

Although *Ateles paniscus* did not occur within the study area, some members of our group did see a captive one in a town about 30 km away. Previous studies also failed to encounter wild *Ateles*. *Saimiri sciureus* was seen outside the site by another researcher in the Porvenir area. The apparent paucity of *Saimiri* in the area is puzzling as they were relatively abundant in previous studies (Freese *et al.*, 1982; Izawa and Bejarano, 1981).

*Cebus* species were surprisingly absent during the current study. Both previous studies recorded them as relatively common. *Lagothrix lagotricha*, *Saguinus imperator*, and *S. mystax* were not seen in 1986. Previous studies did not encounter *L. lagotricha* or *S. mystax* in the wild but did record captives or reports from local people. *S. imperator* was seen by Izawa and Bejarano (1981) in the basin of the Río Muyumanu.

*Callimico goeldii*, the focus of this study, unfortunately was never seen. Previous studies (Izawa, 1979) indicated it to be of rare and patchy occurrence. Certainly its habitat and habits, as detailed by Pook and Pook (1981), hinder observations. Inquiries of local people about existence of a "small all-black monkey" resulted in mixed answers, especially at Porvenir. Usually the initial answer was yes, followed by no when the emphasis was put on all-black, or people would refer to the large all-black *Ateles* in a local town. At the primary study site, a local rubber collector told us that a few years earlier (exact year unclear) they had trapped many monkeys and parrots for a local wildlife exporter. Monkeys were worth \$12 apiece (currency unclear). The small, all-black monkeys (presumably *Callimico*) were among the most desired species. Unfortunately, the current study was too limited in its geographic scope to determine whether *Callimico* still exists in this general area.

Table 1. Monkey Species Recorded in the Cobija Area  
Pando Department, Bolivia

Species	Present Study	Izawa and	Freese
	1986	Bejarano (1981) 1978-80	<i>et al.</i> (1982) 1975
<i>Alouatta seniculus</i>	E	V	E
<i>Cebus apella</i>	—	E	E
<i>Cebus albifrons</i>	—	E	E
<i>Pithecia irrorata</i> <sup>1</sup>	E	E	E
<i>Saimiri sciureus</i>	E	E	E
<i>Callicebus moloch</i>	E	E	E
<i>Aotus trivirgatus</i>	E	E	E
<i>Ateles paniscus</i>	C	R	R
<i>Lagothrix lagotricha</i>	—	R	—
<i>Saguinus fuscicollis</i>	E	E	E
<i>Saguinus labiatus</i>	E	E	E
<i>Saguinus imperator</i>	—	E	R
<i>Saguinus mystax</i>	—	C	—
<i>Cebuella pygmaea</i>	?	E	R,C
<i>Callimico goeldii</i>	—	E	C

**Key:**

E = visual encounter  
V = vocalizations only  
R = reported by locals  
C = captive only  
? = questionable report

<sup>1</sup>*Pithecia irrorata irrorata* according to latest taxonomic review by Hershkovitz (1987). Previously used names were *P. hirsuta* (Izawa and Bejarano, 1981) and *P. monachus* (Freese *et al.*, 1982).

***Saguinus fuscicollis* and *S. labiatus***

*Saguinus fuscicollis* and *S. labiatus* were the most commonly sighted monkey species. During 49 days of active censusing at the primary study site, *Saguinus* groups were seen 79 times. These 79 sightings included 17 of *S. labiatus* alone, 29 of *S. fuscicollis* alone, 3 of an undetermined *Saguinus* species (not clearly seen), and 30 of *S. fuscicollis* and *S. labiatus* mixed or traveling together. It is certainly possible that the two species

associated even more frequently and that at times only one species was seen and recorded. *S. fuscicollis* was also seen during three days of censusing in the Porvenir area along the north bank of the Río Tahuamanu.

An average of 6.09 *S. fuscicollis* groups were seen per km<sup>2</sup>. With an average of 3.72 ind/group, the estimated biomass per area for this species was 5.95 kg/km<sup>2</sup> (Table 2).

*Saguinus labiatus* was less common than *S. fuscicollis*, but still an average of 4.46 groups/km<sup>2</sup> was encountered. An average of 2.69 monkeys was seen per group, yielding an estimated biomass for *S. labiatus* of 3.15 kg/km<sup>2</sup> (Table 2).

Table 2. Density Estimates for Four Monkeys in the Cobija Area  
Pando Department, Bolivia

Species	Group/km <sup>2</sup>		Ind/Group		Ind/km <sup>2</sup>	kg/km <sup>2</sup> Estimated Average (x .75)
	95% confidence					
	mean	interval	mean	range	mean	
<i>Saguinus fuscicollis</i>	6.09	4.0-8.1	3.72	1-6	22.65	5.95
<i>Saguinus labiatus</i>	4.46	2.9-6.0	2.69	1-8	12.00	3.15
<i>Callicebus moloch</i>	2.52	0.1-5.0	2.56	1-4	6.45	4.60
<i>Pithecia irrorata</i>	0.53	0.1-1.0	2.22	1-4	1.18	1.32
<b>Total</b>						<b>15.02</b>

***Callicebus moloch***

Although *Callicebus moloch* choruses were heard daily and often at all hours of the day, they were much less commonly seen. This is perhaps due to their small family sizes. They were visually encountered on 18 of the 49 census days. Their average density was 2.52 groups/km<sup>2</sup> with 2.56 ind/group. The estimated biomass of *C. moloch* was 4.60 kg/km<sup>2</sup> (Table 2).

***Pithecia irrorata***

*Pithecia irrorata* was the rarest of the monkeys for which censusing was attempted. During 49 census days, *Pithecia* was seen only 9 times. Its average density was calculated at 0.53 groups/km<sup>2</sup>. Its relatively quiet habits and monogamous family groups probably contributed to the rarity of sightings. However, upon sighting the researcher, it made its presence quite obvious by emitting loud "growl-grunts," moving rapidly, and fluffing up its fur. Although this behavior was noted both when the researcher saw the monkey first and vice versa, the monkey may also hide or make a quiet escape and, thus, remain undetected.

An average of 2.22 individuals was seen per *Pithecia* group. Four of the nine sightings were apparently single individuals. *Pithecia* biomass was estimated at 1.32 kg/km<sup>2</sup> (Table 2).

**Discussion**

The reduced number of species reported is due at least in part to the limited area in which this study was conducted. Freese *et al.* (1982) surveyed a wider area, which included 25 km of the Río Acre west of Cobija and another 30 km south of the Río Acre to the Río Nareuda. However, they did report a lack of sightings during censusing of the Río Acre. Izawa and Bejarano (1981) surveyed five areas with several types of habitat in northern Bolivia. These areas included the Bolivian side of the Río Acre between Bolpebra and Buenos Aires, a location approximately 30 km east of Porvenir, the Mucden—Triunfo area, the area surrounding the confluence of the Ríos Tahuamanu and Muyumanu, and the San Silvestre—Río Manuripi area (all but the last location can be found in Fig. 1).

Based on my own estimates of group sizes and biomass, I found a lower monkey biomass/km<sup>2</sup> than did Freese *et al.* (1982; Table 3). Although the *S. fuscicollis* biomass estimates were nearly equal, the other

species' estimates were reduced by half or more. Even more disturbing, Freese *et al.* (1982) estimated *Saimiri sciureus* and *Cebus apella* to occur in the Cobija area at densities of 12.6 kg/km<sup>2</sup> and 13.1 kg/km<sup>2</sup>, respectively, but these species were not seen during the current study (except one glimpse of *Saimiri* outside the site). The total estimated monkey biomass for the area reported by Freese *et al.* (1982) was 57.0 kg/km<sup>2</sup> (Table 3) versus 15.02 kg/km<sup>2</sup> in the present study (Table 2).

**Table 3. Comparison of Freese *et al.* (1982) Density Estimates with Current Estimates Adjusted by Freese *et al.* (1982) Group Sizes**

Species	Current Study, 1986			Freese <i>et al.</i> (1982), 1975		
	groups/km <sup>2</sup>	ind/km <sup>2</sup>	kg/km <sup>2</sup>	groups/km <sup>2</sup>	ind/km <sup>2</sup>	kg/km <sup>2</sup>
<i>Saguinus fuscicollis</i>	6.09	36.54	9.59	4.6	27.6	6.2
<i>Saguinus labiatus</i>	4.46	26.76	7.02	4.6	27.6	7.2
<i>Callicebus moloch</i>	2.52	7.56	5.39	4.9	14.7	10.5
<i>Pithecia irrorata</i>	0.53	3.18	3.58	1.1	6.6	7.4
<i>Saimiri sciureus</i>	—	—	—	0.6	24.0	12.6
<i>Cebus apella</i>	—	—	—	0.7	7.0	13.1
	Total 25.58			Total 57.0		

A large part of the differences between the present biomass estimates and those of Freese *et al.* (1982) is due to our respective estimates of group size. They used 'best' estimates for group sizes, whereas averages of 'conservative' estimates were used in the present study. Adjustment of the present density estimates by the Freese *et al.* (1982) group sizes raises the present biomass estimates to 25.58 kg/km<sup>2</sup> (Table 3). Additionally, this adjustment raises the current biomass estimates for *S. fuscicollis* higher than, and for *S. labiatus* to nearly equal, the 1975 estimates of Freese *et al.* (1982). Most of the remaining difference is due to the presence of *Saimiri sciureus* and *Cebus apella* in the Freese *et al.* (1982) study. Disturbingly, the present estimates for *Callicebus moloch* and *Pithecia irrorata* are still only approximately half of those made by Freese *et al.* (1982).

Yoneda (1981) provided much lower density estimates for the two *Saguinus* species in the Cobija area. He estimated *S. fuscicollis* to occur at 2.2 groups/km<sup>2</sup> and 12.2 ind/km<sup>2</sup>. *S. labiatus* density was estimated at 1.7 groups/km<sup>2</sup> and 8.6 ind/km<sup>2</sup>. These estimates are notably lower than those of the present study and Freese *et al.* (1982). This difference, however, may be mostly attributable to a difference between the density estimating methods used by Yoneda (1981) and those used in the other studies. Yoneda's estimates were obtained by including all the groups visiting his study area and figuring an effective census area larger than the study area by assuming home ranges with a diameter of 600 m.

Freese *et al.* (1982) emphasized that human predation is a major factor affecting monkey densities. Larger species are especially affected by this factor. The present data may be an indication of this. The smaller *Saguinus* species are of nearly equal or greater density than 11 years ago, while the larger (though not very large) *Callicebus* and *Pithecia* densities have been reduced by half or more. The large *Cebus* species were not seen at all in 1986. *Saimiri* is unlikely to be of much food value and was probably absent for other reasons. Perhaps its association with *Cebus*, as noted by Izawa and Bejarano (1981) and Terborgh (1983), has been a factor.

Although the Pando Department of Bolivia has few population centers (even small ones), rubber collectors and Brazil nut gatherers are spread throughout a wide area. Any area accessible by footpath, river, or stream is likely to be exploited. Monkeys are hunted for food and for wildlife

export. Although Bolivia has strict laws against such activities, several reliable sources reported their occurrence in the recent past. This could have devastating effects on larger, slower-reproducing species or those of already rare occurrence.

Another factor in northern Bolivia that could affect the monkey densities is yellow fever. Freese *et al.* (1982) pointed out its occurrence in the human population of Bolivia from 1973 to 1975 and suggested that it may have affected monkey populations. However, they had no reports of unusual monkey mortality. During the summer of 1986, yellow fever was again a health problem in northern Bolivia and adjacent Brazil.

Another major concern regarding primate populations of the Pando is habitat destruction. Although vast tracts of forest relatively undisturbed by anything more than rubber-collecting still exist, areas near towns are being rapidly clear-cut for small *chacos* (farms) of limited viability. Attempts to 'settle' the more remote areas of the country will accelerate this process. The continued viability of rubber and Brazil nut as cash crops is dependent upon maintenance of the forest ecosystem. With luck this direct economic interest will provide enough incentive to maintain the forest ecosystem for long-term investment instead of clear-cutting it for short-term rewards. The important role of primates in the tropical forest ecosystem is becoming increasingly apparent, especially their role in the turnover of fruits and dispersal of seeds.

Ann K. Kohlhaas  
Department of Environmental,  
Population and Organismic Biology  
Campus Box B-344  
University of Colorado  
Boulder, CO 80309  
U.S.A.

#### Acknowledgements

I would like to thank the National Geographic Society for its financial support of this project and Dr. James Van Rensen for kindly agreeing to include me on his expedition and research grant from NGS, and for his advice and observations in the field. I would also like to thank Dr. Charles H. Southwick for introducing me to Dr. Van Rensen and acting as an advisor. For generously sharing their observations, expertise, and companionship in the field, I would also like to thank the members of J.V.R.'s research team: E.I. Flores de Capriles, J.A. Gerwin, B.D. Glick, T.A. Parker III, C.E. Quintela, K.V. Rosenberg, J.H. Sánchez Ch., M. Sánchez S., C.G. Schmitt, and D.C. Schmitt. I would also like to thank Fritz Hertel and the Glick family for generously providing accommodations at Porvenir and Santa Cruz, respectively.

#### Literature Cited

- Eisenberg J.F., W.P.J. Dittus, T.H. Fleming, K. Green, T. Struhsaker, and R.W. Thorington, Jr. 1981. *Techniques for the Study of Primate Population Ecology*. National Academy Press, Washington, D.C. 233 pp.
- Freese, C.H., P.G. Heltne, N. Castro R., and G. Whitesides. 1982. Patterns and determinants of monkey densities in Peru and Bolivia, with notes on distributions. *Int. J. Primatol.* 3(1): 53-90.
- Hershkovitz, P. 1987. The taxonomy of South American sakis, genus *Pithecia* (Cebidae, Platyrrhini): A preliminary report and critical review with the description of a new species and a new subspecies. *Am. J. Primatol.* 12: 387-468.
- Izawa, K. 1979. Studies on peculiar distribution patterns of *Callimico*. *Kyoto Univ. Overseas Research Reports of New World Monkeys* 1979: 1-19.
- Izawa, K., and G. Bejarano. 1981. Distribution ranges and patterns of nonhuman primates in western Pando, Bolivia. *Kyoto Univ. Overseas Research Reports of New World Monkeys* 2: 1-11.

Izawa, K., and M. Yoneda. 1981. Habitat utilization of nonhuman primates in a forest of the western Pando, Bolivia. *Kyoto Univ. Overseas Research Reports of New World Monkeys* 2: 13-22.

Masataka, N. 1981a. A field study of the social behavior of Goeldi's monkeys (*Callimico goeldii*) in North Bolivia. I. Group composition, breeding cycle, and infant development. *Kyoto Univ. Overseas Research Reports of New World Monkeys* 2: 23-32.

Masataka, N. 1981b. A field study of the social behavior of Goeldi's monkeys (*Callimico goeldii*) in North Bolivia. 2. Grouping pattern and intragroup relationship. *Kyoto Univ. Overseas Research Reports of New World Monkeys* 2: 33-41.

Pook, A.G., and G. Pook. 1981. A field study of the socio-ecology of the Goeldi's monkey (*Callimico goeldii*) in northern Bolivia. *Folia primatol.* 35: 288-312.

Terborgh, J. 1983. *Five New World primates, a study in comparative ecology*. Princeton Univ. Press, Princeton, New Jersey. 260 pp.

Yoneda, M. 1981. Ecological studies of *Saguinus fuscicollis* and *Saguinus labiatus* with reference to habitat segregation and height preference. *Kyoto Univ. Overseas Research Reports of New World Monkeys* 2: 43-50.

## Primate Survey of the Estación Biológica Beni, Bolivia

by Juan E. Garcia and Teresa Tarifa

Within the framework of a long-term study of the ecology and population dynamics of the primate community in the Estación Biológica Beni, from February to June 1987, we conducted a survey to: (1) determine the distribution and abundance of each species of primate, (2) evaluate the fluctuations in their populations over the last years, (3) identify the most important factors influencing their status, and (4) suggest a normative which permits the protection, conservation and management of each species.

### Estación Biológica Beni

The study area, the Estación Biológica Beni, is situated between the provinces Ballivan and Yacuma in the Department Beni, Bolivia ( $66^{\circ} 18' 30''$  W,  $14^{\circ} 38' 00''$  S). The area is 270 m above sea level, having an approximate extension of 135 ha (Fig. 1).

There are two clearly distinguished seasons: a dry season which lasts from June to November, and a rainy season from December to May. The mean annual temperature is  $24^{\circ}$  C and the average annual precipitation is 1,800 mm.

In accordance with Walter's system, Hanagarth and Marconi (1984) indicate that the area is a transition from the tropical rainfall zone to the tropical summer rainfall zone. Unzueta (1975) describes the area as situated in a zone of (sub)tropical evergreen forest. Ellenbergh and Mueller-Dombois (1965) characterize the vegetation as tropical (or subtropical) evergreen seasonal lowland forest, savannas, and island forest. According to Rivera (pers. comm.) and our knowledge of the area, we identified four different biotopes for this survey:

**High Forest:** tropical evergreen lowland forest, well-drained, with a continuous 20-25 m high subdominant strata and tall trees up to 45 m in height, which make up between 30-40% of the cover. Some of the predominant species are: *ochoo* (*Hura crepitans*), *palo maría* (*Calophyllum* sp.), *mara* (*Swietenia macrophylla*), *bibosi* (*Ficus* sp.), *verdolago* (*Buchenaria* sp.), *blanquillo* (*Bractelaria* sp.) and *pachiuba* (*Socratea* sp.).

**Low River Forest:** tropical forest subject to sometimes drastic flooding and characterized by a discontinuous forest canopy 10-20 m high with trees up to 30 m tall. In the understory lianas grow, including *uña de gato* (*Macfadena unguis-cat*) and other Bignoniaceae in abundance. Among the arboreal species we find *pirquina* (*Xylopia* sp.), *achachairu* (*Rhedia* sp.), *bibosi* (*Ficus* sp.), and *chonta* (*Atocaryum chonta*).

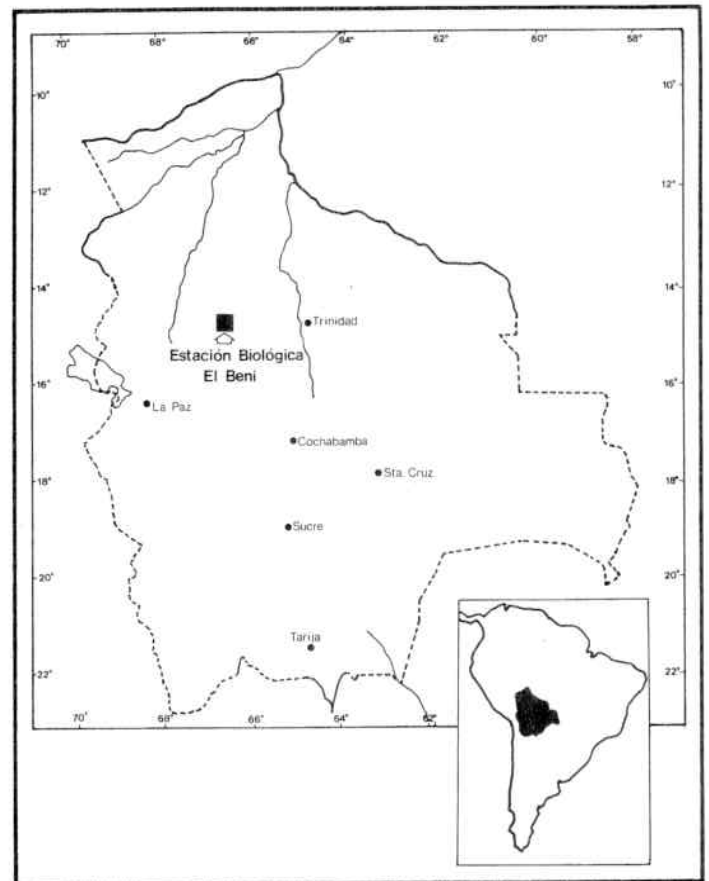


Fig. 1. Map showing the location of the Estación Biológica Beni (map provided by authors).

**Palm Forest:** secondary successional forest with anthropic influences and discontinuous low strata, but no flooding. Palm trees like *motacu* (*Scheelea princeps*) and *chonta* (*A. chonta*) and trees like *ambaibo* (*Cecropia* sp.), *pacai* (*Inga* sp.) and *balsa* (*Ochroma* sp.) dominate.

**Chaparral:** mainly deciduous forest due to drought, situated in transitional zones between forest and savanna. It presents a 5-10 m high top strata. Interlaced lianas like *M. unguis-cat* and other Bignoniaceae abound. There are thorny bushes and some of the more exceptional tree species include *cuse* (*Lunaria* sp.), *llave* (*Heteropterix* sp.) and *tusequi* (*Machaerium* sp.).

Six species of primates occur in the area: *marimona* (*Ateles paniscus*), *maneche rojo* (*Alouatta seniculus*), *silvador* (*Cebus apella*), *chichilo* (*Saimiri boliviensis*), *nocturno* or *cuatro ojos* (*Aotus azarae*), and *faca-faca* or *ururo* (*Callicebus moloch*) (Garcia et al., in press, 1987).

The fauna of the Estación Biológica also includes species which are in serious danger or have already disappeared in other zones like: *tigre* (*Panthera onca*), *ciervo de los pantanos* (*Odocoileus dichotomus*), *lobo de río* (*Lutra longicaudis*), *caimán* (*Melanosuchus niger*) and *arpia* (*Harpya harpya*). Nevertheless, due to the increase in hunting during the last decade, species like *lontra* (*Pteronura brasiliensis*) and *gama* (*Ozotoceros bezoarticus*) have disappeared and *ciervo de los pantanos* and *caimán* are seriously threatened.

There are various human settlements around the periphery of the Estación. These populations live on stockbreeding, agriculture, and subsistence hunting and sometimes trade in meat and skins. Inside the Estación area, indigenous Chimane families practice migratory agriculture and subsistence hunting and fishing.

An important timber industry exists in adjacent areas, where, above all, *mara* (*S. macrophylla*) and *cedro* (*Cedrella* sp.) are extracted.



Sometimes illegal timber exploitation has been detected inside the protected areas (Castelló, pers. comm.).

### Methods

During the study period, we carried out periodic censuses along six transects which covered the considered biotopes (Fig. 2). On each transect numbered marks were placed each 50 m. The selection of each transect was conditioned by our former knowledge of the study area and its accessibility during the rainy season. A total of 87 censuses were taken with 159 km of distance covered over the different biotopes. However, due to the restricted distribution of the chapparal, which is only found on the borders of the *bajios* (depressed savanna zones which are flooded during the year), it was impossible to census in this biotope.

We also gathered information from the local population which helped us evaluate the fluctuations of the primate populations over the past few years.

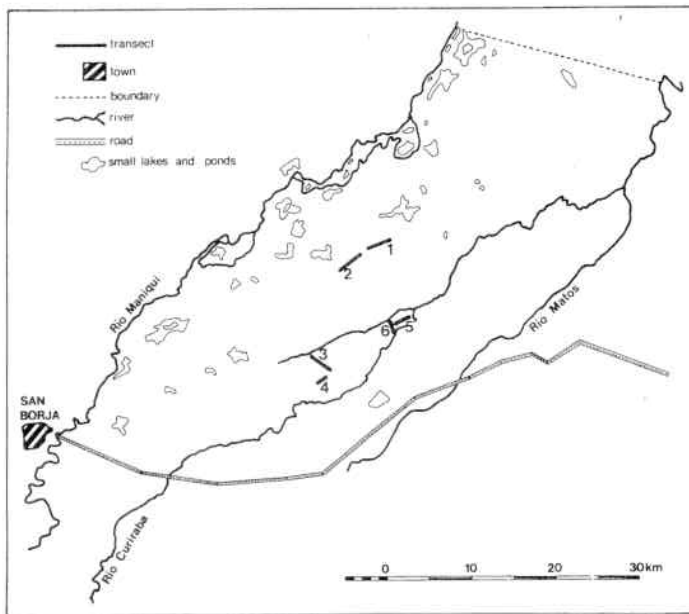


Fig. 2. Map of the study area showing the censusing transects (map provided by authors).

### Ecology and Population Characteristics

#### *Ateles paniscus*

The population of *A. paniscus* was composed of heterosexual groups of 6-50 individuals, the mean being 24.6 (Table 1).

This species was found in only one of the four considered biotopes, i.e., in the high forest, where we encountered 14 troops during 51 km of censusing.

Table 1. Mean Group Size for Primates at Estación Biológica Beni

Species	No. Groups	Mean Size (ind.)	s.d.
<i>A. paniscus</i>	56	24.6	12.8
<i>A. seniculus</i>	42	4.4	1.8
<i>C. apella</i>	82	17.1	9.4
<i>S. boliviensis</i>	59	49.4	27.6
<i>C. moloch</i>	15	2.9	0.8
<i>A. azarae</i>	23	3.6	0.8

Usually the individuals occupied the top strata of the forest. Whenever we located a group of this species it was by auditory detection first, either because of their vocalizations or the noise produced by their jumping from branch to branch. Their most common behavior in our presence was quick escape.

This species is a typical inhabitant of the high forest which grows in the inaccessible parts of the protected area. *Ateles* have practically disappeared from forest on the peripheries of the area, although they were frequently found there 15-20 years ago (Fig. 3).

*Ateles* is favored over the other local primate species for its meat and fat and is frequently hunted by the local population, especially the indigenous Chimanes. During the months of April and May, when there is an abundance of food and the monkeys are in their best condition, the Chimanes go hunting in groups of six or seven and kill up to 45 animals per excursion. This situation has been aggravated by the introduction of firearms and the increasing number of settlements in the area. Especially during the last five years, an increase in hunting has been detected in the high forest with a consequent alarming decrease in the number of *Ateles*.

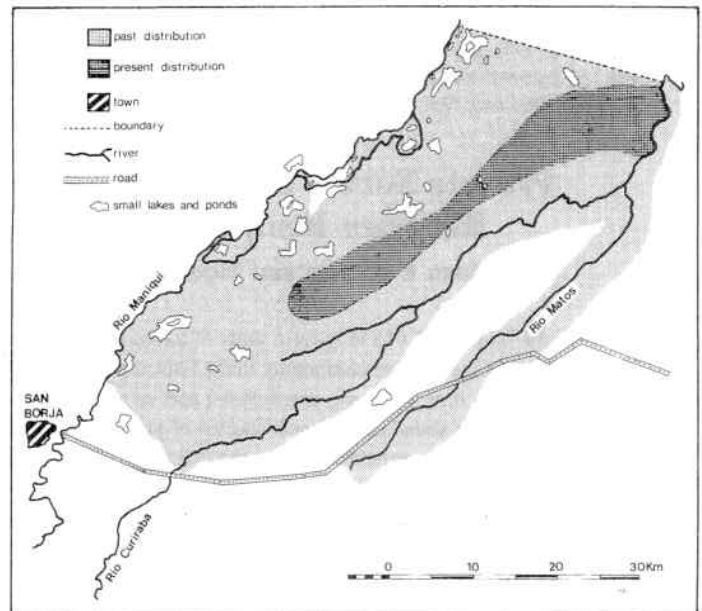


Fig. 3. The distribution of *Ateles paniscus* at the Estación Biológica Beni (map provided by authors).

#### *Alouatta seniculus*

The population of *A. seniculus* was composed of heterosexual groups of one or more sexually mature males and various adult females together with some sexually immature individuals. The mean group size was of 4.4 individuals (Table 1). The relative sex and age class proportions of the population were: 3.9 adult males, 5.7 adult females, 2.5 subadults, 1 juvenile and 1.6 infants.

This species was found in all the considered biotopes that we censused. We counted a total of 17 troops in the 159 km censused.

Like *A. paniscus*, *A. seniculus* prefer the top strata of the forest. When they were discovered, however, they usually remained motionless on the upper branches of the trees (77% of all sightings). They were usually seen (53%) rather than heard (47%).

On many occasions we found females carrying their infants ventrally or dorsally. Frequently, there were also juveniles around, so we concluded births occur throughout the year, although the usual rearing period is at the end of the dry season.

Like *Ateles*, the population of this species has suffered a serious regression over the last years, although they are still to be found in all parts of the area (Fig. 4). They are also very appreciated for their meat, especially by the Chimanes and the local people, who usually hunt adult males. This upsets the equilibrium of the affected group, which sometimes even disintegrates.

#### *Cebus apella*

The studied population was composed of heterosexual groups and

solitary males. Sometimes we observed small groups of one to five individuals which seemed to be dispersed subgroups of other larger ones. The mean group size was 17.1 individuals with a range of 3-50 individuals (Table 1).

This species was found in all the considered biotopes except for the chaparral and seen most frequently in the low river forest. We found a total of 47 troops during 159 km of censusing.

*Cebus* occupy the middle and top strata of the forest. Usually they were located because of their vocalizations or the noise produced by their movements. Once aware of our presence, they normally fled (74% of all sightings).

We saw females carrying their infants ventrally or dorsally throughout the study period, thus indicating that births take place all year round.

*C. apella* sometimes associated with *S. boliviensis*. Considering all the observed groups, on 59% of the occasions they were by themselves and on 41% associated with *S. boliviensis*. We may say that, in general, *Cebus* prefer unspecific troops ( $X^2=6.74$ ,  $p \leq 0.01$ ). Nevertheless, significant differences showed up with respect to the habitat in question; in the low river forest, where this species was more frequently found, a significant preference to form unspecific troops did not exist ( $X^2=4.30$ ,  $p \leq 0.01$ ). Without doubt, the characteristics of the forest type and food availability influence this association.

This species is not in the same vulnerable situation as *Ateles* and *Alouatta*. *Cebus* are found throughout the Estación Biológica (Fig. 4). Their meat is only sometimes used by the Chimanes, who hunt them when they come near the *chacos* (cultivated fields) to prevent them damaging the crops, and who also keep them as pets or use them as bait.

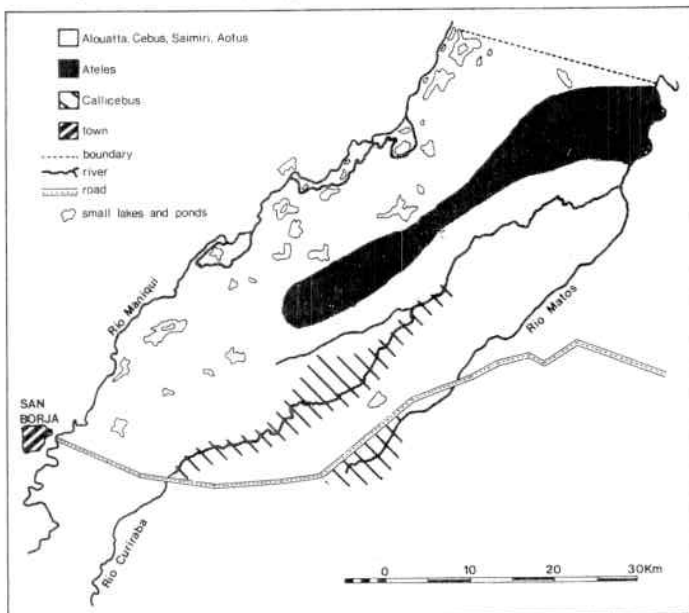


Fig. 4. The present distribution of the six primate species in the area (map provided by authors).

#### *Saimiri boliviensis*

The studied population was composed of heterosexual groups ranging from 11 to over 100 individuals, with a mean of 49.4 (Table 1).

Like *C. apella*, this species was found in all the considered biotopes except for the chaparral, most frequently in the low river forest and rarely in the high forest. We encountered a total of 23 groups during 159 km of censusing.

*S. boliviensis* usually occupy the low and middle strata of the forest, sometimes being seen as low as 2 or 3 m. The troops were always located by their noise and often moved off upon detecting our presence (62% of all sightings).

*S. boliviensis* associated with *C. apella* (92% of the sightings) and

generally we may say that this species prefers to form mixed troops ( $X^2=26.04$ ,  $p \leq 0.01$ ). Only in the palm forest was there no significant preference for this type of association ( $X^2=1.68$ , ns). As with the aforementioned species, preference for mixed troops depends on habitat characteristics and food availability.

The situation of this species is similar to that of *C. apella*, with a similar distribution (Fig. 4). They are only hunted to be used as pets or bait, or when they raid crops. It is very uncommon that they are hunted for food.

#### *Callicebus moloch*

The population of this species was composed of family groups with a mean size of 2.9 individuals (Table 1). The most frequent composition was one adult male, one adult female and the latest infant. Sometimes we found solitary males.

The distribution of this species is the most restricted in the area. It is very selective when choosing its habitat, limiting itself to the areas of the chaparral and the low river forests adjacent to the savannas (Fig. 4).

It is not particularly vulnerable, as it is very rarely hunted. Only a few individuals are captured to be kept as pets.

#### *Aotus azarae*

The population of this species was composed of family groups with a mean size of 3.6 individuals (Table 1). The most frequent composition was one adult male, one adult female and the latest infant or sometimes the two latest born. We also observed solitary young or adult males quite frequently. The largest group was composed of five individuals. Sometimes our guides told us about the existence of larger groups up to 15 individuals, but we think these were actually accidental aggregations of various groups formed, for example, to feed on certain foods.

This species is the most widespread of all the primates present in the area. It was found in all the considered biotopes (Fig. 4), although it seemed to prefer areas of low forest near rivers.

*A. azarae* is the least threatened primate species at the Estación Biológica. This is mainly thanks to two factors: its lack of selectivity with respect to habitat and its nocturnal behavior, which, up to a certain point, protects it from humans.

Table 2. Species Distribution in Four Different Biotopes

Species	High Forest	Low River Forest	Palm Forest	Chaparral
<i>A. paniscus</i>	+	-	-	-
<i>A. seniculus</i>	+	+	+	-
<i>C. apella</i>	+	+	+	-
<i>S. boliviensis</i>	+	+	+	-
<i>C. moloch</i>	-	+	-	+
<i>A. azarae</i>	+	+	+	+

Key: (+) present, (-) absent

#### Conclusions

The six primate species present in the area are not equally represented in the four biotopes (Table 2). Two are in regression: *A. seniculus* and, especially, *A. paniscus*, whose situation is critical as it is found only in the most inaccessible areas of the high forest. Although the situation of *C. apella* and *S. boliviensis* is not critical, it could be soon, since there has been such a clear, recent decrease in their populations. *C. moloch* deserves special attention, as its distribution is very restricted, and as it is so selective with respect to its habitat. Any changes might seriously threaten it. *A. azarae* is in the best situation, so there is no need to devote special attention to it at the moment.

The main factor presently threatening primate populations in the area is hunting. Destruction of the forest is not yet an alarming problem. However, in some areas we noted an increase in the area of land being

cultivated; if this continues, it will especially affect large species like *A. paniscus* and *A. seniculus*.

### Recommendations

Although short-term studies like the present one are not the most appropriate way of establishing the status of primate populations, by including data from former studies, we have been able to identify certain trends. We conclude that some species' situations may soon become really critical. Therefore, we suggest the following measures to protect the primates and the fauna in general of this area:

(1) The studies of the primate community in the Estación Biológica Beni must be continued in order to establish the definitive status of each species.

(2) The abundance and distribution of *A. paniscus*, whose situation is the most critical, must be studied in depth with special attention to population dynamics and food and habitat requirements.

(3) Access to other sources of nourishment and different hunting areas for the Chimanes must be facilitated.

(4) Environmental education programs must be developed to impress upon the inhabitants of the area the importance of fauna and natural resources.

(5) Checkpoints and groups of park attendants should be established to control hunting, the main factor affecting the primate populations in the area.

(6) Construction of observation hides and delineation of recreation areas should be undertaken to allow visitors to appreciate the richness of nature in this area, including the primates.

Juan Enrique García Yuste  
Estación Biológica de Doñana  
Pabellón del Perú  
Avda M<sup>o</sup> Luisa s/n  
41013 Sevilla  
SPAIN

Teresa Tarifa Suarez  
Casilla 5597  
La Paz  
BOLIVIA

### Acknowledgements

We wish to thank the Estación Biológica Beni for making our studies possible. T. Tarifa was supported by a WWF-US grant, and J.E. García was supported by a grant of the Ministerio de Asuntos Exteriores of Spain. Mario Baudoin, Maria de Marconi and Cecile Belpaire de Morales reviewed the original report to WWF-US and provided constructive comments. Sigrid translated the manuscript. We especially wish to thank Tito Zelada and the inhabitants of the Totaizal for sharing their knowledge of the area and providing valuable assistance.

### Literature Cited

- Ellenbergh, H. and D. Mueller-Dombois. 1965. Tentative physiognomic-ecological classification of plant formations of the hearth. *Ber. Geobot. Inst. ETH, Stifg Rubel, Zurich*, 37: 22-47.
- García, J.E., V. Castelló and M. Corvillo. In press. Primates de la Estación Biológica Beni. *Actas 2° Congr. Nac. Biología*. Cochabamba, 1987. Bolivia.
- García, J.E., M. Corvillo and V. Castelló. 1987. Primeras estimas de densidad de *Cebus apella* y *Saimiri boliviensis* en la Estación Biológica Beni, Bolivia. *Ecología en Bolivia* 10: 15-27.

Hanagarth, W. and M. Marconi. 1984. Lineamientos de manejo de la Estación Biológica Beni (notas preliminares). La Paz.

Unzueta, O. 1975. *Mapa Ecológico de Bolivia*. Ministerio de Asuntos Campesinos y Agropecuarios. La Paz.

## Primates of the Rio Jequitinhonha Valley, Minas Gerais, Brazil

by Anthony B. Rylands, Wilson R. Spironelo,  
Valdemar L. Tornisiolo, Rosa L. de Sa,  
Maria C. M. Kierulff and Ilmar B. Santos

The Rio Jequitinhonha extends east-west from the Atlantic Ocean approximately 1,050 km inland, passing through the south of the state of Bahia and the north of the state of Minas Gerais in Brazil, between the latitudes 15°45' S and 17°55' S and longitudes 38°53' W and 43°40' W. It is of considerable interest regarding primate distributions for two reasons. First, it passes through three major vegetation types. From west to east these are: *cerrado* (bush savanna), typical of the central plateau of Brazil, on the upper reaches; *caatinga* (dry thorn scrub), typical of the northeast of Brazil, on the middle reaches; and Atlantic forest, typical of southeast Brazil, on the lower reaches.

Second, the middle and lower parts of the river are included in a Pleistocene refuge area, the Bahian Sub-center of the Serra do Mar, which was identified by Müller (1968), Vanzolini (1970), Haffer (1974) and Brown (1982). Kinzey (1982) discussed the significance of this refuge area for primate speciation and distributions. He indicated that the Bahian Sub-center may have been responsible for the differentiation of, and acted as the dispersal center for, *Brachyteles arachnoides*, *Cebus apella xanthosternus*, *Callicebus personatus melanochir*, *Leontopithecus chrysomelas*, and *Callithrix penicillata*. In this way, the Rio Jequitinhonha marks the approximate geographic limit between these primates, which have the bulk of their distribution in the northeast of Brazil, and those occurring mainly in the south and southeast of Brazil which, according to Kinzey (1982), dispersed from their Pleistocene refuge in the Rio Doce Sub-center in the north of the state of Espírito Santo. Primates which supposedly differentiated in the Rio Doce Sub-center include, *Cebus apella robustus*, *Callicebus personatus personatus*, *Leontopithecus rosalia*, *Callithrix geoffroyi* and *Alouatta fusca fusca*.

Despite this, remarkably little is known of the primates occurring in the Rio Jequitinhonha Valley, as evidenced by the distribution maps of Kinzey (1982; see also the distribution and localities for the *Callithrix jacchus* species group in Hershkovitz, 1977).

In this paper, we report on our findings regarding the occurrence of primates in the 66,700 km<sup>2</sup> of the Rio Jequitinhonha Valley during five fifteen-day expeditions between February and June 1987. No specimens were collected and all information is based on direct observation and reliable reports from local hunters and farmers.

### Primate Habitats

As mentioned, there are three major vegetation types and associated climate regimes in the valley: *cerrado*, *caatinga* and Atlantic forest (Fig. 1).

#### *Cerrado (sensu lato)*

This is a bush savanna characteristic of the central plateau of Brazil. It becomes predominant west of the Rio Araçuaí to the south of the river and west of the upper Rio Salinas to the north of the river. This region is characterized by a dry season (less than 100 mm total monthly rainfall) from April to October, with annual precipitation of 1,000-1,400 mm. *Cerrado* is a mosaic of intergrading vegetation types which result

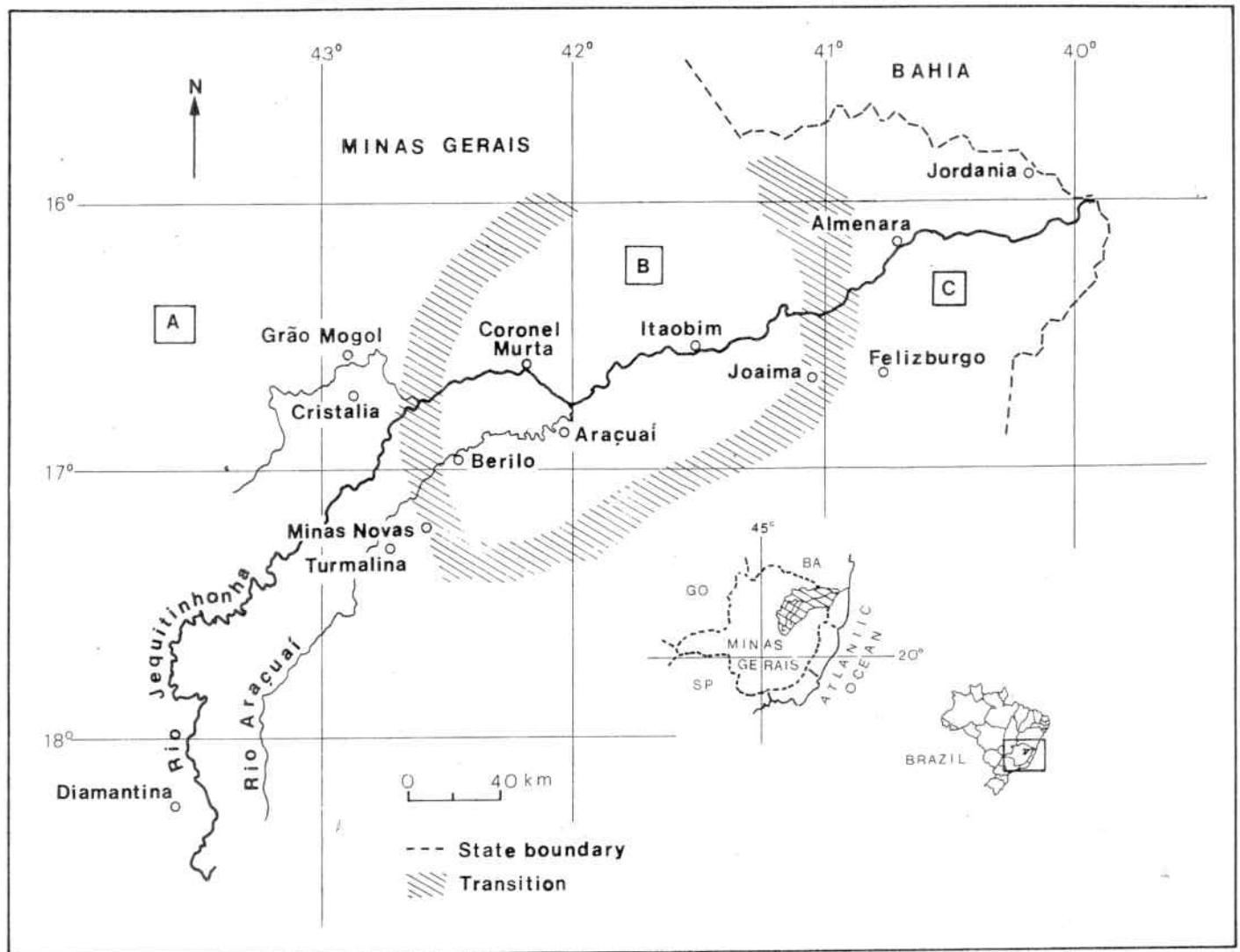


Fig. 1. The Rio Jequitinhonha in northeastern Minas Gerais. A = *Cerrado* (*sensu lato*). B = *Caatinga*. C = Atlantic forest. The shaded area indicates the approximate transition zone between these vegetation types (map provided by authors).

from changes in topography, altitude and soil types. *Cerrado* trees are typically low, with tortuous trunks, thick and cracked bark, and pronounced sclerophylly. This is believed to result from oligotrophic soils, with a scarcity of such elements as calcium and nitrogen (see Sarmiento *et al.*, 1985). Besides the various types of savanna and moorlands typical of the *cerrado* (see Eiten, 1972; Rizzini, 1976; Alho, 1982), there are distinct forest formations which support primate populations. These formations include:

(1) Dry forest or upland mesophytic forest: semideciduous or evergreen broadleaf tall forests that occur in some areas with localized high rainfall. In the Jequitinhonha Valley these are frequently *chapadas* (flat Tertiary plateaus at altitudes of 800-1,100 m). These forests include many plant species typical of the Atlantic forest alongside those typical of or endemic to the *cerrado* (Rizzini, 1976).

(2) *Cerrado* forest (*cerradão*): a closed canopy, xeromorphic, semideciduous low forest (8-12 m in height with emergents reaching 18 m; Eiten, 1972). Plant species are those typical of the *cerrado* (*sensu stricto*; Rizzini, 1976). *Callithrix penicillata* is known to occur in this forest type (Fonseca and Lacher, 1984).

(3) Gallery and river edge forest: evergreen forests along water courses. Today these forests are rarely more than 100 m wide, but in the past they often extended up to two km on either side of a river.

#### *Caatinga*

This is a semi-arid, thorn-scrub desert ecosystem, where rainfall is 500 mm or less. It is typical of northeastern Brazil, and the island of *caatinga* in the Jequitinhonha Valley represents the southernmost limit of this formation (see Mares *et al.*, 1981). In the Jequitinhonha, the dry season is from February to October, although an important feature of *caatinga* is that droughts are prolonged and unpredictable. Like *cerrado*, it is a mosaic of different habitat types. The forest formations which support primate populations include river-edge and gallery forest, and — at higher elevations receiving orographic rainfall — dry or upland mesophytic forest and *cerradão*. *Caatinga alta* or *caatinga* forest is a tall forest (10-20 m) of predominantly xerophyllous trees which are deciduous in the dry season. It is restricted to higher elevations, hillsides, and the perimeters of valleys.

#### Atlantic Forest

This humid evergreen forest is typical of the lower reaches of the river, east of Felizburgo to the south of the river, and east of Almenara to the north (Fig. 1), and formerly covered the entire valley within the state of Bahia. Total annual rainfall is between 1,500-2,000 mm, with a less pronounced dry season from March to September. Nearer to the coast, annual rainfall increases and seasonality becomes almost absent.

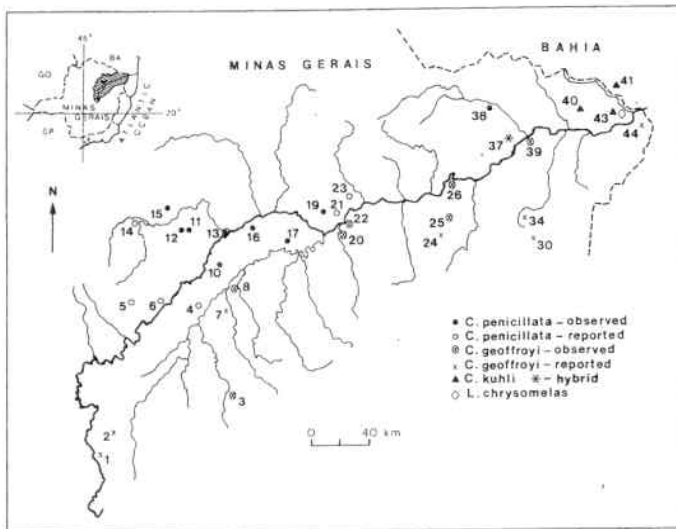


Fig. 2. Localities for the genera *Callithrix* and *Leontopithecus* (see Appendix I; map provided by authors).

### *Callithrix* spp.

Three *Callithrix* species occur in the Rio Jequitinhonha valley: *penicillata* Geoffroy, 1812; *geoffroyi* Humboldt, 1812; and *kuhli* Wied, 1826 (Fig. 2). Both Hershkovitz (1977) and Kinzey (1982) recognized that *C. geoffroyi* occurs to the south of the river, with collecting localities at Araçuaí on the upper Rio Jequitinhonha, the upper Rio Itanhem and Teófilo Otoni (see Appendix I). This was confirmed in this study, with various sightings and numerous reports of *C. geoffroyi* along the south (right) bank of the river in areas of Atlantic forest on the lower reaches, and in gallery forest and dry forest patches in the *caatinga* region on the middle reaches of the river. However, although both Hershkovitz (1977) and Kinzey (1982) extend its distribution along the entire right margin, it is evident that *C. geoffroyi* is limited to the right bank of the Rio Araçuaí, a southern tributary of the Jequitinhonha.

*C. penicillata* was known only from the Rio São Francisco Basin (west of the Rio Jequitinhonha) and the upper Rio Pardo in the state of Bahia immediately to the north of the river (Hershkovitz, 1977; Kinzey, 1982; but see below). However, our findings indicate that its distribution extends east throughout the *cerrado* between the São Francisco Basin and the upper Rio Jequitinhonha, occurring on both margins of the upper reaches of the river to the Rio Araçuaí and limited to the left (north) bank below the Rio Araçuaí, as far east as the municipalities of Almenara and Pedra Azul (Fig. 2). It is possible that populations of *geoffroyi* and *penicillata* hybridize in the area of the upper Rio Araçuaí. However, although some local people indicated mixed species groups, and others indicated parapatry, we were unable to determine the situation in this region.

Hershkovitz (1977), Kinzey (1982) and de Vivo (1988) regard the marmoset to the north of the Rio Pardo in southern Bahia as *penicillata*. However, we follow Coimbra-Filho (1984), Santos *et al.* (1987) and Mittermeier *et al.* (1988) in recognizing the distinct taxon *kuhli* as the inhabitant of the Atlantic forest of this region. Hershkovitz (1977) indicated that this form, referred to as *C. p. penicillata* by Coimbra-Filho and Mittermeier (1973b; see also Coimbra-Filho, 1971; Mittermeier and Coimbra-Filho, 1981), is a hybrid of *penicillata* x *geoffroyi*. Hybridization studies in captive populations and subsequent surveys in southern Bahia have failed, however, to verify this supposition (Coimbra-Filho, 1971, 1984; Santos *et al.*, 1987). De Vivo (1988), while recognizing that it is not a hybrid, argued that geographic variation in coloration, pelage and cranial morphology is insufficient to separate *kuhli* from the *penicillata* populations typical of the central and western regions of the

state of Minas Gerais. Despite the continuing uncertainty of its validity, marmosets clearly recognizable as *kuhli* were observed near Salto de Divisa (locality 43; Fig. 2). In two other localities nearby we also obtained skins which were being used as decoration. In addition, just west of the town of Almenara (locality 37; Fig. 2), Santos observed a group of marmosets that had a pelage coloration intermediate between the *penicillata* observed to the west and *kuhli* known from regions to the northeast in southern Bahia, strongly suggesting a hybrid population.

To the north of the river, *penicillata* was observed in gallery forest and tall forest patches on slopes and high altitude plateaus (up to 1,000 m) in the *cerrado* and also in secondary forest, gallery forest and *caatinga* forest in the *caatinga* regions of the valley. It was replaced by *kuhli* in the zone formerly covered by Atlantic forest.

Although *C. penicillata* and *C. geoffroyi* are the most abundant of the primate species in the Jequitinhonha Valley, it is very evident that their populations are severely reduced. Both are most commonly found in the river-edge and gallery forest, especially in areas with high densities of *angico* trees (*Piptadenia*, *Anadenanthera*; Leguminosae). *C. penicillata* was found to be relatively scarce in the few remnant patches of *cerradão* and upland mesophytic forests which remain. These habitats, including river-edge forest, have been extensively destroyed in the valley. *C. kuhli* populations, similarly, are very reduced as a result of the widespread destruction of the Atlantic forest in the tiny area where it enters the Minas Gerais part of the valley. This reflects its vulnerable status throughout its range (see Coimbra-Filho, 1984; Santos *et al.* 1987).

### *Leontopithecus chrysomelas*

The golden-headed lion tamarin, *Leontopithecus chrysomelas* Kuhl, 1820 (Fig. 2), has a very restricted distribution in the Atlantic forest region between the Rio de Contas and the Rio Jequitinhonha in the south of the state of Bahia (Coimbra-Filho, 1970; Coimbra-Filho and Mittermeier, 1973a; Rylands *et al.*, in press). Although its former distribution is difficult to determine because of the extensive forest destruction within its range, it would seem that it does not occur between the lower Rio Pardo and the Rio Jequitinhonha near the coast, although surveys in 1983, 1986 and 1987 by Santos, W.L.R. Oliver and G.A.B. Fonseca demonstrated its presence in the municipality of Itapebí further west (locality 49, Fig. 5; Santos *et al.* 1987; Rylands *et al.*, in press). Santos *et al.* (1987) indicated that *L. chrysomelas* might also occur in the northeast tip of Minas Gerais, on both sides of the Rio Jequitinhonha. Unfortunately, we were unable to confirm this by actual sightings, but a number of people gave accurate descriptions of this unmistakable animal, informing us that it still survives in remnant forest patches to the north of the Rio Jequitinhonha near the town of Salto de Divisa on the state border with Bahia. Information from the municipality of Jordania was confused, neither confirming nor refuting the suggestion of Santos *et al.* (1987) that it may occur there. We were unable to obtain any evidence of its presence to the south of the river nor upstream of these localities.

The golden-headed lion tamarin is extremely endangered as a result of the destruction of the Atlantic forests in the south of Bahia (for a review of its conservation status, see Rylands *et al.*, in press). The very precarious situation of this newly found Minas Gerais population is indicative of its status throughout its range.

### *Callicebus personatus*

The presence of *Callicebus personatus* Geoffroy, 1812 (Fig. 3) in the Rio Jequitinhonha Valley in Minas Gerais has to date been presumed but unverified. The nearest localities are those of Buenópolis to the west of the valley and Teófilo Otoni to the south (localities 57 and 56; Fig. 5), both identified as the subspecies *personatus* (Kinzey, 1982). Avila Pires (1965) restricts the type locality of *melanochir* Kuhl 1820, to the Rio Belmonte (*i.e.*, Jequitinhonha), but this subspecies is known only from the lower reaches of the river in the state of Bahia (Kinzey, 1982; Santos *et al.*, 1987).

The information we were able to obtain indicates that *Callicebus* has a rather uneven distribution in the valley, being inexplicably absent from some areas and evidently common in others. The only sighting of a masked titi was in a small patch of gallery forest immediately outside of the town of Minas Novas (locality 7; Fig. 3). It is not possible to be certain of the subspecies, except that its quite uniform reddish-yellow pelage with a distinct black face mask extending down the throat would rule out the possibility of it being the southern Bahian subspecies *melanochir*, which is predominantly grey, with a brownish tinge extending up the tail and lower back. This animal is also distinct from the subspecies *nigrifrons* Spix 1823 from farther south in the state of Minas Gerais, which is predominantly grizzled grey/brown with an indistinct face-mask and a reddish-brown tail. Hershkovitz (in litt.) is currently revising the genus and, while maintaining the current taxonomy of three subspecies, indicated in a provisional distribution map that Minas Novas is within the range of the subspecies *nigrifrons*. The distribution map provided by Kinzey (1982) would suggest, however, that the subspecies *personatus* may extend its range through the Jequitinhonha Valley, and the Buenópolis register (locality 57; Fig. 5) listed by Hershkovitz would also testify to this. We have not carried out a study of the variation in pelage coloration within and between these subspecies, and although the identity of the Minas Novas *Callicebus* awaits the taxonomic revision of Hershkovitz, we provisionally allocate this animal to the nominate subspecies. Reports by local people of titis which fitted the description of the Minas Novas masked titi were also obtained farther north, on both sides of the Rio Jequitinhonha, in the *caatinga* region of the municipalities of Itinga and Araçuaí.

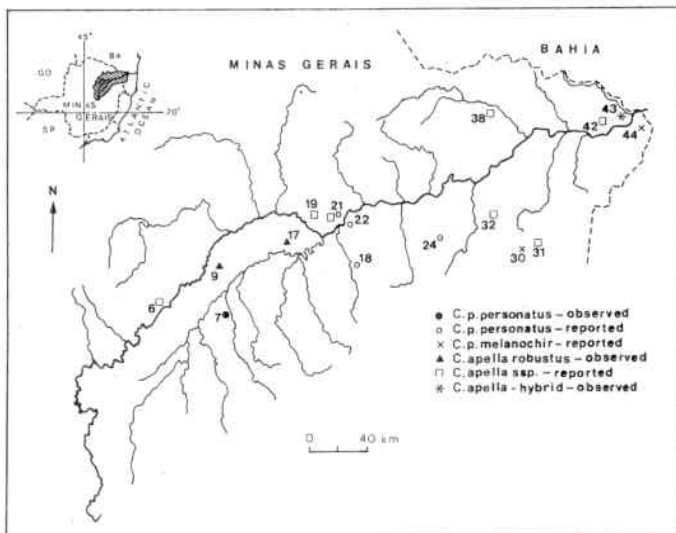


Fig. 3. Localities for the genera *Callicebus* and *Cebus* (see Appendix I; map provided by authors).

Descriptions of grey titis, which we conclude best fit *melanochir*, were obtained from near the Bahia state boundary, in the municipalities of Felizburgo and Jordania. This would extend the distribution of this subspecies slightly west of that previously recorded (see Santos *et al.*, 1987) and implies that it may also be found in the Atlantic forest remnants of the intervening municipalities of Salto da Divisa, Rubim, Santo Antônio do Jacinto, Jacinto, and Santa Maria do Salto.

All three of the *C. personatus* subspecies are considered to be endangered. The destruction of the Atlantic forests in Minas Gerais and especially Espírito Santo have resulted in the masked titi having a very patchy distribution. Although it is common in some areas, populations are small and isolated, and we were able to obtain very few reports of this species in the Jequitinhonha Valley. *C. personatus* occurs in the

*caatinga* forest, but very little of this vegetation type remains today. The subspecies *melanochir* has a very restricted distribution in the valley, being recorded in only two localities despite the relatively large number of small, isolated forest patches in the region near the Bahia state boundary which, theoretically at least, could support populations of this animal.

### *Cebus apella*

Information on the occurrence of *Cebus* from northeastern Minas Gerais was limited to a record of the robust tufted capuchin, *C. apella robustus* Kuhl 1820 (Fig. 3), from Machacalis, upper Rio Itanhém (locality 53; Fig. 5). This animal is also known from Fazenda Pontal, Itamaraju to the south of the Rio Jequitinhonha in Bahia (locality 54; Fig. 5; Kinzey, 1982; Santos *et al.*, 1987). Capuchin monkeys are now very scarce in the Rio Jequitinhonha Valley, and we obtained sightings of groups in only two areas of high forest in the upper part of the river, to the west of the Rio Araçuaí. These animals fit the description of *robustus*, being predominantly a dark mahogany in pelage coloration with their tufts taking the form of a median crest. Descriptions of *Cebus* monkeys were also obtained from a few other areas still having relatively extensive forests to the south of the Rio Jequitinhonha, in the municipalities in the Atlantic forest region of the lower reaches of the river. In Bahia, the Rio Jequitinhonha marks the northern limit to *robustus*' range (Santos *et al.*, 1987; Coimbra-Filho *et al.*, in press), but it is possible that they occur north of the river in Minas Gerais. It would appear that the Rio São Francisco marks the westernmost limit to its distribution, where it is replaced by the subspecies *libidinosus* Spix, 1823 (Kinzey, 1982).

The distinct subspecies *xanthosternus* Wied, 1820, 1826, the buff-headed southern Bahian capuchin, occurs north of the lower Rio Jequitinhonha in the state of Bahia (Santos *et al.* 1987; Coimbra-Filho *et al.*, in press). Cabrera (1957) cites the Rio Belmonte (*id.*, Jequitinhonha) as the type locality. Although we were unable to obtain any evidence for the occurrence of this subspecies in the state of Minas Gerais, a group of capuchins with the appearance of hybrids between *robustus* and *xanthosternus* was seen by Santos just to the north of the river in the municipality of Salto da Divisa. Therefore, a slim possibility remains that a population of *xanthosternus* may yet be found in the region.

Both these capuchin monkey subspecies are considered to be endangered because of widespread forest destruction and hunting pressure (Mittermeier *et al.*, 1982; Santos *et al.*, 1987; Coimbra-Filho *et al.*, in press.) The situation is particularly critical for *xanthosternus*, which has a very restricted distribution. It is extremely doubtful that *xanthosternus* groups still survive in the tiny remnants of Atlantic forest within its range to the north of the Rio Jequitinhonha. Although more widely distributed, the subspecies *robustus* is now extremely rare in the rest of the valley, and we were unable to locate more than a few groups of this normally adaptable animal. Due to hunting, it had disappeared from even quite large forest patches in the areas we visited.

### *Alouatta fusca*

The distribution and taxonomy of the brown howler monkey, *A. fusca* Ihering, 1914 (Fig. 4), are somewhat confused. Ihering (1914) recognized two subspecies: the northern brown howler, *fusca*, and the southern brown howler, *guariba*, which we refer to here as *clamitans* Cabrera, 1957. The separation of the forms is based on the presence of a pronounced sexual dimorphism in pelage coloration in *clamitans* which is absent in *fusca*. Kinzey (1982) follows Ihering (1914), although the validity of this distinction is not entirely proven (Mittermeier and Coimbra-Filho, 1981; Mittermeier *et al.*, 1988). Kinzey (1982) suggested that the subspecies *fusca* is largely restricted to the north of the Rio Doce in the states of Espírito Santo and Minas Gerais, although it crosses the river in some localities and hybridizes in the region of the Rio Matipó in the state of Espírito Santo. The type locality for this subspecies was restricted by Cabrera (1957) to the Rio Paraguaçu, Bahia. However,

ably extinct from the Minas Gerais part of the valley and may remain only in the Serra da Gabiarra in Bahia where Aguirre (1971) estimated a population of 70-80 animals. *Leontopithecus* and *C. kuhli* are probably restricted to at most two or three small forest patches near the Bahia state boundary. Even the relatively hardy and adaptable pencil-ear marmoset is severely reduced in numbers, although at present, unlike the situation with the other genera, we would judge that neither this species nor *C. geoffroyi* is in immediate danger of extinction in the valley.

The Jequitinhonha Valley is undergoing a major long-term development program. One aspect of this program (evidently the principal one to date) is the establishment of vast, subsidized *Eucalyptus* plantations: the Minas Gerais State Forestry Institute (IEF) has recently obtained a major loan from the World Bank for the subsidization and financing of this activity throughout the *cerrado* region of the state. This is disastrous for the local economy because the maintenance of the plantations, cut on a seven-year cycle, requires very few manual laborers, all of whom are imported from the south. *Eucalyptus* plantations are not only inimical to the fauna but will also prove disastrous to the prosperity of the region.

A total of 14 hydroelectric schemes are planned for the valley (one on the Rio Araçuai is already under construction). Being relatively small scale, they are probably not in themselves a major threat to the already largely decimated fauna and flora. They do represent, however, a very major threat in terms of the industry and development they will attract. We hope that the financing of these dams will draw attention to the destruction of the natural ecosystems of the valley and will result in the establishment of protected areas and management programs, as demanded by Brazilian law. This will be an improvement over the present situation, which may be described as aggressive neglect of the diverse and threatened fauna and flora of this valley.

Anthony B. Rylands  
Wilson R. Spironelo  
Maria C. M. Kierulff  
Ilmar B. Santos  
Departamento de Zoologia  
Universidade Federal de Minas Gerais  
31270 Belo Horizonte, Minas Gerais  
BRAZIL

Valdemar L. Tornisielo  
Departamento de Ecologia  
Centro de Energia Nuclear na  
Agricultura  
Universidade de São Paulo  
13400 Piracicaba, São Paulo  
BRAZIL

Rosa Maria Lemos de Sa  
Laboratório de Zoologia  
Instituto de Ciências Biológicas  
Universidade de Brasília  
70910 Brasília, D.F.  
BRAZIL

#### Acknowledgements

This study was financed by the Companhia Energética de Minas Gerais (CEMIG) through Enerconsult Engenharia Ltda. Our thanks to Jorge Campitelli Ferreira and Walter Duarte of Enerconsult for their support throughout the study.

#### Literature Cited

- Aguirre, A.C. 1971. O mono *Brachyteles arachnoides* (E. Geoffroy). Situação atual da espécie no Brasil. Academia Brasileira de Ciências, Rio de Janeiro.
- Alho, C.J.R. 1982. Brazilian rodents; their habitats and habits. In: *Mammalian Biology in South America*. M.A. Mares and H.H. Genoways, eds. University of Pittsburgh, Pittsburgh. pp. 143-66.
- Avila Pires, F.D. 1965. The type specimens of Brazilian mammals collected by Prince Maximilian zu Wied. *Amer. Mus. Novit.* No. 2209, pp. 1-21.
- Cabrera, A. 1957. Catálogo de los mamíferos de America del Sur. *Revista del Museo Argentino de Ciencias Naturales "Bernadino Rivadavia," Buenos Aires, Ciencias Zoológicas*. 4 (1):1-307.
- Coimbra-Filho, A.F. 1970. Considerações gerais sobre a situação atual dos micoleões escuros, *Leontideus chrysomelas* (Kuhl, 1820) e *Leontideus chrysopygus* (Mikan, 1823). *Rev. Brasil. Biol.* 30:249-68.
- Coimbra-Filho, A.F. 1971. Os sagüis do gênero *Callithrix* da região oriental Brasileira e um caso de duplo-hibridismo entre três de suas formas. *Rev. Brasil. Biol.* 31:377-88.
- Coimbra-Filho, A.F. 1984. Situação atual dos calitriquídeos que ocorrem no Brasil (Callitrichidae, Primates). In: *A Primatologia no Brasil*. Vol. 2, M.T. de Mello, ed. Sociedade Brasileira de Primatologia, Brasília. pp. 16-33.
- Coimbra-Filho, A.F., and R.A. Mittermeier. 1973a. Distribution and ecology of the genus *Leontopithecus* Lesson, 1840 in Brazil. *Primates* 14:47-66.
- Coimbra-Filho, A.F., and R.A. Mittermeier. 1973b. New data on the taxonomy of the Brazilian marmosets of the genus *Callithrix* Erxleben, 1777. *Folia primatol.* 20:241-64.
- Coimbra-Filho, A.F., R. Rocha e Silva, and A. Pissinati. In press. Acerca da distribuição geográfica original de *Cebus apella xanthosternos* Wied, 1820. In: *A Primatologia no Brasil*. Vol. 3, A.B. Rylands and C.M.C. Valle, eds. Sociedade Brasileira de Primatologia, Belo Horizonte.
- Eiten, G. 1972. The cerrado vegetation of Brazil. *Bot. Rev.* 38:205-341.
- Fonseca, G.A.B. da, and Lacher, T.E., Jr. 1984. Exudate-feeding by *Callithrix jacchus penicillata* in semideciduous woodland (cerradão) in Central Brazil. *Primates* 25:441-50.
- Haffer, J. 1974. *Avian Speciation in Tropical South America*. Nuttall Ornithological Club, Cambridge, Mass.
- Hershkovitz, P. 1977. *Living New World Monkeys (Platyrrhini), with an Introduction to Primates*. Univ. of Chicago Press, Chicago.
- Ihering, H. von 1914. Os bugios do gênero *Alouatta*. *Rev. Mus. Paulista* 9:231-80.
- Kinzey, W.G. 1982. Distribution of primates and forest refuges. In: *Biological Diversification in the Tropics*, G.T. Prance, ed. Columbia University Press, New York. pp. 455-82.
- Mares, M.A., M.R. Willig, K. Streilein, and T.E. Lacher, Jr. 1981. The mammals of northeastern Brazil: a preliminary assessment. *Ann. Carnegie Mus.* 50:81-137.
- Mittermeier, R.A., and A.F. Coimbra-Filho. 1981. Systematics: species and subspecies. In: *Ecology and Behavior of Neotropical Primates*. Vol. 1, A.F. Coimbra-Filho and R.A. Mittermeier, eds. Academia Brasileira de Ciências, Rio de Janeiro, pp. 29-109.
- Mittermeier, R.A., A.F. Coimbra-Filho, and I.D. Constable. 1981. Conservation of eastern Brazilian primates. Unpubl. report for the period 1979/80, WWF-U.S. Primate Program Project No. 1614, Washington, D.C.
- Mittermeier, R.A., A.F. Coimbra-Filho, I.D. Constable, A.B. Rylands, and C. Valle. 1982. Conservation of primates in the Atlantic forest region of eastern Brazil. *Int. Zoo Ybk.* 22:2-17.
- Mittermeier, R.A., A.B. Rylands, and A.F. Coimbra-Filho. 1988. Systematics: species and subspecies — an update. In: *Ecology and Behavior of Neotropical Primates*. Vol. 2, R.A. Mittermeier, A.B. Rylands, A.F. Coimbra-Filho and G.A.B. da Fonseca, eds. WWF, Washington, D.C. pp. 13-75.

- Müller, P. 1973. The dispersal centres of terrestrial vertebrates in the Neotropical realm. A study in the evolution of the Neotropical biota and its native landscapes. *Biogeografica* 2:1-244.
- Natori, M. 1986. Interspecific relationships of *Callithrix* based on dental characters. *Primates* 27:321-36.
- Rizzini, C.T. 1971. Plantas novas ou pouco conhecidas do Brasil. *Rev. Brasil. Biol.* 31:189-204.
- Rizzini, C.T. 1976. *Tratado de Fitogeografia do Brasil*, 2 vol. Editora USP, São Paulo.
- Rizzini, C.T. 1979. Novos dados sobre *Itaobimia magalhaesi* Rizz. *Rev. Brasil. Biol.* 39:861-70.
- Rizzini, C.T. and A. de Mattos Filho. 1987. Especies vegetais em extincao. *Boletim FBCN* 21:99-104.
- Rylands, A.B., I.B. Santos, and R.A. Mittermeier. In press. Distribution and status of *Leontopithecus chrysomelas* in the wild and captivity. In: *A Case Study in Conservation Biology: The Golden Lion Tamarin*, D.G. Kleiman, ed. Smithsonian Institution Press, Washington, D.C.
- Santos, I.B., R.A. Mittermeier, A.B. Rylands, and C. Valle. 1987. The distribution and conservation status of primates in southern Bahia, Brazil. *Primate Conservation* 8:126-42.
- Sarmiento, G., G. Goldstein, and F. Meinzer. 1985. Adaptive strategies of woody species in Neotropical savannas. *Biol. Rev.* 60:315-55.
- Vanzolini, P.E. 1970. Zoologia, sistemática, geografia e a origem das especies. *Univ. São Paulo Inst. Geogr. Serie Teses e Monogr.* 3.
- Vivo, M. de 1988. Sistemática de *Callithrix* Erxleben, 1977 (*Callitrichidae*, *Primates*). Unpubl. Ph.D. thesis, Instituto de Biociências, Universidade de São Paulo, São Paulo.
8. Rio Capivarí, Chapada do Norte, municipality of Chapada do Norte, Minas Gerais (17°06' S, 42°32' W, altitude 590 m). Secondary gallery forest. V.L. Tornisiello. *Callithrix geoffroyi*. Observation.
9. Fazenda Irmãos Atachi, Buriti, municipality of Berilo, Minas Gerais (16°51' S, 42°38' W, altitude 960 m). High forest. W.R. Spironelo and A.B. Rylands. *Cebus apella robustus*. Observation.
10. Fazenda Irmãos Atachi, Buriti, municipality of Berilo, Minas Gerais (16°51' S, 42°38' W, altitude 930 m). Low secondary forest. W.R. Spironelo. *Callithrix penicillata*. Observation.
11. Cristália, Minas Gerais (16°49' S, 42°41' W, altitude 420 m). Secondary gallery forest. W.R. Spironelo. *Callithrix penicillata*. Observation.
- 12a. Córrego Contendas, Cristália, Minas Gerais (16°45' S, 42°52' W, altitude 730 m). *Cerrado* and *cerrado* forest. R.L. Sa. *Callithrix penicillata*. Observation.
- 12b. Morro do Chapeu, altitude 835 m. Disturbed *cerrado*. C. Kierulff. *Callithrix penicillata*. Observation.
13. Barra do Itacambiricú, Cristália, Minas Gerais (16°45' S, 42°42' W). Gallery forest. W.R. Spironelo. *Callithrix penicillata*. Observation.
14. Fazenda Mandasaia, Grão Mogol, Minas Gerais (16°34' S, 43°12' W). *Cerrado*. W.R. Spironelo. *Callithrix penicillata*. Reported by local people.
15. Fazenda Giro, Grão Mogol, Minas Gerais (16°34' S, 43°02' W). *Cerrado*. W.R. Spironelo. *Callithrix penicillata*. Observation.
16. Porto Mandacurú, right bank of Rio Jequitinhonha, municipality of Virgem da Lapa, Minas Gerais (16°42' S, 42°13' W). *Cerrado* W.R. Spironelo. *Callithrix penicillata*. Observation.
- 17a. Fazenda Paiol, municipality of Virgem da Lapa, Minas Gerais (16°50' S, 42°13' W, altitude 500 m). High forest. W.R. Spironelo. *Callithrix penicillata*. Observation. *Alouatta fusca clamitans*. Observation. *Cebus apella robustus*. Observation.
- 17b. Altitude 445 m. Second growth forest. C. Kierulff. *Callithrix penicillata*. Observation.
18. Fazenda Santa Clara, Vila Piauí, municipality of Araçuaí, Minas Gerais (16°49' S, 41°48' W). Gallery forest and *caatinga* forest. A.B. Rylands and W.R. Spironelo. *Alouatta fusca clamitans*. Reported by local people. *Callicebus personatus personatus*. Reported by local people.
- 19a. Fazenda Santana, municipality of Itinga, Minas Gerais (16°40' S, 41°59' W). *Caatinga* forest. W.R. Spironelo and A.B. Rylands. *Alouatta fusca fusca*. Observation. *Cebus apella* ssp. Reported by local people.
- 19b. Gallery forest and *caatinga* forest. W.R. Spironelo and A.B. Rylands. *Callithrix penicillata*. Observation.
20. Fazenda Arqueana, Rio Piauí, municipality of Araçuaí, Minas Gerais (16°43' S, 41°53' W). Gallery forest in *caatinga*. W.R. Spironelo. *Callithrix geoffroyi*. Observation.

---

**Appendix I**  
**Localities Shown in Figures 2-4**

---

1. Emendas, Rio Jequitinhonha, municipality of Diamantina, Minas Gerais (18°06' S, 43°30' W). A.B. Rylands. *Callithrix geoffroyi*. Reported by local people.
2. São Gonçalo do Rio Preto, Minas Gerais (18°02' S, 43°15' W). *Cerrado*. A.B. Rylands. *Callithrix geoffroyi*. Reported by local people.
3. Capelinha, Minas Gerais (17°42' S, 42°36' W). *Cerrado*. W.R. Spironelo. *Callithrix geoffroyi*. In captivity.
4. Acauá State Reserve (Instituto Estadual de Florestas), municipality of Turmalina, Minas Gerais (17°08' S, 42°46' W). Secondary *cerrado* forest. W.R. Spironelo. *Callithrix penicillata*. Reported by local people.
5. Botumirim, municipality of Botumirim, Minas Gerais (17°08' S, 43°13' W). *Cerrado*. W.R. Spironelo. *Callithrix penicillata*. Reported by local people.
6. Fazenda Guajovira, municipality of Botumirim, Minas Gerais (17°10' S, 43°03' W). *Cerrado*. W.R. Spironelo. *Callithrix penicillata*. Reported by local people. *Cebus apella* ssp. Reported by local people. *Alouatta fusca*. Reported by local people.
7. Córrego da Chacara, Minas Novas, Minas Gerais (17°45' S, 42°30' W). Gallery forest in *cerrado*. A.B. Rylands and W.R. Spironelo. *Callithrix geoffroyi*. Reported by local people. *Callicebus personatus personatus*. Observation.



- 21a.** Fazenda Santa Maria, municipality of Itinga, Minas Gerais (16°36' S, 41°56' W).  
Caatinga forest. W.R. Spironelo.  
*Callithrix penicillata*. Reported by local people.  
*Alouatta fusca fusca*. Observation.  
*Callicebus personatus personatus*. Vocalizations and reported by local people.
- 21b.** Altitude 750 m.  
Caatinga forest. W.R. Spironelo.  
*Cebus apella* ssp. Reported by local people.  
*Alouatta fusca fusca*. Reported by local people.
- 22.** Taquaral, municipality of Itinga, Minas Gerais (16°43' S, 41°52' W).  
Secondary caatinga forest. A.B. Rylands and W.R. Spironelo.  
*Callithrix geoffroyi*. Observation.  
*Callicebus personatus personatus*. Reported by local people.
- 23.** Itinga, left bank of Rio Jequitinhonha, municipality of Itinga, Minas Gerais (16°34' S, 41°47' W).  
Secondary caatinga forest. W.R. Spironelo.  
*Callithrix penicillata*. Reported by local people.
- 24.** Fazenda Lagoa Encoberta, municipality of Joiaima, Minas Gerais (16°49' S, 41°21' W).  
Caatinga forest. V.L. Tornisielo.  
*Callithrix geoffroyi*. Reported by local people.  
*Callicebus personatus personatus*. Reported by local people.
- 25.** Fazenda Anta Podre, municipality of Joiaima, Minas Gerais (16°40' S, 41°59' W).  
High forest. V.L. Tornisielo, W.R. Spironelo and I.B. Santos.  
*Callithrix geoffroyi*. Observation.  
*Alouatta fusca fusca*. Observation.
- 26.** Fazenda Campo Novo, right bank of Rio Jequitinhonha, municipality of Jequitinhonha, Minas Gerais (16°25' S, 41°10' W).  
Degraded caatinga forest. R.L. de Sa.  
*Callithrix geoffroyi*. In captivity.
- 27.** Fazenda Esplanada, municipality of Pampa, Minas Gerais (16°53' S, 40°53' W).  
High forest. W.R. Spironelo.  
*Alouatta fusca fusca*. Reported by local people.
- 28.** Fazenda Carangola, municipality of Pampa, Minas Gerais (16°52' S, 40°52' W).  
High forest. A.B. Rylands and W.R. Spironelo.  
*Alouatta fusca fusca*. Reported by local people.
- 29.** Fazenda São Jorge, municipality of Pampa, Minas Gerais (16°52' S, 40°49' W).  
High forest. A.B. Rylands and W.R. Spironelo.  
*Alouatta fusca fusca*. Reported by local people.
- 30.** Fazenda Nossa Senhora das Graças, municipality of Joiaima, Minas Gerais (16°49' S, 40°40' W).  
High forest. W.R. Spironelo and A.B. Rylands.  
*Callithrix geoffroyi*. Reported by local people.  
*Cebus apella* ssp. Reported by local people.  
*Callicebus personatus melanochir*. Reported by local people.  
*Brachyteles arachnoides*. Local people reported groups in forest patches which no longer exist.
- 31.** Fazenda Nova Esperança, municipality of Felizburgo, Minas Gerais (16°45' S, 40°39' W).  
High forest. A.B. Rylands and W.R. Spironelo.  
*Alouatta fusca fusca*. Reported by local people.  
*Cebus apella* ssp. Reported by local people.
- 32.** Fazenda Ramaiana, municipality of Felizburgo, Minas Gerais (16°40' S, 40°49' W).  
A.B. Rylands and W.R. Spironelo.  
*Alouatta fusca fusca*. Reported by local people.  
*Cebus apella* ssp. Reported by local people.  
*Brachyteles arachnoides*. Reported by local people.
- 33.** Fazenda Córrego Seco, municipality of Joiaima, Minas Gerais (16°40' S, 40°44' W).  
High forest. A.B. Rylands.  
*Alouatta fusca fusca*. Reported by local people.
- 34.** Fazenda Santa Rosa, municipality of Joiaima, Minas Gerais (16°40' S, 40°41' W).  
High forest. A.B. Rylands.  
*Alouatta fusca fusca*. Reported by local people.
- 35.** Fazenda Caraiva, municipality of Felizburgo, Minas Gerais (16°37' S, 40°49' W).  
High forest. W.R. Spironelo.  
*Alouatta fusca fusca*. Reported by local people.
- 36.** Fazenda Agua Fria, municipality of Felizburgo, Minas Gerais (16°38' S, 40°42' W).  
High forest. A.B. Rylands.  
*Alouatta fusca fusca*. Reported by local people.
- 37.** Almenara, municipality of Almenara, Minas Gerais (16°11' S, 40°46' W).  
Secondary gallery forest. I.B. Santos.  
Hybrid of *Callithrix penicillata* x *Callithrix kuhli*. Observation.
- 38.** Fazenda Estancia Betania, municipality of Almenara, Minas Gerais (16°01' S, 40°51' W).  
High forest. V.L. Tornisielo.  
*Callithrix penicillata*. Observation.  
*Cebus apella* ssp. Reported by local people.  
*Alouatta fusca* ssp. Reported by local people.
- 39.** Almenara, right bank of Rio Jequitinhonha, municipality of Almenara, Minas Gerais (16°14' S, 40°41' W).  
Secondary forest. I.B. Santos.  
*Callithrix geoffroyi*. Observation.
- 40.** Fazenda Cristal, municipalities of Jacinto and Jordania, Minas Gerais (16°01' S, 40°12' W).  
Secondary gallery forest. R.L. de Sa.  
*Callithrix kuhli*. Reported by local people and skin (UFMG).
- 41.** Fazenda Boa Vista, municipality of Itarantim, Bahia (15°53' S, 40°09' W).  
Secondary gallery forest. R.L. de Sa.  
*Callithrix kuhli*. Reported by local people and skin (UFMG).
- 42.** Fazenda Serra Branca, municipality of Salto de Divisa, Minas Gerais (15°57' S, 40°05' W).  
High forest, transition between caatinga and Atlantic coastal forest. I.B. Santos.  
*Cebus apella* ssp. Reported by local people.  
*Alouatta fusca*. Reported by local people.
- 43a.** Fazenda Morro Grande, left bank of Rio Jequitinhonha, municipality of Salto de Divisa, Minas Gerais (15°52' S, 40°05' W).  
High forest, transition between caatinga and Atlantic forest. I.B. Santos and W.R. Spironelo.  
*Leontopithecus chrysomelas*. Reported by local people.
- 43b.** High transition forest. I.B. Santos and W.R. Spironelo.  
*Callithrix kuhli*. Observation.  
*Leontopithecus chrysomelas*. Reported by local people.  
Hybrid of *Cebus apella robustus* x *Cebus apella xanthosternus*. Observation.

44. Salto de Divisa, right bank of Rio Jequitinhonha, municipality of Salto de Divisa, Minas Gerais (16°05' S, 39°56' W). High forest. W.R. Spironelo and I.B. Santos. *Callithrix geoffroyi*. Reported by local people. *Callicebus personatus melanochir*. Reported by local people. *Cebus apella* ssp. Reported by local people.
53. Machacalis, upper Rio Itanhem (17°05' S, 40°45' W). Atlantic forest. A. Machado, F.S. Pereira and E. Dente, 1954. *Callithrix geoffroyi*. *Cebus apella robustus*. *Alouatta fusca fusca*. Cited in Hershkovitz (1977), locality no. 314a. Cited in Kinzey (1982), locality no. 43. Cited in Santos *et al.* (1987), locality no. 8, Fig. 11. Cited in de Vivo (1988), locality no. 1, p. 309.

---

**Appendix II**

**Other Localities in the States of Minas Gerais and Bahia  
Mentioned in the Text (see Fig. 5)**

---

46. Rio Belmonte (*id.*, Rio Jequitinhonha) (15°45' S, 38°53' W). M. Wied-Neuwied, 1816. *Callicebus personatus melanochir*. Cited in Kinzey (1982), locality no. 24. Cited in Santos *et al.* (1987), locality no. 5, Fig. 7. Cited by Avila Pires (1965) as the type locality of *Callithrix melanochir* Kuhl, 1820. *Callithrix kuhli*. Cited by Hershkovitz (1977), locality no. 306 and by Kinzey (1982), locality no. 24, as the hybrid *C. penicillata* x *C. geoffroyi*. Cited by de Vivo (1988), locality no. 25, p. 315, as *Callithrix penicillata*. Vicinity of Belmonte. Santos *et al.* (1987), locality no. 1, Fig. 13. *Alouatta fusca fusca*. Reported by local people. *Brachyteles arachnoides*. Reported by local people. Belmonte, Passuá (15°51' S, 38°54' W). Belmonte, Vitoria, Fazenda Vitoria. *Cebus apella xanthosternos*. Cited in Kinzey (1982), locality no. 24. Cited in Santos *et al.* (1987), locality no. 2, Fig. 9.
47. Fazenda Angelim, near Córrego do Angelim. Santos *et al.* (1987), locality no. 9, Fig. 10. *Cebus apella xanthosternos*. Reported by local people.
48. Vicinity of Santa Maria Eterna, left bank of the Rio Jequitinhonha. Santos *et al.* (1987), locality no. 7, Fig. 10. *Cebus apella xanthosternos*. Reported by local people.
49. Vicinity of Itapebi, near Rio Jequitinhonha. Santos *et al.* (1987), locality no. 3, Fig. 13. *Alouatta fusca fusca*. Reported by local people. *Cebus apella xanthosternos*. Reported by local people.
50. Fazenda "Tuiti," near Santa Maria Eterna, left bank of Rio Jequitinhonha. Santos *et al.* (1987), locality no. 10, Fig. 10. *Brachyteles arachnoides*. Reported by local people. *Cebus apella xanthosternos*. Reported by local people.
51. Vicinity of Barreiras, Itapebi-Belmonte Road. Santos *et al.* (1987), locality no. 2, Fig. 13. *Alouatta fusca fusca*. Reported by local people. Barreira, Rio Jequitinhonha, municipality of Belmonte. Wied, 1815/20. *Brachyteles arachnoides*. Cited in Aguirre (1971), locality no. 7, p. 48). Now believed to be extinct in the region (Aguirre, 1971). Cited in Kinzey (1982), locality no. 24. Belmonte, Barreiras (16°04' S, 39°20' W). *Brachyteles arachnoides*. Cited in Kinzey (1982), locality no. 24. Cited in Santos *et al.* (1987), locality no. 2 (Fig. 14).
52. Serra da Gabiarrá, municipality of Santa Cruz Cabralia, Bahia (16°07' S, 39°42' W). Aguirre (1971). *Brachyteles arachnoides*. Reported by Aguirre (1971) as still existing. Cited in Kinzey (1982), locality no. 24a. Reported to I.B. Santos and W.L.R. Oliver (unpubl. data, 1987). *Alouatta fusca fusca*. Reported by local people to I.B. Santos and W.L.R. Oliver (unpubl. data, 1987).
54. Fazenda Pontal, Itamaraju (17°04' S, 39°32' W). *Cebus apella robustus*. L. Deane, 1969. *Brachyteles arachnoides*. Formerly present. Aguirre (1971). Cited in Kinzey (1982), locality no. 24c.
55. Araçuaí, upper Rio Jequitinhonha (16°52' S, 42°04' W). *Callithrix geoffroyi*. Cited in Hershkovitz (1977), locality no. 314a. Cited in Kinzey (1982), locality no. 42.
56. Teófilo Otoni (17°51' S, 41°30' W). *Callithrix geoffroyi*. *Callicebus personatus personatus*. Garbe, 1908. *Cebus apella robustus*. Elias, 1948. *Alouatta fusca fusca*. Garbe, 1908; R.M. Gilmore, 1936. *Brachyteles arachnoides*. A. Machado, 1958. Cited in Hershkovitz (1977), locality no. 314b. Cited in Kinzey (1982), locality no. 47. Cited in Santos *et al.* (1987), locality no. 9, Fig. 11. Cited in De Vivo (1988), locality no. 2, p. 309.
57. Buenópolis (17°54' S, 44°11' W). 674 m. *Callithrix penicillata*. A. Machado, 1958. Cited in Hershkovitz (1977), locality no. 312a. Cited in Kinzey, locality no. 48. *Callicebus personatus personatus*. Cited in Hershkovitz (in prep.).

# Africa

## *Pan paniscus* in Salonga National Park

by Angela Meder, Paul-Hermann Bürgel and Carsten Bresch

According to widespread opinion, no bonobos (*Pan paniscus*) can be found in Salonga National Park (PNS) in the central Zaire basin (Badrian and Badrian, 1977; Kano, 1979) (Fig. 1). However, in December 1987, during a visit to the Président Délégué Général Dr. Mankoto ma Mbalele, in Kinshasa, we were informed that guards in Salonga Park had recently observed bonobos at several places. With the kind assistance of Dr. Mankoto, two of us, A.M. and P.-H.B., had the opportunity to observe the apes first-hand.

We travelled first to Monkoto, headquarters for the northern section of the park, where the Conservateur Chef du PNS-Nord, Tshobo Masunda, described several encounters his guards had with bonobos near the northern boundary of PNS-Nord, as well as north of the town of Anga,

in the southern section of the park. To enable us to confirm these observations, Masunda drove us first to the Catholic mission at Bokela, near the northern park border, then about 20 km further south to the village of Lokata, almost 5 km north of the Lomela River, which marks the park border. We crossed the river in a pirogue and began a three-day walk through the park.

On the second day, our guides discovered the first bonobo food remains: remnants of *Aframomum*, cola fruits, and stipes of unidentified monocots split open for the pith. We also found nine nests, at heights ranging from 6-20 m from the ground, clustered in an area about 40 m in diameter. Several nests were built in tree forks into which broken branches of the same or different trees had been wedged. We also saw broken crowns of young trees (2-3 cm thick) lying on the ground. Our guides attested that a bonobo will break off a tree crown and drag it along the ground for a time, holding the trunk. When the bonobo lets go, the trunk points in the direction the animal has taken. We have as

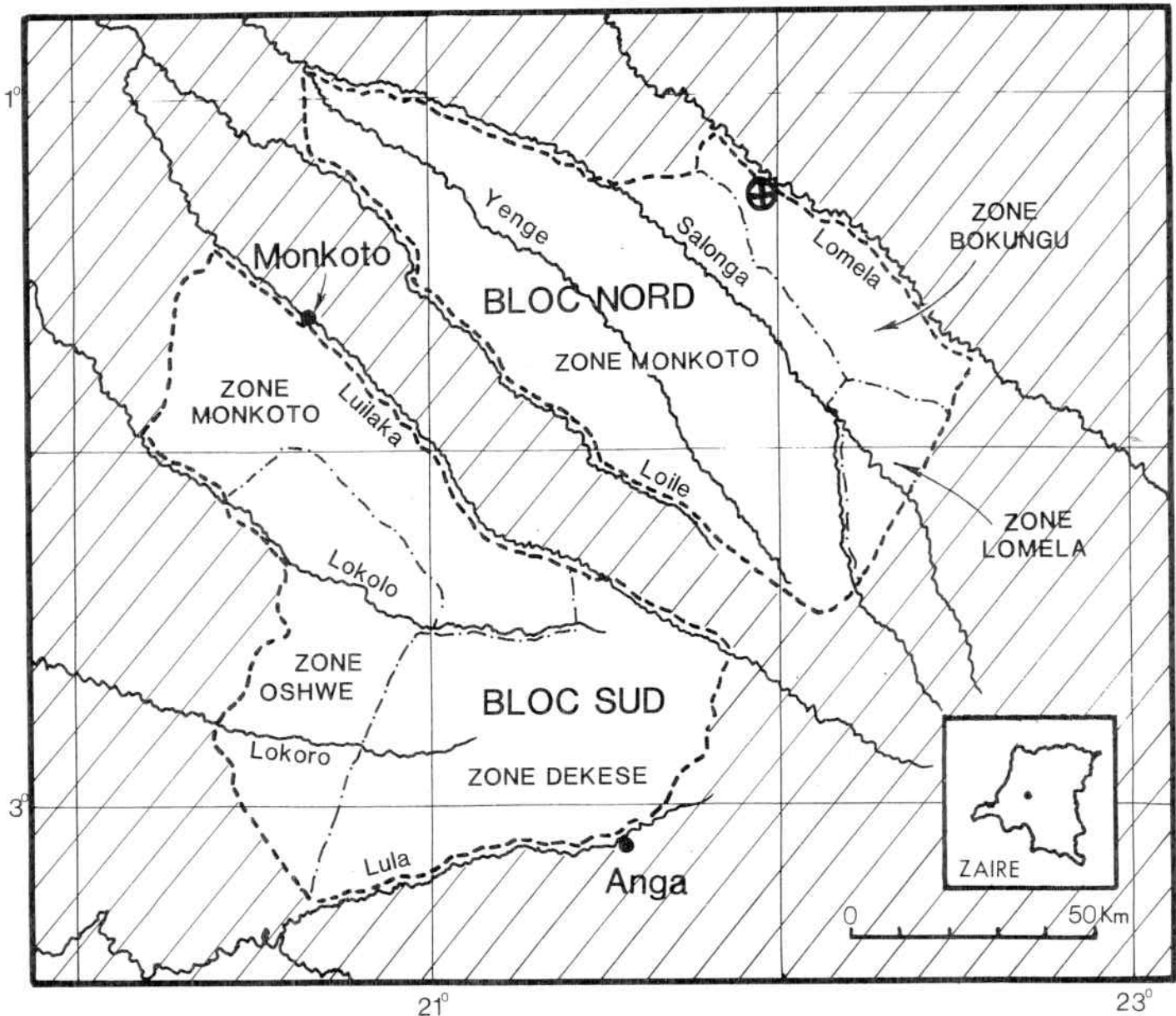


Fig. 1. Map of Salonga National Park (map by S.D. Nash from authors' original).

yet no convincing explanation for this behavior.

We followed the traces and met up with a bonobo group around noon. From the noises and movement in the foliage, our guides estimated that the group included about 20 animals. We actually saw only three adult apes. One was a male who was resting on his back in the sun as we approached and did not notice us until we were 15 m away. Then he jumped quickly into a tree and stayed there, visible, until our departure about 20 min later. Throughout that time he uttered single shrill cries, which we tape recorded. This male was the only member of the group which did not disappear.

Several times on our hike through the rainforest, we observed mixed species groups of monkeys in which *Cercopithecus wolffi*, *Cercopithecus ascanius*, *Cercocebus atterimus* and *Colobus pennanti* were identified with certainty.

Anglea Meder  
Paul-Hermann Bürgel  
Carsten Bresch  
Institut für Biologie III  
Universität Freiburg  
Schänzlester 1  
D7800 Freiburg  
WEST GERMANY

#### Acknowledgements

For the help they gave on our search for the bonobos, we want to thank the Président Délégué Général, Dr. Mankoto ma Mbaelele, the Conservateur Chef du PNS-Nord, Mr. Tshobo Masunda, and his team, and Pater Franz and the sisters of the Bokela mission.

#### Literature Cited

- Badrian, A. and N. Badrian. 1977. Pygmy chimpanzees. *Oryx* 13: 463-68.
- Kano, T. 1979. A pilot study of pygmy chimpanzees, *Pan paniscus*. In: *The Great Apes*, D.A. Hamburg and E.R. McCown, eds, pp. 122-35.

## Conservation of Eastern Lowland Gorillas in the Masisi Region, Zaire

by Mwanza Ndunda, Tamaki Maruhashi, Takakazu Yumoto  
and Juichi Yamagiwa

The eastern lowland gorilla (*Gorilla gorilla graueri*) has been classified as a third subspecies of *Gorilla gorilla* (Groves, 1967; Corbet, 1967). Goodall and Groves (1977) noted that, except in the shape of the face, the morphological traits of this subspecies were intermediate between those of the other two subspecies (*G. g. gorilla* and *G. g. beringei*). Studies on their comparative ecology and morphology will possibly provide us with a key to understanding the evolution of *G. gorilla*. However, no reliable information has been available concerning the distribution and status of *G. g. graueri* since Emlen and Schaller's short survey (1960).

The eastern lowland subspecies ranges from low tropical rainforest to montane forest in eastern Zaire. The population is divided into isolated pockets of forest (Emlen and Schaller, 1960), which are being reduced in area, in some cases drastically (Goodall and Groves, 1977). The International Primatological Society recently stressed the need for censuses of eastern lowland gorillas and an assessment of the threats to their survival (see IPS News, No. 14, 1987).

Financed by a Grant-in-Aid for Overseas Scientific Survey from the Japan Ministry of Education and Culture in cooperation with the Center

for Natural Scientific Research in Zaire (CRSN) and the Zairian Institute for Nature Conservation (IZCN), we conducted a preliminary survey on *G. g. graueri* from August to September 1987 in the Masisi region (Fig. 1). Masisi is a high plateau, 1,400-2,700 m, which forms the boundary between the Zaire Basin and the Greater Rift Valley. The region has a high rainfall which may have provided a lush habitat for gorillas in the past.

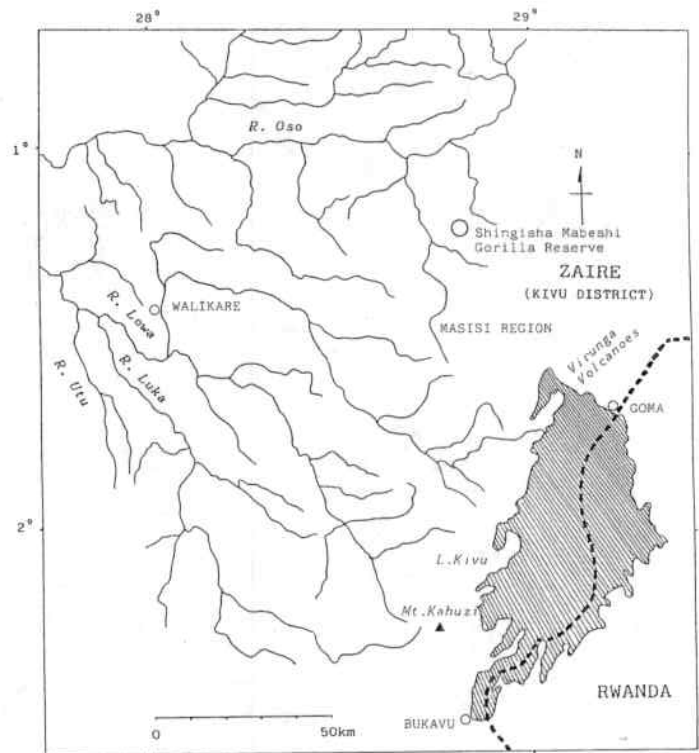


Fig. 1. Map of the study area (map provided by authors).

However, from 1937-1960, three large-scale immigrations, encouraged by Belgian policy, were conducted into Masisi by the Banyarwanda (Rwandan people). The Banyarwanda have built linear villages along the mountain ridges and cultivate the slopes and graze livestock, as is their custom in Rwanda (Fig. 2). Their principal crops are banana, cassava, maize, sorghum, potato, cocoyam, beans, squash, and green vegetables; and their domestic animals include cattle, goats, swine, ducks, and chickens. In addition to traditional farming methods, European techniques like the use of paddocks to enclose wide areas for cattle-raising and planting pasture have become popular. These techniques, promoted by farm-contractors after Independence, have increased the number of cattle in the region and also the rate of deforestation. The population of Banyarwanda in Masisi is now six times greater than the population of Bahunde people, who lived there previously. The increasing population requires more land for more farms, a demand which has resulted in an abrupt increase in deforestation and a consequent decrease in gorilla habitat in Masisi.

We conducted a population census on gorillas and chimpanzees for eight days, covering about 30 km<sup>2</sup> of the Shingisha Mabeashi Gorilla Reserve in Masisi. This area includes six mountains (1,500-2,000 m), with cultivated and grazed slopes. Only a few small primary, or secondary, forests remain in a mosaic-like pattern around the tops of the mountains and along the valleys (Fig. 3). We found three groups of gorillas, a solitary male gorilla, and four parties of chimpanzees within the study area. The estimated population densities of the two species were almost identical: gorillas, 0.8 ind/km<sup>2</sup>; and chimpanzees, 0.9-1.1 ind/km<sup>2</sup>. In comparison with the population density of gorillas in other areas, the



Fig. 2. Banyarwanda village built on a mountain ridge in the Masisi region (photo by T. Yumoto).

density of gorillas in Masisi was relatively high (0.6 ind/km<sup>2</sup> in Virungas, Harcourt *et al.*, 1983; 0.6 ind/km<sup>2</sup> in Kayonza, Schaller, 1963; 0.4 ind/km<sup>2</sup> in Kahuzi, Yamagiwa, 1983; 0.4 ind/km<sup>2</sup> in Utu, Goodall, 1975; 0.7 ind/km<sup>2</sup> in Rio Muni, Jones and Sabater Pí, 1971; and 0.2 ind/km<sup>2</sup> in Gabon, Tutin and Fernandez, 1984). Moreover, since the gorillas utilized less than 30% of the study area, the actual density within their ranging area must have been very high. It seems likely that the gorillas have no further areas in which to expand their range in Masisi.

The gorillas' habitats within the study area can be divided into primary forest, secondary forest, patches of elephant grass (*Pennisetum purpureum*), pasture, and cultivated fields. Within the study period, gorillas never built their nests or fed in the primary forest, but frequently ranged in the secondary forest and in the elephant grass. They also passed through the cultivated fields and raided crops such as *ensete* bananas and cocoyams (Fig. 4). This tendency possibly reflects their food preferences. Their diet at the time of our study consisted primarily of the piths of elephant grass and *ensete* bananas. The elephant grass flourished widely on the slopes, and the bananas were planted along the edges of the cultivated fields. When gorillas entered these areas, they appeared to range less. Although they rarely built nests beside a previous nest site, we did find two consecutive nest sites in the same location in the elephant grass. Scarcer food in the primary forest may encourage gorillas to stay in open vegetation, where fibrous food items are available throughout the year. Human disturbance has also clearly reduced their home range and forced them into restricted areas.

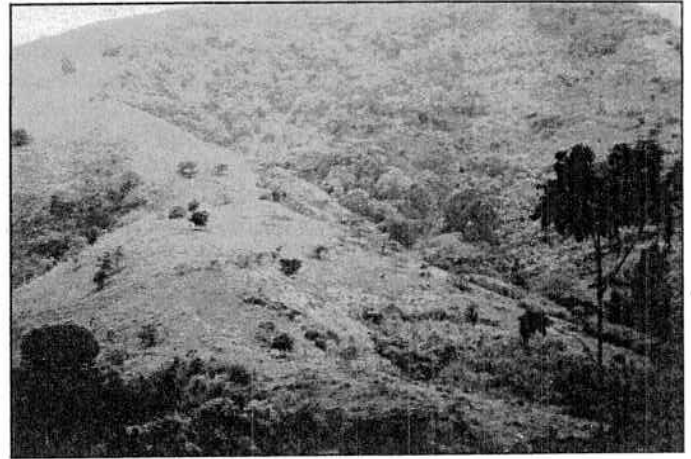


Fig. 3. A small primary forest patch used by gorillas in the Shingisha Mabeshi Gorilla Reserve (photo by J. Yamagiwa).

Hunting pressure in the Masisi region is low, since the local people are not in the habit of eating wild animals. Although the local people did remain tolerant of the gorillas which frequently appeared in their pastures or cultivated fields, crop raiding by the gorillas made farmers nervous and raised their aggressiveness towards the animals. We heard reports of gorillas eating maize, cocoyam, cassava, plantain banana pith, sugar cane, beans, and eucalyptus bark. As mentioned, active deforestation by the local people has gradually reduced the gorillas' habitats, and the increased struggle for land between the local people and the gorillas has driven the latter away towards the tops of the mountains. We believe the gorillas will never be able to maintain a healthy population under these conditions and will become extinct in the near future. A conservation policy is urgently needed in order to save the gorillas of Masisi.

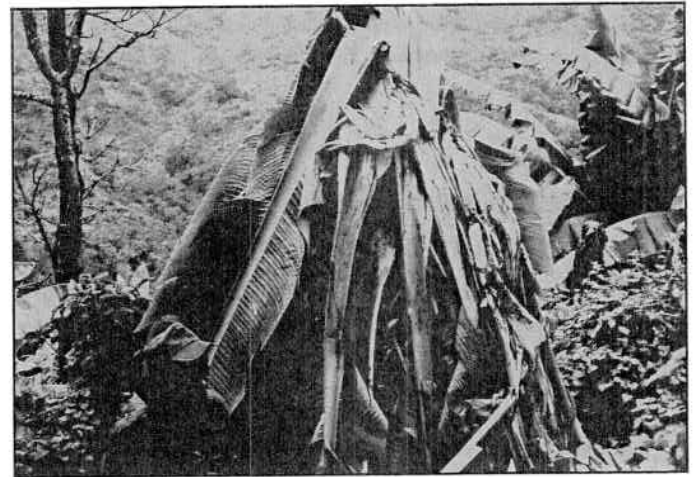


Fig. 4. A broken *ensete* banana tree after being fed on by gorillas (photo by J. Yamagiwa).

The following recommendations are made:

- (1) The gorillas and their habitats must be separated immediately and completely from areas of human activity in Masisi. If the gorillas maintain their present contact with the local people, they can easily become infected by human diseases. If the gorillas continue to range within such isolated habitats, inbreeding will have deleterious effects on their reproductive success. One of the farm owners in Masisi suggested to us that the only solution for successful separation would be to buy the necessary land for gorilla conservation from the local people. The area required would be at least 40 km<sup>2</sup>, which might cost about US \$64,000.
- (2) The separation plans should consider: 1) the area necessary for several gorilla groups to survive, 2) the vegetation types necessary to

provide the gorillas with a variety of food resources throughout the year, 3) a bridge zone which would permit gorillas to come in contact with neighboring populations, and 4) a buffer zone which would prevent gorillas from coming in contact with the local people.

(3) In order to assess and satisfy these conditions, a detailed survey of the animals' ecology and habitat preferences should be undertaken prior to the proposed separation, which cannot be successful unless such factors are taken into account.

Gorillas form a cohesive group and range over a wide area (Fossey, 1974; Casimir, 1975; Yamagiwa, 1983). Most of the maturing males live in solitude for several years after separating from their natal groups (Caro, 1976; Yamagiwa, 1986). Most of the nulliparous females tend to transfer between groups (Harcourt *et al.*, 1976), and the behavior of gorillas varies with the aging cycle of social units, which is produced by competition among silverbacks for mates and by females' choices of units to transfer to (Yamagiwa, 1987a; 1987b). A gorilla conservation program must, therefore, take proper account of their movements and ensure adequate inter-unit relationships.

Future research should also embrace the ecological traits of the local gorilla population, since the monthly or annual range size and feeding behaviors of gorillas vary from region to region (Schaller, 1963; Goodall, 1977; Goodall and Groves, 1977). Since the ranging of gorillas in Masisi was strongly affected by the distribution of elephant grass and *ensete* bananas, suitable habitats for the gorillas should include such secondary regenerating forest areas which provide the gorillas' main food items. The bridge zone should be comprised of vegetation which will provide the gorillas with food and nesting sites. This zone should enable them to travel between several mountains and to contact other groups or solitary males. Non-food trees for the gorillas should be planted in the surrounding buffer zone to discourage the gorillas from approaching the local people, domestic animals, and crops.

(4) If such complete separation cannot be expected, relocation of the gorillas should be planned as soon as possible. In this case, consideration must be given to the most suitable habitats for them as well as to the effects of relocation on the animals themselves, the fauna and flora, and, especially, other gorilla populations. The results of our survey suggest that the ecological and external characters of the Masisi gorillas may not resemble those of gorillas in the Virungas or Kahuzi regions but rather those of the Itebero-Utu region. It is said that gorillas immigrated into the Masisi region over the last several decades from lowland forests near the Walikare region. It is recommended, therefore, that any relocation be done to one of the protected areas in the lowland forests. However, in order to respect their genetic, morphological, ecological or behavioral independence, we should not mix gorillas who belong to different local populations, so the best solution for relocation would be to find a suitable unoccupied space near the Masisi region.

About 30 people currently work to protect the gorillas in the Shingisha Mabeshi Reserve, only a few of whom are paid by donations from a local farm owner. Other sources of financial support are urgently needed for these dedicated people. Although the recent activities of IZCN in cooperation with the Frankfurt Zoological Society and World Wildlife Fund have made great progress towards saving gorillas and conserving their habitats in higher montane forests such as at the Virungas and Kahuzi, increased international awareness and aid are now needed to save the eastern lowland gorillas of the lower tropical rainforests. Saving the gorillas will help preserve the fauna and flora, and will thus contribute to the conservation of the natural resources in the Masisi region. Therefore, in order to reach a consensus and find a balance with local development, any conservation plans should be incorporated into local management plans.

Mwanza Ndunda  
Centre de Recherches en Sciences  
Naturelles  
Lwiro  
D.S. Bukavu  
ZAIRE

Tamaki Maruhashi  
Musashi University  
Nerima  
Tokyo 176  
JAPAN

Takakazu Yumoto  
Laboratory for Plant Ecological  
Studies  
Kyoto University  
Sakyo  
Kyoto 606  
JAPAN

Juichi Yamogiwa  
Japan Monkey Centre  
Inuyama  
Aichi 484  
JAPAN

#### Literature Cited

- Caro, T.M. 1976. Observations on the ranging behavior and daily activity of lone silverback mountain gorillas (*Gorilla gorilla beringei*). *Anim. Behav.* 24: 889-97.
- Casimir, M.J. 1975. Feeding ecology and nutrition of an eastern gorilla group in the Mt. Kahuzi, region (République du Zaïre). *Folia Primatol.* 24: 81-136.
- Corbet, G.B. 1967. The nomenclature of the eastern lowland gorilla. *Nature (London)* 215: 1171-72.
- Emlen, J.T. and G.B. Schaller. 1960. Distribution and status of the mountain gorilla (*Gorilla gorilla beringei*). *Zoologica* 45: 41-52.
- Fossey, D. 1974. Observations on the home range of one group of mountain gorilla (*Gorilla gorilla beringei*). *Anim. Behav.* 22: 568-681.
- Goodall, A.G. 1975. Mountain gorillas in danger. In: *Wildlife '75*, N. Sitwell, ed. London Editions, London.
- Goodall, A.G. 1977. Aspects of the feeding behavior of a mountain gorilla group (*Gorilla gorilla beringei*) in the Tshibinda-Kahuzi region (Zaire). In: *Primate Ecology: Studies of Feeding and Ranging Behavior in Lemurs, Monkeys and Apes*, T.H. Clutton-Brock, ed. Academic Press, London, pp. 449-79.
- Goodall, A.G. and C.P. Groves, 1977. The conservation of eastern gorillas. In: *Primate Conservation*, Prince Rainier III, H.S.H. of Monaco and G.H. Bourne, eds. Academic Press, New York, pp 599-637.
- Groves, C.P. 1967. Ecology and taxonomy of the gorilla. *Nature (London)*. 213: 890-93.
- Harcourt, A.H., K.J. Stewart and D. Fossey. 1976. Male emigration and female transfer in wild mountain gorillas. *Nature (London)*, 263: 226-27.
- Harcourt, A.H., J. Kineman, G. Campbell, J. Yamagiwa, I. Redmond, C. Aveling and M. Condiotti. 1983. Conservation and the Virunga gorilla population. *Afr. J. Ecol.* 21: 139-42.
- Jones, C. and J. Sabater-Pi. 1971. Comparative ecology of *Gorilla gorilla* (Savage and Wyman) and *Pan troglodytes* (Blumenbach) in Rio Muni, West Africa. *Bibli. Primatol.* 13: 1-96.

- Schaller, G.B. 1963. *The Mountain Gorilla*. Univ. of Chicago Press, Chicago.
- Tutin, C.E.G., and M. Fernandez. 1984. Nationwide census of gorilla (*Gorilla g. gorilla*) and chimpanzee (*Pan t. troglodytes*) populations in Gabon. *Am. J. Primatol.* 6: 313-36.
- Yamagiwa, J. 1983. Diachronic changes in two eastern lowland gorilla groups (*Gorilla gorilla graueri*) in the Mt. Kahuzi region, Zaire. *Primates* 24: 174-83.
- Yamagiwa, J. 1986. Activity rhythm and the ranging of a solitary male mountain gorilla (*Gorilla gorilla beringei*). *Primates* 27: 273-82.
- Yamagiwa, J. 1987a. Intra- and inter-group interactions of an all-male group of Virunga mountain gorillas (*Gorilla gorilla beringei*). *Primates* 28: 1-30.
- Yamagiwa, J. 1987b. Male life history and the social structure of wild mountain gorillas (*Gorilla gorilla beringei*). In: *Evolution and Coadaptation in Biotic Communities*. S. Kawano, J.H. Connell and T. Hidaka, eds. Univ. of Tokyo Press, Tokyo, pp: 31-52.

## Estimates of Effective Population Size for a Forest Primate, the Tana River Mangabey

by Margaret F. Kinnaird

A central question in conservation biology is what constitutes a viable population. How large must a population be, or how small may it become, and still assure its long-term persistence and adaptability in a given area? The size of a viable population depends on a variety of biotic and abiotic factors, including population dynamics, environmental variation, genetics and population structure (Soulé, 1987). Attempts to estimate minimum viable population sizes (MVP's) have been based primarily on genetic or demographic considerations. Viable population size determined from genetic analysis alone has numerous shortcomings and should be used only as a rough, first estimate of the minimum number of individuals required in a population (Shaffer and Samson, 1985; Koenig, 1988). Such genetic analyses are, however, useful tools when evaluating populations that have not been studied in detail and for which long-term demographic data are not available.

In this paper, I use a simple genetic model to estimate a minimum viable population size and the minimum area necessary to support such a population for a little known and endangered forest primate, the Tana River crested mangabey (*Cercocebus galeritus galeritus*, Fig. 1). I compare these estimates with the actual population size of *C.g. galeritus* in the wild and discuss the possible implications of discrepancies between derived and actual values.

*C.g. galeritus* is found only in the small patches of gallery forest (Fig. 2) that border a 60 km stretch of the Tana River floodplain in eastern Kenya (Homewood, 1976). The subspecies is afforded some protection within the 171 km<sup>2</sup> Tana River National Primate Reserve. In the 12 years since the establishment of the reserve, the mangabey population has declined by an estimated 25% (Marsh, 1986). Consequently, there has been a growing concern over the status of this primate and the prospects for its long-term persistence.

Estimates of viable populations generally are summarized with the effective population size,  $N_e$ .  $N_e$  is defined as an idealized population in which there is random mating, equal contribution by all individuals to the gene pool (i.e. no variance in number of progeny), no overlap of generations, and a stable population (Kimura and Crow, 1963; Hartl, 1980). The assumptions of the idealized model are violated in most, if



Fig. 1. Tana River crested mangabey eating unripe seeds of the date palm, *Phoenix reclinata* (photo by M.F. Kinnaird).

not all, real populations and generally render  $N_e$  considerably smaller than  $N$ , the census number of individuals in a population. Therefore,  $N_e$  must be adjusted to compensate for the above population variables.

In estimating the MVP of *C.g. galeritus*, I used methods derived by Kimura and Crow (1963) to correct for the influence of differential reproduction among individuals on  $N_e$ . This correction is necessary, particularly in polygamous species where the sexes do not contribute equally to the next generation.  $N_e$  is calculated from  $N$  as:

$$(a) \quad N_e = 4 (N_m)(N_f)/(N_m + N_f)$$

where  $N_m$  is the number of breeding males and  $N_f$  is the number of breeding females.

Corrections for overlapping generations must be made when juveniles and adults are present in the population at the same time because all individuals are not equally likely to breed with each other. I use Soulé's (1980) correction for overlapping generations, stated as:

$$(b) \quad N_e = 1/2 (N)$$

The influence of non-random mating and the problem of correcting for dispersal distance from the natal area have been discussed by Koenig (1988). Because of the linear and fragmented nature of the mangabey habitat, there is a higher probability that mangabeys will disperse to neighboring groups than to distant groups, or to groups across the river. No data exist, however, on the dispersal patterns of mangabeys, so I must assume random mixing in calculating  $N_e$ .

Franklin (1980) and Soulé (1980) have suggested that a minimum  $N_e$  of 50 breeding individuals is necessary to prevent the deleterious effects of inbreeding within a normally outbreeding population. A minimum of 500 individuals is necessary for most populations to maintain their levels of genetic variance, thereby lowering their susceptibility to extinction. By reversing the equations above, it is possible to determine what mangabey population size ( $N$ ) is necessary to yield the desired  $N_e$  of 50 or 500.

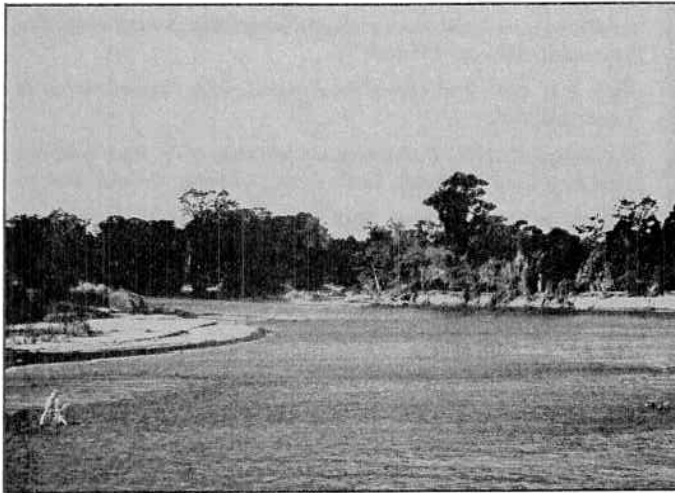


Fig. 2. Gallery forest along the banks of the lower Tana River (photo by M.F. Kinnaird).

Table 1 summarizes counts of four groups of mangabeys censused within the reserve during 1988. A total of nine reproducing males and 23 reproducing females were counted for all groups combined. Using equation (a), I calculated an  $N_e$  of 25.8 mangabeys, a value that is 81% of the actual breeding population of 32. I then increased  $N$  such that  $0.81N = N_e$  to derive the census population sizes necessary to maintain the desired  $N_e$  of 50 or 500. This translates into population sizes of 62 and 617 breeding mangabeys to maintain effective populations of 50 and 500 animals, respectively. Using equation (b), the effect of overlapping generations is then accounted for by doubling these estimates; this results in required breeding populations of 123 and 1,235 mangabeys.

How large a forest, or combined area of forest patches would be necessary to support these populations? An estimated 15 mangabey groups reside in forests on the west bank of the Tana River within or near the boundaries of the reserve (Decker and Kinnaird, unpub. data). The total area covered by the 14 forests considered is approximately 6.89 km<sup>2</sup> (Marsh, 1976). This gives a density of 2.17 mangabey groups/km<sup>2</sup>. Considering an average group size of 17.5 animals (Table

1), mangabey density is estimated at 38 individuals/km<sup>2</sup>. Only 46% of these individuals, however, are reproductively capable (Table 1), which gives an estimate of 18 breeding mangabeys/km<sup>2</sup>. Assuming these densities are optimal for mangabeys under the present forest conditions, one can extrapolate the areas required to support the desired populations. Table 2 summarizes for each desired  $N_e$  the census population ( $N$ ) necessary to maintain that  $N_e$ , and the minimum area necessary to support these populations.

The next and most obvious question is, how do these estimates compare to the existing, censused population? And is the existing protected forest area as large as the areas postulated to maintain viable populations? Based on census work by Marsh (1986) and Decker and Kinnaird, I estimated the present mangabey population at 550-900 animals. This translates into a breeding population size of 253-414 individuals, a range of values that, according to the calculations above, satisfies only the requirements for an  $N_e$  of 50. This assumes that all breeders mix randomly, an assumption that may not hold considering that the Tana River most likely creates a formidable barrier between mangabeys on the east and west banks of the river. Based on documented movements between forest patches by mangabeys (Homewood, 1976; Kinnaird, unpub. data), the likelihood of random mixing between individuals of the west bank subpopulation is much greater. Approximately 255 mangabeys, or 118 breeding individuals, reside within or near the reserve boundaries along the west bank of the river. If the assumption of random mixing holds for the west bank, the census number of breeding mangabeys in these forests alone just barely satisfies the requirements for an  $N_e$  of 50, and does not approach the numbers necessary to maintain an  $N_e$  of 500.

Marsh (1976, 1986) and Homewood (1976) estimated the total area of remaining forest habitat along the Tana River at 16-25 km<sup>2</sup>. This value stands well below area estimates necessary to maintain  $N_e$ 's of 500 and above. Even though 25 km<sup>2</sup> is greater than that area necessary for an  $N_e$  of 50, it must be pointed out again that this includes discontinuous, isolated forest patches and forest areas separated by the river. If we consider only the above mentioned 14 forests along the west bank of the river, the area estimates of 6.89 km<sup>2</sup> just barely satisfy that required to maintain an  $N_e$  of 50 breeding mangabeys.

Table 2. Estimates for *C.g. galeritus* of Number of Breeding-Individuals( $N$ ) and Habitat Area Required to Maintain Values of  $N_e$

	$N_e$	
	50	500
$N$	123	1235
Area (km <sup>2</sup> )	6.8	68

Table 1. Counts of Four *C.g. galeritus* Groups by Age and Sex

	Ad M	Ad F	Subad M	Subad F	Juv	Inf	Tot
Group 1	2	5	0	0	7	3	1
Group 2	2	4	0	0	2	2	1
Group 3	3	8	1	2	12	0	2
Group 4	2	6	0	0	6	3	1
<b>Total</b>	9	23	1	2	27	8	5
Mean	2.25	5.75	0.25	0.5	6.75	2.0	1
Mean as %	45.6		1.4	2.8	38.57	11.4	1

These results indicate that the present mangabey population may be barely large enough to prevent the deleterious effects of inbreeding but may not be large enough to maintain their levels of genetic variance. Whether this limited genetic variance indicates an increase in the mangabeys' susceptibility to extinction remains a question. *C.g. galeritus* is a rare primate and based on its limited range, its population probably has always been small. Even prior to the establishment of the reserve, maximum population estimates from the early 1970s of 1,500 individuals (Homewood, 1976) would not have supported an  $N_e$  greater than 50 individuals. Given the small area of habitat available to mangabeys, it is unlikely, unless densities were once even greater than those reported during the 1970s (30 breeding ind/km<sup>2</sup>; calculated from Homewood, 1976), that such population numbers were ever achieved.

Many authors have stressed that genetic considerations are not the only, and perhaps not even the major, determinants of a species' vulnerability to extinction (Robinson and Ramirez, 1982; Soulé, 1987; Koenig, 1988; Shaffer and Samson, 1985). Extinction is a matter of probabilities



and the probability of extinction increases as population size decreases (Soulé, 1980). For inherently small populations like that of *C.g. galeritus*, major fluctuations due to population dynamics or environmental change may increase dramatically the probability of extinction. Marsh (1986), for example, has attributed the recently documented population decline of *C.g. galeritus* to a reduction in important food species resulting from overall forest senescence. Such conditions, coupled with severe drought, fire or other stochastic events would increase significantly the probability of the mangabey's extinction.



Fig. 3. Tana River crested mangabey inspecting a tree branch for insects (photo by M.F. Kinnaird).

The above results give us a first approximation of the numbers and areas necessary to prevent problems associated with inbreeding and perhaps a rough index of the minimum numbers necessary to "buffer" the effects of major demographic fluctuations. It would seem apparent that the present population and the size of the reserve are barely adequate to protect *C.g. galeritus*. Any reduction in reserve size, with the presumed consequent reduction in population numbers, would almost certainly lower this mangabey's probability of survival. This underscores the need for strict management of the forests within the Tana River National Primate Reserve and the importance of all remaining forest areas outside the reserve.

Margaret F. Kinnaird  
Program for Studies in Tropical  
Conservation  
School of Forest Resources and  
Conservation  
118 Newins-Ziegler Hall  
Univ. of Florida  
Gainesville, FL 32611  
U.S.A.

and

Tana River Primate Project  
National Museums of Kenya  
P.O. Box 88  
Garsen  
KENYA

#### Acknowledgements

Funds for this study were provided by Wildlife Conservation International, New York Zoological Society. The study was sponsored within Kenya by the National Museums of Kenya and the Institute of Primate

Research. The Tana River Primate Project receives core support from the National Museums of Kenya, Yerkes Regional Primate Center, Emory University and Anheuser-Busch. Permission to work within Kenya was granted by The National Council for Science and Technology and The Office of the President. I thank J. Robinson, T. O'Brien, T. Struhsaker and J. Else for discussions concerning effective population sizes and for reviewing previous versions of this manuscript.

#### Literature Cited

- Franklin, R.I. 1980. Evolutionary change in small populations. In: *Conservation Biology: an evolutionary-ecological perspective*. Sinauer Associates, Inc., Sunderland, MA, pp. 135-150.
- Hartl, D.L. 1980. *Principles of Population Genetics*. Sinauer Associates, Inc., Sunderland, MA.
- Homewood, K. 1976. *The ecology and behaviour of the Tana mangabey (Cercocebus galeritus galeritus)*. Ph.D. thesis, University College, London.
- Kimura, M. and J.F. Crow. 1963. The measurement of effective population number. *Evolution* 17: 279-288.
- Koenig, W.D. 1988. On determination of viable population size in birds and mammals. *Wildl. Soc. Bull.* 16: 230-234.
- Marsh, C.W. 1976. *A management plan for the Tana River Game Reserve*. Report to the Kenya Department of Wildlife Conservation and Management, Nairobi.
- Marsh, C.W. 1986. A resurvey of Tana River primates and their habitat. *Primate Conservation* 7: 72-81.
- Robinson, J.G. and J. Ramirez. 1982. Conservation biology of neotropical primates. *Special publication of the Pymatuning Laboratory of Ecology* 6: 329-344.
- Shaffer, M.L. and F.B. Samson. 1985. Population size and extinction: a note on determining critical populations sizes. *American Naturalist*. 125: 144-152.
- Soulé, M.E. 1980. Thresholds for survival: maintaining fitness and evolutionary potential. In: *Conservation Biology: an evolutionary-ecological perspective*. Sinauer Associates, Inc., Sunderland, MA, pp. 151-170.
- Soulé, M.E., ed. 1987. *Viable populations for conservation*. Cambridge Univ. Press, Cambridge.
- Editor's Note:** This paper was submitted in September 1988 and is based on preliminary field data available at that time. Please consider contacting M. Kinnaird directly for her most recent findings.

## Distribution Survey of the Malagasy Lemurs: Request for Information and Initial Report

by Ian Tattersall

Despite over a century of exploration and zoological collection in Madagascar, we still know remarkably little about the geographical distributions of the Malagasy primates. True, in most cases we know where to go to see representatives of this or that species or subspecies, but in no case do we have a precise idea of the boundaries, geographical or ecological, that limit such populations. Nonetheless, even as primate habitat on the island disappears, a steady stream of discoveries is being made of range extensions or of previously known isolates (or even species). Clearly, Madagascar is so vast, and our knowledge so rudimentary, that almost any journey into the field may reveal new and unexpected information about what species or subspecies occurs where. Such discoveries are often made by field workers who are not primatologists, or for whom zoogeographical survey is not a priority. Their important observations may well go unreported in the literature or be reduced to anecdotal hearsay.

In hopes of preserving these sorts of observations, I am offering clearinghouse services. I have prepared questionnaires which are available at the address below. All those working in the field in Madagascar are invited to fill these out when they make casual sightings of interest. The basic questions relate to identity and locality, with the option of furnishing additional information on habitat and group size, for example. In light of the comments made in the accompanying note by Meyers and Tattersall, "Field reporting of variation within lemur species," which follows, information would ideally also include a description of external and pelage characters observed, and of any variations noted in them. It is important to emphasize here that I am requesting only information for which publication plans do not otherwise exist; my concern is that valuable information not be lost. If response justifies it, I will prepare periodic summaries of the kind appearing below. Ultimately, I hope, a permanent home for this clearinghouse will be found in Madagascar itself.

### Initial Results

Summarized below are interesting responses which have already been received as the result of an initial distribution of questionnaires. I suggest that published references to them be made as in the following examples: Reid (in Tattersall, 1988) or Hawkins (in Tattersall, 1988).

*Propithecus verreauxi coronatus*. Don Reid reports that on 14 July, 1987, he saw four individuals of *P. v. coronatus* in the forest near the lighthouse at Katsepy (approx. 15°43' S, 46°13' E), across the Helodrano (Bay of) Bombetoka from Mahajanga. These animals were of classic *coronatus* type, with black faces and crowns and brown throats. This observation would appear to clear up once and for all the question of the distinctness or otherwise of *P. v. coronatus* and *P. v. deckeni*, recently discussed by Tattersall (1986), since in this same forest, in 1973, Sussman and I equally clearly observed pure white *deckeni* (Tattersall, 1982). Even the generalization that "along the coast only *deckeni* has been reported" (Tattersall, 1986:60) is now shattered, and we are obliged by clear sympatry to distinguish no longer between the subspecies *deckeni* and *coronatus*. Whether the two variants, in their extreme forms, had geographically discrete origins remains a matter for conjecture, but together with the extensive melanization already documented in *deckeni*, it is clear that all *P. verreauxi* possessing the *deckeni/coronatus* inflated muzzle should be regarded as belonging to the chromatically variable subspecies *P. v. deckeni* (Peters, 1870).

*Haplemur griseus*. Two individuals of this species were observed by A.F.A. Hawkins on 27 October 1987, on the Ankarana Massif (Ankarana Special Reserve), at 12°49' S, 48°37' E, approximately 25 km SW of Anivorano Atsimo. To my knowledge this is the first record of *Haplemur griseus* from as far north as the Ankarana, although a recent subfossil find of *H. simus* at the site of Andrafiabé (Godfrey and Vuillaume-Randriamanantena, 1986) has documented the former presence in the region of a congener. The two bamboo lemurs were sighted at 1707 h, feeding on bamboo beside a track through selectively logged mixed seasonal/evergreen forest. This locality was visited on numerous occasions in both 1986 and 1987, but only one other sighting, by Paul Stewart, was made of *H. griseus* in the vicinity; these primates are thus probably quite rare in this area. No identification was made to subspecies, but Hawkins's impression is that these individuals were greyer in their pelage than the *Haplemur* seen in the eastern rainforest. It seems likely that this observation represents a northward range extension of the western gentle lemur, *H. g. occidentalis*, which is recorded as far north as Anaborano, some 80 km south of this locality; but clearly this occurrence invites further investigation.

*Daubentonia madagascariensis*. Encouragingly, we are hearing reports of this species from increasing numbers of localities. In October 1987, Quentin Bloxam observed an aye-aye in primary forest on the Ankarana Massif (map coordinates approximately as quoted above) and

also saw extensive evidence in the region for aye-aye damage to dead trees. In 1986, Ganzhorn and Rabesoa recorded several sightings of aye-ayes in the forest of Analamazaotra, near Andasibé in the eastern rainforest, at an altitude of ca. 900 m. In addition, Eleanor Sterling reports seeing two aye-ayes in July 1987, in secondary growth next to the (only) paved road 0.5 km from the station at Andasibé (12°49' S, 49°14' E). This locality is outside the forest reserve proper, and the presence there of aye-ayes appears to confirm the suggestion of Ganzhorn and Rabesoa (1986) that these rare lemurs may occur at a higher population density than previously believed.

### Conclusion

It is clear that we shall never properly understand the history of the diversification of the Malagasy primate fauna in the absence of adequate information on the current distributions of its component species and populations. Equally, it is impossible to make rational plans for the preservation of that diversity if we do not know its full geographical and ecological extent and complexity. Every new observation made can contribute towards the understanding and the conservation of this unique fauna, and I would like to thank the individuals quoted above for having cooperated in placing their observations on record. I hope that other field workers will consider doing likewise.

Ian Tattersall  
Department of Anthropology  
American Museum of Natural History  
New York, NY 10024  
U.S.A.

### Literature Cited

- Ganzhorn, J.U., and J. Rabesoa. 1986. The aye-aye (*Daubentonia madagascariensis*) found in the eastern rainforest of Madagascar. *Folia Primatol.* 46: 125-26.
- Godfrey, L., and M. Vuillaume-Randriamanantena. 1986. *Haplemur simus*: endangered lemur once widespread. *Primate Conservation.* 7: 92-6.
- Peters, W.H.C. 1870. Über *Propithecus deckenii*, eine neue Art von Halbaffen aus Madagaskar. *Mber. K. preuss. Akad. Wiss.*:421-24.
- Tattersall, I. 1982. *The Primates of Madagascar*. Columbia University Press, New York.
- Tattersall, I. 1986. Notes on the distribution and taxonomic status of some subspecies of *Propithecus* in Madagascar. *Folia Primatol.* 46: 51-63.

## Field Reporting of Variation Within Lemur Species

by David M. Meyers and Ian Tattersall

Chromatic variations have been documented for virtually all primate species. In many cases these chromatic variations are distributed geographically, and are conventionally summarized by the division of species into subspecies. However, our surveys of chromatic variation among local populations of Malagasy primates have led us to the conclusion that frequently those populations we recognize as subspecies are themselves substantially variable. Sometimes this variation in the Malagasy primates is organized on a spatial basis, however, we find ourselves continually frustrated by an inability to tie it to geography. This note is a plea to Madagascan field researchers to provide the information which can make such analysis possible. It is important that data of this kind be gathered quickly, since with each day that passes more of the forest of Madagascar is ravaged, and 'pristine' information becomes more difficult to obtain.

A couple of illustrations may help to emphasize this point. *Varecia variegata* and *Lemur fulvus* are among the diurnal Malagasy primates which vary most markedly in pelage coloration. Although large numbers of *Varecia* skins are preserved in museum collections, very few of these skins are provenienced, which renders interpretation of the chromatic variation, particularly evident in the black-and-white form, virtually impossible. Is this variation clinally distributed? It is impossible to tell. Alternatively, are there discrete geographical variants within this form? It is equally difficult to exclude this possibility.

The situation is as enigmatic with *Lemur fulvus*, which offers us a spectrum of variation that is also undecipherable on the basis of current information. Six subspecies of this lemur are generally recognized on Madagascar, but anyone familiar with the museum collections of specimens ascribed to this species well knows that there are many individuals which cannot be allocated to a particular subspecies on the basis of our present knowledge. The boundaries of virtually none of the recognized subspecies are known with any precision, either geographically or ecologically, and actual or suspected cases of natural hybridization are unprovable.

Out of all this uncertainty the question naturally arises: Does the accepted taxonomy adequately reflect the variations that actually exist within *Lemur fulvus*? The answer is almost certainly negative. If this is the case, then simply reporting observations of brown lemurs to subspecies (let alone simply to species, which is still sometimes done) may actually serve to perpetuate a myth.

None of this is to say that more complete information will always lead to a clear-cut picture, especially where subspecies, by their nature ephemeral, are involved. But good observational notes can provide important information about the history of the variations observed. For example, Meyers recently noted a complex geographical distribution of subspecific traits within the species *Lemur macaco*. The Andranomalaza River clearly divides the subspecies *L. m. macaco* from *L. m. flavifrons* downstream, where the river is wide. However, upstream, where the river narrows, we located a hybrid zone. Had smooth clinal variation been found surrounding the entire river system, the taxonomic status of *L. m. flavifrons* would have been questionable; as it is, the distribution observed speaks eloquently of the history of the two subspecific variants. Do such hybrid zones exist for *Lemur fulvus* and *Varecia variegata*? Only detailed surveys — and the careful reporting of observed variation — will tell.

Now that the pace of fieldwork in Madagascar is picking up, it is imperative that observational data not be lost simply because the observer believes that the reporting of a subspecies sighting at a particular locality will convey all pertinent biogeographical information about the subject. It is crucial that observers understand that even casual observations can fill important lacunae in our knowledge of the geographical distribution of chromic and external morphological variation in lemur species. To be of greatest use however, reports of such observations must include detailed descriptions of the variations noted as well as precise reporting of locality and habitat. A mechanism for reporting Malagasy primate observations of this kind for which there are no plans for direct publication is described in the accompanying article by Tattersall, "Distribution survey of the Malagasy lemurs: request for information and initial report."

David M. Meyers  
Department of Anthropology  
Duke University  
Durham, NC 27706  
U.S.A.

Ian Tattersall  
Department of Anthropology  
American Museum of Natural History  
New York, NY 10024  
U.S.A.

## Lemur Observations in the Lowland Rainforest of Anandrivola, Madagascar

by Chris J. Raxworthy and Peter J. Stephenson

The Anandrivola forest lies on the west coast of Antongil Bay in north-eastern Madagascar (Fig. 1). It forms part of the continuous belt of eastern rainforest and is bordered to the north by the River Rantabe and to the south by the Fananehana. Most of the forest is low altitude (below 800 m), but there has been such considerable deforestation along the coast that there is probably little forest below 300 m in this region. During the months of August and September 1986, as part of a University of London expedition, a research camp was established on the River Bekakazo (15°48' S, 49°36' E), a small tributary of the River Bandabe, about 8 km west of the coastal village of Maintimbato, which is near Rantabe. The forest surveyed was between 475-625 m and receives no formal protection. Although the primate survey was only a subsidiary part of the expedition's research, six species were recorded.

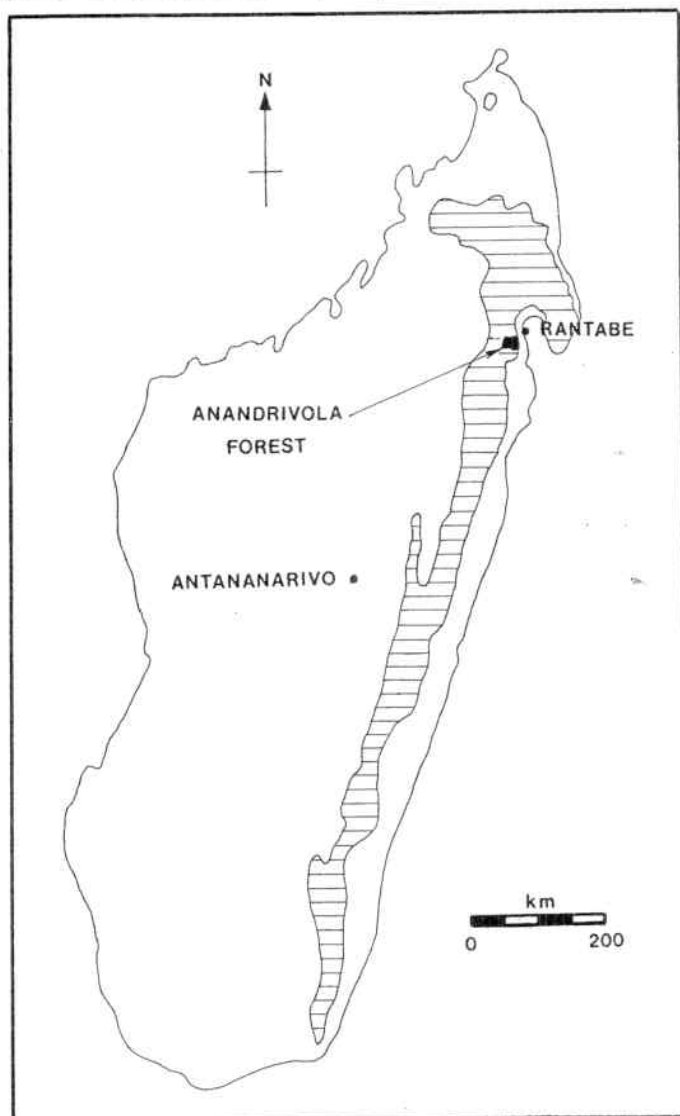


Fig. 1. Map of Madagascar showing the location of Anandrivola forest and the extent of the remaining primary eastern rainforest (map provided by authors).

Brown lemurs (*Lemur fulvus*) were seen frequently, although they were usually extremely timid and would quickly move off through the overstorey canopy on being disturbed, making observations and counts difficult.

However, at least seven individuals were seen in one troop, whilst on another occasion a lone animal was encountered. The coloration appeared to be variable, from light orange-brown to sooty grey for the body. The head was very dark brown, neck white, and tail generally a lighter brown than the body (especially on the tail tip). These specimens were probably *L. f. albifrons* based upon the distribution and pelage color. However, Tattersall (1982) records that the tail is usually darker than the dorsum for *albifrons*, which is in contrast to our observations. Mobbing was only experienced once, when a male broke away from a troop of three individuals and approached to within 10 m of the observer. This lemur alarm-called for about 5 min before finally breaking off. Although this species is meant to be diurnal, troops continued to be active on warm nights, when they were especially vocal in the forests surrounding camp.

Probably equally as common as the brown lemurs were the black and white ruffed lemurs (*Varecia variegata variegata*). On warm days this species was often heard in the forest. When approached, the troop would typically start alarm barking, sometimes continuing for more than 20 min. One troop was seen on three consecutive days in the same group of trees about an hour before dusk, and each time a mobbing response was initiated. By the fourth day, they had habituated sufficiently to remain silent. Some unhabituated troops remained still and silent when disturbed, and, undoubtedly, many groups were missed because of this. At Zahamena, during a six week survey in August-September 1985, no ruffed lemurs were either recorded or seen (Raxworthy, 1986), despite this species having been recorded for the reserve on another occasion (H. Simons, pers. comm.). Variation in vocalization response on being disturbed may be influenced in this species by both seasonal effects and by altitude. Most of the troops were comprised of two individuals, though on one occasion a troop of four was encountered.



Fig. 2. An indri seen in Bekakazo Valley in the Anandrivola Forest (photo by C.J. Raxworthy).

The indri (*Indri indri*; Fig. 2) was the only other diurnal primate recorded in Anandrivola. Despite its size, however, it proved to be much more elusive than the other diurnal species. Only six troop sightings were made during 42 days, although there were at least five troops in the forest immediately around the Bekakazo Valley. These troops were heard call

ing on all but the very wettest days. Probably most of the time the troops remained silent and still when disturbed, but a loud 'honk-honk' alarm call, which carried well over a kilometer, was provoked on several occasions. On one occasion, when a pair of indri were disturbed, both animals made the alarm call before moving away through the trees in different directions. One was followed and eventually stopped in the fork of a tree, about 15 m from the observer, and resumed the alarm call in intermittent bursts. Within just a few minutes, *Varecia variegata* calls were heard as well. Four individuals advanced and they took up positions in surrounding trees. They then persisted to make harsh calls, leaning forward out of the branches to bark at the observer. The indri appeared totally nonchalant about the ruffed lemurs, who likewise were only interested in the human intruder. This unusual phenomenon of *Varecia* coming to mob a stranger in response to an indri call has never before been recorded, as far as we know. The association certainly does not appear to be totally coincidental because the very same evening another observation was made of these two species together. Again a lone indri was seen, this time apparently settling down for the night in the fork of a tree. Very close by, a troop of three *Varecia* were also resting.

These sightings were some 200-300 m apart but may have involved the same individuals. Even so, this would appear to illustrate a potential interspecific relationship that could theoretically be beneficial to both species. Two very vocal lemurs could increase their chances of spotting, warning of, and possibly chasing away, intruders if their efforts were pooled. Only further observation will show whether this was a freak behavioral phenomenon within this particular group.

A further point to note is that the indris at Anandrivola were much darker in color than those further south at Perinet (Analamazoatra). Their bodies were all black except for the characteristic white rump patch and white on the heel of each foot and on the lower flanks, which diffused to grey towards the back. There was no white on the forearms, head or thighs. Faces and throats were marked by an almost circular patch of grey. This feature is not seen in the Perinet animals. Two individuals were photographed (from a troop of three) and both showed the above mentioned pelage coloration. Tattersall (1982) describes a general trend for indri to become darker towards the north, but no subspecies or race has yet been described.

Anandrivola lies close to the present northern distribution limit of the indri. Tattersall (1982) found that in the Andapa Basin, about 120 km further north of Anandrivola, indri is now at best exceedingly rare, and Petter *et al.* (1977) note that in the last few decades the northern part of its range has contracted sharply. The indri is absent from the Masoala Peninsula, on the other side of Antongil Bay (Tattersall, 1982).

Three nocturnal species of lemur were recorded. Torching at night revealed the presence of *Avahi laniger* and *Lepilemur mustelinus* on a number of occasions, and a dead specimen of *Cheirogaleus major* was discovered on the forest floor. This dwarf lemur was male and had a head-body length of 26 cm and a tail length of 27 cm, which more or less fits in with previous measurements for this animal. The tail was 5 cm in diameter at the base and showed no sign of fat storage. The woolly pelage was uniformly grey with a paler underside. Dark eye rings were apparent. It had a couple of wounds around the neck probably made by a carnivore. A guide saw a lone *Galidia elegans* in the region, and this small, nocturnal viverrid was most likely the culprit. The much larger *Cryptoprocta ferox*, which may also be in the region, would presumably have eaten more of its prey.

One *Avahi* was found dead in a trap set by the local people. This individual was a female with a head-body length of 28.3 cm and a tail length of 37.5 cm. A 1 kg pesola measured a body weight of 1 kg, which is probably reasonably accurate. This species is usually only seen at night by torchlight, so it is worth noting the coloration of this specimen. The pelage was dark brown on the back with grey underparts trimmed in white.

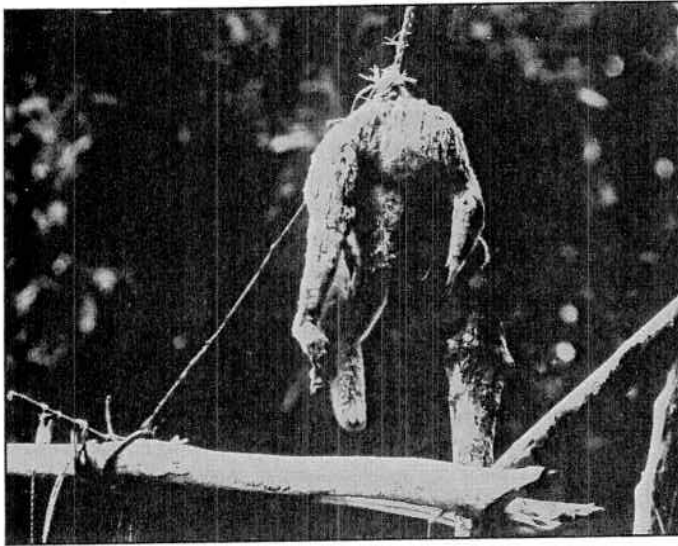


Fig. 3. A dead avahi (*Avahi laniger*) caught in a lemur trap (photo by C.J. Raxworthy).

The muzzle was black and the face brown, becoming increasingly reddish over the ears. The tail was also a red-brown color. Pale cream fur was present on the backs of the legs and over the eyebrows.

Perhaps rather surprisingly, no mouse lemurs (*Microcebus murinus*) were seen, despite many hours of torching. The local guides informed us that the aye-aye (*Daubentonia madagascariensis*) was not known to occur in the immediate area and no nests were seen. However, several nests were seen in secondary forest along the coastal road between Maroantsetra and Rantabe in 1985, and we were told by the local inhabitants that aye-ayes were common. We also failed to find *Propithecus diadema*, and it may prove eventually (once more work has been completed) that this species is extremely vulnerable to hunting. Less surprisingly, we did not see the extremely rare hairy-eared dwarf lemur (*Allocebus trichotis*), although the only records of this primate have been made in this region of the country.

A total of seven strip clearings were found in the forest surrounding the Bekakoza Valley, each clearing containing 2-3 lemur traps. The clearings had been cut as long thin strips up to 100 m long and 5-10 m wide. Across these areas were positioned aerial walkways made from saplings which acted as crossing points for those lemur species reluctant to descend to the forest floor. Fitted in the middle of the walkway was a noose under tension which tightened when a centrally placed trigger string was pushed to one side as the lemur walked through. These traps seem best suited to catching branch-running lemurs such as ruffed lemurs and brown lemurs, but the aforementioned dead *Avahi laniger* was seen caught in one of them (Fig. 3). No other species was found trapped. Like all indriids, the *Avahi* is adapted to vertical clinging and leaping, so these traps may be capable of catching many of the other rainforest lemurs as well. Similar traps have been recorded on the Masoala Peninsula where it was thought they caught lemurs by the throat (Constable *et al.*, 1985). However, the trapped lemur at Anandrivola had the noose tightened around its lower abdomen. Lemur traps seen at Zahamena Reserve in 1985 differed in that the walkways were oriented towards a central point in a clearing which had been baited with food.

Despite the hunting in this region, undoubtedly the main cause for concern is the continued loss of lowland rainforest. Judging from 1:50,000 maps of the area, the deforested coastal strip has been pushed up to 4 km inland over the last 20 years. What is even more worrying is that no existing mainland reserve protects the lowland forest of this region. The Masoala Reserve, created for just this purpose in 1927, was degazetted in 1964. Clearly there is an urgent need to complete a survey of this region

with the aim of identifying a possible new area of forest which could be maintained as a viable reserve for the future. The continued existence of some lemur species may depend on it.

Chris J. Raxworthy  
Biology Department  
Open University  
Walton Hall  
Milton Keynes MK7 6AA  
U.K.

Peter J. Stephenson  
Department of Zoology  
Royal Holloway & Bedford New College  
University of London  
Bakeham Lane  
Egham TW20 9TY  
U.K.

#### Acknowledgements

We received much assistance from the Direction des Eaux et Forêts, the Ministère de l'Enseignement Supérieur, the Ministère de la Recherche Scientifique et Technologique pour le Développement, and the International Advisory Group of Scientists. The following people also helped us considerably in Madagascar: D. Cemmick, N. Lindsay, M. Nicoll, N. Quansah, F. Rakotondraparany and H. Simons. The expedition was financed by grants from The Conservation Foundation, WWF, Royal Geographical Society (British Sugar Silver Spoon Award), University of London Union, and The Twenty-Seven Foundation.

#### Literature Cited

- Constable, I.D., R.A. Mittermeier, J.I. Pollock, J. Ratsirason, and H. Simons. 1985. Sightings of aye-ayes and red-ruffed lemurs on Nosy Mangabe and the Masoala Peninsula. *Primate Conservation* 5: 59-62.
- Petter, J.J., R. Albignac, and Y. Rumbler. 1977. *Mammifères Lemuriens (Primates Prosimiens)*. Faune de Madagascar 44: ORSTOM, Paris.
- Raxworthy, C.J. 1986. The lemurs of Zahamena Reserve. *Primate Conservation*, 7: 46-48.
- Tattersall, I. 1982. *The Primates of Madagascar*. Columbia Univ. Press, New York.

# Asia

## Hoolock Gibbons in Arunachal Pradesh, Northeast India

by R. P. Mukherjee, S. Chaudhuri and A. Murmu

In the past, northeastern India was well known for its abundance of wild animals, including non-human primates. Recently, however, the habitat and the wildlife have suffered from increasing pressures arising from hunting and changes in land use. Large tracts of undisturbed primary forests have been converted into agricultural lands or sites for other development projects and are now much disturbed by loggers, settlers, and farmers practicing shifting cultivation.

The hoolock gibbon (*Hylobates hoolock*) is still found in seven states of northeastern India. In recent years, Tilson (1979) and Mukherjee (1982, 1986) studied this species in Assam, Tripura and Manipur. Despite the variety and uncertain status of the primate fauna in Arunachal Pradesh, no intensive field study of any of the primates had been conducted in this state prior to the one we partially present in this report. Our study was initiated to ascertain the impact of habitat changes and to evaluate the abundance, distribution, and present status of the primates, particularly *Hylobates hoolock*. Gibbons inhabit the forests south of the Brahmaputra River and are known to occur in the forests of the Tirap, Lohit, and Dibong Valley districts of Arunachal Pradesh. This paper includes the findings of a census in Tirap District (Fig. 1).

### Ecology of the Study Area

The Tirap District of Arunachal Pradesh lies south of the Brahmaputra River (26°40'–27°40' N, 95°11'–97°10' E) and takes its name from the

Tirap River, which flows from the southwest to the northeast of the district before turning west in the plains of Assam. This mountainous district is carved out of the Sadiya and Lakhimpur frontier tracts and flanked by the Petkai Range, which marks the Burmese border. The district is about 6,907 km<sup>2</sup> and supports an almost exclusively rural human population of about 128,135 at a density near 18 ind/km<sup>2</sup>.

Elevation in Tirap District varies from about 200 m in the northwest to about 4,000 m over the mountains. At lower elevations and in the valleys, the climate is cool and highly humid. The cold season prevails from November to February, then thunderstorms rage frequently in the pre-monsoon months of March to May. The major part of the annual precipitation of 2,500–4,000 mm falls from June to October. However, the amount varies significantly according to elevation, decreasing at elevations above 1,500 m or so.

Temperatures vary from place to place, depending on a location's elevation and exposure to the sun. Winter sets in across the district towards the end of November and continues until about the beginning of March. The temperature during this period varies from 12–23 °C and can plummet to –5 °C. During the summer, from March to August, the mean minimum and maximum temperatures are about 23 °C and 31 °C, respectively. Humidity is high practically all year long.

The flora of Tirap District, as of other Arunachal Pradesh districts, is rich in variety and extent. Vegetation is, on the whole, of the tropical rainforest or wet evergreen types, depending on altitude and soil conditions. Less humid areas sustain a few grasslands. Primary forests are now limited to comparatively less accessible areas. In the existing forests, the predominant trees of the upper storey are *Dipterocarpus macrocarpus*, *Terminalia myriocarpa*, *Pterospermum acerifolium*, *Alnus nepalensis*, *Shorea assamica*, etc. The scattered, tall, second-tier trees are *Albiz-*

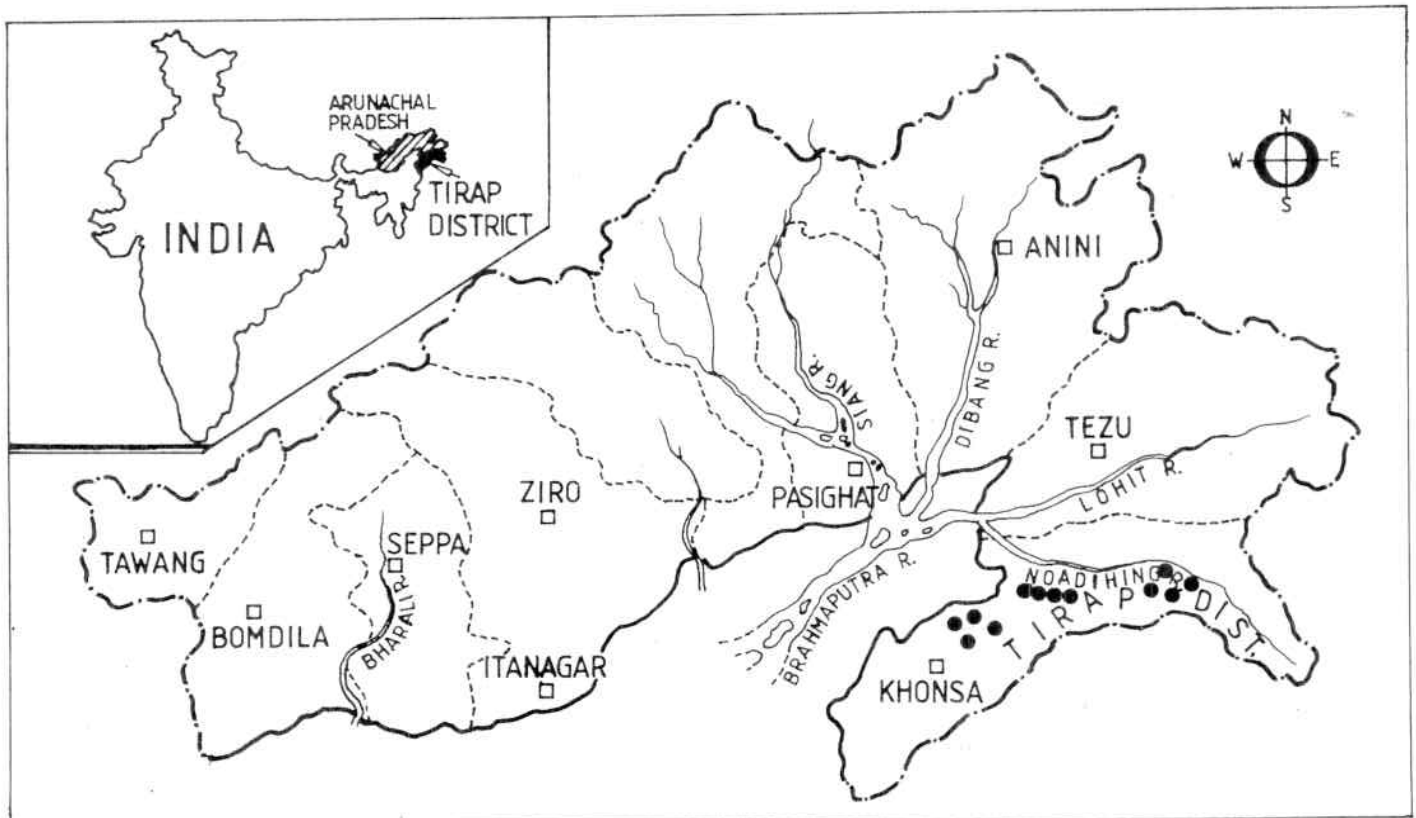


Fig. 1. Map showing the distribution of 12 hoolock gibbon groups in the study area of Tirap District (map provided by authors).

zia spp., *Talavma hodgsonii*, *Manglietia insignio*, *Schima wallichii*, *Gynocordia odorata*, *Castanopsis tribuloides*, *Livistonia speciosa*, *Wallichia disticha*, etc. Trees of the lower storey are *Arbroma anyusta*, *Autidesma bumius sprang*, *A. ghesembilla gaertu*, *Alanquim barbatum*, and *Bridelia cuneata gehram*. The climbers are chiefly of the families Menispermaceae, Annonaceae, Vitaceae, Connaraceae and Cucurbitaceae.

The study areas of Miao and Namdhapa National Park are located in the Changlang forest division, which lies between 95°0'-97°0' E and 27°0'-27°40' N and is formed mostly of moderate to precipitous hills intersected by numerous streams. This area falls within the geographic sub-tropics and enjoys a sub-tropical climate. The annual average temperature and rainfall vary from 15-31° C and 50-1,729 mm respectively.

The Deomali study area is located in the Deomali forest division, which lies along the Patkai Hill Range between 95°15'-95°38' E and 27°13' N. The forest tract is small, about 50 km long and 13 km wide, and cut by numerous rainfed streams and rivers. The prevailing climate is largely influenced by the terrain of rugged high hills, narrow valleys, and small, patchy depressions. The entire human population of the area depends on the forest and forest products for its livelihood.

### Methods

Our Tirap District primate surveys were conducted in the months of January, November and December 1986. Surveys were conducted in the east (in Miao and part of Namdhapa National Park) and in the west (in Deomali, Namsang and Khonsa). In this district, the hoolock gibbon mainly inhabits hill forest, a habitat with rugged terrain and dense vegetation which made field observation difficult.

Observations were made by walking along transects and by making point censuses from lookout points on rugged terrain. Loud calls of the hoolock gibbon were also used to estimate the number of groups in an area. These calls are audible up to a distance of 1-2 km, depending on terrain and wind direction. In the western part of the district, we conducted surveys by driving a jeep at slow speeds with at least three observers accompanying the driver.

Table 1. Characteristics of Hoolock Gibbon Groups in the Study Area

Area	Group composition				Group Size
	♂♂	♀♀	JJ	II	
Miao	1	1	-	1	3
	1	1	2	1	5
	1	1	3	-	5
	1	1	1	-	3
Namdhapa National Park	1	1	-	-	2
	1	1	1	1	4
	1	1	-	-	2
Deomali	1	1	-	1	3
	1	1	1	-	3
	1	1	1	-	3
	1	1	-	1	3
<b>Total</b>	12	12	8	5	38

### Results

Gibbon groups were present in almost all the mixed forests we surveyed, especially in the Miao and Namdhapa National Park forests, and less frequently towards Khonsa (Fig. 1). They appeared randomly distributed across forested hill tops, slopes, and valleys, but were usually

encountered well inside a forest. The species favors lofty, dense vegetation where 10-15 m trees form a dense canopy over lower secondary growth. Climbers, orchids, and bamboos also grew within some of these areas. In Namdhapa National Park, densely growing cane made it impossible for us to penetrate some areas.

Gibbons were observed feeding on leaves and fruits of plants like *Amoora wallichii*, *Spondias mangifera*, *Terminalia balerica*, *Eugenia praecox*, *E. jambolana*, *Mangifera sylvatica*, *Artocarpus lakoocha*, *A. integrifolia*, *A. etaplasa*, *A. chaplasa*, *Ficus* sp., *Anthocephalus cadamba*, *Baccaurea sapida*, *Bombex ceiba*, *Dillenia indica*, *Garcinia* sp., and orchids.

Over the course of the survey, the size and composition of 12 groups of hoolock gibbons were observed and the calls of almost an equal number of groups were recorded. Group size varied from 2-5 individuals (Table 1). We observed six groups of three individuals which typically included one adult male, one adult female and one offspring.

During the winter, the gibbons become active 60-90 min after dawn, and settle down for their nightly rest about 90-120 min before dusk. Before feeding in the morning, gibbons change their sleeping positions to warm themselves in the sun. Early in the morning, a group may start making a loud call, singing for either a short or long period. One day, a group sang 66 times from 0700-0800 h, 48 times from 0800-0900 h, 36 times from 0900-1000 h, and 24 times from 1000-1030 h, at which point they stopped singing. This indicates that calling decreases as morning temperatures rise.

During the morning, when gibbons spend most of their time feeding and singing, physical activity is relatively extensive. Gibbons frequently change their position, and their range of movement is greater than at any other time of the day. Members of a group tend to stay quite near each other while resting, but when active they usually disperse up to a distance of about 10 m from each other. Group members separate most while foraging, but infants clutch their mothers' bellies or at least remain close to them.

In areas of high gibbon density, each hoolock gibbon group occupies an area of about 2 km<sup>2</sup>. Home ranges of neighboring groups may partially overlap. On one occasion at Miao, two groups were observed close to each other on a hill top and not interacting. When disturbed by our presence, however, they moved down to the valley by different routes. Adult males usually led the group, but occasionally an older juvenile did so.

### Discussion

We have now surveyed three northeastern states: Tripura (1982), Manipur (1986), and, as presented here, the districts of Lohit and Tirap in Arunachal Pradesh. We believe gibbons have a wider distribution in Arunachal Pradesh than in other Indian states. We observed gibbons in almost all the forests in the study areas of Tirap District, whereas we had found the species confined to small pockets in Tripura and Manipur. Concurrently, the number of groups in each habitat in Tirap was higher than the number in corresponding habitats in Tripura and Manipur, where the forest is discontinuous and largely disrupted by shifting cultivation and logging, and where, especially in Manipur, the ape is hunted for food. Within the Tirap District study area, gibbons cover a wider distribution in greater numbers in Miao and Namdhapa National Park than they do in Deomali.

As for group size and composition, in Tirap two groups included five animals, and half of the groups included juveniles. In Tripura and Manipur, however, none of the groups had five members and many fewer included juveniles. The wide distribution and larger group size in Tirap may be attributable to a greater density or a more even dispersion of food and better sleeping sites. Perhaps because of the denser popula-

tion, gibbons in Tirap sing more frequently and for longer periods of time than groups in the other states.

R. P. Mukherjee  
S. Chaudhuri  
A. Murmu  
Zoological Survey of India  
M Block, New Alipore  
Calcutta 700 053  
INDIA

#### Literature Cited

Mukherjee, R.P. 1982. Survey of non-human primates of Tripura, India. *J. Zool. Soc. India* 34(1, 2): 70-81.

Mukherjee, R.P. 1986. The ecology of the hoolock gibbon, *Hylobates hoolock*, in Tripura, India. In: *Primate Ecology and Conservation*. Vol. 2. J.G. Else and P.C. Lee, eds. Cambridge University Press.

Tilson, R.I. 1979. Behaviour of hoolock gibbon (*Hylobates hoolock*) during different seasons in Assam, India. *J. Bombay Nat. Hist. Soc.* 76(1): 1-16.

## A Primate Survey in Southern Assam, India

by Anwaruddin Choudhury

The state of Assam, situated in eastern India, is still richly forested with evergreen rainforests in the east and south, and semi-evergreen and moist deciduous forests in the rest of the state. About 30,700 km<sup>2</sup>, or 39% of the total geographical area of Assam, are supposedly covered with forests, of which 17,300 km<sup>2</sup>, or 22%, are classified as Reserved Forest. However, because of illegal felling and encroachment, the actual forest cover is now much less, 25% according to the National Remote Sensing Agency. Although primates are well-known to be present, few field studies have been made to determine their status in the state.

In 1986, I began a study of the distribution and status of the primates in Assam. In this paper I will report on a March 1986 survey in the district of Cachar.

The study area is situated in southern Cachar (approximately 24°10' N - 24°28' N and 92°30' E - 92°37' E; Fig. 1) within the sub-division of Hailakandi, and includes sections of Innerline and Katakhal Reserved Forests. Much of the terrain is hilly, being the northern foothills of the Mizo (Lushai) Hills. Between the hill ridges which run north-south, and along the banks of the Dhaleswari River, are flat areas, locally called *thals*.

The climate of the area is tropical: the summer hot and wet, the winter generally cool and dry. The annual precipitation is 2,400-2,800 mm (NAO, 1977), with most of the rain falling in summer.

The vegetation is tropical rainforest with small patches of semi-evergreen forest containing some deciduous tree species. The dominant tree species include: *Ficus* spp., *Albizia lucinda*, *A. lebbek*, *A. procera*, *A. stipulata*, *Arctocarpus chaplasi*, *Palaquium polyanthum*, *Terminalia myriocarpa*, *Lagerstroemia flos-reginae*, *Emblia officinalis*, *Macaranga denticulata*, and *Dipterocarpus turbinatus*. Large patches of bamboo (mainly *Melocanna bambusoides* and *Teinostachyum dullo*) are also present.

Habitat destruction and hunting are threatening the local large mammals. In the study area, I encountered signs of sambar (*Cervus unicolor*), muntjac (*Muntiacus muntjak*), and wild pig (*Sus scrofa*). Tiger (*Panthera tigris*), leopard (*P. pardus*), and dhole or wild dog (*Cuon alpinus*) also occur, but are very rare. Signs of elephant were observed in the Katakhal Reserved Forest only.

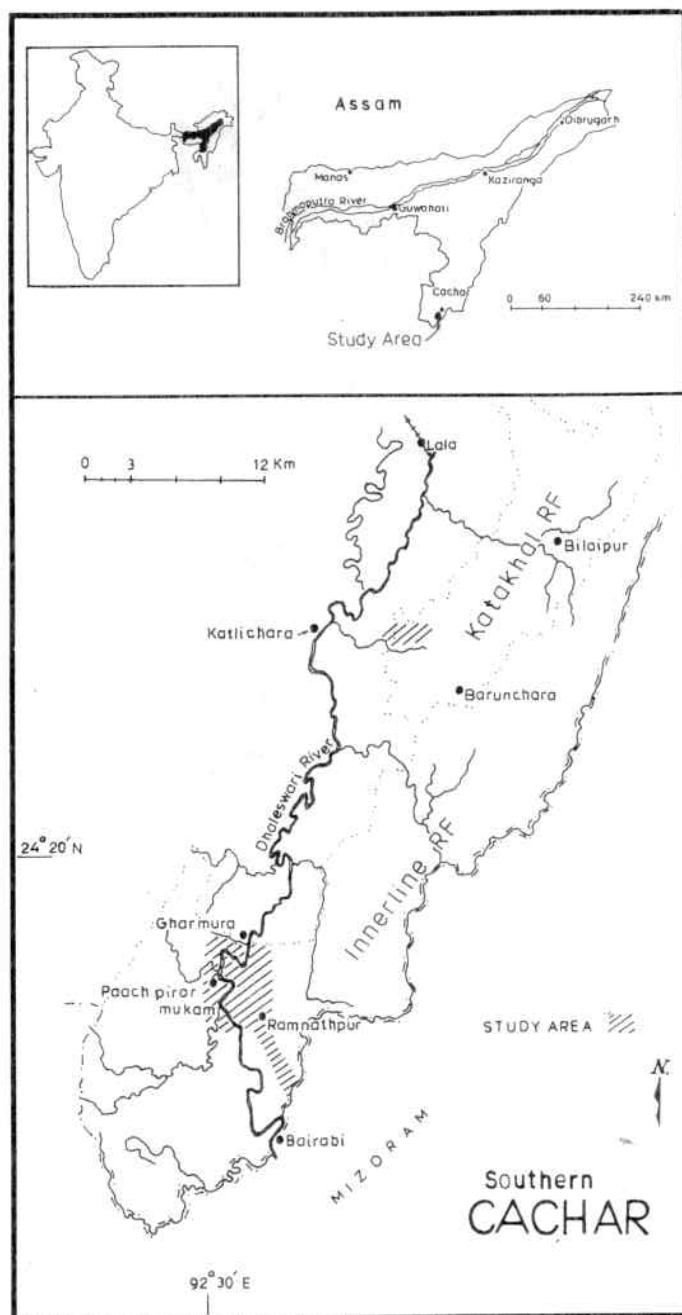


Fig. 1. The location of the study areas in southern Cachar in Assam. (map provided by author).

The following information was gathered on the local primate species:

**Rhesus monkey (*Macaca mulatta*):** This is one of the commonest and most abundant monkey species in the study area. Rhesus are usually spotted on the ground, and sometimes in the lower strata of the forest in small trees like *Zizyphus jujuba*. When scared they occasionally climb into the upper forest strata. During the survey I encountered three troops of rhesus six times. It is very difficult to estimate group size because the animals are persecuted by the local residents for regularly and seriously raiding crops and have learned to flee from people. Once I counted more than fifty individuals in a troop; reportedly, troops sometimes consist of over 100 individuals. The exact population in the study area is not known, but is at least 120-150 animals.

**Capped langur (*Presbytis pileata*; Fig. 2):** This is perhaps the commonest monkey of the study area. I encountered the following groups



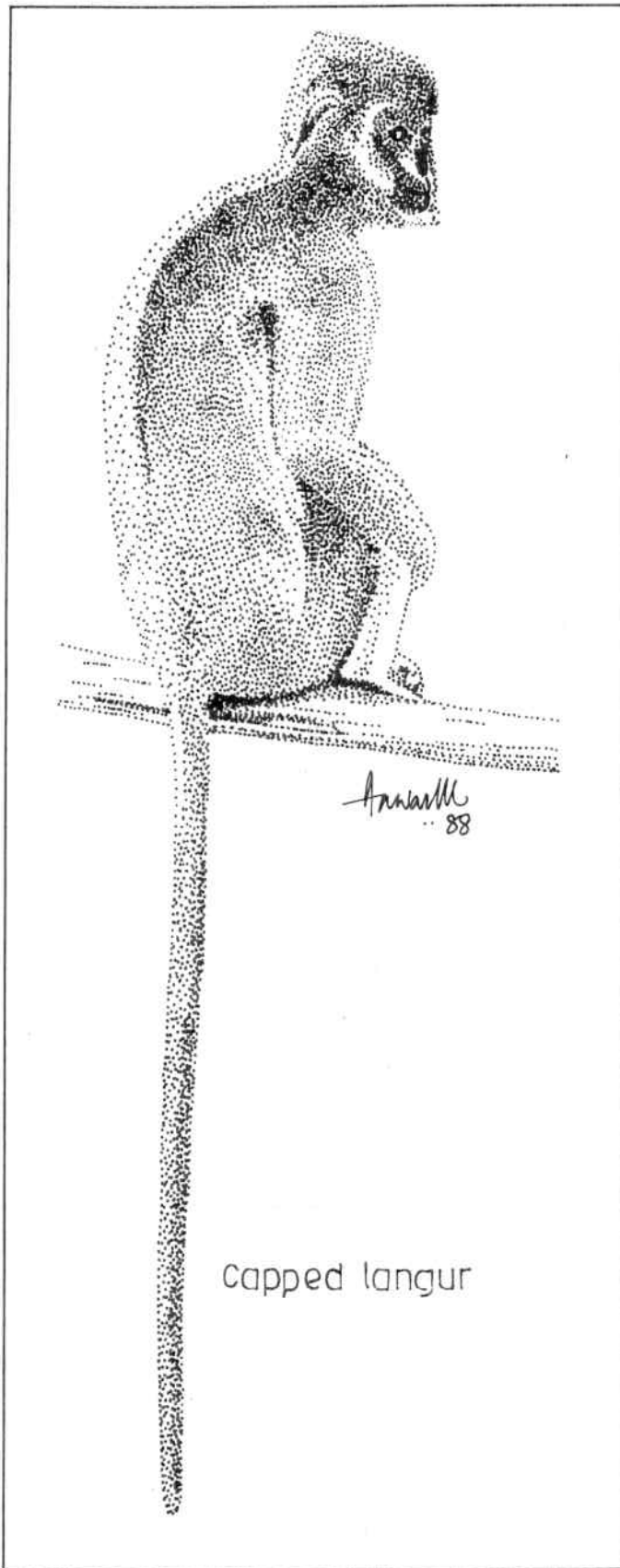


Fig. 2. Drawing of a capped langur (by the author).

of capped langurs nine times: a lone individual, three troops of 8-15 animals, and one troop of 21 animals (likely to be two separate troops feeding nearby) including four infants and five juveniles between Bada

Jamiranala and Dhaleswari River (Fig. 3). More than 60 animals are definitely present in the study area. This species was never observed on the ground and was reported to never raid crops.

**Phayre's leaf monkey (*Presbytis phayrei*):** Prior to this survey, this species was unknown in Assam. Roonwal and Mohnot (1977) do not recognize its existence anywhere in India; Mukherjee (1982) describes its distribution in India as restricted to Tripura. The local residents confuse it with the hoolock gibbon because of its color, and the capped langur because of its tail. I observed two troops and a lone individual on six occasions on a low hill in the study area. They moved on the ground and in the trees through forest and bamboo stands, and easily tolerated my presence. The two troops of five and nine individuals were divided by a distance of 0.5 km and may well be members of a single troop. The total population in the area is approximately 15 animals.

**Hoolock or white-browed gibbon (*Hylobates hoolock*):** I saw this elusive species only once and heard their calls on at least thirteen occasions. Many of the more distant calls may have been from groups outside the study area. Within the study area, I estimate there are only four groups. I encountered a group consisting of three individuals. A local guide reported observing a group consisting of four males and three females; McCann (1933) also observed a group this large. Tilson (1979), however, encountered a maximum of five in a group. The total population of gibbons in the study area could be anywhere between 12-17 animals.

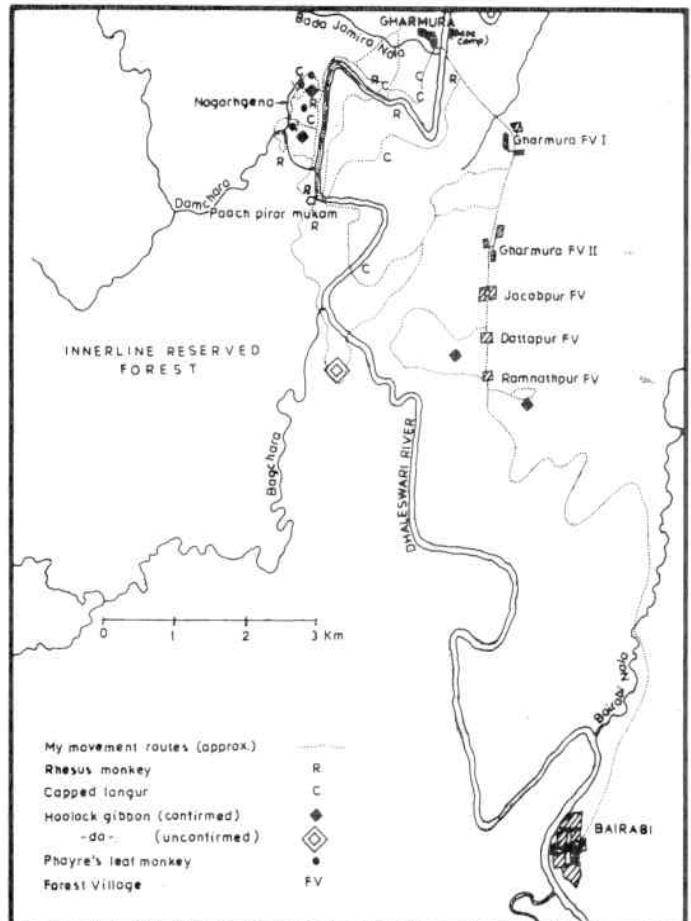


Fig. 3. The locations of different primate sightings in the main study area (map provided by author).

**Slow loris (*Nycticebus coucang*):** This nocturnal species is also difficult to observe. It is presumed to be in the area because of a 1974 record of an individual being captured in a *lechu* tree (*Nephelium* sp.) on the border of the Katakhal Reserved Forest.

**Pig-tailed macaque (*Macaca nemestrina*):** The study area is well within the distribution limits of this species. I received one unconfirmed report of a sighting in Ramnathpur. The description of a monkey with a blackish patch on its head, a lion-like mane, and a body color similar to a rhesus, suggests a pig-tailed macaque.

**Stump-tailed macaque (*Macaca arctoides*):** Although the study area is within the distributional range of this species, I did not observe it.

The study area is greatly disturbed. Most of the *thals* are inhabited by Bengali-speaking Moslems and Hindus. Mongoloid tribesmen like Reangs and Chakmas travel through the hills and practice slash-and-burn agriculture. The Forest Department also burns forest for plantation purposes. Settlers enter the forest daily to collect firewood and bamboo. Because of legal and illegal felling, the tall trees preferred by the hoolock gibbons have become scarce, especially in the Innerline RF on the west bank of the Dhaleswari River.

There are five "Forest Villages" inside the study area whose inhabitants are employed by the Forest Department. Most of these villages are expanding rapidly and, with additional unauthorized encroachments, pose a serious threat to the existing forest area.

There is no poaching of primates in the study area, but near the southern border Mizoram tribesmen regularly hunt all primates for food. They use modern firearms, available because a section of their tribe, the Mizo (Lushai) tribesmen, are now guerrillas. Few primates are left in the area.

The area now needs complete protection. The encroachers must be relocated or simply evicted. In 1983, the government of Assam was moved to declare about 1,800 km<sup>2</sup> of the area, including the present study zone, a wildlife sanctuary, but so far nothing practical has been done in this regard.

Anwaruddin Choudhury  
Officer of the Deputy Commissioner  
Sibsagar - 785 640  
Assam  
INDIA

#### Literature Cited

- Choudhury, A. 1986. Discovery of Phayre's leaf monkey in Assam. *The Sentinel*, Guwahati.
- Mukherjee, R.P. 1982. Phayre's leaf monkey (*Presbytis phayrei*) of Tripura. *J. Bombay Nat. Hist. Soc.* 79 (1): 47-56.
- National Atlas Organization. 1977. *Water Resources, Eastern India, National Atlas of India*. Government of India, Calcutta. plate 91.
- Roonwal, M.L. and S.M. Mohnot. 1977. *Primates of South Asia: Ecology, Sociobiology, and Behavior*. Harvard Univ. Press, Cambridge.
- Tilson, R.L. 1979. Behavior of the hoolock gibbon (*Hylobates hoolock*) during different seasons in Assam, India. *J. Bombay Nat. Hist. Soc.* 76: 1-16.

## Ecology of the Capped Langur and Phayre's Leaf Monkey in Bangladesh

by Craig B. Stanford

Despite the region's long history of human habitation and high human population density, the fauna of the Bay of Bengal, which includes Bangladesh, is poorly known. Previous surveys have documented the presence and status of a rich primate fauna (Green, 1978; Gittins and Akonda, 1982; Reza Khan and Ahsan, 1986), but no long-term systematic study has yet been conducted on any of the ten primate species present. This paper reports the results of a preliminary study of the ecology of two little-known colobine monkeys in reserve forest areas in north-central and northeastern Bangladesh: the capped langur (*Presbytis pileata*) and Phayre's leaf monkey (*Presbytis phayrei*).

Pocock (1928; 1939) reports *Presbytis pileata* from the east Bay of Bengal region in Assam and Burma, but both he and Fooden (1971) state *P. pileata* and *P. phayrei* to be strictly allopatric in this region. More recent surveys in the area by Reza Khan and Ahsan (1981) and Gittins and Akonda (1982) revealed a narrow zone of sympatry in the easternmost portion of the country. Gittins and Akonda estimated the total population of *P. phayrei* in Bangladesh at 1,300, and *P. pileata* at 30-35,000 (1982). *P. pileata*'s reported range is western Burma, the northeastern states of India, and central and eastern Bangladesh. Across this relatively small area it shows much variation in pelage coloration. The subspecies *P. pileata durga* of central and northern Bangladesh is brightly colored, with a flame orange venter and lateral facial tufts, and a slate gray dorsum, limbs and tail (Fig. 1). *Presbytis phayrei* has been considered wholly or partially conspecific with *Presbytis obscura* by some taxonomists (Brandon-Jones, 1984), but is here considered a distinct



Fig. 1. Adult male *Presbytis pileata* in Madhupur National Park (photo by C.B. Stanford).

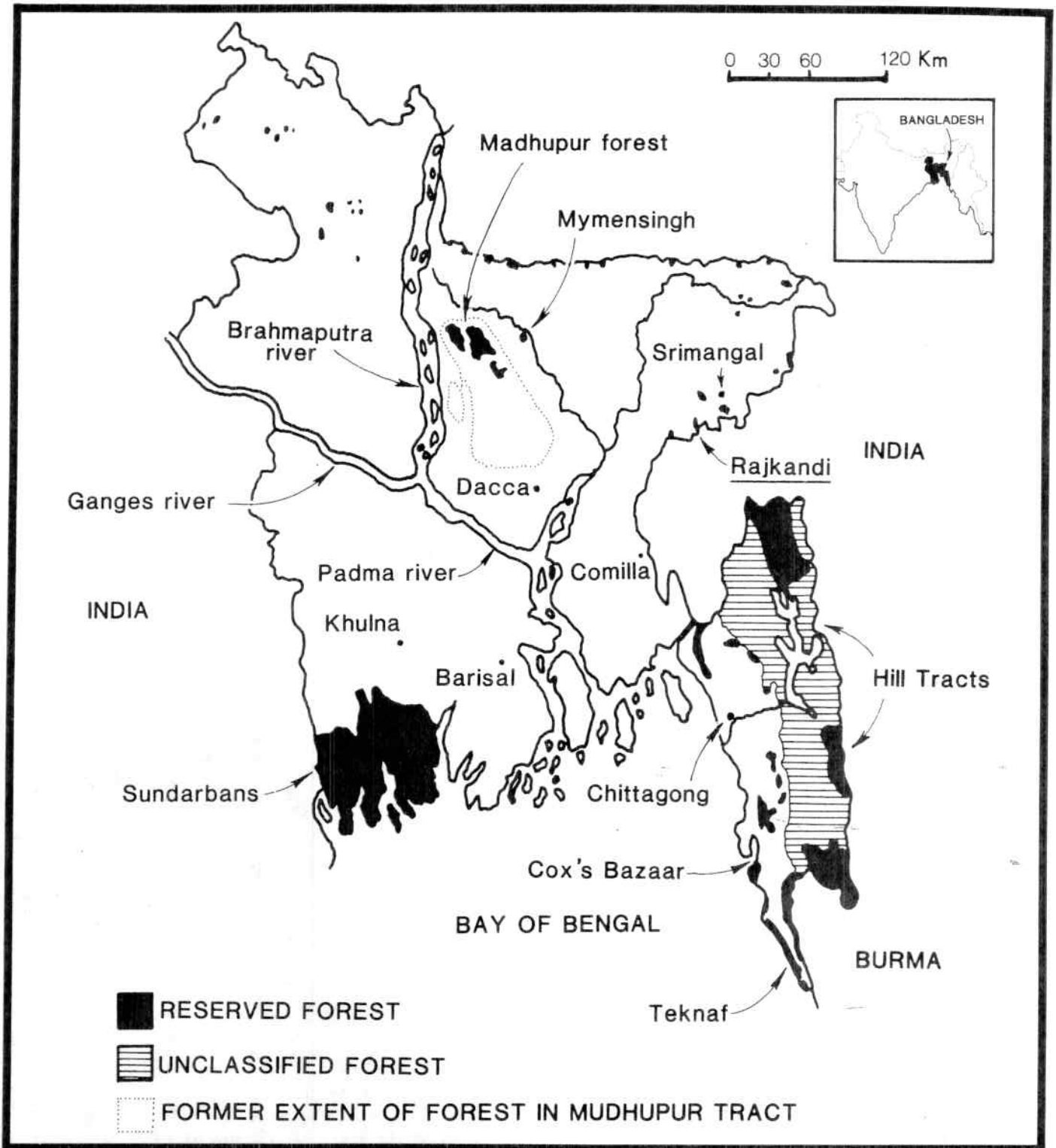


Fig. 2. Map of Bangladesh showing Madhupur National Park and Rajkandi Reserve Forest and the location of other forested areas (map by S.D. Nash based on author's original).

species. *P. phayrei* is distributed from easternmost Bangladesh and Assam through Burma and much of mainland Southeast Asia.

The study sites were Madhupur National Park in Tangail District and Rajkandi Reserve Forest in Sylhet District (Fig. 2, Table 1). Madhupur is moist deciduous forest dominated by sal (*Shorea robusta*) and is comprised of approximately 149 tree species (Khan, pers. comm.). Rajkandi is a semi-evergreen/bamboo forest habitat located in the wet zone of the eastern Bay of Bengal region, receiving up to 750 cm of precipitation per year.

Madhupur National Park (24°30' N, 90°10' E) was once part of an extensive area of sal deciduous forest of the central plain of Bangladesh, at a slight elevation never more than 15 m. The region consists of flat ridges running north-south which are bisected by long, narrow depressions (*bairds*), formerly swamp forests which have been largely given over to rice cultivation. Today the forest tract is broken into blocks of varying sizes. The national park lies at the northwestern corner of the region and has an area of approximately 100 km<sup>2</sup>; the northern section of the park has been almost completely cultivated by the local Garo tribal

population. The predominant cash crop in this area is pineapple. The southern portion of the park, approximately 40 km<sup>2</sup>, formed the study area. This area includes several settlements and patches of scrub forest but is still predominantly sal forest and is in good condition. Most of the trees are approximately 15 m high with emergents, especially *Albizia* spp., reaching 25 m. Although hunting of primates and other large mammals is intensive in some forest regions of Bangladesh, the Garo of Madhupur do not hunt or eat langurs. Rhesus macaques are abundant in the park and occasionally raid rice crops, leading to human harassment.

Table 1. Primates Present at Study Sites in Bangladesh

Madhupur National Park (moist deciduous forest)	Rajkandi Reserve Forest (semi-evergreen forest)
<i>Presbytis pileata</i>	<i>Presbytis pileata</i>
<i>Macaca mulatta</i>	<i>Presbytis phayrei</i>
<i>Nycticebus coucang</i> (?)	<i>Hylobates hoolock</i>
	<i>Macaca mulatta</i>
	<i>Macaca nemestrina</i>
	<i>Macaca assamensis</i> (?)
	<i>Nycticebus coucang</i>

Rajkandi Reserve Forest (24°15' N; 91°55' E) in Sylhet District is located near the border with the Indian state of Tripura. At least five species of primate are sympatric at this site, including the hoolock gibbon, the only living ape on which no long-term field research has been conducted. Remaining natural forest in this northeastern region has been reduced to isolated forest blocks varying from 10-70 km<sup>2</sup> in area; Rajkandi is a tract of approximately 50 km<sup>2</sup>. This is a high quality forest, probably the best of any wet forest in Bangladesh outside the Chittagong Hill Tracts, as is reflected in the diversity of primate and other mammalian species.

The specific goals of this field project were:

- (1) to obtain data on the ecology of these two species and on the two forest types in which they are found,
- (2) to establish a long-term study site and develop a project involving a Bangladeshi graduate student in a region where a rich primate fauna is represented,
- (3) to discuss with Bangladeshi scientists and government officials issues and concerns in Bangladesh involving wildlife conservation and management.

Approximately 200 hours were spent in contact with groups of *Presbytis pileata* at the two sites, and 100 hours of 5-min scan samples were collected at Madhupur National Park. At this site *P. pileata* is sympatric with *Macaca mulatta* and *Nycticebus coucang*. Groups were located at sunrise and followed throughout the day to obtain data on home range and day range. We collected samples of the plant species which the langurs ate and of the common plant species which the langurs avoided and identified these with the help of the Forest Department (Table 2). In addition, A.W. Akonda, Senior Research Officer in the Forest Department, S.M.A. Rashid of the Dept. of Zoology, Dhaka University, and I conducted a census of *P. pileata* groups in Madhupur with the help of a student team from Dhaka University.

Both the census data and my own periodic transect surveys indicate the population density of langurs in my 20 km<sup>2</sup> study area at Madhupur to be 13.2 ind/km<sup>2</sup>, considerably lower than previous estimates conducted by Gittins and Akonda (1982) and by Khan and Ahsan (1981). Although it was not possible to determine whether langur populations have declined in the past eight years in this area, habitat utilization data from this study indicate that langur groups spend a large amount of time feeding and resting in edge vegetation. This tendency may lead to overestimates of population density when transect sampling is done only along forest roads and larger trails.

Table 2. Plants Eaten by *Presbytis pileata* at Madhupur

Species	Family	Part Eaten
<i>Dillenia pentagyna</i>	Dilleniaceae	leaf tip, petiole
<i>Entada scandens</i>	Myrsinaceae	leaf
<i>Ficus benghalensis</i>	Artocarpaceae	leaf tip
<i>Garuga pinnata</i>	Burseraceae	petiole
<i>Hymenodictyon exelsum</i>	Rubiaceae	??
<i>Kydia calycina</i>	Malvaceae	leaf
<i>Lannea grandis</i>	Anacardiaceae	leaf
<i>Lagerstroemia parviflora</i>	Lythraceae	fruit, leaf
<i>Miliusa velutina</i>	Anonaceae	leaf
<i>Schleichera trijuga</i>	Sapindaceae	fruit, leaf
<i>Spondias mangifera</i>	Anacardiaceae	fruit
<i>Terminalia bellerica</i>	Combrataceae	??
<i>Adina cordifolia</i>	Rubiaceae	leaf
<i>Albizia procera</i>	Leguminosae	leaf, seeds
<i>Albizia</i> sp.	Leguminosae	leaf
<i>Butea frondosa</i>	Leguminosae	leaf

*P. pileata* was found to occur in groups averaging 7.0 individuals at Madhupur and 7.8 at Rajkandi, figures in agreement with previous surveys (Green, 1978; 1981). *P. phayrei* was found to occur in one-male groups averaging 8.8 individuals. Nearly all *P. pileata* groups were one-male (n=43 of 44 groups at Madhupur, n=12 of 12 groups at Rajkandi); 2 lone males were regularly observed at Madhupur. Although previous observers had reported *P. pileata* to be totally arboreal, animals at Madhupur, particularly adult males, were observed to travel, rest and feed on the ground occasionally in the course of most days. All activity and feeding data for the two species are presented in Table 2 and Figure 3.

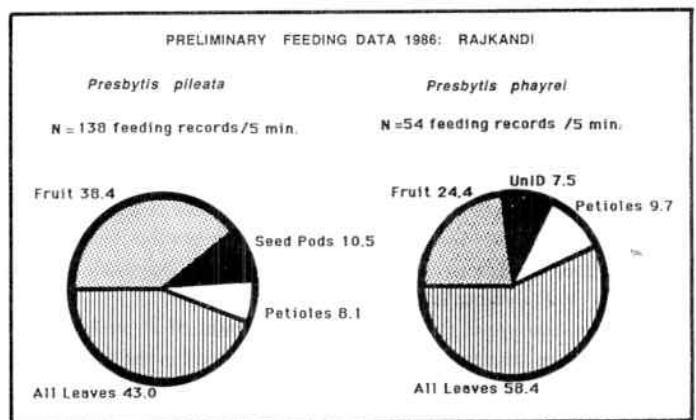


Fig. 3. Pie graphs summarizing preliminary feeding data collected for both langurs in Rajkandi Reserve Forest in 1986 (graphs provided by author).

Data were collected on the diet and feeding ecology of both species. At Madhupur *P. pileata* is largely folivorous, although during the third month of data collection a shift to feeding on the fruits of *Spondias mangifera* (Anacardiaceae) occurred and this fruit accounted for about one-third of the feeding observations. Limited observation at Rajkandi suggests that in the presence of *P. phayrei* the diet consists more heavily of fruit and seed pods of the emergent *Albizia procera*. *P. phayrei* is reported to be highly folivorous in Assam (Mukherjee, 1977), and *P. pileata* may shift its diet when sympatric with *P. phayrei*. During the early morning and late afternoon hours there was a strong tendency for *P. pileata* in both habitats to feed and rest in *Albizia* sp. trees near ( $\leq 5$  m from) the forest edge. A less pronounced tendency to do this was also noticed for *P. phayrei*.

Day range for *P. pileata* was noted in the course of following groups from sunrise to sunset for seven-day periods at each site. Day range at Madhupur is variable and often very limited, ranging from 50-500

m/day (mean = 224.5 m). Home range for the group at this time was approximately 50 ha. At Rajkandi the density of the forest and the lack of trails prevented detailed behavioral observation, but day range for *P. pileata* appeared to be significantly greater in semi-evergreen forest than in moist deciduous forest. One *P. phayrei* group we followed ranged up to about 1.0 km/day. Average home range for *P. phayrei* groups was 75 ha.

Almost two-thirds of the adult female *P. pileata* (n=72) at Madhupur had small infants. *P. pileata* is reported to possess a yellow neonatal coat color (Pocock, 1928), though there is some disagreement on this point, indicating probable geographic variation in natal coat color. During the time of this study no neonates of either species were present in either study area; all infants were estimated to be 6-8 months old, suggesting a birth peak in April-May, at the onset of the monsoon. Approximately 30% of the *P. phayrei* adult females at Rajkandi had infants (n=29), and one displayed the cream-to-yellow neonatal color that has been reported (Tilson, 1976; Pocock, 1982).

Behavioral observation of *P. pileata* at Madhupur is based on 100 hours of 5-min interval scan sampling. Because the local human population typically ignores the animals, the langurs at Madhupur are easily habituated and can be closely approached. Little intergroup aggression was observed, although *P. pileata* groups frequently moved into adjacent feeding trees and fed for extended periods. Group males typically assumed a 'vigilant' posture at the top of the group's feeding tree, spreading their hind legs against the notch of a tree trunk and conspicuously displaying a semierect penis. This behavior has also been reported for the species by Green (1981). Males did this most often in the general direction of the next nearest group, but often out of sight of the other group's resident male. Although this behavior could be an indication of territoriality in this species, in a total of 200 contact hours in both forest types no interaction beyond this display was observed between resident males of different groups. Generally, low levels of intragroup social interaction were recorded and group members, with the exception of mothers with infants, typically spent the bulk of the day dispersed within the crowns of adjacent feeding trees. Two social groups were observed to have 'peripheral' females that interacted little or not at all with the other members of the group and followed at a distance of 50 m or more. Neither female appeared to be sick or otherwise abnormal and neither carried an infant. Whether these are instances of female transfer in *P. pileata* is uncertain.

In semi-evergreen forest at Rajkandi, groups of *P. pileata* and *P. phayrei* were observed on three occasions to feed in the same or adjacent trees. No direct interaction was observed between the groups and there appeared to be no actual mixing of the species' groups.

*Macaca nemestrina* occurs at very low density in this forest (Stanford, unpubl.; Gittins and Akonda, 1982) and *M. mulatta* is common. *Hylobates hoolock* has been recorded to occur at Rajkandi in densities of 0.4 groups/km<sup>2</sup> (Khan and Ahsan, 1986) and is a potential competitor for plant foods, but only incidental observations were made of this species during the course of our pilot study.

Although tigers are extinct in most of Bangladesh outside the Sunderbans (where they are abundant), leopard occur at Rajkandi and are, along with a rich array of raptorial birds, possible predators on primates. Leopard have been considered rare in the Madhupur region for the past 15 years. Both crested serpent eagle (*Spilornis cheela*) and black eagle (*Ictinaetus malayensis*), however, are common in Madhupur National Park and are potential predators of young langurs.

In spite of a human population density averaging 1,000/km<sup>2</sup> and a forest cover estimated at no more than 4-5% of the 142,450 km<sup>2</sup> land surface, Bangladesh still contains a species-rich primate fauna. Conservation problems of different types exist and the subdivision of remaining forest tracts into ever smaller blocks bodes poorly for the future of all primate species. The continued occurrence of some species, for example a remnant popula-

tion of long-tailed macaques (*Macaca fascicularis*) on the Teknaf Peninsula near the southeastern Burmese border, is unlikely.

The forest in Madhupur National Park is rapidly being degraded and, if present rates continue, will not sustain viable populations of primates or other large vertebrates within a very few years. The park urgently needs a land-use study to examine the cultivation practices of both Bengali and Garo tribal settlers. Illegal logging and continuing encroachment for pineapple cultivation are the most imminent threats. Ironically, this park also holds the greatest present tourism value in the region, the months of December-March being a time when large numbers of Bangladeshis visit the area for picnics and wildlife observation. This forest tract thus holds the potential for development and management as a conservation center that could incorporate public education about environmental issues with preservation of the distinctive flora and fauna of tropical moist deciduous forest.

Rajkandi Reserve Forest and the other forest blocks remaining in Sylhet allow only an already very limited gene flow between animal populations and are without tourism value because of their more remote locations. The problem of deforestation here is due to clearcut logging practices, with natural forest being harvested and replaced with teak (*Tectona grandis*) and other commercially valuable tree species. No national conservation strategy exists for Bangladesh, and a forest and wildlife management plan for remaining natural forest is urgently recommended.

Craig B. Stanford  
Dept. of Anthropology  
University of California  
Berkeley, CA 94720  
U.S.A.

#### Acknowledgements

Fieldwork in Bangladesh was supported by predoctoral grants from the University of California and the Department of Anthropology, U.C. Berkeley. I am grateful to the Ministry of Agriculture, Peoples' Republic of Bangladesh, for permission to work in the forests, and to the Forest Department and the Chief Conservator of Forests, Dhaka, for their cooperation. A. Wahab Akonda, Senior Research Officer, Wildlife Section, provided invaluable aid in establishing study sites and meeting with officials in Bangladesh concerned with wildlife conservation. Thanks also go to Md. Ali Reza Khan, Alain Zoo and Aquarium, Abu Dhabi, and D. Chivers, University of Cambridge, for advice and support.

#### Literature Cited

- Brandon-Jones, D. 1984. The Colobus and Leaf-monkeys. In: *The Encyclopedia of Mammals*, D. MacDonald, ed. Facts on File Publications, New York.
- Gittins, S.P. and A.W. Akonda 1982. What survives in Bangladesh? *Oryx* 16: 275-81.
- Green, K. 1978. Primates of Bangladesh: a preliminary survey of population and habitat. *Biol. Conserv.* 13: 141-60.
- Green, K. 1981. Preliminary observations on the ecology and behavior of the capped langur, *Presbytis pileatus*, in the Madhupur forest of Bangladesh. *Internat. J. of Primat.* 2: 131-51.
- Pocock, R.I. 1928. The langurs, or leaf-monkeys, of British India. *J. Bombay Nat. Hist. Soc.* 32: 660-77.
- Pocock, R.I. 1939. *The Fauna of British India, including Ceylon and Burma*. Vol. 1. of *Mammalia*. Taylor and Francis, London.
- Reza Khan, M.A. and M.F. Ahsan 1981. The group structure, composition and age-sex relationship of primates in Bangladesh. *Proc. of Third National Zool. Conf.* 1981: 287-302.
- Tilson, R.L. 1976. Infant coloration and taxonomic affinity of the Mentawai Islands leaf monkey, *Presbytis potenziani*. *J. Mammal.* 57: 766-68.

## Status Report on Some Chinese Primates

by Bangjie Tan and Frank E. Poirier

Some of the following information compiled by B. Tan from newspaper and other reports in China was given to F.E. Poirier during a trip to China. Poirier has revised Tan's material for this report and provided additional material gathered during his own research in January and February of 1987. This information is an update of a previous article by Tan (see *Primate Conservation* 5:63-81).

There is both good and bad news concerning primate conservation in China. Despite limited financial support, local researchers are making efforts to assess the situation of China's primates. However, much of the basic information is still missing, and the status of many primate species is unknown or in dispute.

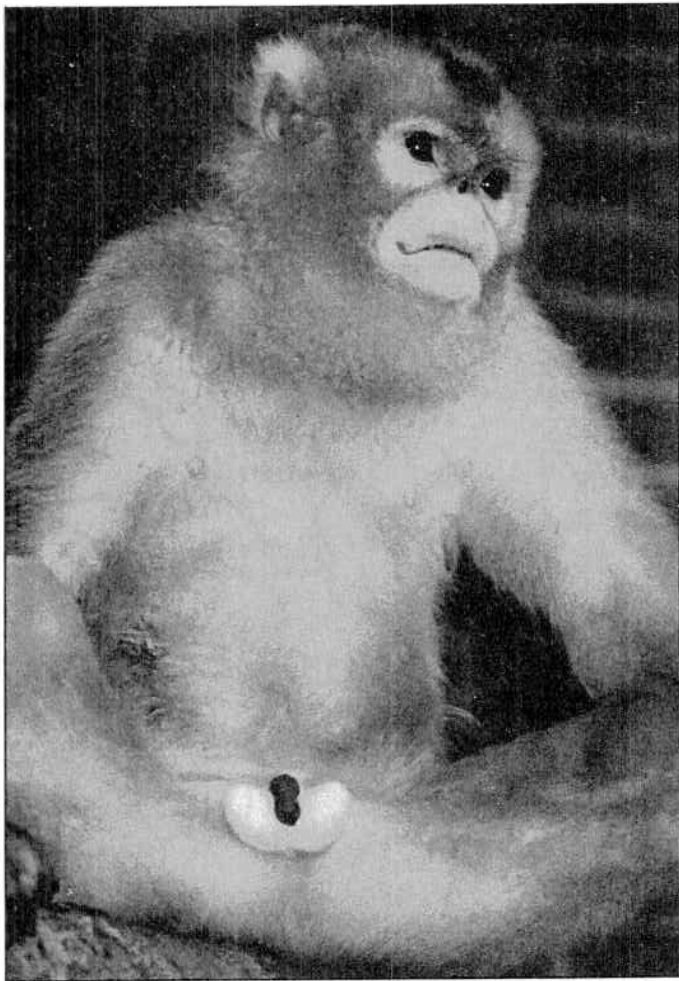


Fig. 1. Golden snub-nosed monkey (*Rhinopithecus roxellana*) (photo by R.A. Mittermeier).

### Snub-Nosed Monkey (*Rhinopithecus* or *Pygathrix*)

Perhaps the most famous of all of China's primates is the golden snub-nosed monkey (Fig. 1) which, like the gibbon, the slow loris (*Nycticebus*), and the Tonkin or Francois' langur (*Trachypithecus francoisi leucocephalus*) in Guangxi Province, is listed as one of the most endangered species. Both Tan (1985) and Poirier (1983a) have previously published reports on the golden snub-nosed monkey for the IUCN.

Recently, the Zhouzhi Nature Reserve for golden snub-nosed monkeys was created in Shaanxi Province (Fig. 4). The golden snub-nosed monkey in Shaanxi Province belongs to the species *R. roxellanae*. (It is debatable whether the Chinese snub-nosed monkey should be divided into three

species, i.e., *R. roxellanae*, *R. bieti*, and *R. brelichi*, or should be considered three subspecies of the species *R. roxellanae*, but we do not wish to address the matter here.) The Zhouzhi Nature Reserve has a total area of 1,000 km<sup>2</sup> and is located in the Qinling Mountains in the southern region of Zhouzhi County at 34°20' N and 108°20' E. The total number of resident snub-nosed monkeys is unknown.

A recent report states that research on *Rhinopithecus roxellanae* has been conducted for eight years in the Shennongjia Nature Reserve, Hubei Province. The population is estimated to be about 1,000 animals living in three large groups. A thousand animals is said to be double the 1982 population; however, Poirier reported in 1983a that observers then estimated a population of 1,000 animals in Shennongjia. This same figure was provided again in 1986.

Reports from Yunnan Province for the species *R. bieti*, probably the rarest of the snub-nosed monkeys, are mixed. Recently, perhaps as many as 30 *R. bieti* were sold in local markets, where their bones and skins fetch high prices (Figs. 2-3). On the other hand, it is reported that about 800 *R. bieti* are living in three groups in the Baima Xue Shan Nature Reserve in Deqin County. During a recent visit to the Kunming Institute of Zoology, Poirier learned that a pilot project on this population has begun. Although it was once thought that these animals were strictly arboreal, new information suggests that they spend a considerable amount of time on the ground. They live in dark conifer forests at altitudes near 4,000 m. Their main food source is the leaves and buds of a conifer — an unusual food for monkeys. It is reported that 1,000 snub-nosed monkeys inhabit Yunnan.



Fig. 2. A *Rhinopithecus roxellana* skin is offered for sale in Chengdu, Sichuan Province, in 1987 (photo by R.A. Mittermeier).

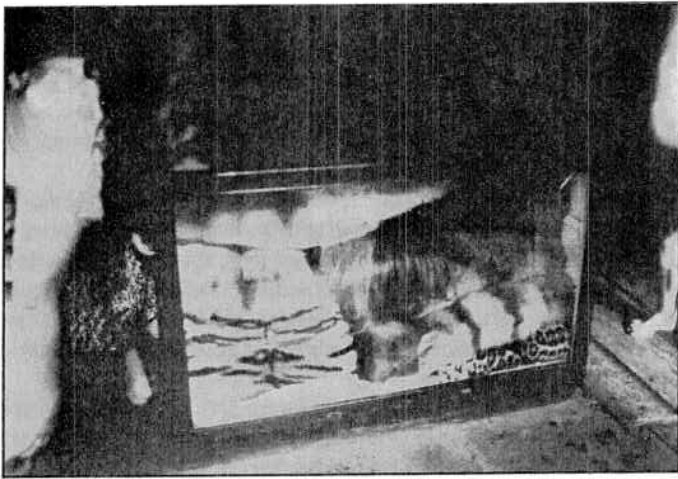


Fig. 3. *Rhinopithecus roxellana* skin for sale in Chengdu, Sichuan Province, China, in 1986. Also in the display case are tiger, leopard and red panda skins (photo by R.A. Mittermeier).

#### Rhesus Macaque, *Macaca mulatta*

The range of observable phenotypic differences between Indian and Chinese rhesus monkeys probably exceeds the range of differences that can be attributed to mere individual variation. In China itself, there are also noticeable physical differences between rhesus monkeys of separate, far-flung populations. It is not clear, however, if such differences warrant subspecific recognition. Chinese rhesus monkeys, at least those from Yunnan Province, have a somewhat thicker hair coat than their Indian counterparts. This may be an adaptation to differing climatic conditions. The hair on the top of the head is often longer than similar hair on Indian rhesus, and their coloring is also a somewhat darker gray or brown. Some female Chinese rhesus monkeys have much redder faces than those of their Indian counterparts. In their stockier build, Chinese rhesus resemble Japanese macaques more than do Indian rhesus.

The rhesus macaque is probably the most numerous and widespread of China's primates (Poirier, 1983b, 1985; Poirier and Hu, 1983; Tan, 1985). Newly found populations of rhesus monkeys have been reported and new reserves for the protection of rhesus monkeys are being established. For example, members of the Rhesus Monkey Resources Survey Team, organized by the Qinghai Wildlife Resources Control Commission, recently located twelve groups of rhesus monkeys, a total of more than 1,000 animals. Each group had an average of about 100 animals.

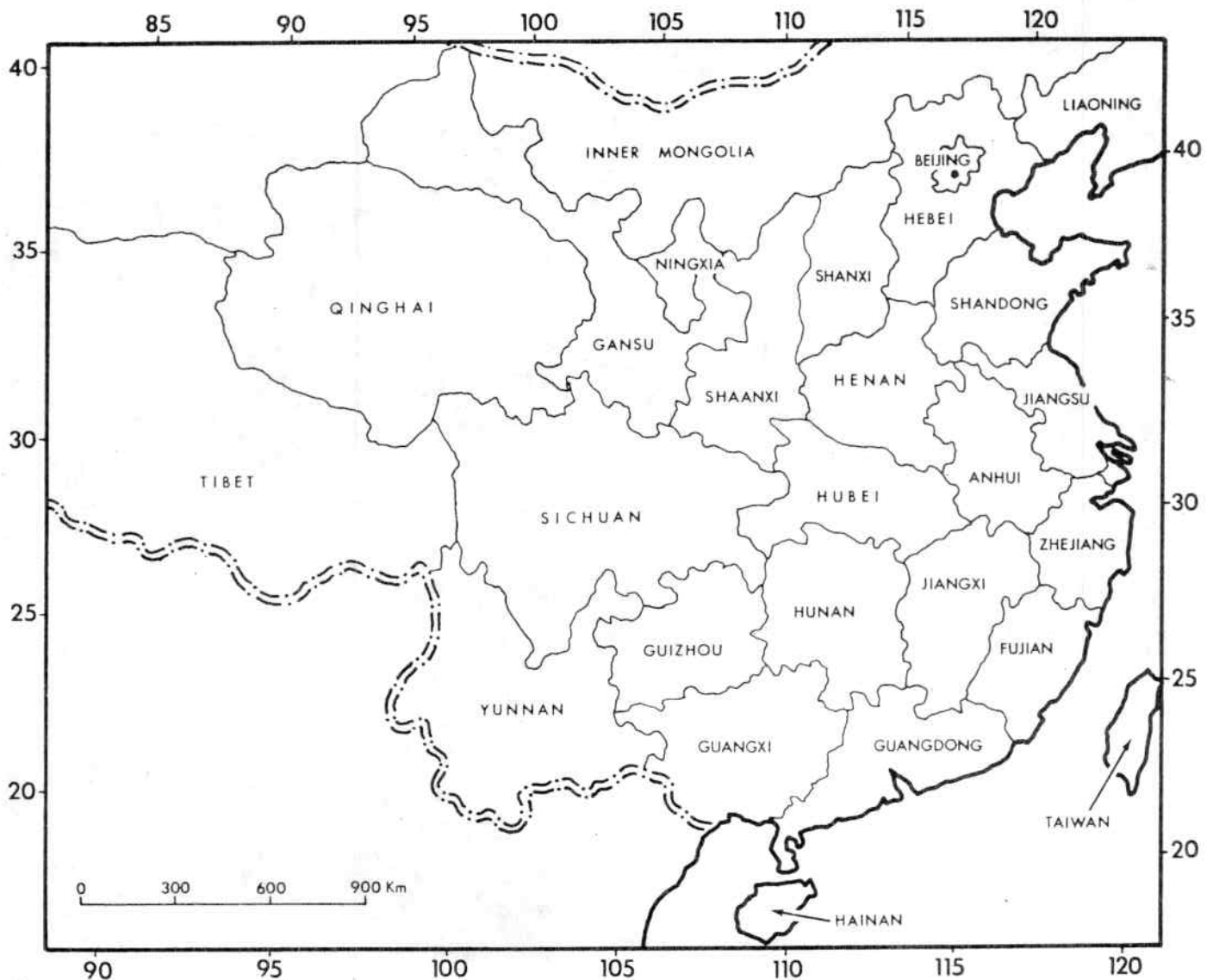


Fig. 4. The provinces of China (map by S.D. Nash).

These animals inhabit forests both in Yushu Prefecture and along the Marco River in Guolo Prefecture of the Tibetan Autonomous Region. Both prefectures are located in southern Qinghai at elevations of between 3,100 m and 4,400 m. These are relatively high elevations for rhesus macaque habitation.

A reserve of nearly 34,000 ha has been established for rhesus monkeys by the Henan Provincial Government in the Taihang Mountains in northern Henan Province. More than a dozen groups, totalling more than 1,000 animals, inhabit the mountains in Jiyuan, Xinyang, and Xiuyu Counties. All three counties are located in northern Henan, north of the Yellow River and close to the border of Shanxi Province. The macaques are apparently being provisioned.

The Nanwan Peninsula Rhesus Monkey Nature Reserve, located on Hainan Island and established in 1976, is now open to the public. More than 100 animals are in close contact with visitors. The total macaque population in the reserve is estimated to be over 800 animals.

About 40-60 langurs belonging to the species *P. francoisi* and about 120 rhesus monkeys have recently been located in a river valley district near Shuicheng County (26°50' N, 105° E) in western Guizhou Province. Unfortunately, at least 40 of these animals were killed by poachers.

A number of breeding colonies, almost exclusively for rhesus macaques, have been established in China in recent years. Some organizations, such as the Kunming Institute of Zoology, Kunming, Yunnan, and the National Laboratory Primate Centre of China in Xishuangbanna, Yunnan, are offering small numbers of rhesus macaques for sale. Some research and medical institutes housing monkeys are offering to trade animals in exchange for advanced training abroad for their skilled personnel. Apparently, only captive-bred animals can be sold abroad. If this rule is strictly applied, it will help to prevent trapping, and thus protect wild populations.

#### Slow Loris (*Nycticebus*)

The Beijing Zoo obtained a pair of pygmy (or lesser) slow lorises (*N. pygmaeus*, Bonhote) from Gejiu in southern Yunnan Province. This species was only discovered in China in 1986.

The slow loris (*N. coucang*) was recently found in Sichuan Province, far north of its previously described range in southern Yunnan and southern Guangxi Provinces. The Yunnan population is believed to number only a few hundred animals and the Guangxi population is almost extinct. It has been suggested that the slow loris of Sichuan Province may have been brought from Yunnan (Weizhi Ji, pers. comm.).

#### Gibbons (*Hylobates*)

Although once widely distributed in China, as evidenced by the fossil record and historical documents (Gao *et al.*, 1981), gibbons now have a very restricted range. Their widest distribution and species diversity seems to be in Yunnan Province. According to two researchers at the Kunming Institute of Zoology, S. Ma and Y. Wang (1986), four gibbon species inhabit Yunnan. The white-browed or hoolock gibbon (*H. hoolock*) is found in western Yunnan. There may be fewer than 100 of these animals, or, according to a survey conducted in 1983 and 1984 by D. Yang (pers. comm.), between 100 and 150 animals. The white-handed gibbon (*H. lar yunnanensis*), found in southwest Yunnan, is very rare. The total population is established at 30-40 individuals. The white-cheeked gibbon (*H. leucogenys*) is found in Xishuangbanna, in southwestern Yunnan. There may be about 100-120 of these animals, according to D. Yang.

Four subspecies of *H. concolor* inhabit southern China. The black-crested or black gibbon (*H. c. concolor*) is found in the south central part of Yunnan, primarily in the region of the Ailao Mountains. *H. c. jingdongensis* is found in the Jingdong Mountains of south central Yunnan. Although there is one estimate of more than 1,000 of these animals, other estimates from China suggest a figure of about 300 animals. *H. c.*

*hainanus* is found only on Hainan Island, where there is a total population of perhaps fewer than 100 animals. *H. c. fuvogaster* is limited to Cangyuan County in western Yunnan. Its numbers are unknown but must be very small given the limited distribution.

Bangjie Tan  
Chinese Association of  
Zoological Gardens  
Beijing Zoo  
Beijing  
P.R.C.

Frank E. Poirier  
Department of Anthropology  
Ohio State University  
Columbus, Ohio 43210  
U.S.A.

#### Literature Cited

- Gao, Y-T., H-R. Wen, and Y-H. He. 1981. The change in historical distribution of Chinese gibbons (*Hylobates*). *Zool. Research* 2: 1-8. In Chinese.
- Ma, S., and Y. Wang. 1986. The taxonomy and distribution of the gibbons in southern China and its adjacent region — with description of three new subspecies. *Zool. Research* 7:893. In Chinese with English summary.
- Poirier, F.E. 1983a. A status report on the golden monkeys (*Rhinopithecus roxellanae*) from the People's Republic of China. *IUCN/SSC Primate Specialist Group Newsletter* 3: 31-2.
- Poirier, F.E. 1983b. Chinese primates: Some real and one mythical?. *Explorers Journal* 61: 124-30.
- Poirier, F.E. 1985. *Macaca mulatta* in China. *National Geographic Research* 1: 298-99.
- Poirier, F.E., and H. Hu. 1983. *Macaca mulatta* and *Rhinopithecus* in China: Preliminary research results. *Curr. Anthropol.* 24: 387-88.
- Tan, B. 1985. The status of primates in China. *Primate Conservation*. 5:63-81.

## Status of the Yunnan Snub-nosed Monkey

by Qikun Zhao

It is generally acknowledged that the geographic range for the Yunnan snub-nosed monkey (*Rhinopithecus bieti*) is between the Yangtze and Mekong rivers and the latitudes 26°30' N and 31° N (Li *et al.*, 1981), an area of about 15,000 km<sup>2</sup>. However, only a narrow and incomplete forest belt remains, mostly in the mountains, between 3,400-4,200 m (Figs. 1-2), making the habitat available for the monkey probably less than 4,000 km<sup>2</sup>. This is one of the most restricted ranges of any living primate (Wolfheim, 1983).

Our recent work on the eastern slope of the Baima Snow Mountain shows that the monkeys tend to use the upper part of the forest belt in winter, mainly ranging between 3,800-4,100 m. The vegetation at this altitude consists of evergreen fir and azalea or oak. The species appears to be extremely specialized to this habitat type.

Only 10 specimens (7 adult males and 3 adult females) are available for body-weight estimates. The average weight is over 10 kg (Pan, pers. comm.) and, according to Wolfheim's classification (1983), the monkey is considered "absolutely large."

Observations of group size range from 23 (Li *et al.*, 1981) to about 300 (Wu and He, pers. comm.). Considering hunting pressure varies greatly from site to site, the small group size reported is probably abnormal. A multimale group is the basic social unit of *Rhinopithecus bieti* (Li *et al.*, 1981; We and He, pers. comm.).



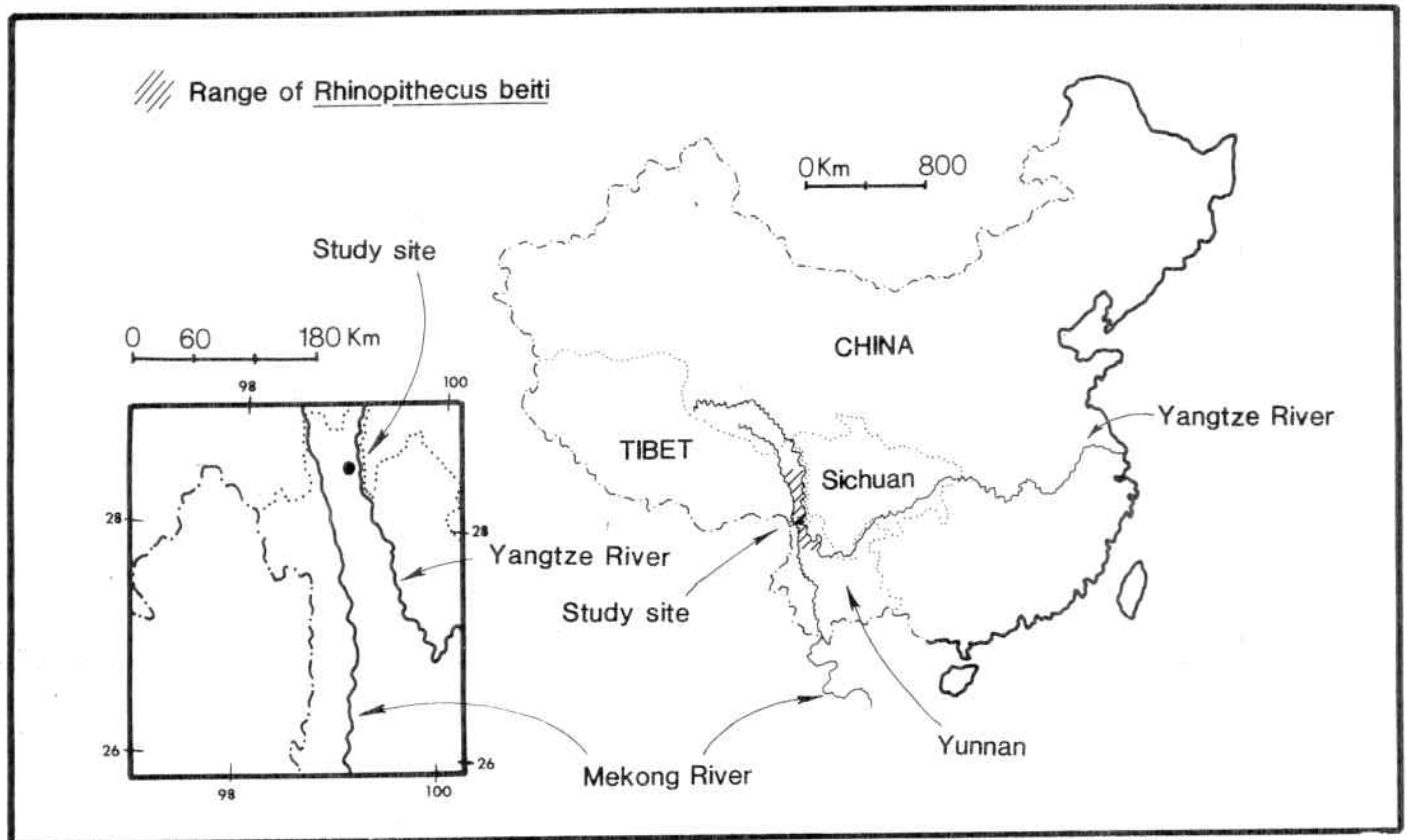


Fig. 1. Map showing the geographic range of *Rhinopithecus bieti* and the study site (map by S.D. Nash after original provided by author).

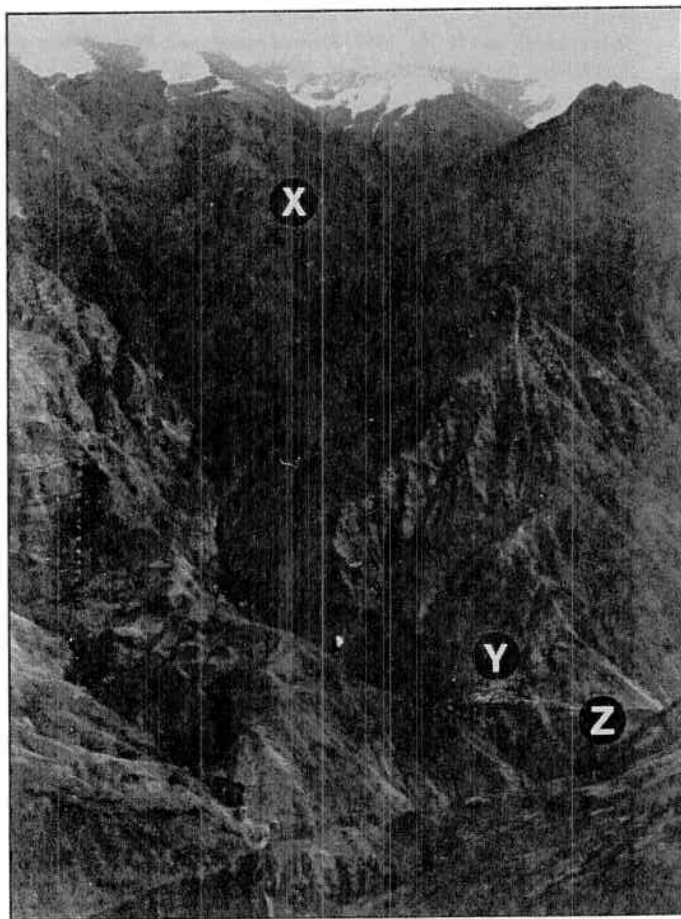


Fig. 2. A general view of the habitat of *Rhinopithecus bieti* (X indicates grazing land, Y a village, and Z a wheat field; photo by Q. Zhao).

Tibetans and several other minorities live within the monkey's range. Local family planning policy now allows one couple to have three children, and, with few exceptions, each couple does. This increase in the human population correlates with a decrease in the wild habitat, due to the inhabitants' dependence on both agriculture and stock raising. Grazing land is gradually degenerating into brambly or barren land and supplementary grassland is now necessary. The people usually enlarge grazing lands by burning the coniferous forest, lighting dried trees cut six months or a year previously. Burning is usually done during the dry season when the wind is strong, generally in November. Some attempts at burning are unsuccessful, and most burnt areas are expected to develop into grazing lands by summer (Fig. 3). The exploitation of long-standing timber has almost thoroughly deforested the hillsides near the roads. Soil erosion has been observed in the altered habitat neighboring the study site (Fig. 4).

Local people suffer from the water shortages due to this deforestation. In the middle of March, while making the four-day northward trek on horseback to our study site, along a 3,000 m trail on a bare hillside on the western bank of the upper Yangtze River, we saw and passed through several villages, each of which appeared to be near or within a small piece of green field surrounded by broad, barren slopes. It seemed that the shrunken forests were closer to the sky than to the villages. The villagers there used to be able to live on spring water which flowed down from the neighboring forest, but now they depend on water coming through the supply channels cut with government financial support 10 years ago, which are sometimes 10 km long, or even longer.

Hunting is a traditional activity in the region, but there are some cultural restrictions on hunting the Yunnan snub-nosed monkey: some natives believe that "the man who killed the monkey will be an animal in next life." During the Cultural Revolution, however, this species became prized by hunting teams from the people's communes. According to Bai (1987), at least 500 Yunnan snub-nosed monkeys were killed by only six hunters from one commune.

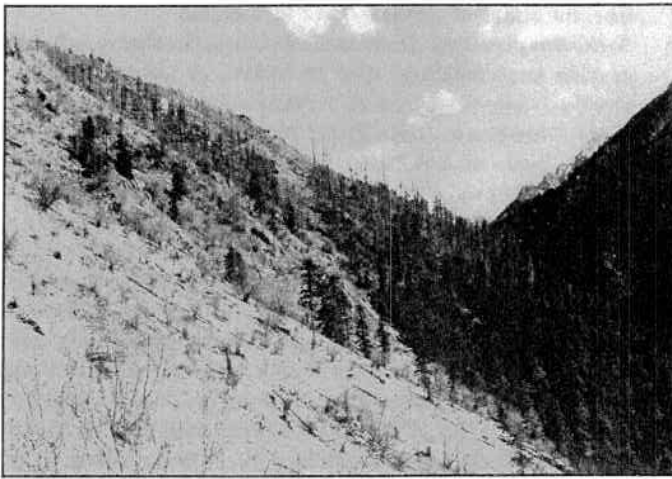


Fig. 3. An area meant to become summer grazing land (photo by Q. Zhao).

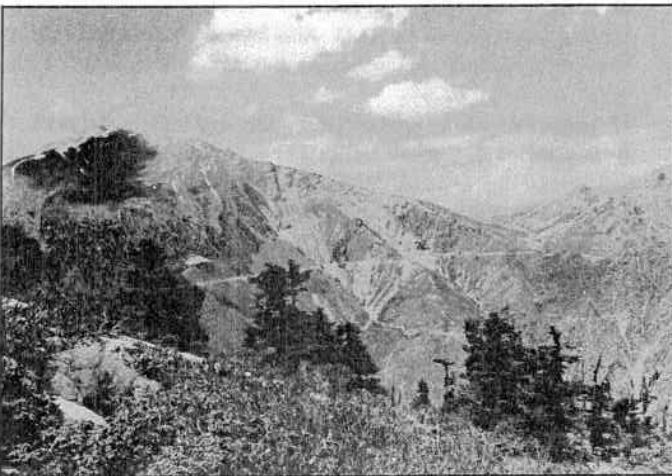


Fig. 4. Soil erosion in the altered habitat of the reserve (photo by Q. Zhao).

The destruction continues. In addition to the 139 animals killed in 1978-81 (Yan and Mu, 1981; cited by Tan, 1985), the bones of about 70 snub-nosed monkeys were sold at the market in the town of Deqin in 1985-86 (Bai, 1987). Although these reports are mainly anecdotal, they do indicate severe hunting pressure on the species. Ecologically uneducated locals continue to hunt indiscriminately for the animal's meat, skin, and bones, even within the reserve, where steel snares are commonly found. Nonhuman predation, of course, also occurs (Fig. 5).

Bai (1987) recorded various purchasing prices of Yunnan snub-nosed monkey products: in 1984, for the bone, Y5.6(US\$1.50)/kg, and for the skin, Y2/each; in 1986, for the bone, Y13/kg, and for the skin, Y7/each. During our study, we observed purchasing prices for these products advertised on the doors of state-operated commercial agencies. In addition, the managers of the town markets were busy with every aspect of wildlife trade except trade in protected-animal products.

Even worse, the editorial board of *Chinese Wildlife*, a journal published by the Chinese Wildlife Conservation Association, introduces *Rhinopithecus roxellanae* to its readers with "It has very high economic value. Its fur is fine, soft and long; a coat made from the fur is light and good for keeping warm. According to medical literature, both its bones and meat are [useful as] medicines" (*Chinese Wildlife*. No. 1(1987): 47).

Although we have no reliable data on the northern limit of the geographic range, or the species' population status, typical group com-

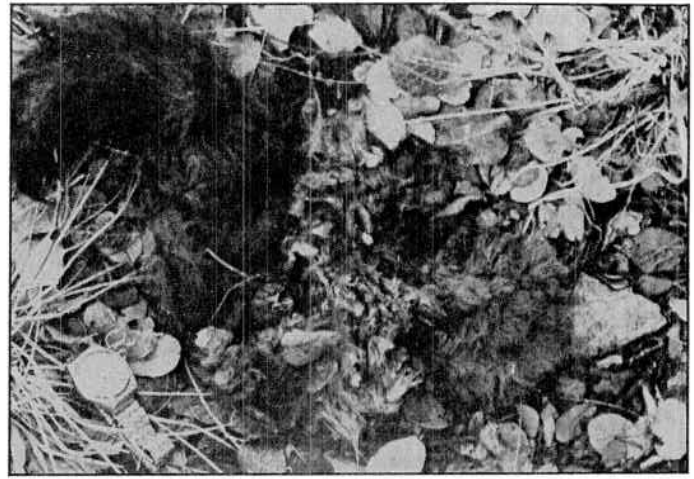


Fig. 5. A sign of nonhuman predation: the dried pelage and internal organs of a juvenile *Rhinopithecus bieti* (photo by Q. Zhao).

Table 1. Factors Influencing the Status of *Rhinopithecus bieti*

Ultimate Factors	Influence on Survivability	Proximate Factors	Influence on Survivability
Geographic range	very small	Habitat alteration	severe
	very negative		very negative
Habitat	specialist	Human predation	severe
	very negative		very negative
Body Size	large		negative
Social Structure	large groups		very positive
	multimale		very positive

position, reproductive fitness, feeding and ranging behaviors, based on the important ultimate and proximate factors in the present analysis (Table 1) and on Wolfheim's (1983) balance factors model, we recommend that the Yunnan snub-nosed monkey be rated as "severely threatened." The species is vulnerable because of its very small geographic range, highly specialized use of habitat, and large size, though its large group size and multimale social structure are advantageous to survival.

We believe the survival of the species can be ensured if adequate conservation action is taken immediately. The species, after all, has borne tremendous pressure from both hunting and habitat alteration in the past years. According to the model, if human damage ceases or is reduced enough for the species' natural resiliency to compensate, the balance can be recovered and the species will survive.

In addition to implementing effective strategies for the conservation of highly endangered primates (Mittermeier, 1986), successful wildlife conservation in China will have to include (1) the formulation of a comprehensive, national conception of conservation, so that national wildlife conservation regulations apply to all individuals and organizations, including state-operated commercial agents; (2) an increase in public awareness, probably starting in scientific circles; and (3) the assurance that national economic and technological programs pay special attention to the economic and social development of the rural areas necessary for wildlife conservation.

Qikun Zhao  
 Kunming Institute of Zoology  
 Academia Sinica  
 Kunming  
 Yunnan  
 P.R.C.

### Acknowledgments

This study was supported by a grant from The Science Fund of The Chinese Academy of Sciences to Y.-Z. Pen and colleagues.

### Literature Cited

- Bai, S.-C. 1987. A survey on poaching Yunnan snub-nosed monkeys. *Chinese Wildlife* 1: 13-15. In Chinese.
- Li, Z.-X. et al. 1981. The distribution and habitat of the Yunnan snub-nosed monkey. *Zool. Research* 2: 9-16. In Chinese.
- Mittermeier, R. A. 1986. Strategies for the conservation of highly endangered primates. In: *Primates: The Road to Self-Sustaining Populations*, K. Benirschke, ed. Springer-Verlag, New York, pp. 1013-22.
- Tan, B.-G. 1985. The status of primates in China. *Primate Conservation* 5: 63-81.
- Wolfheim, J.H. 1983. *Primates of the World*. Univ. of Washington Press, Seattle.

## Notes on the Current Status and Conservation of Primates in Vietnam

by Radoslaw Ratajszczak

The fauna of the People's Republic of Vietnam is rich in primates. Sixteen species are known from Vietnam, two of which, *Trachypithecus francoisi* and *Hylobates concolor*, are represented by several distinct forms of as yet uncertain taxonomic classification. Due to long periods of political instability and wars in the region, the status of primates in Vietnam remains largely unknown. This summary is based on data obtained from staff at the University of Hanoi, the Forestry Research Institute, the Departments of Nature Protection (Ministry of Forestry), and National Parks, and from the author's own observations.

### Major Threats to Survival

The primary cause of wildlife destruction in Vietnam is continuous and uncontrolled human population growth. In 1979, the population was estimated at 52.75 million, by 1986 it had reached 60.9 million. The current rate of population growth is approximately 2.4%. In recent years, there has been a strong correlation between population growth and deforestation rates. Satellite images suggest that forested areas cover 21% of the country. However, since a significant part of this forested area is secondary shrub or wasteland, the forests actually available for primates, in particular gibbons and langurs, cover a much smaller percentage of the land. With ever increasing speed, forests are being converted to fields. Vietnam loses about 200,000 ha of forest yearly. Deforestation has been most severe in the northern and central provinces, where fragmentation of the forests has been so great that the remaining forested patches are too small to support viable populations of primates. Furthermore, this fragmentation prevents gene pool exchanges between neighboring primate populations.

A second significant threat is poaching. Nearly all species are considered edible, with the exception of *Nycticebus pygmaeus*, *N. coucang* and *N. nemaeus*, which are considered not very tasty in some areas. There are no 'sacred' species. Poaching exists as an important means of securing animal protein to a larger degree in the north than in the south, and the large number of firearms and crossbows in private ownership makes control nearly impossible. In addition, because tiger bones are now unavailable, monkey bones have become highly prized for making medicines. Poaching is also encouraged by government institutions' continued export of macaques for biomedical research and by the extensive primate pet trade, in which the most commonly available species are lorises, macaques, and gibbons.

### Current Status of Primate Taxa in Vietnam

*Nycticebus pygmaeus*: Distributed throughout the country and still found in quite large numbers. Able to survive in secondary forests and shrubland. Survives even in Ba Vi National Park, only about 50 km from Hanoi. Often kept as a domestic pet. Nearly always available in the Hanoi market. Eyes sometimes used as a medicine. Included in Appendix II of Endangered and Rare Species of Vietnamese Fauna.

*N. coucang*: Distribution and situation similar to *N. pygmaeus*. Lives sympatrically with *N. pygmaeus* in most localities and, therefore, must be considered a valid species. According to local sources is always found in smaller numbers than *N. pygmaeus*. Also included in Appendix II.

*Macaca mulatta*: Widespread species, probably still the most numerous of all primates in Vietnam. Most popular animal to export for biomedical research; the total captured decreases every year due to overcollecting. A population of some 600 animals is being established on an island in the Gulf of Tonkin. Not included on the Protected Animals List.

*M. arctoides*: Distributed in the north only. Second place in macaque exports. Under strong hunting pressure. Not included on the Protected Animals List.

*M. fascicularis*: Two subspecies, *M. f. valida* and *M. f. condorensis*, are distributed only in the south. Also hunted for meat and captured for biomedical research, but in smaller numbers. Not included on the Protected Animals List.

*M. nemestrina*: Very sparse distribution, and only in the south. Occasionally captured. One offered for sale as far north as Hanoi. Considered endangered and included in Appendix II of Vietnamese list.

*M. assamensis*: Very rare and distributed only in small areas along the Laotian and possibly Chinese borders. Included in Appendix II of Vietnamese list.

*Rhinopithecus avunculus*: Nearly nothing has been added to our knowledge of this species since its discovery. It was briefly observed in the wild by a team of Vietnamese zoologists in 1969, at which time it was still numerous in the Ma Tuyen Province. Was observed to eat leaves of *Ficus* sp. Still survives with certainty in Ba Be National Park, an area of only 5,000 ha where the primate population must be low. No surveys in the field since 1969. Status unknown, but all local informants agree that it is endangered. Included in Appendix I.

*Pygathrix nemaeus*: This species, traditionally regarded as the most threatened, may in fact be more numerous and less endangered than many other species. Forest cover within its range is still relatively great. Said to be common in Nam Cat Tien (35,000 ha), Yok Don (40,000 ha), and in Mon Ray (45,000 ha) National Parks, *P. nemaeus* is rarely hunted. The local population considers its meat unpalatable, even inedible, due to the high concentration of toxic substances absorbed with its leafy diet. The animals in Nam Cat Tien are easily observed; when approached they come down to low branches to inspect the intruder. Capture for pet trade is unknown, and the species seldom appears on the Saigon market. The only serious potential threat is deforestation. Fortunately, most *Pygathrix* inhabit areas of large, unfragmented forests, some exceeding 100,000 ha. Included in Appendix II of Vietnamese list.

*P. nigripes*: This species known from at least eight localities, three of these being sympatric with *P. nemaeus*, so it must be a valid species. Unfortunately, field zoologists have not differentiated this species from *P. nemaeus* (Lippold, 1977), and populations recorded in areas close to the Kampuchean border, especially in Bu Gia Map and Tai Bai Cat Tien National Parks, may include *P. nigripes*. Probably all remarks mentioned under *P. nemaeus* could be applied to *P. nigripes*. The population of *P. nigripes*, however, is probably lower. Not included on the Endangered Species List.

*Trachypithecus phayrei*: Little evidence can be found for the species' continued presence in Vietnam. Said to occur in central Vietnam only. Museum examples are scarce, and no reliable evidence exists from recent sightings by local zoologists. The Hanoi Zoo currently keeps one

adult female, *T. phayrei*, acquired two years ago as a young animal from a local trapper. The species is listed as occurring in Cuc Phuong National Park, but local poachers don't know of it and the author failed to find any evidence of its presence in that area, except for two ancient stuffed animals in a local museum. This species should be considered seriously threatened in Vietnam. Its distribution, although covering a vast area, is still poorly known, and the population may be quite low. Chiry Mechvichai, Director of the Bangkok Zoo, has been unable to find any individuals of this species in Thailand for at least ten years. Not included on the Endangered Species List.

***Trachypithecus francoisi*:** A species showing considerable polymorphism, being represented by seven distinctive forms. No intermediate examples known from museum collections, but in general museum materials are scarce. Recent fieldwork done by Chinese zoologists revealed *T. f. francoisi* and *T. f. leucocephalus* living sympatrically without interbreeding. Therefore, the following forms may be treated as separate biological entities, possibly at the species level:

***T. f. francoisi*:** Nothing known about taxonomic distribution or numbers in Vietnam. Not represented in Academy of Science Museum collection. Included in Appendix II.

***T. f. hatinhensis*:** Recently described form from the same locality as *T. caudalis caudalis* and *H. c. sihi*. Nothing further can be added to our knowledge due to the suffering caused by the herbicide spraying of Ha Tinh and Ninh Binh Provinces during the war; the population must be extremely small. Not included on the Protected Animals List.

***T. f. poliocephalus*:** Almost certainly extinct on the mainland due to lack of available habitats. On Cat Ba Island, where it is confined to only one third of the total national park area (about 10,000 ha), the total population is unlikely to exceed 100 animals. Poaching and deforestation remain the most important threats to its survival. Unconfirmed report of this form occurring on Kai Chien Island. Included in Appendix I.

***T. f. delacouri*** (Figs. 1-2): This strikingly beautiful monkey was in the past more widely distributed in Vietnam than at present. Previously its distribution covered at least four provinces (Thanh Noa, Ninh Binh, Hoa Binh and Thanh Hoa). Most areas in these provinces are now deforested and hunting pressure is great. The only place where it is protected to some degree is in Cuc Phuong National Park. The author was able to locate a small group of three animals during his stay there. Two other monkeys from that group had been shot by a poacher in 1987. Total population does not exceed 100 and these may be the last surviving individuals. Unconfirmed reports mention this species occurring to the north and south of Cuc Phong National Park, and it is possible that its original range also covered parts of what is today Laos. Thus a part of its distribution may be relatively safe, though this is not supported by scientific evidence. Included in Appendix II.

***T. f. ssp.*:** A still undescribed all-black form from the northwest part of the country, known only from one skin collected by the Kelley-Roosevelt expedition in the 1930s. Vu Van Dung, a zoologist from the Ministry of Forestry, said that he saw a group of totally black monkeys in that area in 1972. Not included in the Endangered Species List.

***Hylobates lar*:** Vietnamese scientists list this species as occurring in that country, but they may be confusing it with *H. pileatus*. The only recent evidence I could find was a young male acquired from Vietnam in 1987 by the Budapest Zoo. Included in Appendix I.

***H. pileatus*:** Not definitely known from any locality in Vietnam, but distributed in Kampuchea in localities only a few miles from the Vietnamese border. Highly possible that a small part of its range lies within Vietnam.



Fig. 1. Drawing of a Delacour's langur (*Trachypithecus francoisi delacouri*) by R. Wirth.

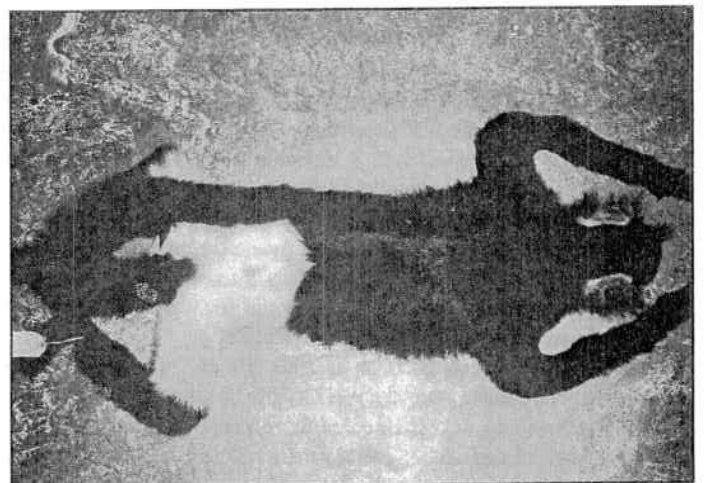


Fig. 2. Museum specimen of Delacour's langur (photo by R. Wirth).

***H. concolor*:** There is still some disagreement as to the validity and taxonomic status of different forms of this species. Recent work by Chinese scientists in Yunnan reveals overlapping ranges of *H. c. leucogenys* and *H. c. concolor* without interbreeding. Included in Appendix II.

***H. c. concolor*.** Dao Van Tien lists this subspecies as present in six provinces located primarily to the north of Hanoi. Nothing more is known as to present distribution and numbers. Suspected to be rare, even extinct, in most areas.

***H. c. leucogenys*.** Confined to the northern and western provinces. The population is extremely low, probably extinct in many areas. For example, in Cuc Phuong National Park none have been sighted for about ten years. Under strong hunting pressure. Apparently still quite numerous in Laos, where a significant number are exported annually for the pet trade.

***H. c. siki*.** Nothing can be added to our knowledge of this subspecies. It is confined to nearly the same area as *P. f. hatinhensis* and *T. c. caudalis*. This area suffered greatly during and after the war. Forest cover fragmented and poaching rampant. Possibly the most endangered of all the subspecies.

***H. c. gabriellae*.** This subspecies has its widest distribution in Vietnam. Still common in several national parks in the south, e.g. Nam Bai Cat Tien and Voh Don. Regularly available on the Ho Chi Minh market. Several exported annually. Not under immediate threat of extinction.

#### Current Conservation Measures

Following a long period of wars and instability, Vietnam is trying to implement new laws regarding environmental protection. In 1986, the government of Vietnam issued a decree to create 87 national parks, reserves, and protected areas, totalling about 1,000,000 ha.

A new list of protected species is in preparation which will include three species of primates in Appendix I and eight species in Appendix II. The Vietnam government is also preparing a final version of the National Conservation Strategy.

A network of transfrontier reserves, primarily for kouprey (*Bos sauveli*) but also important for the protection of primates, is being discussed with the Laotian and Kampuchean governments.

Vietnam will sign the CITES convention in the near future in order to halt illegal trade in wildlife. New laws have been issued by some provincial governments to limit privately owned firearms. The resettlement program for the Huong minority living within Cuc Phuong National Park has begun and will be completed by the end of March 1988, an action that will lower the hunting pressure on *T. f. delacouri* in that area. Similar programs are being planned for the Cat Ba and Ba Vi National Parks.

#### Conservation Measures Proposed

Since the actual number and distribution of primates is virtually unknown, a first logical step will be to initiate a countrywide survey with special emphasis on protected areas. It is absolutely necessary to concentrate fieldwork in the north and central regions in order to locate remnant populations of *R. avunculus*, *H. c. concolor*, *H. c. leucogenys*, *H. c. siki*, *T. f. francoisi*, *T. f. delacouri*, *T. f. ssp.*, *T. f. hatinhensis* and *T. phayrei*. Following the survey, key areas for species protection should be indicated. Vietnam has a number of qualified zoologists able to do such a survey, but they lack the financial resources and field equipment necessary for large-scale surveys. Strong support from international organizations is therefore essential for this as well as all other environmental protection efforts in Vietnam.

Transport of especially threatened groups to national parks or uninhabited islands along the coast should be attempted. In some cases, captive breeding with subsequent reintroduction should be tried if no other possibilities exist. Several forms — *R. avunculus*, *N. pygmaeus*, *P. nigripes*, *T. francoisi* and subspecies — and possibly *M. assamensis*, should be included in the Red Data Book.

#### Summary and Conclusions

This paper does not purport to be a complete work on the status of primates in Vietnam. It is not possible to draw any definite conclusions as to the size of primate populations at this stage. Some species have not been recorded in the wild for the past 20 or 30 years, and others are known by their skins only. Today the fauna of Vietnam, with all its beautiful endemic forms, remains among the least known in the world. Some species of primates may become extinct before any conservation actions or biological surveys are taken. Of the 24 forms, 14 can already be considered seriously threatened.

In spite of projects undertaken by the Vietnamese government to protect the environment, the future looks dim. Deforestation and uncontrolled hunting will persist because the people subsist in poverty. International conservation groups should generate more interest in protecting the environment of Vietnam in order to assure the survival of its myriad and wonderful species. We can only hope that in years to come there will still be something left to conserve, and that the negative factors will gradually be reduced.

Radoslaw Ratajszczak  
Wielkopolski Park Zoologiczny  
Poznan  
W. Browarna 25  
POLAND

**Editor's Note:** In January 1990, Ratajszczak, with Roger Cox and Ha Dinh Duc, submitted "Report of a preliminary survey of primates in North Vietnam" to WWF and the IUCN which detailed the results of a survey carried out in Vietnam between 6 July and 5 October 1989 to assess the conservation status of *Trachypithecus francoisi*, *Rhinopithecus avunculus*, and *Hylobates concolor*. The project continues, and we hope to offer periodic up-dates of the results in future issues.

#### Literature Cited

Lippold, L.K. 1977. The douc langur: A time for conservation. In: *Primate Conservation*, H.S.H. Prince Ranier III and G.H. Bourne, eds. Academic Press, New York. pp. 513-38.

## Status of the Banded Langur in Singapore

by Peter W. Lucas, Christopher J. Hails and Richard T. Corlett

Singapore is a crowded island with 2.6 million people living in an area of only 570 km<sup>2</sup>. Separated by a strait, now 0.6 km wide at the narrowest point, from the Peninsular Malaysian state of Johor for the last 7-10,000 years, this island is also home to three primate species. When the modern city of Singapore was founded in 1819, four primate species were present, namely *Macaca nemestrina*, now extinct in Singapore; *Nycticebus coucang*, which may still survive; *Macaca fascicularis*, of which several hundred remain today; and *Presbytis femoralis femoralis*, the subject of our report. This banded langur, probably the largest wild mammal left on the island, may be a distinct subspecies and is certainly on the verge of extinction.

Controversy abounds over the taxonomy of the leaf monkeys of Sundaland. However, according to the most conservative description, two subgenera of *Presbytis* populate the region, *Presbytis (Presbytis)* and *Presbytis (Trachypithecus)*. Weitzel and Groves (1985) recognize *Presbytis* and *Trachypithecus* as genera. Brandon-Jones (1984) also recognizes two genera, terming them *Presbytis* and *Semnopithecus*. Only one species of *Presbytis (Presbytis)* is ever known to have existed in Singapore, and it is called *Presbytis melalophos* by some (e.g., Napier

and Napier, 1967; Medway, 1978; Bennett, 1983) and *Presbytis femoralis* by others (e.g., Wilson and Wilson, 1976; Brandon-Jones, 1984; Whitten *et al.*, 1984). Chasen (1940) maintained that the race known from Singapore is a separate subspecies (*Presbytis femoralis femoralis*), as does Medway (1978). Skins in the Zoological Reference Collection (ZRC) — previously the Raffles Museum Collection — of the National University of Singapore, part of the material that Chasen had available to him for his assessment, are almost completely black except for a pale area on the inside of the thigh and a thin whitish line passing vertically down the anterior midline of the trunk.

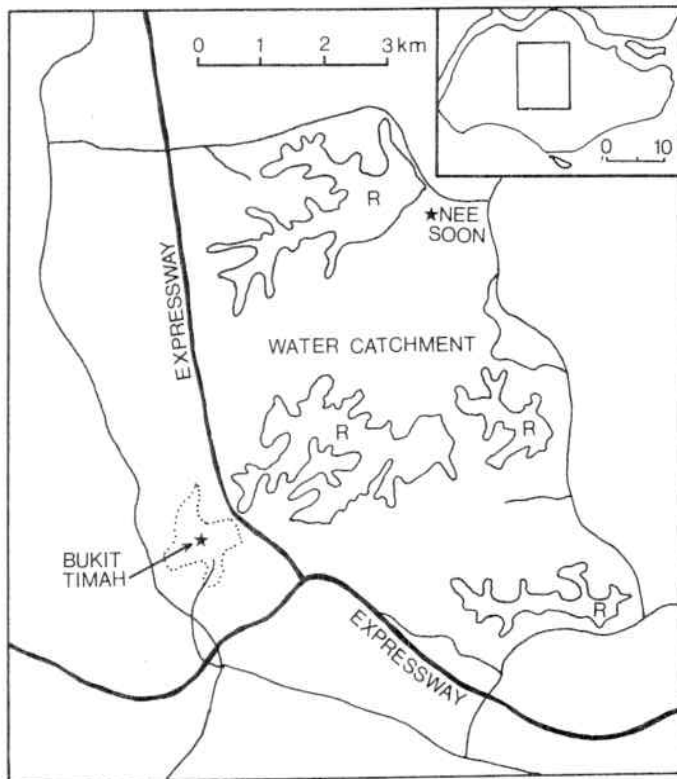


Fig. 1. Map of the central part of Singapore, showing reservoirs (marked R) and major roads. The stars indicate the two known localities of *Presbytis f. femoralis*, and the inset shows the position of this area in relation to the rest of the island (map provided by the authors).

Recent sightings at two locations in Singapore (Fig. 1) have been made of monkeys that match this description. One occurred at Bukit Timah, an isolated 71 ha patch of primary and secondary rainforest that has been under some form of protection since the 1840s. The other occurred at Nee Soon, a mosaic of regenerating freshwater swamp forest, dryland rainforest and secondary forest. This area was protected as a forest reserve in the 1880s and now forms part of the ca. 2,000 ha central water catchment, the rest of which is covered in secondary forest 50-70 years old and small patches of primary forest. The two locations where langurs have been sighted are about 5½ km apart and separated by an expressway.

#### Bukit Timah

Until October, this area probably contained one or two individuals, one of which was observed by the authors on two occasions. Independent reports of two surviving monkeys came until recently from a resident of a village on the margins of the reserve, the forest rangers, and a member of the staff of the ZRC. However, on 4 October 1987, a mature female, identical in coloration to those in the ZRC, was found dying about 100 m outside of the reserve boundaries. This animal is now preserved in the collection. None have been seen at Bukit Timah since.

#### Nee Soon

On 23 March 1983, C. J. Hails heard a typical banded langur 'machine-gun' alarm call near Nee Soon. On 10 April 1987, a member of a bird-watching group reported seeing a troop comprising 3-4 adults, 2-3 of which were holding infants, and 3 juveniles (R. Subharaj, pers. comm.). On 24 April 1987, in the same patch of forest, Hails saw a female holding an infant; other members of the group were heard but not clearly seen. The infant appeared dark in color, which suggests that it was not a newborn, since newborn *Presbytis (Presbytis)* are predominantly very pale in color.

Several years of ecological research necessitating frequent trips to the Catchment and Bukit Timah reserves by the authors between 1982 and 1987 have not resulted in any other sightings. It is doubtful that more than one or two troops exist at Nee Soon.

#### Historical Accounts

There is historical corroboration of the continuous presence of the banded langur in Singapore. Cantor stated that langurs were common in the last century (Chasen, 1924), but by 1924, Chasen wrote that only a few remained at Bukit Timah and in the forest at Changi, which was destroyed by fire in the 1930s. Despite his statement in an earlier correspondence (Chasen, 1939) that about 12 langurs were left at Bukit Timah, Chasen made no comment on the population of leaf monkeys in Singapore in his 1940 list of Malaysian mammals (Chasen, 1940). He was apparently unaware of the fauna of the Mandai-Seletar area adjacent to Nee Soon, which, in the 1930s, included troops of *Macaca nemestrina* and *P. f. femoralis* (Corner, 1978). The swamp forest Corner studied was cleared soon after he concluded his work, and the Nee Soon area is the only remaining patch of such forest on the island. Corner (pers. comm.) estimates the population size of langurs in his study site in 1940 was only 6-8 individuals, almost the same as it is today.

More recently, Harrison (1966) attested that *P. f. femoralis* is rare but that he believed "that there is a group . . . around Bukit Timah Nature Reserve." In 1973, Murphy reported the presence of a single pair at Bukit Timah, which accords with the present numbers, but he also recalls seeing a troop there in the 1960s (pers. comm.).

The present status of the population of 10 individuals is clearly precarious. Only 2-3 infants have been seen lately. If not enough monkeys survive in either Bukit Timah or Nee Soon, then conservation measures depend on a consensus about the taxonomy of the Singapore *Presbytis*. If it is a true subspecies, it may be one of the rarest primates in the world. However, it may also belong to the same subspecies as the southern Jahor *P. f. australis* (as suggested by Chasen, 1940). Nevertheless, it is still a distinct and separate population. Ryder (1986) has stressed the importance of preserving evolutionarily significant populations regardless of their trinomial status. Whatever measure is taken, we hope that this communication will advertise the evermore precarious existence of this unusual and interesting primate and spur action to forestall its demise.

Peter W. Lucas  
Department of Anatomy

Christopher J. Hails  
Botanic Gardens, Cluny Road

Richard T. Corlett  
Department of Botany

National University of Singapore  
10 Kent Ridge Crescent — 0511  
SINGAPORE

#### Acknowledgments

We thank Mrs. C.M. Yang and the staff of the Zoological Reference Collection of the National University of Singapore, members of the Orni-

thological Study Group, C. Groves, V. Weitzel and the forest rangers at Bukit Timah. C.W. Marsh and E.L. Bennett kindly commented on a draft.

#### Literature Cited

- Bennett, E.L. 1983. The banded langur: Ecology of a colobine in West Malaysian rain-forest. Ph.D. thesis, Univ. of Cambridge, Cambridge.
- Brandon-Jones, D. 1984. Colobus and Leaf Monkeys. In: *Encyclopaedia of Mammals I*, D. MacDonald, ed. George Allen and Unwin, London, pp. 398-408.
- Chasen, F.N. 1924. A preliminary account of the mammals of Singapore Island. *Singapore Naturalist* 1 (3): 76-86.
- Chasen, F.N. 1939. Letter to Chief Game Warden of Malaya, E.O. Shebbeare — requesting restrictions on firearm permits. Singapore National Archives.
- Chasen, F.N. 1940. A handlist of Malaysian mammals. *Bull. Raffles Mus.* 15: 1-209.
- Corner, E.J.H. 1978. The Freshwater Swamp-forest of South Johore and Singapore. Botanic Gardens, Parks and Recreation Dept., Singapore.
- Harrison, J. 1966. An Introduction to Mammals of Singapore and Malaya. Malayan Nature Society, Singapore Branch.
- Medway, L. 1978. *The Wild Mammals of Malaya (Peninsular Malaysia) and Singapore*, 2d ed. Oxford University Press, Oxford.
- Murphy, D.H. 1973. Animals in the forest ecosystem. In: *Animal Life and Nature in Singapore*, S.H. Chuang, ed. Singapore University Press, Singapore, pp. 53-73.
- Napier, J.R. and P.R. Napier. 1967. *A Handbook of Living Primates*. Academic Press, London.
- Ryder, D. 1986. Species conservation and systematics: the dilemma of subspecies. *Trends Ecol. Evol.* 1: 9-10.
- Weitzel, V. and C.P. Groves. 1985. The nomenclature and taxonomy of the colobine monkeys of Java. *Int. J. Primatol.* 6: 399-409.
- Whitten, A.J., S.J. Damanik, J. Anwar, and N. Hisyam. 1984. *The Ecology of Sumatra*. Gadjah Mada Univ. Press, Yogyakarta.
- Wilson, C.C. and W.L. Wilson. 1976. Behavioural and morphological variation among primate populations in Sumatra. *Folia Primatol.* 23: 245-274.

## Some Observations on the Primates of Kalimantan Tengah, Indonesia

by David J. Chivers and Kenneth M. Burton

Information is scarce on the distribution and status of the 13-odd primate species occurring in Kalimantan, or Indonesian Borneo, especially inland from the coast. We present here observations made in August and September 1986 on a reconnaissance for Project Barito Ulu, a long-term study of fruit-eating animals and forest regeneration in the watershed of the Barito River in Kalimantan Tengah. This report also includes data collected previously from Kalimantan Tengah and Kalimantan Selatan on lorises, tarsiers, langurs, proboscis monkeys, macaques, gibbons, and orang-utans. Special attention is given to agile and Müller's gibbons in Barito Ulu and to their hybrids, which can be identified by their songs. The occurrence of proboscis monkeys 760 km upriver from the sea, in hilly terrain away from the flood plain, is of special interest. Also discussed are the need for future surveys and the impact of increasing forest clearance on conservation.

#### Background

Systematic and long-term studies of primate ecology and behavior on the island of Borneo have so far taken place on or near the coast (Fig. 1) at several different sites: in East Malaysia at Samunsam in Sarawak (e.g. Salter *et al.*, 1985; Bennett, 1986), at Sepilok (Davies, 1984;

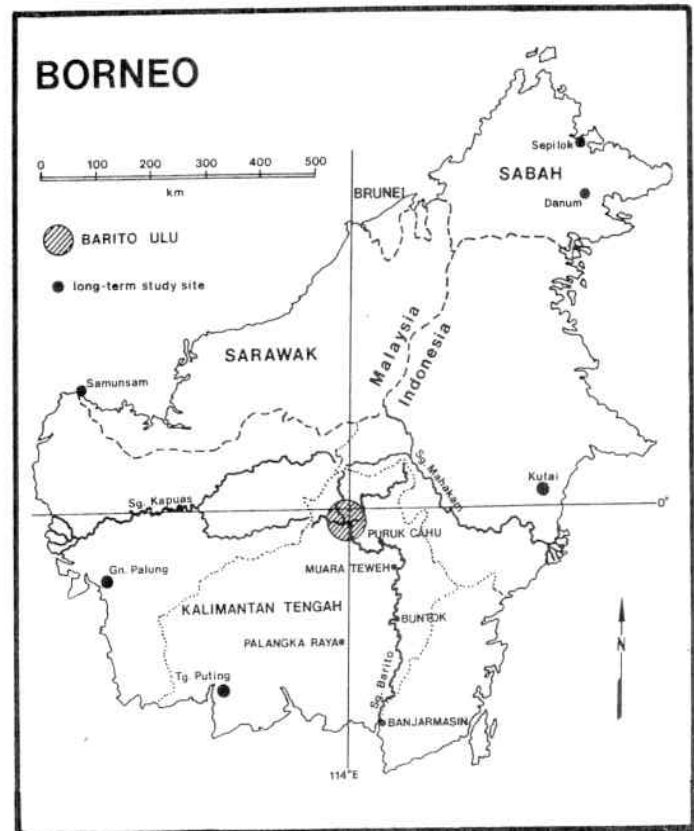


Fig. 1. Map of Borneo showing the main sites of long-term primate studies and main towns and rivers of Kalimantan Tengah. The Barito Ulu study area is hatched (map provided by authors).

Crompton and Andau, 1987), and on the Segama River near the Danum Valley in Sabah (MacKinnon, 1974); in Kalimantan (Indonesia) at Kutai in the east (e.g. Rodman, 1973, 1978; Fittinghoff, 1975; Wheatley, 1978; Mitani, 1984; Berenstein, 1986), at Tanjung Puting in the southwest (e.g. Galdikas, 1978, 1981, 1984, 1985; Sugardjito, 1978; Bismark, 1980; Supriatna *et al.*, 1986), and now at Gunung Palung in the west (M. Leighton *et al.*, in progress).

Not only have there been no comparable studies nearer the center of the island, where much of the remaining forest is to be found (MacKinnon, 1986), but there is virtually no information on primate distribution and status away from the aforesaid locations in Kalimantan, except for surveys in West Kalimantan (Marshall and Sugardjito, 1986) and at Nangapinoh on the Melawai River in 1978, when MacKinnon and others carried out a survey at Bukit Raya. MacKinnon (1986), however, has extrapolated from these and other studies done elsewhere in Indonesia to assess the conservation status of each Indonesian habitat type and primate species.

Kalimantan is composed of the provinces of Kalimantan Barat (West), Kalimantan Tengah (Central), Kalimantan Timur (East), and Kalimantan Selatan (South) (Figs. 1 and 2). The main vegetation types are: mangrove, freshwater swamp and peat swamp forests; heath forest; evergreen lowland alluvial plains and dipterocarp forests; evergreen hill forest; and montane and moss forests (UNDP/FAO, 1981).

Kalimantan Tengah, which encompasses the hills and plains of southern Borneo, is mostly of low elevation with large, south-flowing rivers. The only high mountains in the province lie along the northern watershed boundary (Fig. 2). A broad fringe of mangrove, extensive heath, and swamp forests grow on the poor soils in the south. Further north there are large areas of lowland dipterocarp forests on relatively poor soils (except along river valleys).

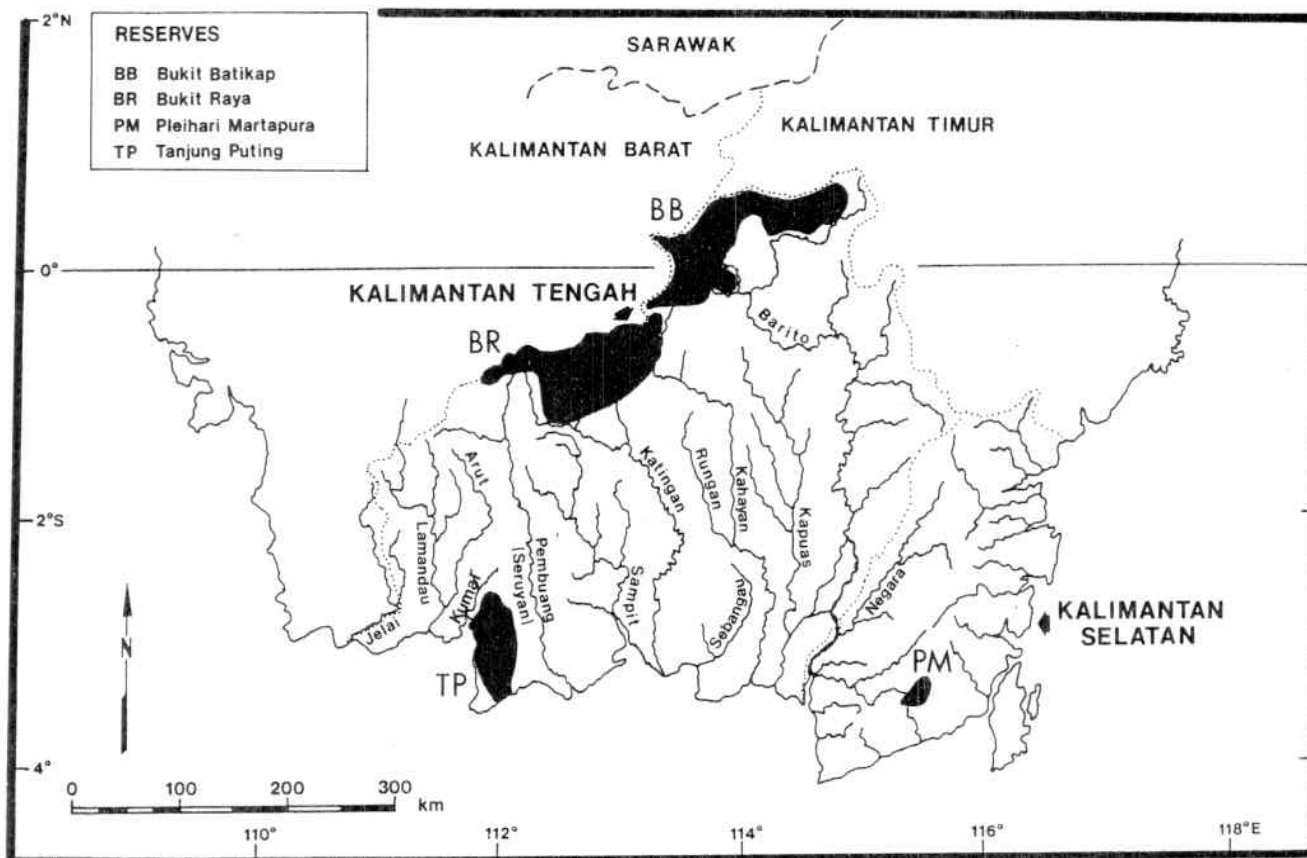


Fig. 2. Map of Kalimantan Tengah and Kalimantan Selatan showing the major rivers of the area and the nature reserves (map provided by authors).

The watershed of the Barito River, along the Joloi, Busang and Murung tributaries (Fig. 4), has been selected for a long-term research project on the ecology of fruit-eating animals (primates, bats, and birds) in relation to forest regeneration in the tropical rainforests in the center of the island. The project is designed to promote the scientific study of Kalimantan in relation to Indonesia's long-term needs for forestry and economic development. In selecting the site, the first consideration was distance from the coast, the second was special zoogeographical interest.

The headwaters of the Kapuas and Barito rivers have been identified as the 'weak link' in the barrier between the Sumatran 'immigrants' and the endemic Bornean fauna at the end of the Pleistocene glacial. In this area, the agile gibbon (*Hylobates agilis albibaris*) meets the grey or Müller's gibbon (*Hylobates muelleri muelleri*), and the two taxa hybridize where the Busang and Joloi rivers join first each other and then the Murang to form the Barito (Marshall *et al.*, 1984; Marshall and Sugardjito, 1986; Fig. 2).

This paper results mainly from observations made by the authors between 26 August and 9 September 1986, during the reconnaissance for Project Barito Ulu. It includes data J. Marshall collected during his August 1979 and August 1982 visits to the area north of Muara Teweh; records K. Burton kept on primates during his ornithological surveys along the Katingan, Rungan, Kahayan, Kapuas (the smaller Kapuas in Kalimantan Tengah, not the larger in Kalimantan Barat) and Barito rivers from July 1984 to May 1986; and some records on the Negara River in Kalimantan Selatan, a small province sharing, in part, the same river systems as those in the southeast of Kalimantan Tengah (Fig. 2). To these are added the observations J. Marshall and M. Markaya made in the Pleihari Martapura Nature Reserve, Kalimantan Selatan, 22-26 July 1979.

By collating these disparate observations, we seek to remedy in a small way the deficiencies in knowledge concerning primate distribution in Kalimantan Tengah (Medway, 1977; Payne and Francis, 1985).

### The Primates

About 13 species and numerous subspecies of primate occur on the island of Borneo (Payne and Francis, 1985; Chivers, 1986; MacKinnon, 1986). Since our data are limited in quantity and geographical extent, our discussion will be confined to the level of species. Although the greatest species diversity occurs in the north, particularly in north-western Borneo, which represents a Pleistocene refugium (*e.g.* Chivers, 1977), at least 11 species occur in Kalimantan Tengah.

These include two nocturnal primates: *Nycticebus coucang* and *Tarsius bancanus*. The first, the slow loris, is a strepsirhine widespread over Southeast Asia. The second, the western or Horsfield's tarsier (Compton and Andau, 1987), is a haplorhine which also occurs in southern Sumatra.

The monkeys of Kalimantan Tengah are represented mainly by macaques (*Macaca* spp.) and langurs (*Presbytis* spp.). Macaques, the only cercopithecine monkeys in Asia, are opportunistic frugivores which live in complex multi-male societies (Lindburg, 1980). The long-tailed macaque (*M. fascicularis*) inhabits the forest edge, whereas the pig-tailed macaque (*M. nemestrina*) ranges widely through the forest, spending much time on the ground and covering a considerable range of altitude and forest types (Chivers, 1980; Caldecott, 1986; Robertson, 1986). Both species are common throughout Southeast Asia.

Colobine monkeys, represented mainly by langurs, are also widespread and varied throughout tropical Asia (Chivers, 1986), augmented around the periphery of the Sunda Shelf in Southeast Asia by the 'odd-nosed' monkeys (Groves, 1970). They tend to live in one-male social groups and are adapted for folivory due to their large, sacculated stomachs which allow the bacterial fermentation of cellulose (Curtin, 1976; Bennett, 1984; Davies, 1984). In Kalimantan Tengah, there are at least three species of langur: the silvered langur (*Presbytis cristata*), the red langur (*P. rubicunda*), and the white-fronted langur (*P. frontata*). The silvered langur also inhabits Sumatra, Java, and the west coast of the Malay penin-



sula. Both the red and white-fronted langurs are endemic to Borneo. Also endemic to Borneo is the bizarre proboscis monkey (*Nasalis larvatus*), which is confined mainly to the coastal mangrove forests and banks of major rivers (Rodman, 1973; Bismark, 1980; Salter *et al.*, 1985; Bennett, 1986).

The apes are represented by the orang-utan (*Pongo pygmaeus*), occurring also in northern Sumatra, and two species of lesser apes — gibbons (*Hylobates* spp.). Orang-utans are frugivorous and 'solitary' in habit (Rodman, 1973; MacKinnon, 1974; Rijksen, 1978; Galdikas, 1978, 1981, 1984, 1985; Mitani, 1985c; Rodman and Mitani, 1987; Sugardjito *et al.*, 1987).

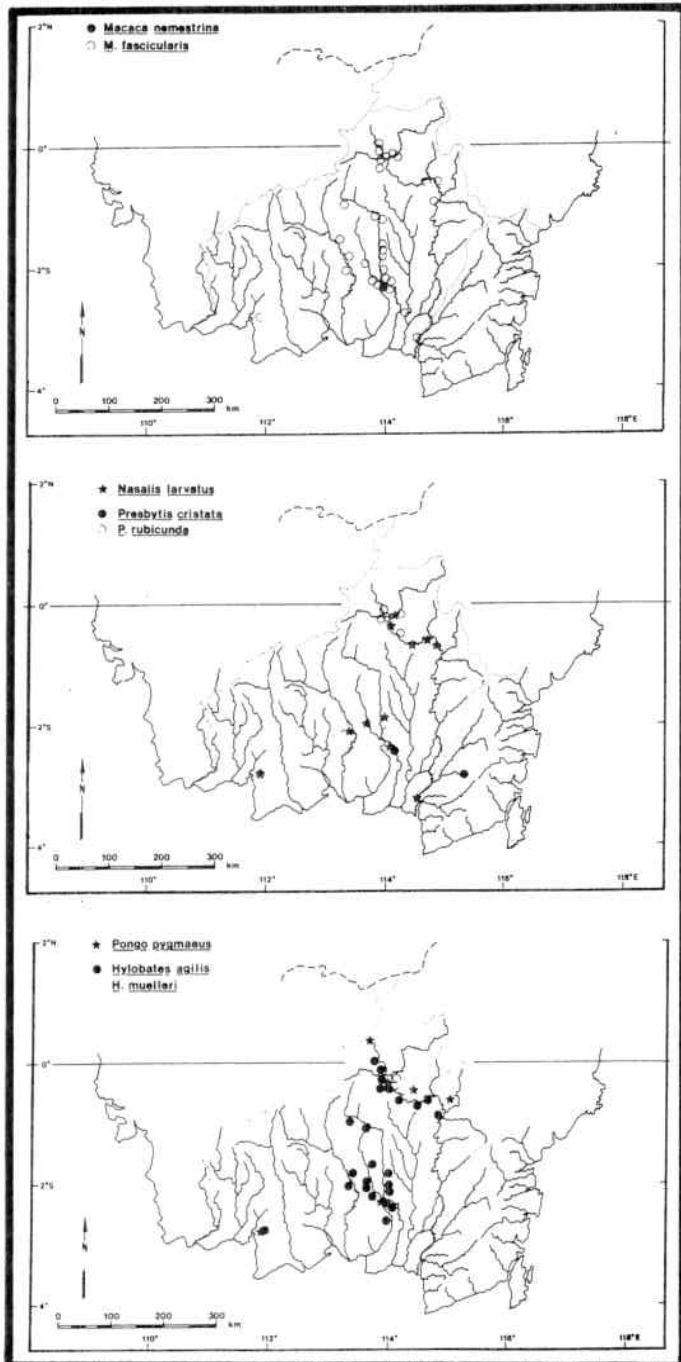


Fig. 3. Maps showing distribution of primates in Kalimantan Tengah and Selatan: (a) *M. fascicularis* and *M. nemestrina*, (b) *N. larvatus*, *P. cristata* and *P. rubicunda*, (c) *P. pygmaeus*, *H. agilis* and *H. muelleri* (maps provided by authors).

There are nine species of gibbon in Southeast Asia, all monogamous, territorial, suspensory frugivores with elaborate songs and duets (Preuschoft, Chivers, Brockelman and Creel, 1984; Mitani, 1985a, 1985b; Leighton, 1987). In the north and east of Borneo are three subspecies of *H. muelleri*. In the southwest, J. and E. Marshall (1976) discovered *H. agilis*, a species with two other subspecies, throughout most of Sumatra and in a small part of the Malay Peninsula.

#### Distribution of Primates in Kalimantan Tengah and Selatan (Fig. 3)

**Nycticebus:** Several sightings of slow loris have been reported from Tanjung Puting, but K. Burton saw none, apart from some in captivity.

**Macaca:** *M. fascicularis*, very popular as a pet amongst the local Dayaks, was common along all the rivers visited (Fig. 3a). *M. nemestrina* (a solitary adult male) was seen only on the left bank of the extreme upper Sebangau. Nevertheless, it is reported from Tanjung Puting, and captives were also seen in Palangka Raya and a village upriver. Although it is an animal of the remoter forests, it appears from reports to be much less common in Kalimantan than Sumatra (Crockett and Wilson, 1980), where it is used to collect fruit.

**Presbytis:** Groups of about five *P. cristata* were seen in plantations near Pilang on the Kahayan River and in severely disturbed forest along a tributary of the Negara near Loksado (Fig. 3b). *P. rubicunda* were seen more often, but only in relatively pristine forest. Groups of 1-8 animals were observed near Bukitrawi on the Kahayan; in swamp forest near Palangka Raya; in the Tanjung Puting Reserve; about mid-way along the road between Pundu (on the Cempaga, a tributary of the Sampit) and Kasongan (on the Katingan), far away from any water; and in the Pleihari Martapura Nature Reserve (Fig. 3b). The species is hunted for food by the local people, despite its legally protected status.

**Nasalis:** *N. larvatus* was seen on the Katingan, Rungan and Kahayan (particularly near Tumbangnusa) rivers, on Kembang Island in the Barito River near Banjarmasin and, abundantly, in Tanjung Puting Reserve, where it was studied from 1984-85 (Yeager, 1987; Fig. 3b). Nearly all the monkeys were seen in swampy areas close to rivers. One was seen swimming to the bank of a small river to escape an oncoming boat, and, in Tanjung Puting, another was seen that had been killed by a crocodile.

**Pongo:** *P. pygmaeus* was observed only in Tanjung Puting, where it is still quite common, and was heard once on the left bank of the upper Sebangau River (Fig. 3c). Though seldom kept as pets now, orang-utans are still hunted for food and because they destroy crops. Several killings have been reported from the middle Katingan, and many orphaned infants are still brought to the Tanjung Puting rehabilitation center.

**Hylobates:** Gibbons, too, are protected, yet are commonly kept as pets. *H. agilis* was heard virtually everywhere west of the Barito River — often along both banks of the Kahayan, Rungan, Katingan and Sebangau rivers, and in Tanjung Puting Reserve (Fig. 3c). Sugardjito (1978) studied 17 families at Tanjung Puting for 2-3 years. The Marshalls studied several of the same families there in 1974 and tape-recorded others at Pangkalanbun.

*H. muelleri* was recorded on a tributary of the Negara River in Kalimantan Selatan, where, in 1979, Marshall and Mahfudz studied 15 pairs inhabiting the Pleihari Martapura Nature Reserve. This earlier discovery of Müller's gibbon close to the left bank of the Barito (at the latitude of Banjarmasin), along with R. Brindamour's tape recordings of agile gibbons at Palangka Raya, first identified the Barito River as the barrier between the species. This conclusion was confirmed only a few days later when, at Muara Teweh, Marshall and Mahfudz tape-recorded the simultaneous choruses of eight families of *H. muelleri* on the left (east) bank and two families of *H. agilis* on the right (west) bank — all audible from the town center.

#### The Barito Watershed

The 1986 study involved travelling the river from Buntok to Muara

Joloi and back to Muara Teweh, surveying a logging track NNW from Teluk Jolo and the waterways and forests of the Joloi, Busang and Murung rivers above Muara Joloi (Fig. 4). The location of the camps and a detailed itinerary are shown in Figure 5.

This survey was complicated by difficulties in detecting primates because our visit coincided with the end of a pronounced eight-week dry period. Few trees were fruiting which would have attracted the frugivorous primates, making the animals more conspicuous. During periods of food scarcity, primates may conserve energy by calling less and travelling less (Chivers, 1980), making gibbons especially, and langurs, more difficult to locate. In addition, the relatively impoverished rainforest on the poor-quality soils in the center of the island probably contains a lower density of primates than in most other study areas in Southeast Asia, e.g. the Malay Peninsula (Chivers, 1980) and Sumatra (Rijksen, 1978). When, in the second half of the survey the rains did come, calling and locomotion were depressed on three occasions by heavy rain in the late night and early morning. Nevertheless, five species of primate were observed and three others reported.

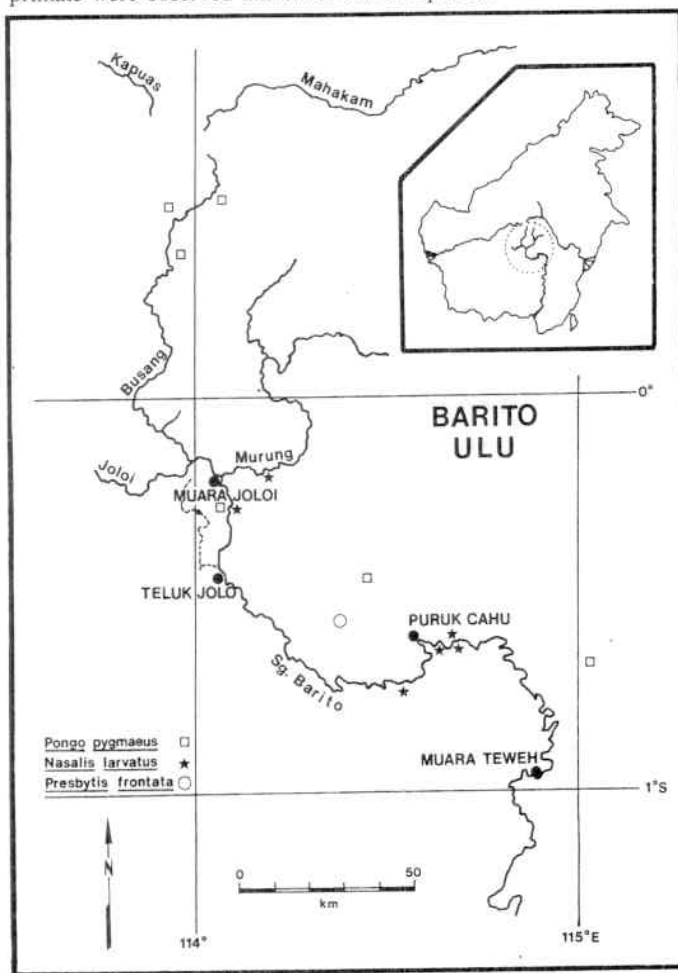


Fig. 4. Map of Barito Ulu north from Muara Teweh, showing main towns and villages, and indicating sightings or reports of *P. pygmaeus*, *N. larvatus*, and *P. frontata* (map provided by authors).

***Tarsius bancanus*:** One was caught by J. Marshall at 0400 h in a mist net on the left bank of the Busang River at the mouth of the Rekut in August 1979. Marshall released it in daylight and observed its leaping locomotion.

***Macaca fascicularis*:** These monkeys were the most common primate found along all rivers. They were observed at 17 locations within the survey area (Fig. 6a), in groups of up to 10 individuals — a group size smaller than usually recorded. One group was seen by a stream in the logging area NNW of Teluk Jolo, and several were seen along the Barito,

particularly around Puruk Cahu and Muara Teweh, on all three visits. ***Presbytis rubicunda*:** These monkeys were seen and heard at four locations: on the right bank of the Joloi just above Muara Joloi; on the right bank of the Joloi above the mouth of the Busang; and on both banks of the Murung River, near the mouth of the Danau Tolong (Fig. 6a). Groups were small, containing probably not more than five individuals. J. Marshall also observed a group on the left bank of the Busang near the mouth of the Rekut.

***Presbytis frontata*** (perhaps): On two occasions a brief langur call was heard — once on the right bank of the Joloi above the mouth of the Busang, and once on the right bank of the Murung by the Danau Tolong. The calls were reminiscent of those of the *P. melalophos* species group, which occurs in Kalimantan Barat (Payne and Francis, 1985) but is not known to occur in this area. More likely they were calls of *P. frontata*, which has been reported from northern Kalimantan Tengah. In 1982, J. Marshall observed a group of grey langurs on the left bank of the Murung above Muara Joloi, and we were shown a photo of a langur, taken by an Australian gold prospector west of Puruk Cahu, inland from the left bank of the Barito (Fig. 4), that was undoubtedly a member of this species.

***Nesalis larvatus*:** Essentially a coastal species, this monkey primarily inhabits wetland forests (Bennett, 1986), but is known to occur some way up the major rivers of Borneo. It was a major discovery to find it — albeit only one adult female (or, perhaps, a sub-adult male, E. Bennett, pers. comm., on examination of a photograph) and one juvenile — on the left bank of the Murung River, about 15 km above Muara Joloi, away from the alluvial plain and in an area of more rugged terrain and rapids (Fig. 6a). This location is about 760 km from the sea by river, 380 km direct. The monkeys are reported to be seen regularly by the Barito south of the Muara Joloi and to be common above and below Puruk Cahu. One evening, we saw four groups of up to nine individuals on both banks of the Barito, 500 km from the sea by river, 335 km direct (Fig. 4).

In 1979, Marshall and Mahfudz saw one proboscis monkey on the bank of the Barito between Puruk Cahu and Muara Teweh and watched another large animal swim into the middle of the river below Teluk Jolo, before hunters in a canoe speared it for food. The proboscis monkey is protected by law, but is reportedly hunted for food near Muara Teweh.

***Pongo pygmaeus*:** We did not see any orang-utans on our visits to the study area. However, they are reliably reported by a Korean gold prospector to be quite common several days' travel further up the Busang (Fig. 4). The people of Muara Joloi report occasional visits of orang-utans to their plantations south of the village. They have also been seen by an Australian gold prospector northwest of Puruk Cahu and by a Welsh oil surveyor northeast of Luwe Ulu, an hour upriver from Muara Teweh. Clearly, though, they are scarce in the area surveyed.

***Macaca nemestrina* and *Nycticebus coucang*:** We did not observe these two elusive primates during our surveys. Nevertheless, they are probably reasonably abundant since they are well known to the local people, as is the grey/black langur (*P. frontata*).

***Hylobates agilis*:** One morning, 12 family groups were heard along 18 km of logging road (0.7 group/km, between 14–32 km from P. T. Tunggal Pameenang Logging Co.'s base camp near Teluk Jolo), to the west of the Barito River, and to the south of the Joloi River (Fig. 6b). Seven more groups were located during six days of surveying the Joloi and Busang rivers to the west of Muara Joloi (Table 1, Figs. 6b and 7). Typical songs were recorded of male dawn solos with the diagnostic diphasic calls and female great calls lasting close to the Kalimantan average duration of 18 seconds (Marshall and Sugardjito, 1986; Table 2; Fig. 8).

***Hylobates muelleri*:** Two groups were heard, and one both seen and heard, on the left bank of the Murung River, east of Muara Joloi. A fourth group was heard on the right bank, near the Danau Tolong

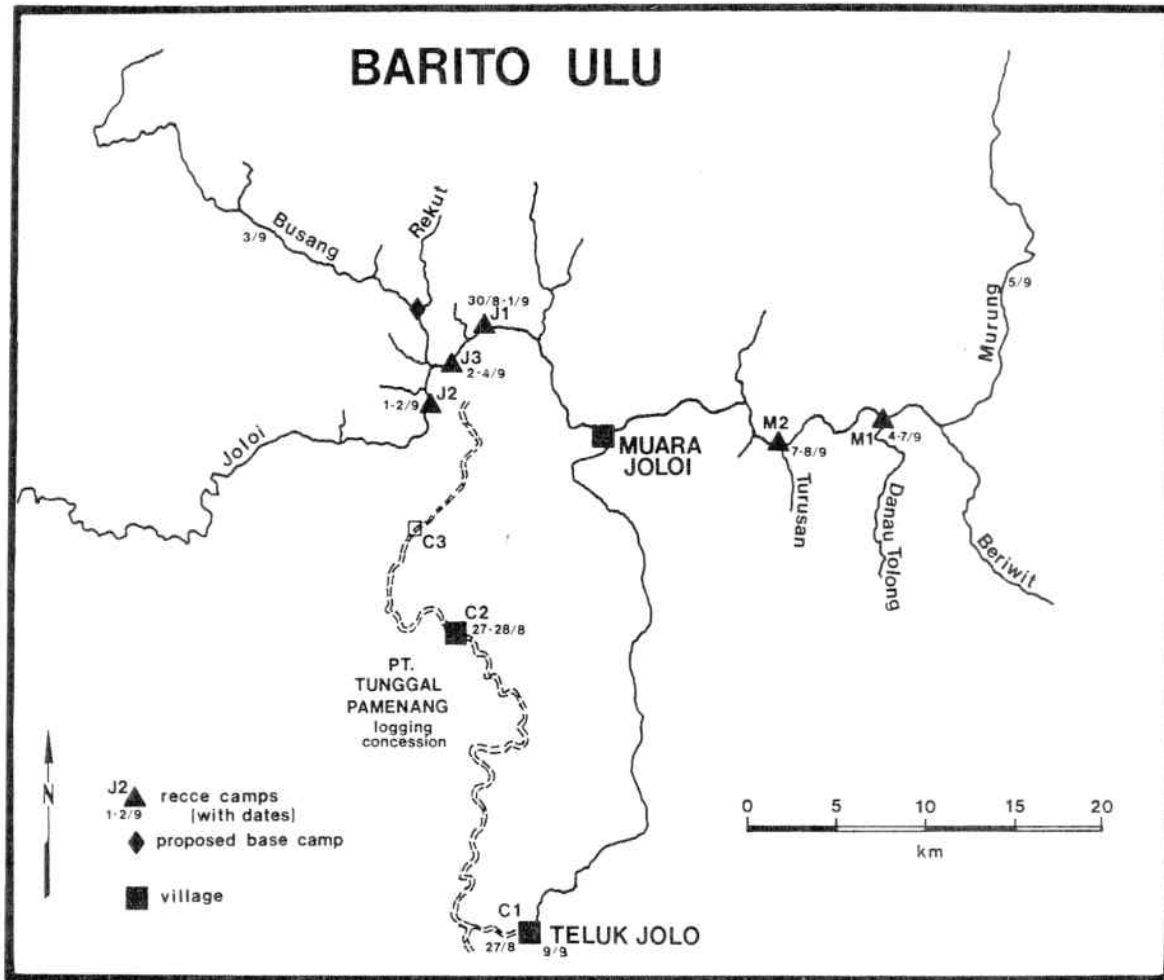


Fig. 5. Map of the Muara Joloi area, showing rivers, tributaries, logging area, and 1986 reconnaissance route, with dates and locations of camps (map provided by authors).

tributary, opposite P. T. Tunggal Pamenang Logging Co.'s Camp 2 (Figs. 6b and 7). In our recording an adult female is joined by a daughter later in the bout, and a male also adds a coda (Table 2, Fig. 8).

***Hylobates* spp.:** Brief sightings of gibbons occurred on three occasions in 1986 (Fig. 7): (1) in mid-morning on 2 September, while travelling up the Itik River from Joloi Camp 2, K. Burton saw two animals that swung away from the river bank, and one, at least, looked light in color from behind; (2) during the Busang reconnaissance on 3 September, at 1208 h, D. Chivers saw four gibbons near the Puka tributary with very dark fronts, pale backs and some white, at least, on their cheeks; and (3) at about 0930 h on 5 September, while the authors were in the forest, the Maura Joloi headman saw one grey gibbon across the Danau Tolong tributary from Murung Camp 2, presumably one of the group heard calling from that direction earlier in the morning (Tape 64A/250-384).

Table 1. Female Gibbons Encountered in Barito Ulu, 1986\*

Location	Agile	Müller's	Hybrid	Agile Backcross	Müller's Backcross
Joloi Camp 1	2	(1)	1 (1)		
Joloi Camp 2	2			1	
Busang (Rekut)	1				1 (1)
Joloi Camp 3	2 (1)		1 (2)	1	
Murung Camp 1		3			1
Murung Camp 2			(1)		1
<b>Total</b>					
Definite	7	3	2	2	3
Possible	(1)	(1)	(4)		(1)

\*Species identification is based on great calls. Parentheses indicate uncertainty.

The Itik River gibbon (1) was almost certainly *H. agilis*, the Busang (2) possibly *H. agilis*, or hybrids or backcrosses, and the Danau Tolong (3) definitely *H. muelleri*. It is unfortunate that the Busang group, seen on the opposite bank from the quiet hybrids observed in 1979 by J. Marshall (Marshall and Sugardjito, 1986) did not call. They seemed to be blacker ventrally than *H. agilis*, but not sufficiently brown on the back and yellow-brown on the rump to be pure *H. agilis*.

***Hylobates* hybrids:** The hybrid and backcross individuals located by J. Marshall in 1979 and 1982 have been fully described by Marshall and Sugardjito (1986). The key distinguishing criteria of the hybrids' songs are the angle of the sonagram trace (in between the horizontal arrangement of notes of *H. lar* and *H. agilis* and the vertical arrangement of *H. pileatus* and *H. muelleri*) and the rapidity of the fastest trill (typical of *H. pileatus* and *H. muelleri*). In 1986, hybrid and backcross individuals were recorded in five families (with two others possibly heard, — 2 (possibly 4) hybrids, 2 agile backcrosses and 3 (possibly 4) Müller's backcrosses among the females; Table 2, Figs. 7 and 8). These identifications were made by J. Marshall, who analyzed sound spectrograms of the songs on a digital Kay Sona-graph at the Smithsonian Institution's Division of Amphibians and Reptiles.

The locations in which these individuals were heard (Figs. 6b and 7) are, from east to west:

(1) on the Murung: (a) on the right bank opposite the Danau Tolong tributary, an *agilis* backcross male and a *muelleri* second generation backcross female, with their hybrid daughter (Tape 64A/540-650); (b) on the right bank just below Camp 2, a female *muelleri* backcross (Tape 65A/160-215);

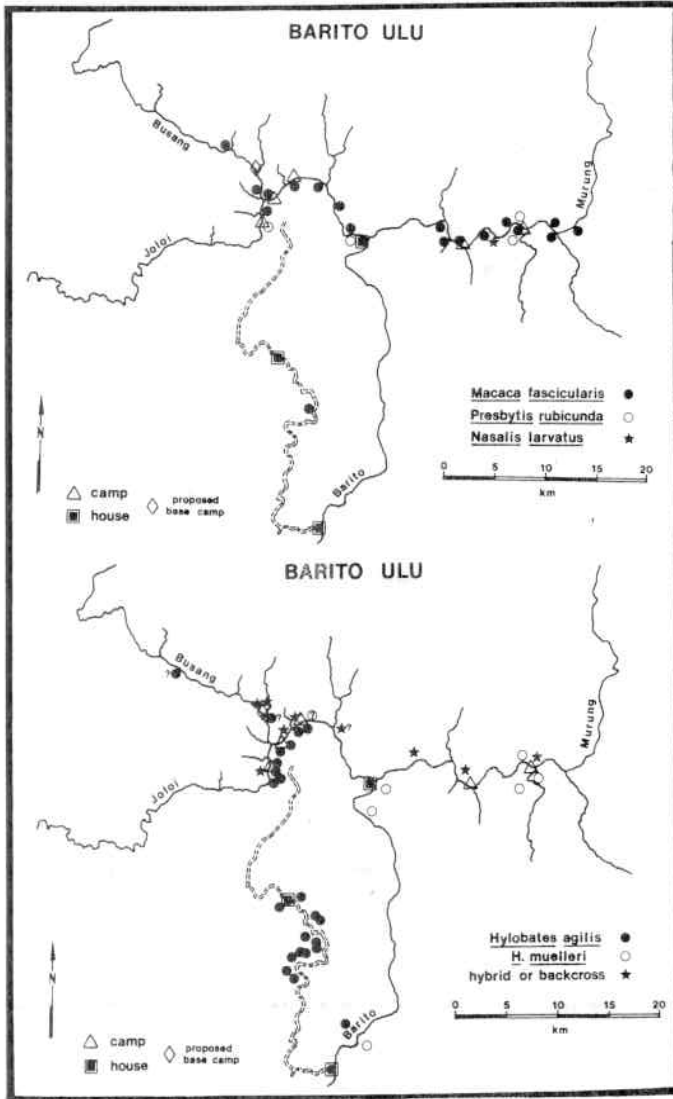


Fig. 6. Maps showing distribution of primates in Barito Ulu: (a) *M. fascicularis*, *P. rubicunda* and *Nasalis larvatus*, (b) *H. agilis*, *H. muelleri* and hybrids or backcrosses (maps provided by authors).

(2) on the Joloi: (c) on the left bank, near Camp 1, a male *agilis* backcross and a female hybrid (Tape 63A/100-230); (d) on the left bank, opposite Camp 2, above the mouth of the Busang (thus outside Marshall and Sugardjito's original 1986 hybrid zone), an *agilis* backcross pair (Tape 64A/418-486;540-570);

(3) on the Busang: (e) on the left bank, just above the mouth of the Rekut tributary, an *agilis* backcross male and a *muelleri* backcross female (Tape 64A/045-080). Marshall and Sugardjito (1986, Fig. 14) recorded a similar pair at the same location, but that female's opening notes were of a different shape and an immature female was present. D. Chivers heard a second group nearby which may have been the original parental group of the young female being recorded and thus account for these discrepancies.

Hybrid animals were also suspected from the structure of female great calls on the left bank of the Joloi, just below the mouth of the Busang; on the right bank of the Murung by the Kerajan tributary, some way below Camp 2 (K. Burton, pers. obs.); and on the left bank of the Joloi, below Camp 1.

Hybridization is possible because of several crossing points along the lower five km of the Busang where the river runs through a steep forested gorge. Marshall and Sugardjito (1986) reported four pairs of the huge, riparian *Dipterocarpus oblongifolius* with intermingling branches or crowns less than three meters apart which may act as gibbon bridges.

In 1986, the two lower crossing points had disappeared. The inclined trees had either fallen or been felled. Yet, if trees now growing increase their inclination (J. Marshall doubts this, pers. comm.), they will make new crossing points.

Table 2. Details of Gibbons and Their Songs in Barito Ulu, 1986

Location	Identity	Female Great Call		Time
		n	no. of notes	
	Male / Female	x (range)	x (range)	h
Logging Road	31 km <i>agilis</i>			0606
from Teluk Jolo	25 km <i>agilis</i>	1	19	0811
Joloi Camp 1				
Left Bank	295° <i>agilis</i> hybrid backcross	9	23 (21-26)	0620
Joloi Camp 2				
Right Bank	115° <i>agilis</i>			0630
	90° <i>agilis</i> <i>agilis</i>	3	20 (19-21)	0702
Left Bank	240° <i>agilis</i> <i>agilis</i>	1	16	0641
	250° backcross backcross	14	17 (16-18)	0740
Busang, sandbank at mouth of Rekut				
Left Bank	350° <i>agilis</i> <i>muelleri</i> backcross backcross	4	17 (17-18)	0756
Murung Camp 1				
Left Bank	150° <i>muelleri</i> <i>muelleri</i>	9	12 (11-12)	0737
Right Bank	350° <i>muelleri</i> <i>muelleri</i>	5	10	0620
	15° ? <i>agilis</i> backcross	7	14 (13-15)	0629
	SA hybrid backcross	4	9 (8-9)	16 (15-17)
Murung Camp 2				
Right Bank	350° ? <i>muelleri</i> backcross	3	16 (16-17)	0811

The recordings made in 1986 provide the first example of a second generation backcross to *muelleri*, and, in the prolonged song of the Joloi hybrid female, a unique example of a terminal trill. Finally, the density of gibbons in the hybrid zone (north of the Busang, Joloi, and Murung rivers) seems to be lower than in the pure *agilis* and *muelleri* zones (south of the Joloi and Murung rivers and on either side of the Barito). As suggested by Marshall and Sugardjito (1986), this indicates less breeding success among the hybrids, since there is, as yet, no evidence that they inhabit forest of inferior quality.

In summary, during the 11-day reconnaissance in the study area of which three mornings were affected by rain, 63 gibbon songs were heard (5.7 songs/day, including 1.8 male solos/day). Of these, 46% were by *H. agilis*, 11% by *H. muelleri* (we spent less time in their range, and had more rain), and 27% by known or possible *Hylobates* hybrids or backcrosses. The calling peaked at 0600-0700 h, 80% of songs being given between 0600-0900 h. Of the songs, 32% were male solos, of those, 85% were given before 0700 h, that is, before or soon after dawn.

## Conclusion

The most important findings in these surveys are as follows:

- (1) Orang-utans are scarce near the rivers and logging tracks in the Barito watershed and in most of the other surveyed parts of Kalimantan Tengah. The animals may be commoner in remoter forests, but seem to have a patchy distribution.
- (2) Proboscis monkeys occur in the Barito watershed, both in an area of rapids and hilly terrain and in the seriously threatened, flatter, wetter forests around Barito tributaries.
- (3) Marshall, Sugardjito and Markaya's (1984) discovery of hybridization between agile and Müller's gibbons north of the Joloi, Busang, and Murung rivers is confirmed and elaborated.

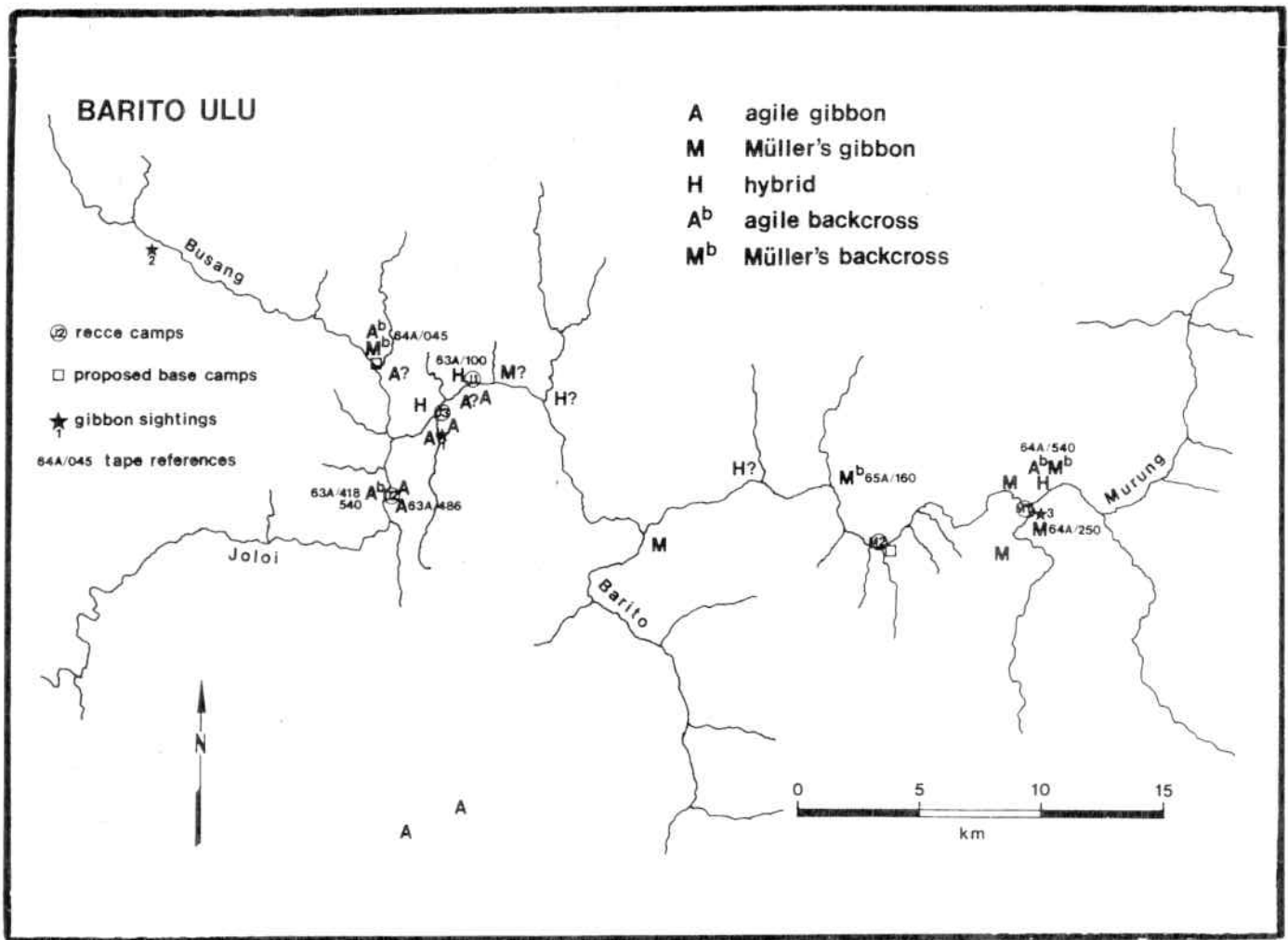
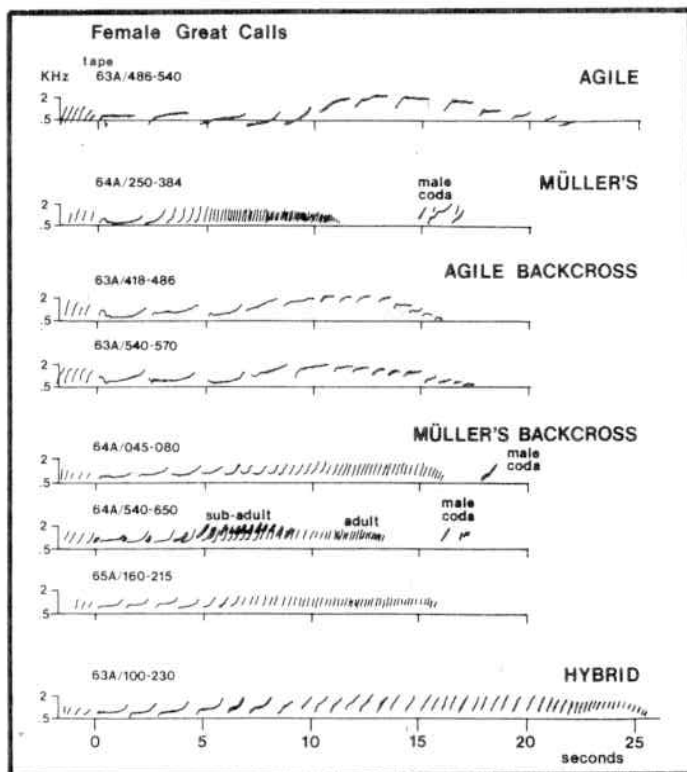


Fig. 7. Map showing location and identities of gibbons heard and seen in Barito Ulu, with references to recordings (see text, Table 2 and Fig. 8; map provided by authors).



Based on our observations, we recommend the following actions:

- (1) Systematic long-term study of primate socioecology in the Barito watershed, especially of *Hylobates* species and hybrids and of *Nasalis larvatus*.
- (2) Systematic surveys to determine the distribution and status of all primates, especially orang-utans, proboscis monkeys, and langurs, particularly both white-fronted and banded langurs, in the complex river systems and northern mountains of Kalimantan Tengah, if not in all of Kalimantan. Attention should also be given to the pig-tailed macaque, slow loris, and Horsfield's tarsier.

The need for these studies assumes critical importance in view of the rapid clearing of forest for transmigration schemes, agriculture, and oil, gold, and coal prospecting. The riverine and lowland forest, richest in flora and fauna, are the most threatened. UNDP/FAO (1981) has identified key conservation areas within Kalimantan, but these recommendations do not adequately incorporate new primate data. For example, while conservation areas are recommended for the hill forests around the northernmost border of Kalimantan Tengah (Bukit Batikap I, II and III), they do not extend far enough south to include the primary hybridization area around Maura Joloi and the riverine habitat of the proboscis monkey — forest of prime zoogeographical importance. More comprehensive surveys will surely identify other areas of major importance.

Fig. 8 (left). Sonogram tracings of a selection of female great calls, with some male codas, recorded in Barito Ulu in 1986 (see text, Table 2 and Fig. 7; figure provided by authors).

The application of such survey information, through the construction and implementation of management plans, would lead to a pattern of long-term, sustained forest use of benefit to both humans and wildlife. Plans should afford total protection to areas of greatest biological importance so that regeneration of nearby production forest may be guaranteed. Project Barito Ulu aims to elucidate the relevant biological processes more fully. At present, there are great risks that the development of natural resources, essential to the economy in Kalimantan, will jeopardize the wildlife, and the people, needlessly.

David J. Chivers  
Sub-dept. of Veterinary  
Anatomy  
University of Cambridge  
Tennis Court Road  
Cambridge CB2 1QS  
U.K.

Kenneth M. Burton  
Department of Biology  
Indiana University  
Bloomington, IN 47405  
U.S.A.

#### Acknowledgments

We thank those who made the 1986 reconnaissance possible. For their administrative, logistical, or scientific support: S. Sastrosumarto (Director-General, Agency for Forestry Research and Development in Jakarta), K. Somoarna (Director, Forest Research and Development Center in Bogor) and his staff, J. P. Djandam (Head of the Forestry Department of Kalimantan Tengah), officials in Palangka Raya, Forest Department officers in Kalimantan Tengah, the manager and staff of P. T. Tunggal Pamenang, scientists of the Museum Zoologicum Bogoriense, especially Mr. Boeadi and Mr. Noerdjito, and C. Darsono, his family and staff in Jakarta. For their organization, companionship and field assistance: R. Ridgeway, D. Natawiria, M. Kalinting, Z. Abidin and Mr. Bulandi. For their financial support, among others: the Royal Society (London), the University of Cambridge Travelling Expenses Fund, the British Council, Sir Malcolm MacDonald and Partners, and Royal Dutch Airlines.

For the comfort and success of his time in Palangka Raya, K. Burton thanks Volunteers in Asia, Inc., Palangka Raya University, the Department for Conservation and Protection of Nature in Palangka Raya and Kumai, and the Green Indonesia Foundation, Bogor, for graciously permitting him to participate in the Barito Ulu Reconnaissance.

Above all, we both express our profound thanks to J. Marshall for all his assistance, skill, enthusiasm, and humor.

#### Literature Cited

- Bennett, E.L. 1984. The banded langur: Ecology of a colobine in West Malaysia. Unpubl. Ph.D. thesis, University of Cambridge, Cambridge.
- Bennett, E.L. 1986. *Proboscis Monkeys in Sarawak: Their Ecology, Status, Conservation and Management*. WWF Project MAL 63/84, Kuala Lumpur.
- Berenstain, L. 1986. Responses of long-tailed macaques to drought and fire in eastern Borneo. *Biotropica* 18: 257-62.
- Bismark, M. 1980. *Populasi dan tingkahlaku bekantan (Nasalis larvatus) di suaka margasatwa Tanjung Puting, Kalimantan Tengah*. Laporan no. 357, Lembaga Penelitian Hutan, Bogor.
- Caldecott, J.O. 1986. An ecological and behavioural study of the pig-tailed macaque. *Contrib. primatol.* 21: 1-259.
- Chivers, D.J. 1977. The lesser apes. In: *Primate Conservation*, Prince Rainier and G.H. Bourne, eds. Academic Press, New York, pp. 539-98.
- Chivers, D.J., ed. 1980. *Malayan Forest Primates: Ten Years' Study in Tropical Rain Forest*. Plenum Press, New York.
- Chivers, D.J. 1986. South-east Asian primates. In: *Primates: The Road to Self-Sustaining Populations*, K. Benirschke, ed. Springer-Verlag, New York, pp. 127-51.
- Crockett, C.M. and W.L. Wilson. 1980. The ecological separation of *Macaca nemestrina* and *M. fascicularis* in Sumatra. In: *The Macaques*, D. Linburg, ed. Van Nostrand Reinhold, New York, pp. 148-81.
- Crompton, H.W. and P.M. Andau. 1987. Ranging, activity patterns, and sociality in free-ranging *Tarsius bancanus*: A preliminary report. *Int. J. Primatol.* 8: 43-71.
- Curtin, S.H. 1976. Niche separation in sympatric Malaysian leaf-monkeys (*Presbytis obscura* and *Presbytis melalophos*). *Yb. Phys. Anthropol.* 20: 421-39.
- Davies, A.G. 1984. An ecological study of the red leaf monkey (*Presbytis rubicunda*) in the dipterocarp forests of northern Borneo. Unpubl. Ph.D. thesis, University of Cambridge, Cambridge.
- Fittinghoff, N.A. 1975. Riverine refuging in East Bornean *Macaca fascicularis*. *Amer. J. phys. Anthropol.* 42: 300-01.
- Galdikas, B.M.F. 1978. Orang-utan adaptation at Tanjung Puting Reserve, Central Borneo. Unpubl. Ph.D. thesis, University of California, Los Angeles.
- Galdikas, B.M.F. 1981. Orang-utan reproduction in the wild. In: *Reproductive Biology of the Great Apes*, C.E. Graham, ed. Academic Press, New York, pp. 281-300.
- Galdikas, B.M.F. 1984. Adult female sociality among wild orang-utans at Tanjung Puting Reserve. In: *Female Primates*, M.F. Small, ed. Alan R. Liss, New York, pp. 217-36.
- Galdikas, B.M.F. 1985. Subadult male orang-utan sociality and reproductive behavior at Tanjung Puting. *Am. J. Primatol.* 8: 87-99.
- Groves, C.P. 1970. The forgotten leaf-eaters, and the evolution of the Colobinae. In: *Old World Monkeys*, J.R. and P.H. Napier, eds. Academic Press, New York, pp. 555-88.
- Leighton, D.R. 1987. Gibbons: territoriality and monogamy. In: *Primate Societies*, B.B. Smuts, D.L. Cheney, R.M. Seyfarth, R.W. Wrangham and T.T. Struhsaker, eds. Chicago University Press, Chicago, pp. 131-45.
- Lindburg, D.G. ed. 1980. *The Macaques: Studies in Ecology, Behavior and Evolution*. Van Nostrand Reinhold, New York.
- MacKinnon, J.R. 1974. The behavior and ecology of wild orang-utans (*Pongo pygmaeus*). *Anim. Behav.* 22: 3-74.
- MacKinnon, K.S. 1986. The conservation status of nonhuman primates in Indonesia. In: *Primates: the Road to Self-Sustaining Populations*, K. Benirschke, ed. Springer-Verlag, New York, pp. 99-126.
- Marshall, J.T. and E.R. Marshall. 1976. Gibbons and their territorial songs. *Science* 193: 235-37.
- Marshall, J.T. and J. Sugardjito. 1986. Gibbon systematics. In: *Comparative Primate Biology, Vol. 1: Systematics, Evolution and Anatomy*, D.R. Swindler and J. Erwin, eds. Alan R. Liss, New York, pp. 137-85.
- Marshall, J.T., J. Sugardjito and M. Markaya. 1984. Gibbons of the lar group: relationships based on voice. In: *The Lesser Apes*, H. Preuschoft, D.J. Chivers, W.Y. Brockelman and N. Creel, eds. Edinburgh University Press, Edinburgh, pp. 533-41.
- Medway, Lord. 1977. *Mammals of Borneo. Field Keys and Annotated Checklist*. Monographs of the Malaysian Branch of the Royal Asiatic Society, No. 7, Kuala Lumpur.
- Mitani, J.C. 1984. The behavioral regulation of monogamy in gibbons (*Hylobates muelleri*). *Behav. Ecol. Sociobiol.* 15: 225-29.
- Mitani, J.C. 1985a. Gibbon song duets and inter-group spacing behavior. *Behav.* 92: 59-96.

Mitani, J.C. 1985b. Response of gibbons (*Hylobates muelleri*) to self, neighbor and stranger song-duets. *Int. J. Primatol.* 6: 193-200.

Mitani, J.C. 1985c. Sexual selection and adult male orang-utan loud calls. *Anim. Behav.* 33: 272-83.

Payne, J. and C.M. Francis, 1985. *A Field Guide to the Mammals of Borneo*. Sabah Society and WWF-Malaysia, Kuala Lumpur.

Preuschoft, H., D.J. Chivers, W.Y. Brockelman and N. Creel, eds. 1984. *The Lesser Apes: Evolutionary and Behavioural Biology*. Edinburgh University Press, Edinburgh.

Rijksen, H.D. 1978. *A Field Study of Sumatran Orang-utans (Pongo pygmaeus abelii, Lesson 1827): Ecology, Behaviour and Conservation*. H. Veeman & Zonen BV, Wageningen.

Robertson, J.M.Y. 1986. On the evolution of pig-tailed macaque societies. Unpubl. Ph.D. thesis, University of Cambridge, Cambridge.

Rodman, P.S. 1973. Population composition and adaptive organization among orang-utans of the Kutai Reserve. In: *Comparative Ecology and Behaviour of Primates*, R.P. Michael and J.H. Crook, eds. Academic Press, London, pp. 171-209.

Rodman, P.S. 1978. Diets, densities and distributions of Bornean primates. In: *The Ecology of Arboreal Folivores*, G.G. Montgomery, ed. Smithsonian Institution Press, Washington, D.C., pp. 465-78.

Rodman, P.S. and J.C. Mitani. 1987. Orang-utans: sexual dimorphism in a solitary species. In: *Primate Societies*, B.B. Smuts, D.L. Cheney, R.M. Seyfarth, R.W. Wrangham and T.T. Struhsaker, eds. Chicago University Press, Chicago, pp. 146-54.

Salter, R.E., N.A. MacKenzie, N. Nightingale, K.M. Aken and P.P.K. Chai. 1985. Habitat use, ranging behaviour and food habits of the proboscis monkey *Nasalis larvatus* in Sarawak. *Primates* 26: 436-51.

Sugardjito, J. 1978. Behavioural ecology of the dark-handed gibbon, *Hylobates agilis albibarbis*, in Kalimantan Tengah, Indonesia. Unpubl. Ph.D. thesis, Universitas Nasional, Jakarta.

Sugardjito, J., I.J.A. Te Boekhorst and J.A.R.A.M. Van Hooff. 1987. Ecological constraints on the grouping of wild orang-utans (*Pongo pygmaeus*) in the Gunung Lesser National Park, Sumatra, Indonesia. *Int. J. Primatol.* 8: 17-41.

Supriatna, J. 1979. Aktivitas dan pergerakan lutung merah (*Presbytis rubicunda*) di cagar alam Tanjung Puting, Kalimantan Tengah. Unpubl. Ph.D. thesis, Universitas Nasional, Jakarta.

Supriatna, J.B.O. Manullang and E. Soekara. 1986. Group composition, home range and diet of the maroon leaf monkey (*Presbytis rubicunda*) at Tanjung Puting Reserve, Central Kalimantan, Indonesia. *Primates* 27: 185-90.

UNDP/FAO. 1981. *National Conservation Plan for Indonesia, Vol. 5, Kalimantan*. Field Report 17, FO/INS/78/051. F.A.O., Bogor.

Wheatley, B.P. 1978. Foraging patterns in a group of long-tailed macaques in Kalimantan Timur, Indonesia. In: *Recent Advances in Primatology, Vol. 1: Behaviour*, D.J. Chivers and J. Herbert, eds. Academic Press, London, pp. 347-49.

Yeager, C. 1987. Behavioral ecology of the proboscis monkey (*Nasalis larvatus*) (abstract). *Amer. J. Primatol.* 12: 377.

## Status of Primates in the Pagai Islands, Indonesia: A Progress Report

by Richard R. Tenaza

This is an update on primate conservation in the Pagai Islands. It is based mainly on work conducted in the Pagais from 8 September to 16 December 1987. Project objectives during this period were to learn more about threats to the existence of Pagai primates, to seek ways to reduce those threats, to evaluate an area in South Pagai as a possible nature reserve or national park site, and to establish a base camp for continued studies at that site.

*Simias concolor*, *Hylobates klossii*, *Macaca pagensis*, and *Presbytis potenziani* are endemic to the four Mentawai Islands (references in Tenaza, 1987). The recent IUCN Action Plan for Asian Primate Conservation considered all four species to be endangered and ranked *Simias concolor* and *Macaca pagensis* among the eight most highly endangered primates in all of Asia (Eudey, 1987). The Action Plan also emphasized the importance of (1) establishing a reserve in the Pagai Islands to protect the southern subspecies of Mentawai primates, and (2) starting a captive breeding program.

### Poisoning of Primates

Earlier I reported that Union Carbide's powdered pesticide 'aldicarb' was used to poison Pagai macaques for their depredations on coconuts (Tenaza, 1987). During the last field season I found that islanders also use aldicarb to poison Mentawai langurs (*Presbytis potenziani*) because langurs eat bananas from gardens. Sale of aldicarb in Sikakap was officially banned early in 1987 after a man from a South Pagai village was charged with using it to murder another man. Nonetheless, in December 1987, islanders still were using this pesticide to poison primates.

### Hunting

The Christianization of an ancient Mentawai animistic rite now prompts the Saturday hunting of *Simias* to provide ritual meat for the Sunday sabbath (Tenaza, 1987). About 85% of Pagai natives are Lutheran. I therefore sought advice from the Reverend Melki Tatubeket, head of the Mentawai Lutheran Church, about how to curb the Sabbatical slaughter of *Simias*. The minister was strongly opposed to any attempt to stop islanders from hunting *Simias*. He argued that hunting *Simias* is an old tradition and an enjoyable pastime that should not be tampered with. Other Mentawai Lutheran church leaders I interviewed expressed similar views. Most of them hunt *Simias* themselves.

Air rifles loaded with poisoned pellets are replacing traditional bows and poisoned arrows as the Pagai islanders' favored weapons for shooting primates (Tenaza, 1987). Because a rifle pellet holds much less poison than an arrow point does, a monkey hit by a poisoned pellet takes longer to die than one struck by an arrow. Often wounded animals escape and die elsewhere, lost to the hunter.

Early in 1987, the government of West Sumatra, the province which includes the Mentawai Islands, officially banned the use of air rifles in Mentawai. However, the sale and possession of air rifles remains legal, and the use-ban is not enforced. If Pagai wildlife is to be protected, both the sale and possession of air rifles must be outlawed, and the laws enforced. [Earlier I mistakenly reported that .22 caliber air rifles are used in Pagai (Tenaza, 1987). Actually, use of .22 caliber air rifles is restricted throughout Indonesia; the smaller .177 caliber is used.]

### Islet Populations of *Simias*

In 1986 I discovered that two uninhabited islets off southeast South Pagai have primates on them: Simalegu Island (area ca. 200 ha) has a

population of *Simias*, and Sinakak Island (area ca. 600 ha) has populations of all four Mentawai primates. I heard from locals that nearby Berikopek and Simatapi Islands also were populated by *Simias*. In 1986 I searched both of these islands but found no primates (Tenaza, 1987) until I tried again in 1987.

#### Simatapi Island.

On 18 September 1987, D. Pohlman and C. Moller (visiting American students) saw a group of three dark-phase and two pale-phase *Simias* in forest adjacent to gardens on Simatapi Island. Locals told me they frequently see *Simias* by their gardens on Simatapi, and that sometimes they are able to shoot them there. On the morning of 13 October 1987, I saw a dark-phase *Simias* infant that a Mr. Panoko had just captured alive in his garden — proof that in 1987 *Simias* was still reproducing on the island.

The Simatapi Island village is called Sinakak, not to be confused with uninhabited Sinakak Island immediately to the north of Simatapi. Sinakak village has ca. 200 residents who live in 40 single-family houses. Two-thirds or more of Simatapi's approx. 250 ha is garden, village, and severely-disturbed forest. The remaining forest is being cut away for gardens. As many as 15-20 *Simias* may be left on Simatapi. These animals should be captured for captive breeding instead of being left to the mercy of hunters and habitat loss.

*Macaca* and *Presbytis* raid native gardens throughout Pagai, but Simatapi is the only place I know of where *Simias* eats cultivated plants. According to Simatapi's residents, the monkeys eat tapioca leaves and bananas in their gardens. This suggests a paucity of natural foods for *Simias* on the island, not a surprising conclusion considering how little forest is left.

#### Berikopek Island.

We found no primates on Berikopek, even though visibility was good because the forest is very open from heavy logging. Had primates been present, I think we would have seen them. It appears that Berikopek's primates have been poisoned (Tenaza, 1987) and hunted to extinction in recent years. Local hunters reported killing *Simias* on Berikopek as recently as five years ago.

#### Simalegu Island.

On Simalegu, *Simias* were more difficult to locate in 1987 than they had been in 1986, suggesting their numbers had decreased. Potipar, a man from Sinakak Village, confirmed my suspicion that hunters had reduced the number of *Simias*. Potipar spends much time on Simalegu tending his coconut trees along the eastern edge of the island. He told me he knew of five *Simias* that had been killed on Simalegu between July 1986 and September 1987 by hunters from the villages of Sinakak and Matotonan. It is likely that others were killed that he did not know about. In December 1987, while I was still in the area, a man from the village of Matotonan killed a pale-phase *Simias* on Simalegu. This happened after the *kepala desa*, or area chief, had assured me he had put a stop to hunting on Simalegu and Sinakak.

To facilitate observations of *Simias* on Simalegu, in 1987 my assistants and I cleared, marked (at 25 m intervals), and mapped 7 km of trail on the island. This network gave access to about 150 of Simalegu's 200 ha. Based on our surveys, we estimated that in late 1987 there were approximately 40 *Simias* on Simalegu. I had estimated 60-100 in June 1986.

#### Sinakak Island.

Spelled 'Sinaka' on some old maps and in my earlier report (Tenaza, 1987), Sinakak Island has an area of approximately 600 ha. A kilometer-wide expanse of permanently inundated mangrove forest connects it to South Pagai and allows the migration of primates between Sinakak and

South Pagai. During the 1987 season, my Indonesian collaborators B. Djaya and A. Januar marked and mapped 13 km of trails on Sinakak Island.

#### Primate Population Densities in the Sinakak Study Area

Extrapolating from counts B. Djaya and I made in the 300 ha Sinakak study area, I have made the following rough preliminary estimates of the numbers of primates on Sinakak Island: *Simias*, 120; *Presbytis*, 40; *Macaca*, 50; *Hylobates*, 100. These give a density of 52 primates/km<sup>2</sup> (20 *Simias*, 7 *Presbytis*, 8 *Macaca*, 17 *Hylobates*).

#### Transmigration

'Transmigration' is a program aimed at relieving poverty and overcrowding in Indonesia's 'inner islands,' particularly Java, by resettling landless rural poor to the less populated outer islands of Irian Jaya (Indonesian New Guinea), the Moluccas, Sulawesi (Celebes), Kalimantan (Indonesian Borneo), and Sumatra. Other objectives of the program are (1) to speed up economic development of the outer islands by increasing their populations, and (2) to increase national food production by having transmigrants convert forest to agricultural land (USAID, 1987).

From 1979 to 1984 a total of 365,977 families, comprising about 1.5 million people, were officially transmigrated to the outer islands. Of those, 62% went to Sumatra. These figures do not include those who moved to the outer islands before 1979, nor the many thousands who moved after 1979 without government sponsorship (USAID, 1987).

According to records in the Transmigration Office in Padang, the capitol of West Sumatra, 620 km<sup>2</sup> in the Mentawai Islands are earmarked for transmigration. This includes 100 km<sup>2</sup> in South Pagai, 100 km<sup>2</sup> in North Pagai, 120 km<sup>2</sup> in Sipora, and 300 km<sup>2</sup> in Siberut. By December 1987, about 270 transmigrant families had settled near Tuapejat, northern Sipora. Transmigration to North Pagai was scheduled to begin in 1988. The Department of Transmigration's plan is to resettle 2,500 families to Siberut and 1,100 families to Sipora by 1994. I have not seen documents disclosing the numbers of transmigrant families to be settled in the Pagai Islands. However, based on the ratio of transmigrants to transmigration land area in Sipora and Siberut, probably 1,600-1,800 families will be settled in the Pagais by 1994. Transmigration to Mentawai is planned to continue beyond 1994, but projections of anticipated numbers were not available in Padang.

Between 1950 and 1984, the average size of all transmigrant families moved was 4.1 (USAID, 1987: 3-11). Assuming similar family size for transmigrants to Mentawai, and assuming at least 1,600 families will be moved to the Pagais, more than 21,000 people will be moved to Mentawai by 1994 (if the program proceeds on schedule). Transmigrants will change rainforest to croplands. They will plant subsistence crops, and cash crops such as clove, coconut, and citrus fruits for export to Sumatra.

#### Forest Clearing for Native Gardens

Pagai Islanders produce a more than adequate supply of food by gardening and fishing. Most, however, find it difficult or impossible to make money to buy enough cigarettes, clothing, cooking utensils, and other manufactured goods to satisfy their wants. Ninety-five percent or more of adult islanders are tobacco addicts. The most consuming problem the majority face every day is how to get enough money to buy cigarettes, and the average islander spends more money on cigarettes than on any other commodity.

To raise cash to buy cigarettes and other goods, Pagai men cut down rainforest to plant more cash crops, mainly cloves and coconut for copra. Clove is planted on well-drained slopes and hilltops, both along the coast and inland, whereas coconuts are planted mainly on flat ground close to the sea. By 1987, several forest areas where I found primates in 1986 had been cleared for clove gardens. On Sinakak Island, men from



Simatapi had cleared 30 ha of forest understory vegetation in preparation for clearcutting the forest to plant cloves. After my arrival in September 1987, they went ahead and cut down 10 ha of forest on Sinakak Island, but they agreed to temporarily stop hunting and further forest clearing to give me time to explore conservation measures that could benefit both them and the wildlife.

Patchouli (*Pogostemon patchouli*) has recently been introduced to Mentawai as a cash crop for export mainly to the United States, where the oil extracted from the dried leaves is used in perfumes. In N.E. Siberut 500 ha of patchouli has been planted and a small factory to extract patchouli oil built. Residents of Bubuget in S.E. South Pagai have planted 38 ha of patchouli, to my knowledge Pagai's first patchouli field. In December 1987, I met a provincial government agricultural advisor from Pariaman who was in South Pagai encouraging islanders to clear more forest to plant patchouli. I was told by botanists in Padang, however, that planting patchouli in Mentawai is not advisable. If planted on newly cleared lowland rainforest land in Sumatra it usually grows satisfactorily for three years, after which it requires fertilization. The islanders do not have access to commercial fertilizers, nor do they keep enough animals to produce sufficient quantities of manure to be used for fertilizer. One village chief in South Pagai wants to start collecting human excrement for fertilizer.

### Rattan Harvesting

Pagai men also fell trees to collect the large rattan called *manau*. It is sold to traders for export to Sumatra. The tops of these vine-like palms grow hooked securely to crowns of trees, often 30 m or higher in the rainforest canopy. Particularly skilled tree climbers climb to cut *manau*, but most men choose the safer method of cutting down the trees that support *manau*. To get a single *manau* vine, a Pagai man usually cuts down at least one large tree, and often two or three. Thousands of trees must have been killed in Pagai during the 1987 *manau* rush. Earlier (Tenaza, 1987) I underestimated the damage to forest caused by *manau* collecting.

The price of *manau* fluctuates strongly. In 1987 islanders were paid the equivalent of US \$1.25 per 3 m length of best quality (largest diameter) *manau*, more than 500% over the 1986 price of US \$0.23 per 3 m length. In 1986 few men collected *manau*, but in 1987 many worked hard at it. When the 1987 *manau* rush was over, only *manau* too small to sell was left in the forests.

After *manau* became too scarce to bother looking for, men either stopped collecting rattan or shifted their attention to smaller rattans known as *tabu-tabu* and *sago*. In late 1987, islanders were paid US \$0.09 per 4 m length for *tabu-tabu*, and US \$0.09 per 6 m length for *sago*. Often a man standing on the ground can simply pull these smaller vines free from the trees. Harvesting *tabu-tabu* and *sago* is less damaging to forest, therefore, than harvesting *manau*.

### Logging

As I described earlier (Tenaza, 1987), commercial selective logging continues on North Pagai. The only news I have to report on this subject is a story I heard from a logging company official that his company has been asked repeatedly by Forestry Department officials to stop selective logging and start clearcutting their concession in the Pagai Islands. Clearcutting could facilitate agriculture, softwood production, and transmigration, but would be detrimental to the environment, wildlife, and valuable hardwoods that are currently the base of commercial logging in Mentawai (cf. USAID, 1987: 1-19 ff). The logging company, I was told, would prefer to keep selectively-logged forests in the Pagai concession commercially productive by planting and harvesting *manau* rattan in the logged areas. From the environmental perspective, that certainly would be preferable to clearcutting.

### Pet Trade

The biggest change I noted in the pet trade is that the lowest price islanders charged for Kloss's gibbon infants has apparently increased. In 1986 I was offered young gibbons for about US \$27, but in 1987 none were available for less than US \$90. Prices appeared to have been driven up by personnel on foreign lumber ships. Sikakap residents told me that early in 1987 a man on one of these ships traded a television set for a gibbon, and that others on foreign ships recently had paid the equivalent of up to US \$300 in cash for infant gibbons. Several islanders in South Pagai told me that whenever they can they kill female gibbons to sell their infants.

### Desirability of Establishing Captive Breeding Programs

Census records indicate Pagai's indigenous population is increasing at 7.3% per year (Tenaza, 1987). At that rate, the native population will double in less than ten years. Combined with the projected influx of transmigrants, it is inevitable that thousands of Pagai primates will perish through habitat loss in the next few years. To help conserve these subspecies, I recommend capturing as many animals as possible in places where their habitat faces certain destruction, and putting them into captive breeding programs. They could be conditioned to captivity before being moved from Pagai (Tenaza, 1987). In addition to breeding Pagai primates in qualified zoos, it would be desirable to manage colonies of free-ranging animals on uninhabited islands off Java. Introduced populations would be easier to protect and more accessible for management and research there than on islets in Mentawai.

To my knowledge, neither *Simias* nor *Presbytis potenziani* has ever been exported alive from the Mentawai Islands. Hunters often attempt to keep *Simias* and *Presbytis* infants alive after killing their mothers. Given only taro, bananas, and rice to eat, these infants invariably die within a few days. In 1971, I kept an infant *Simias* alive and healthy for two months on a diet of leaves, fruits, milk (fed by bottle), fiddler crabs, and fresh water shrimp. Lice also had to be controlled.

Someone with extensive experience managing captive leaf monkeys must be involved full-time in any effort to capture, manage, or move *Simias* or *Presbytis*, especially since details of the care necessary to keep these animals alive have not yet been worked out. Kloss's gibbons and Pagai macaques, on the other hand, may survive months or years in captivity, even with poor care, as is often demonstrated by Pagai villagers and traders in Sikakap.

### Recommended Conservation Areas

I recommend designating Sinakak and Simalegu islands as conservation areas. Both would be relatively easy to patrol and protect. Simalegu warrants protection for its population of *Simias* alone, and an inventory of the island probably will provide even stronger justifications in terms of biological diversity. Sinakak Island deserves protection because it supports a rich fauna including populations of all four species of Mentawai primates, and a rich flora comprising several habitat types including lowland rainforest, swamp forest, *Rhizophora* stands, fields of mangrove fern, streams, and rivers.

Previously I suggested that a coastal strip of South Pagai and adjacent islets be made a conservation area (Tenaza, 1987: 109), but this is probably impractical. All the land in question is owned by indigenous residents, not by the government, and my earlier suggestion does not give adequate consideration to their needs. From their viewpoint, land is getting scarce. In 1987, two villages had a dispute over the ownership of a small island off S.E. South Pagai. Both groups wanted it for gardens. To settle the matter the men of both villages met on the island and fought with knives and machetes. Such confrontations are likely to increase as population growth and cash-lust prompt more intense competition for cropland.

Simalegu and Sinakak are each owned by about fifty families. The local *kepala desa* called a meeting of the family heads involved to ask their opinions about relinquishing the islands for a nature reserve. There was 90% agreement among the owners of Simalegu that they would give the island up if they could profit from doing so. The consensus was easily reached because the swampy island has little potential for crop production. The few clove trees planted there are barely surviving. Along the east coast of the island there is a stand of mature coconut trees growing in a strip about 25 m wide, but this is the only land on Simalegu fit for coconuts. Although Simalegu's swamps will grow *sago*, only about one hectare has been planted and since left untended and not harvested. A man from Sinakak Village did tell me, however, that he wants to try raising pigs, chickens, and rice on Simalegu.

Sinakak Island, on the other hand, is more suitable for gardens. About 50 ha already are planted in bananas, clove, and rice, and several men from Sinakak Village want to cut down more of Sinakak Island's forests to plant food, cloves, and patchouli in December 1987. Sixty percent of Sinakak Island's owners, most of whom live in Sinakak Village, were willing to surrender it if they could profit from the transaction, but the others were undecided.

#### Establishment of a Base Camp on Sinakak Island

In 1987 I built a base camp by the S.W. coast of Sinakak Island, South Pagai (see map in Tenaza, 1987: 106). The Sinakak Island camp, 50 km by sea from Sikakap, is intended to become a base for conservation efforts and long-term studies of Pagai wildlife.

#### Summary

1. Despite an official ban on sale of aldicarb in Pagai, poisoning of macaques and Mentawai langurs with aldicarb continued unabated in 1987.
2. Availability of air rifles has increased hunting pressure on *Simias*. A 1987 government ban on use of air rifles in Mentawai was not enforced.
3. *Simias* were discovered on Simatapi Island in S.E. South Pagai. They should be removed for captive breeding before all are killed by hunting and habitat loss.
4. 620 km<sup>2</sup> of Mentawai rainforest is earmarked for transmigration, and more than 20,000 people from Indonesia's inner islands might be moved to Mentawai by 1994.
5. Indigenous inhabitants are rapidly turning rainforest to garden. Some rainforest areas where I watched primates in 1986 were clove gardens by 1987.
6. Pagai men felled trees to harvest the attached *manau* rattan. This caused considerable forest damage in 1987.
7. It is rumored that the logging company working Pagai is being pressured to stop selective logging and start clear-cutting.
8. Pagai primates in forests destined to be clearcut for gardens or other purposes should be saved for captive propagation.
9. A base camp for research on Pagai primates has been established on Sinakak Island in S.E. South Pagai.

Richard R. Tenaza  
Biology Department  
University of the Pacific  
Stockton, CA 95211  
U.S.A.

#### Acknowledgements

This work was supported by grants from WWF and WCI. R. Mittermeier and R. Mast at WWF, and C. Carr, W. Conway, and M. Pearl at WCI gave me advice and assistance. C. Darsono and his family provided invaluable help in Jakarta. The Indonesian Institute for Sciences

(LIPI) arranged governmental permission for my work. S.T. Alisjahbana and N. Suleiman arranged my sponsorship by Universitas Nasional in Jakarta. B. Djaya and A. Januar of Universitas Nasional were my Indonesian counterparts. C. Moller helped me in Pagai for four weeks; A. Hetrick and D. Pohlman helped there for six weeks. R. Simanjuntak of Sikakap was my head field assistant. West Sumatra's Lieutenant Governor DRS. H. Sjoerkani assisted me repeatedly in Padang. I thank Prof. Dr. Emil Salim, Indonesia's Minister of Population and Environment, for hearing my arguments for setting up conservation areas in the Pagai Islands.

#### Literature Cited

- Eudey, A.A. 1987. *IUCN/SSC Primate Specialist Group Action Plan for Asian Primate Conservation: 1987-91*. UNEP, IUCN, WWF.
- Tenaza, R. 1987. The status of primates and their habitats in the Pagai Islands, Indonesia. *Primate Conservation* 8: 104-10.
- USAID. 1987. *Natural Resources and Environmental Management in Indonesia*. Jakarta, Indonesia.

# Global

The following two papers were presented at the XIIth Congress of the International Primatological Society in Brasilia, 24-29 July 1988.

## Comments on Conservation Awareness in India

by Major General E. D'Souza

India, a developing country, is required to draw a line between necessary economic development and equally important conservation. We are a multilingual, multireligious and multiethnic society with 14 major languages, 12 scripts, and a literacy rate of 43% — a mind-boggling challenge to communicators and educators. The demographic pressures of 800 million people and 400 million head of livestock competing for the same limited arable land have resulted in the loss of essential forest cover.

However, religion and diet afford much protection to the primate species. Lord Hanuman, the monkey God, is revered, and at least 50% of the population is vegetarian. Some trees like the Bo, under which Lord Buddha meditated, are venerated, and grow throughout the country in sacred groves. The 17 Project Tiger reserves, national parks, sanctuaries and reserved forests contribute to the protection of precious forest cover, now only about 11% of India's land area, ideally closer to 30%. A National Wastelands Board has been instituted to reforest degraded lands.

It is difficult to have a national awareness campaign. Thus, three major categories are being addressed: the youth of India who will inherit the land; rural India, which is totally dependent on natural resources for shelter, fuel, food, fodder and water; and the Armed Forces, a source of disciplined manpower deployed in remote, ecologically-rich areas.

### Youth

Literacy levels among the young are high. The outreach to youth is through organizations like the Nature Clubs of India, national and state-level nature orientation camps conducted in national parks and sanctuaries by volunteers trained at National Leadership Camps and Environmental Education Workshops. Holding such camps at the national level has a multiplier effect and allows ideas to cross-fertilize. AVs, films, exhibitions, and literature play their role. The limiting factor is the lack of funds.

### Rural Areas

Low literacy levels, centuries-old traditions, inaccessibility, and lack of communication are inhibiting factors. What is needed is personal contact and models. For example, when Project Tiger was first introduced to villagers in the Bandipur Project Tiger Reserve, it was received sceptically. The villagers wanted to know what sense there was in protecting tigers when women of the village had to trudge from 10 to 15 km for a headload of water, fodder or fuel. Ten years later, after the forests had regenerated, five dry stream beds again had running water, and other forest produce was readily available. The importance of carrying the conservation message to village women became apparent.

### The Armed Forces

The Armed Forces represent a captive audience in India, therefore, their involvement in protecting the habitat and in reforestation is of paramount importance. A visible dent has been made through awareness pro-

grams featuring talks, presentations, films, AVs and workshops. For the last five years for example, presentations have been made at the prestigious Defence Services Staff College to potential decision makers. Similar presentations have been made in important Schools of Instruction. Two major workshops of ten days' duration have been held in sanctuaries for officers at the Army Command level. Every officer cadet graduating from the National Defence Academy undergoes a crash course in conservation, and many attend National Nature Orientation Camps.

India is the only country to have raised Ecological Territorial Army Battalions. Personnel of these units are ex-servicemen recruited to function in their own areas. Two such units have been operating in the Himalayas to protect forests and promote afforestation. One unit is operating along the Macro Ganga Canal running through the Thar Desert, planting and nurturing trees. Two more such units are being trained. Army and Navy officers are being appointed honorary wildlife wardens. Air Force officers, as standard operating procedure, report on species sighted and on degradation. Each large Army Formation has a Conservation Cell. The greening of Army Cantonments is an ongoing process and the results serve as good examples of tree planting for local civilians. The very presence of Armed Forces personnel acts as a deterrent to poachers.

### Other Problems

Consumerism in affluent Western countries results in the cutting down of forests in less developed countries. The boast of certain Western nations that their forests are preserved is a hollow one, as it has been achieved at the expense of Third World forests.

Population control and conservation go hand in hand in the Third World. In India, demographic pressures cause serious deforestation problems. The two cannot be separated. Both have to be treated together and the solution is education.

The Third World certainly depends on Western know-how. However, the export of this important commodity must not be forcefully imposed but subtly transferred to the local population while encouraging its involvement and making full use of its knowledge.

### Conclusion

There is little doubt that the conservation of nature and natural resources is of the utmost importance, particularly in the Third World. Best results can be achieved through education awareness programs which appeal to the local people, *i.e.* those produced in a style and language they can understand and offering a result which will improve the quality of their lives — a difficult aim to achieve where there is a constant clash between economic development and conservation.

Major General E. D'Souza (Rtd.)  
E-22, Cozihom  
251 Smt. Nargi's Dutt Road  
Bandra  
Bombay 400 050  
INDIA

## Primates, Forest Conservation and Development

by Clive Marsh

Since most primates live in moist tropical forests, the central issue for any discussion of primate conservation and development is the loss of such habitats. Primates are, of course, only one of numerous taxa under threat. Indeed, primates are biologically not an ideal indicator group, since most species have rather generalized feeding habits compared to, say, birds or insects, and thus survive certain kinds of disturb-

ance quite well. However, primates occur in all three tropical continents and play a dramatic "flagship" role in drawing attention to the plight of tropical forests. Moreover, if only for the limited professional reason of preserving their subject matter, primatologists simply cannot ignore the wider problems of conservation.

A small but important field of primate ecology is concerned with assessing the impact of different kinds of habitat disturbance and fragmentation (Marsh *et al.*, 1987). These include the harvesting of non-timber forest produce, understory clearance for shade-demanding crops, small clearings for shifting cultivation, mechanized logging, fire, inundation, and large-scale clearance. The subject of this paper, however, is not the consequences of disturbance but its causes. To understand these requires a broader view of forest land use in the context of development. The first part of the paper outlines a three-stage model of the development of tropical forest land use. This is illustrated with particular reference to the East Malaysian state of Sabah. Each phase of development presents differing challenges to conservation, and the second part of the paper reviews opportunities for and constraints on action at local, national and international levels.

### Stages in the Development of Forest Land Use

Current forest land-use trends in countries in the humid tropics parallel those that have occurred in temperate regions and to some extent reflect the development of societies as a whole. The sequence typically begins with low-intensity subsistence economies that have only a modest impact on the forest resource. Both hunter/gatherer and traditional shifting cultivation economies fall into this class. At this stage of development, large areas of forest typically remain unused, or passively conserved, and human use is roughly sustainable. Planning in the modern sense is usually non-existent, although traditional societies invariably have traditional customs and rules governing land tenure and fallow cycles, for example.

In recent times, traditional forest economies have been widely undermined either by pressure from immigrant farmers, or by more capital intensive forms of exploitation, such as timber extraction or cattle ranching. As generally practiced, these are pioneer activities which require large areas of land and are basically unsustainable. They constitute a second phase of development which is modern in the sense that it is planned or at least authorized by government and results in the opening up of a wide area by roads.

Logged-over tropical forests commonly take 50 or more years to regenerate but rarely get a chance to do so as other activities generally interfere. In so far as the commonly stated justification for logging is to generate revenue for more sustainable forms of development (permanent agriculture, industry, *etc.*), this can be referred to as "runway deforestation," by analogy to an aircraft striving to gain speed for take-off before reaching the end of the runway (Burns, 1986). Burns contrasts this with "treadmill deforestation" which he uses to describe progressive land degradation for immediate consumption without long-term capital gains.

A third phase of forest land use, which most of the developed world has entered, is characterized by a greater diversity of land use, from intensive agricultural production to total protection, and the stability of those uses within legally fixed boundaries. This phase is, at best, incipient in tropical countries, and it remains to be seen if and when they will maintain diversity and stability — and with what remaining forest.

To illustrate these three phases of forest land use and the problems they present, consider the case of the East Malaysian state of Sabah. Sabah is 73,700 km<sup>2</sup> in area, about 10% of the land area of Borneo, and is autonomous in matters relating to land use.

### Stage I: Traditional, Low-Intensity Forest-Use

Historically, Sabah has been inhabited by fishing people scattered around the coast and shifting cultivators living on the hills of the west

coast and interior districts and occupying about one fifth of the total land area. Eastern Sabah and adjacent parts of northern Kalimantan (Indonesian Borneo) have traditionally been virtually unpopulated and, until about 1960, constituted a good example of passive conservation. At the low population densities prevailing in Borneo (usually less than 10 persons per km<sup>2</sup>) shifting cultivation of dry rice is a viable and economically sustainable activity. Indeed, in conditions of high rainfall, steep land and poor soils, shifting cultivation is arguably the optimum form of agriculture (Hatch, 1982). Contrary to much popular belief, shifting cultivation in Borneo principally clears old secondary vegetation rather than primary forest (Chin, 1987) and results in relatively little soil erosion, except at high population densities, when the system breaks down anyway due to fallow periods inadequate to suppress weeds (Hatch, 1982).

On the other hand, an integrated shifting cultivation economy always includes hunting, fishing, and the collection of non-timber forest produce, which tend to cause local depletions, particularly of large animals and large rattan canes. In western Sabah, for example, the orang-utan and Sumatran rhinoceros have probably always been scarce due to hunting and are now all but extinct (Davies and Payne, 1982).

A word of caution on the subject of shifting cultivation: while even today in unlogged parts of Borneo, shifting cultivation is relatively benign and sustainable, the same cannot be said of all other parts of Southeast Asia. In upland regions of the Philippines, Thailand, and Indo-China, more seasonal climates and higher population densities make the system much less stable. Land shortages in the lowlands have also contributed to human invasion of the hill forests, often with disastrous results. "Forest farmers" of all kinds are by any reckoning the biggest single agent of forest loss worldwide (Myers, 1980). Thus, "sustainable" shifting cultivation is probably now a rarity and most forest farming is best considered a form of extensive modern exploitation, or a by-product of it.

### Stage II: Pioneering Forest Exploitation

The second phase of forest land use in Sabah began in earnest about 1960 and is now approaching its end. It has been characterized by widespread logging and use of the huge revenues generated for rapid, if often wasteful, development of other sectors of the economy.

From the mid-1950s onwards, several developments made Southeast Asian dipterocarp logs suddenly prominent on world markets, despite the fact that on a per volume basis dipterocarp species have never been as highly priced as, for example, teak or mahogany. Conveniently, the 150 or so species in Sabah dominate the forests and can be lumped into a handful of functional classes (*e.g.* red, white and yellow seraya), thus encouraging intensive extraction. On the technical side, bulldozers and chainsaws became readily available, thus greatly reducing the effort and costs of production. On the demand side, Japan emerged as a major industrial power with a big appetite for wood and has been followed by South Korea and Taiwan. Geography also favored the development of the industry: the sea distance to Japan is not great and the convoluted outline of the Malay archipelago keeps road haulage distances to the coast or navigable rivers relatively short.

From the standpoint of conservation, two of the most important aspects of the timber industry are its impact on traditional forest livelihoods and the sustainability of its production. Although few detailed studies have been made, it is clear that the effects of logging on traditional Bornean rural economies are profound (*e.g.* Caldecott, 1988; Marsh and Gait, 1988). Among the main physical effects are:

- silting of rivers, leading to reduced fish catches, reduced water quality for domestic use, and increased susceptibility to droughts and floods;
- reduced and altered wildlife availability for hunting (*e.g.* bearded pigs are greatly reduced while sambar deer may increase);
- reduced production of rattan canes and ilipe nuts (oil-yielding seeds

of certain dipterocarps) which are traditional sources of cash income;

- loss of land for cultivation through soil compaction and road construction.

Subtler but no less important social consequences stem from the construction of logging roads which replace foot and river transport:

- more numerous but temporary opportunities for local wage labor with logging companies;
- improved opportunities to sell rattan and wildlife products to outside traders which, combined with physical damage to stocks, leads to rapid resource depletion;
- improved access to consumer goods of all kinds, leading to greater reliance on the cash economy;
- improved access by government officials, including better technical services such as medical treatment, schools etc. These services encourage more settled living, which in turn leads to a gradual breakdown of the shifting cultivation cycle, but often without an adequate system of permanent agriculture to replace it;
- social disruption of traditional communities, especially by direct contact with loggers.

The immediate effect of logging is thus a boom in the local economy, followed by a slump when the company moves on and roads deteriorate. In the longer-term the subsistence economy is undermined, leading to urban migration by young people, greater dependency on the government, and general politicization. In Sabah, these trends have recently come to be recognized as a major problem requiring much greater efforts to promote *in situ* rural development (Kitingan, 1987a).

The second big issue for the timber industry is its sustainability, for in theory timber is an indefinitely renewable resource. To understand why this is not so in practice requires a brief digression into the history of tropical forestry practice, starting with the Malayan Uniform System (MUS) of forest management (Wyatt-Smith, 1963). Under this system, developed in the 1950s, all large trees are cut at a single felling and followed by poison-girdling of non-commercial species so as to favor a richer regeneration of dipterocarps at the end of the second rotation 60-100 years later. The system apparently worked well, given certain provisos (Tang, 1987).

Firstly, there should be a good crop of seedlings before logging. This requires a degree of control or luck that rarely occurs in practice, but if poison-girdling is abandoned (as it largely has been), a good mixed second crop is still possible.

Secondly, damage to seedlings by tractors must be minimized. This was easier in the 1950s and 1960s when extraction intensities were lower than today because fewer species were marketable. Heavy logging also encourages invasion by climbers and herbaceous weeds that smother tree seedlings. Control of damage therefore requires strictness and adequate funds to repair damage, for example, by climber cutting and replanting along tractor trails. This requirement is intrinsically unstable because the timber company generally has no vested interest in minimizing damage, and governments are reluctant to spend heavily on silvicultural treatment when the money could be spent on projects with much quicker returns (Leslie, 1987).

The third and most important requirement of the MUS, and indeed any forest management system, is that the forest be left alone while the second crop matures. In practice, many of the forests that were previously treated and monitored grew on good soils and have long since been converted to agricultural plantations. Hence, the remaining forest land under production is mostly in the hill forest where natural seedling stocking is generally poorer (Tang, 1987). Meanwhile, the timber industry has expanded greatly, increasing the political pressure to speed the rate of exploitation of virgin forest far above any sustainable rate. Worse yet, to take advantage of incremental growth in the residual stand, improved market conditions and lower extraction costs, areas have frequently been relogged within a few years of the first cutting.

The imbalances in this system are obvious. Firstly, the apparent profitability of the industry relies on the virtual absence of any long-term investment in regeneration after logging. Secondly, local people living in or downstream from a logging area suffer serious costs which are rarely acknowledged and still less adequately compensated for. Logging activities thus tend to concentrate rather than disperse wealth and to transfer it from rural to urban areas.

One might expect that such a rapacious system would require a heavy-handed, not to say dictatorial, government to survive. Yet, in Sabah, this is not so, as a severely exploitive timber industry thrives alongside a flourishing democracy. The simple truth here is that timber revenues — both private profits and government royalties — fuel the economy and are perceived as essential to development. Even rural populations derive some benefits, albeit often in the form of politically nominated projects. Meanwhile, the transitory nature of governments discourages present restraint in pursuit of future benefits. Therefore, the industry will probably continue in its present form for a further 5-10 years until depletion causes a sharp drop in production (Kitingan, 1987b). It remains to be seen whether the indirect development benefits accumulated since 1960 will be sufficient to avert a slump as the industry declines — in other words, whether runaway deforestation will be justified even from a limited economic perspective.

### Stage III: Towards Stabilized Forest Management

To identify a third phase of development in Sabah characterized by a post-timber economy is an act of prediction rather than description, for it has not yet arrived. Nevertheless, despite (or because of) its record of rapid timber depletion, Sabah has been forward-looking in a number of aspects of forest management, which augurs a more stable future. The state is also fortunate in having a population of less than 1.5 million people, and over 60% of its land still under some form of forest cover (Table 1), most of which will survive for a long time to come.

A. Vegetation Classification		
Types	Area (ha)	% Total Land Area
Mangroves	316,460	4.3
Swamp forest	198,849	2.7
Montane forest	771,561	10.5
Lowland forest	3,200,093	43.4
Primary	1,343,350	18.2
Secondary	1,856,743	25.2
Total forested area:	4,486,963	60.9
B. Land-Use Classification		
Permanent Forest Reserves	3,348,640	45.4
National and State Parks	247,187	3.4
Municipal water catchments	2,590	0.03
Forests scheduled for conversion to agriculture	888,546	12.1
Total forested area:	4,486,963	60.9
Data from Sabah Forest Department (Chai, 1987)		

Good forest management involves three main components — a protected-area system, an area of extensively managed natural production forest, and a smaller estate of intensively managed plantation forest. To conservationists, the protected-area system is the most important component. Sabah has a reasonably representative set of six kinds of pro-

tected areas totalling about 658,000 ha or 8.9% of the land area (Table 2). While Kinabalu Park is the most obvious and best developed attraction, lowland areas, such as Danum Valley and Tabin, have some of the most varied and abundant wildlife left in Borneo. While a few additions to this system may be possible, the main challenge for conservation is to hold and manage existing areas effectively and to retain logged-over forest around them to serve as buffer zones. What proportion of the state's biota will survive in the long-term in these areas is not known.

Table 2: Protected Areas In Sabah

Category	No. of Areas	Name	Size of Area (km <sup>2</sup> )	Category Sub-Totals (km <sup>2</sup> )	Notes
National Parks	1	Crocker Range	1,399	1,399	montane
State Parks	5			1,057	
		Mt. Kinabalu	754		montane
		Tawau Hills	280		partly disturbed
		Tunku Rahman	15		sea area excluded
		Pulau Tiga	7		— do —
		Turtle Islands	1		— do —
Protection Forest Reserves	28			1,000	
including:		Tawai Plateau	227		ultrabasic soils
		Bidu Bidu Hills	161		ultrabasic soils
		Mt. Lumaku	52		montane
		Timbun Mata	115		large island
Virgin Jungle Reserves	49			883	
including:		Sepilok	47		Orang-utan Center
		Maligan	93		montane heath
		Gomantong	18		limestone caves
		Sg. Imbak	181		remote interior
		Sepaguya/Silam	41		profile from coast to 1,000 m
Wildlife Reserves	2			1,411	
		Tabin	1,205		mostly logged
		Kulamba	206		swamp forest
Sabah Foundation Concession Areas	2			828	
		Danum Valley	438		mostly lowland
		Maliau Basin	390		mostly montane
			TOTAL: 6,578 km <sup>2</sup> (8.9% total land area)		

As for the second component of good forest management, extensive-ly managed natural production forestry, one important institutional initiative was the establishment of the Sabah Foundation in 1966. This organization was innovative in two ways. Firstly, it is a state-owned body charged with improving education and social welfare in the state using revenues generated from a variety of business interests, the chief of which is timber. Thus, in addition to normal timber royalties to the state, net profits are put to public use rather than retained privately. Secondly, its concession is large enough (973,000 ha, including about half of all remaining unlogged production forest in the state) and has been held for long enough (100 years) with enough management control to give the organization a vested interest in a sustainable off-take of timber. Two large areas have also been taken out of production and named as Conservation Areas. Although not immune to outside pressures,

first-cut production should last well into next century. The Sabah Foundation thus offers a rather better model for forest management than has been followed elsewhere in the state and by most other timber-producing countries. Sadly, in most cases it may now be too late for the establishment of comparable institutions.

The third component of stabilized forest management is the intensification of timber production through plantation forestry, which in Sabah has been carried out by three organizations stressing different objectives. Sabah Softwoods Sdn Bhd (misnamed because it grows mostly light hardwoods) was established in Tawau in 1974 as Malaysia's first (and so far only) large-scale commercial tree plantation. To date 29,000 ha have been planted, which produced a profit for the first time in 1987. The pioneering nature of this project has generated considerable interest worldwide (Golokin and Cassels, in press). Rather different in its aims is the Sabah Forest Development Authority (SAFODA), which was established in 1976 as a statutory body to plant forests on areas degraded to grassland, using labor from nearby communities. To date 22,000 ha have been planted at scattered sites mostly in the drier north of the state. A third project was initiated recently by Sabah Forest Industries Sdn Bhd to grow pulpwood for a papermill in the southwest of the state. An interesting aspect of this project has been encouraging shifting cultivators to interplant tree seedlings with their rice, with a view to selling the timber to the mill when they reclear the land eight years later. Plantation forestry is thus by no means a uniform activity: objectives, methods, funding and choice of species must all be carefully matched to local conditions.

Since tropical tree plantations are still considered dubious by many conservationists and foresters, we should be quite clear about their potential and limitations. What they cannot do is preserve species diversity to the same extent as even logged-over natural forests. The commercially preferred tree species are usually exotics, and although many ungulates and birds thrive in them, many other groups do not (see Duff *et al.*, 1984). Plantations are also a poor substitute for natural forest as sources of non-timber forest produce, and their role in watershed protection is probably no better than agricultural tree crops such as rubber or oil palm. Biologists are fond of pointing out the risk of pest and disease problems in plantations of only a few species (*e.g.* Lee, 1980). They are right to do so, but with adequate research effort these problems have not so far proved too serious. Fire, however, remains a serious hazard during occasional droughts such as occurred in 1983 (Beaman *et al.*, 1985; Malingreau *et al.*, 1985).

If plantations do not serve any of the main conservative functions of natural forest, why should we wish to promote them? The one good reason is that if the world needs timber, it is much better that it come from plantations than from dwindling stocks of mismanaged natural forest, or illegally from protected areas. To this extent, the development of plantations is a crucial element in stabilizing land-use patterns in the humid tropics, and also is likely to strengthen professionalism in forestry and to reduce pressure on protected areas. Therefore, conservationists should recognize that the wise development of plantation forestry is not generally contrary to their aims and does deserve the best efforts of research biologists and foresters to help it succeed. It is for this reason that both conservation *per se* and plantation forestry are identified as key objectives in the Tropical Forestry Action Plan (WRI, 1985). We may argue about the balance, but both protected areas and plantations have vital and complementary roles to play in saving tropical forests.

#### Opportunities for Forest Conservation

The model of forest development outlined above is at best an approximation of reality, because elements of all three "stages" can be seen today, even within a small state like Sabah. Nevertheless, an awareness of the development context is essential to planning appropriate conservation action. For example, recommendations for a complete system

of new protected areas are only sensible in countries with very large forest areas still at an early stage of development, such as Amazonia or Indonesia in the 1970s (see Wetterberg *et al.*, 1976; MacKinnon, 1982). On the other hand, sophisticated management plans of the kind now demanded of most North American national parks may be inappropriate in regions undergoing pioneering transformation, or in countries with poorly developed parks and wildlife services. In such circumstances, attaining even modest conservation objectives is a major achievement, requiring action at both local and national levels, and sometimes international efforts as well.

#### Local Level

The local level where problems occur and projects succeed or fail is the "front line" in conservation. Protected areas frequently face multiple threats, which need to be countered by a judicious mix of public relations, education, research, law enforcement and local development. These call for management skills of a high order. Arguably, the biggest single weakness of current conservation efforts in the humid tropics is a shortage of suitable managerial staff in the field.

In populated areas, conservation must complement other rural development initiatives in propagating agroforestry techniques and education at basic levels. Apart from adequate funding, a vital ingredient to success is the effective involvement of people. This requires much talking and listening to ordinary people and their immediate representatives, and a willingness to adapt ideas to people rather than the other way around. Non-government organizations (NGO's) have generally been much quicker than governments to grasp what is needed in this regard.

In the field of primate conservation, the Mountain Gorilla Project in Rwanda and Zaire may be cited as an example of an integrated set of initiatives that has tried to grapple realistically with very difficult problems of encroachment and poaching in one of the most densely populated parts of the world. Not least among other efforts in research, education, and tourism development was a study by Webber (1987) assessing the views of different sectors of society towards protected areas. His finding that local farmers are more appreciative of water catchment benefits while non-farmers and especially university graduates attach more value to wildlife preservation and tourism bears on the management and education measures that are needed. The sociology of conservation has rarely before been considered.

#### National Level

Conservation action at the national level is principally concerned with the policies and processes of government. These assume increasing importance with the strength of a government's writ over the land and with the level of development of the country as a whole.

Policy disputes affecting conservation have three main components: knowledge, values, and political power. "Knowledge" refers to the technical aspect of conservation — for example, an understanding of the arguments in favor of leaving a piece of forest and the adverse consequences of clearing it. Despite generalized lip-service, these arguments are often not appreciated by those in power, and it is sometimes sufficient for conservationists merely to point them out clearly to effect a change of policy, providing this is done at the right time and in the right way. For example, the Conservation Strategy for the Malaysian state of Selangor (WWF-Malaysia, in prep.) has argued, apparently successfully, that a large block of mangrove swamp that was scheduled for development for agriculture should best be left untouched to safeguard the livelihood of traditional fishermen in the area — mangroves are vital habitat for prawns and breeding grounds for many fish. This example illustrates a technical advisory role for conservationists, the value of which few governments would nowadays dispute. National conservation strategies and environmental impact assessments of major projects are increasingly recognized as useful tools for avoiding problems and facilitating sensible development. To be effective, however, they must

be undertaken before crucial decisions are made. Too often environmental advice is sought too late in the planning process to be really effective.

A second policy position in which conservationists commonly find themselves is one of minority dissent, based ultimately on value differences. For example, even in the most aggressively developing countries, a decision to build a large dam is generally made with a fair knowledge of the adverse environmental and social side effects. Judgement of costs and benefits, however, ultimately involves an ethical component, and conservationists, by definition, attach greater weight to environmental factors than do many other people. In such cases, a degree of patience may be in order for conservationists, even if they are ultimately proved to have been "right," for a decision to proceed with a project may in fact reflect the general will of the people (whether consulted or not). If a conservation cause is lost there is still a vital role to be played in highlighting the environmental costs of a project, so as to help ensure that adequate attention is given to ameliorative measures. Lost political battles are rarely wasted effort, because they draw attention to otherwise neglected issues and in time may change the consensus of opinion in society. This can be clearly seen in western countries, where in the last 20 years significant shifts of opinion have occurred on a wide range of environmental issues.

A third type of conservation problem occurs where minority commercial interests prevail over conservation interests shared by a wider community or society as a whole. Asia, no less than Latin America, is full of examples of poorer sections of the community, or even virtually all of society, losing out on environmental issues to powerful vested interests (*e.g.*, Bunker, 1981). Logging or other exploitive intrusion onto tribal lands is perhaps the most common problem in this category.

Note, however, that in assessing where the national interest may lie, there are often two levels of both benefit and cost. Thus, the principal local beneficiary of a timber or mining concession is the concessionaire and his employees, but there may also be secondary economic benefits from royalty payments to the government, some of which contribute to development in other ways. Likewise, the immediate costs of exploitation are borne principally by the community living in the area (which in the case of a sheltered tribe suddenly exposed could amount to its entire existence), while a second level of cost accrues nationally from a depletion of future forest or mineral resources, gene bank, recreational opportunities, *etc.* Both local and national-level arguments ought to be considered. However, conflicts of this kind are fundamentally political and are too often resolved in favor of business interests without adequate consultation or compensation.

Before leaving the subject of national policies on conservation, two caveats are in order. One is to note that throughout most of the developing world, high population growth rates continue to undermine or reverse both conservation and development initiatives. Sadly, it seems in Asia that only countries which are already grossly overpopulated, such as India, China or Indonesia, are willing to admit and address the problem realistically. Others, more fortunate in this regard, seem less concerned, or even positively advocate population growth, on the dubious grounds of producing a larger domestic economy, having more "clout" in the world, or redressing perceived ethnic imbalances. These are poor reasons to impoverish a country's people and blight its environment.

The second common saboteur of otherwise good conservation policy aims is the limited ability of the civil service in most developing countries to implement them. The relationship between conservation and development here involves a reciprocal dependency. Sustainable economic development requires the protection of wildlands so as to assure an adequate asset base of natural resources. Hence, the truism that conservation is not opposed to development but is essential to it. Equally true, but less often appreciated, is the proposition that positive conservation requires development, for without the stability, skills and funding for the civil service produced by development, wise land-use deci-

sions will probably not be made and certainly not implemented. The catch in this argument is that in the early stages of most countries' development, natural resources are generally exploited indiscriminately and with little heed for the future. By the time countries have an adequate civil service and a reasonably prosperous middle class to take an interest in such matters, it may be too late for much effective conservation. In analyses of development, cause and effect are often hard to disentangle, but the message here is clear — conservation is not a rich country's luxury, but must be addressed at an early stage in development. Tragically, it is in some of the poorest countries that firm conservation (and population control) measures are most desperately needed yet are most difficult to implement.

An increasingly clear observation of the "Third World" is that it is differentiating into a widening spectrum of societies, from some highly successful countries that are well on their way to "First World" living standards (and environmental problems), through a large number of states just keeping their heads above water, to a final group that by almost any yardstick is regressing. An appreciation of this fact is more than a traveller's commonplace; it is essential to formulating effective conservation action at the national level. Thus, planning initiatives that are appropriate in relatively advanced countries, such as Malaysia or Brazil, may be hopelessly unrealistic in others.

#### International Level

In recent years, the emphasis of conservation action has focused strongly on problems and possibilities at the international level. Since land use would seem basically a national rather than international responsibility the reasons for this are worth noting.

Firstly, tropical forest conservation is occurring in all parts of the tropics and is thus a global as opposed to a purely national concern. Deforestation has transnational consequences on international waterways and shared climates. Forest conservation has therefore come to be seen as an essential component of development which should be entitled to a share of international development aid. This is the reasoning behind proposals such as the World Conservation Strategy or FAO's Tropical Forest Action Plan, and the creation of new international agencies such as UNEP or the recently established International Tropical Timber Organization (ITTO).

Secondly, when causes of deforestation are examined, an underlying international economic link is often found. For instance, in many parts of Latin America, forest is cleared principally for beef pasture, the produce of which is exported to the United States or elsewhere — the "hamburger connection" (Myers, 1981). Likewise, the principal consumers of tropical timber are Japan, Europe and the United States.

Awareness of the role of consumers in tropical deforestation has led to various initiatives in what might be termed "demand-side" conservation. Although not directly concerned with forests, the most important and successful of these is the CITES convention, which seeks to control wildlife trade by agreements between both importing and exporting countries. More debatable in value are unilateral attempts to control demand through consumer boycotts of hamburgers or tropical timber, for example.

Such initiatives may be admirable in intent, but they touch a raw nerve in developing countries for the good reasons that boycotts can hurt domestic economies and damage international reputations. If developed nations wish to protect tropical forests, it is argued, then they should help pay to do this rather than penalize countries already suffering from chronically poor returns for their primary products. The intent of product boycotts is to reduce demand, and therefore prices, still further. This is surely not the right way to promote either wise land-use policies or more equitable trade relations.

Boycotts can also be economically naive. Janzen (IUCN, 1988) has recently pointed out that when Burger King, a major US hamburger com-

pany, in 1984 ceased buying beef from Costa Rica, the main period of forest conversion for beef pasture was already over. Hence, little or no benefit occurred in the manner desired. On the other hand, the boycott did help to depress the local economy, squeezing government revenues for other activities, including conservation. A wiser form of consumer pressure would encourage the diversion of part of such a company's advertising budget (currently US\$200 million annually) towards direct efforts at forest conservation. In the case of Costa Rica, such a contribution could have a multiplier effect if donated through a "debt-for-land" deal, in which hard currency national debt can be purchased from creditor banks at a big discount. In exchange, the debtor nation agrees to spend the full debt sum in local currency on a nominated conservation project. Initiatives of this kind reflect a growing sophistication among conservationists and are much more likely to work constructively than crude pressure of the kind represented by boycotts. They also represent the first practical steps towards making wealthy countries contribute to the opportunity costs of leaving tropical forests intact (e.g., Kitingan, 1987b).

Finally, the international approach to tropical forest conservation is the only avenue of action open for scientists and others in western countries. A generation or two ago, many of today's western conservationists would have been foresters or game wardens in the African and Asian countries that were then colonies. As noted above, this hands-on, local involvement is still by far the most important for conservation. However, since there are naturally now very few management opportunities of this kind for foreigners, western involvement finds expression principally through international organizations such as the multilateral development banks, bilateral aid programs and the U.N. technical agencies.

One consequence of this is a large and growing mismatch between plans and their implementation. Funding sometimes seems all too readily available for foreign specialists to produce surveys, strategies, management plans and the like. Yet these have little chance of being implemented if the mainstream agencies of government — generally parks, wildlife and forestry departments — are inadequately budgetted, staffed, and motivated. Perhaps the next challenge for creative NGO's is to find ways to improve the recruitment, training, pay, and career structure of government officers whose work is so pivotal to rainforest conservation — in short, to raise the status of conservation as a profession in developing countries.

Clive Marsh  
Sabah Foundation  
Kota Kinabalu  
Sabah  
MALAYSIA

#### Literature Cited

- Beaman, R.S., J.H. Beaman, C.W. Marsh, and P.V. Woods. 1985. Drought and forest fires in Sabah in 1983. *Sabah Soc. J.* 8: 10-30.
- Bunker, S.G. 1981. The impact of deforestation on peasant communities in the Medio Amazonas of Brazil. In: *Where Have All the Flowers Gone: Deforestation in the Third World*. V.H. Sutlive, N. Altshuler and M.D. Zamora, eds. College of William and Mary, Williamsburg, pp. 45-60.
- Burns, D. 1986. Runway and treadmill deforestation: reflections on the economics of forest development in the tropics. IUCN/IIED Tropical Forest Policy Paper No. 2. IUCN, Cambridge.
- Caldecott, J.O. 1988. Hunting and wildlife management in Sarawak, 2d ed. IUCN, Cambridge.
- Chai, D.N.P. 1987. Forest resource base of Sabah: current status. Paper presented at seminar entitled: Rationalization of Timber Industries in Sabah. Forest Department, Sandakan.



- Chin, S.C. 1987. Deforestation and environmental degradation in Sarawak. *Wallaceana* 48: 6-8.
- Davies, G. and J. Payne. 1982. A faunal survey of Sabah. WWF Malaysia, Kuala Lumpur.
- Duff, A.B., R.A. Hall, and C.W. Marsh. 1984. A survey of wildlife in and around a commercial tree plantation in Sabah. *Malays. Forester* 47: 197-213.
- Golokin, S. and P. Cassels. In press. An appraisal of Sabah Softwoods Sdn Bhd. 12 years after establishment. In proc. of seminar entitled: Future role of forest plantations in the national economy and incentives required to encourage investments in forest plantation development. Sabah Foundation, Kota Kinabalu.
- Hatch, T. 1982. Shifting cultivation in Sarawak, a review. Sarawak Department of Agriculture, Kuching.
- Hecht, S.B. 1981. Deforestation in the Amazon basin: magnitude, dynamics and soil resource effects. In: *Where Have All the Flowers Gone: Deforestation in the Third World*. V.H. Sutlive, N. Altshuler and M.D. Zamora, eds. College of William and Mary, Williamsburg, pp. 61-100.
- IUCN. 1988. Janzen and Umana plead for a hamburger dis-connection. *IUCN Bulletin* 19th, Vol. 1, p. 10.
- Kitingan, J.G. 1987a. People development: a new direction. Sabah Foundation policy paper No. 1/87. Sabah Foundation, Kota Kinabalu.
- Kitingan, J.G. 1987b. Traditional Asian tropical hardwood supply: present and future. Address to WOODMAC ASIA 87 conference, Singapore.
- Lee, D. 1980. *The Sinking Ark*. Heinemann, Kuala Lumpur.
- Leslie, A.J. 1987. The economic feasibility of natural management of tropical forests. In: *Natural Management of Tropical Moist Forests*, F. Mergen and J.R. Vincent, eds. Yale University, New Haven, pp. 177-198.
- MacKinnon, J.R. 1982. *National Conservation Plan for Indonesia* (8 vols.) FAO/UNDP, Bogor, Indonesia.
- Malingreau, J.P., G. Stevens, and L. Fellows. 1985. The 1982-83 forest fires of Kalimantan and North Borneo: satellite observations for detection and monitoring. *Ambio* 14: 314-321.
- Marsh, C.W., A.D. Johns, and J.M. Ayres. 1987. Effects of habitat disturbance on rain forest primates. In: *Primate Conservation in the Tropical Rain Forest*. C.W. Marsh and R.A. Mittermeier, eds. Alan R. Liss, New York, pp. 83-108.
- Marsh, C.W. and B. Gait. 1988. Effects of logging on rural communities: a comparative study of two villages in Ulu Kinabatangan. Forestry Division Information Paper No. 20. Sabah Foundation, Kota Kinabalu.
- Myers, N. 1980. *Conversion of Moist Tropical Forests*. National Academy of Sciences, Washington, D.C.
- Myers, N. 1981. The hamburger connection: how Central America's forests become North America's hamburgers. *Ambio* 10:3-8.
- Tang, H.T. 1987. Problems and strategies for regenerating dipterocarp forests in Malaysia. In: *Natural Management of Tropical Moist Forests*. F. Mergen and J.R. Vincent, eds. Yale University, New Haven, pp. 23-46.
- Webber, A.W. 1987. Socioecologic factors in the conservation of Afromontane forest reserves. In: *Primate Conservation in the Tropical Rain Forest*. C.W. Marsh and R.A. Mittermeier, eds. Alan R. Liss, New York, pp. 205-229.
- Wetterberg, G.B., M.T. Jorge Padua. C. Soares de Cabro, and J.M. Vasconcello. 1976. Una analise de prioridades em conservacao de natureza na Amazonia. PNUD/FAO/IBDF/BRA-45 Serie Tecnica 8: 1-62.
- WRI-World Resources Institute. 1985. *Tropical Forests: A Call for Action*. WRI, Washington, D.C.
- Wyatt-Smith, J. 1963. Manual of Malayan silviculture. *Malay. For. Record No. 23*. Forest Dept., Kuala Lumpur.

---

# APPENDIX

---

## Instructions for Contributors

### Manuscript Format

All manuscripts should be typewritten and double-spaced with generous margins. Please indicate, in parentheses near the title, the month and year the manuscript was completed. Abstracts are not to be used, footnotes are to be avoided (except for tables or figures), and subdivision titles (such as Methods, Conclusions) are not necessary. Tables are welcome if they provide additional information and do not repeat information given in the text. Please give all measurements in metric units. Please accent all foreign words carefully. 'Literature Cited' should be an alphabetical list of only those publications cited in the text, and should be in the following style:

#### Example journal article:

Struhsaker, T.T. 1972. Rain-forest conservation in Africa. *Primates* 13:103-9.

#### Example article in book:

Goodall, A.G. and C.P. Groves. 1977. The conservation of eastern gorillas. In: *Primate Conservation*, Prince Rainier of Monaco and G.H. Bourne, eds. Academic Press, New York, pp. 599-637.

#### Example book:

Hershkovitz, P. 1977. *Living New World Monkeys (Platyrrhini)*. Vol. 1. Univ. of Chicago Press, Chicago.

#### Example dissertation:

Homewood, K.M. 1976. Ecology and behavior of the Tana Mangabey (*Cercocebus galeritus galeritus*). Unpubl. Ph.D. thesis, Univ. of London, London.

### Manuscript Length

Announcements should be a page or less in length, articles for the 'News from the Field/Captivity' section should be 2-5 pages in length, and articles for the journal section may range from 5-20 pages. In exceptional cases, we will consider publishing longer articles of great interest to primate conservation.

### Maps

Please refer to maps in this issue as a guide to style. Maps should always be made as concise as possible and should include an inset showing the location of the area discussed in relation to its home country or continent. If you want us to produce the map for your article, please provide adequate reference material (*i.e.*, rough sketches and photocopies of published maps).

### Photographs

Black and white prints are ideal. Original color slides from which we can make prints are also acceptable. However, please send only sharply focused, high-quality slides and photographs. Please label each slide with a photographer credit and number identifying the caption. Captions should be listed on a separate sheet, or after Literature Cited. We will also consider publishing color illustrations if they add a great deal to the contribution in question. Furthermore, we are always interested in receiving high-quality photographs for our covers, especially those of little known and rarely photographed primates, even if they do not accompany an article.

### All Figures

Please indicate on all figures the title and author of the manuscript to which they belong and package them carefully so they will not be bent in the post. Figures will only be returned at the special request of the author.

Please mail your contribution to:

The Editor, *Primate Conservation*  
c/o Wildlife Preservation Trust International, Inc.  
34th Street and Girard Avenue  
Philadelphia, PA 19104  
U.S.A.

## The IUCN/SSC Primate Specialist Group Membership List

### Additions

These members have been added to the group since the appearance of the last issue of *Primate Conservation*.

#### Americas Section

Luis Albuja V.  
Escuela Politécnica Nacional  
Depto. de Ciencias Biológicas  
Quito  
ECUADOR

Sergio Figueroa  
Dirección Nacional Forestal  
Ministerio de Agricultura Ganadería  
Av. Eloy Alfaro y Amazonas  
Quito  
ECUADOR

Flavio Coello Hinojosa  
Jefe Conservación de Amazonía  
Dirección Nacional Forestal  
Ministerio de Agricultura y Ganadería  
Av. Eloy Alfaro y Amazonas  
Quito  
ECUADOR

#### Africa Section

A. Kortlandt  
88 Woodstock Road  
Oxford OX2 7ND  
U.K.

#### Asia Section

Mohammed Farid Ahsan  
Assistant Professor  
Dept. of Zoology  
Chittagong University  
Chittagong 4331  
BANGLADESH

### Corrections

We regret that the names of the following long-standing members were omitted from the Membership List printed in Issue No. 8.

#### Americas Section

Warren G. Kinzey  
Program Director for Phys. Anthro.  
National Science Foundation  
1800 G Street, N.W.  
Washington, D.C. 20550  
U.S.A.

#### Asia Section

Bruce Wheatley  
Dept. of Anthropology  
University of Atlanta  
at Birmingham  
University Station  
Birmingham, AL 35294  
U.S.A.

## Changes

The following members have changed addresses since the appearance of the last issue of *Primate Conservation*.

### Africa Section

E.O. Asibey  
World Bank  
1818 H Street, NW  
Rm. J8232  
Washington, D.C. 20433  
U.S.A.

Thomas M. Butynski  
Impenetrable Forest Conservation Project  
Zoology Dept.  
Makerere University  
P.O. Box 7062  
Kampala  
UGANDA

Robert W. Cooper  
1044 West Orange Road  
Santa Ana, CA 92706  
U.S.A.

John E. Fa  
Editor, Primate Conservation  
Monographs  
7715 Irish Town  
GIBRALTAR

A.H. Harcourt (until Fall 1990)  
Dept. of Anthropology  
University of California at Davis  
Davis, CA 95616  
U.S.A.

Kelly J. Stewart (until Fall 1990)  
Dept. of Anthropology  
University of California at Davis  
Davis, CA 95616  
U.S.A.

Andrew D. Johns  
Co-Director Makerere University  
Biological Field Station  
c/o Prof. Derek Pomeroy  
Dept. of Zoology  
Makerere University  
P.O. Box 7062  
Kampala  
UGANDA

### Madagascar Section

Jean-Jacques Petter  
Chaire d'Ethologie et Conservation  
des Espèces Animales  
Ministère de l'Éducation Nationale  
Museum National d'Histoire Naturelle  
57, rue Cuvier  
75231 Paris Cedex 05  
FRANCE

### Asia Section

J. Mangalaraj Johnson  
Indian Forest Service  
23, Srinivasanagar  
Tiruchirappally 620017  
SOUTH INDIA

Anthony J. Whitten  
105 Gilbert Road  
Cambridge  
U.K.

### Captive Section

Jon M. Jensen  
Associate Director  
Pew Scholars Program in Conservation  
and the Environment  
Dana Hall  
School of Natural Resources  
University of Michigan  
Ann Arbor, MI 48109-1115  
U.S.A.

Kenneth C. Searle  
Honorary Zoological Curator  
H.K. Zoological and Botanical Gardens  
604-608 Gloucester Tower  
Pedder Street  
HONG KONG

Jurgen Wolters  
August-Bebel-Str. 57  
Postfach 531  
D-4800 Bielefeld 1  
WEST GERMANY

### Editorial Board

James G. Else  
Yerkes Primate Research Center  
Emory University  
Atlanta, GA 30322  
U.S.A.

### Special Section

John P. Hearn  
Wisconsin Regional Primate  
Res. Ctr.  
1223 Capitol Court  
Madison, Wisconsin 53706  
U.S.A.



Printed and bound by Consolidated Business Forms, Lock Haven, PA, U.S.A.

Back cover. *Pithecia albicans*, a saki monkey from the Tefé region of upper Amazonian Brazil. Endemic to Brazil, this species of *Pithecia* has the most restricted range of the genus (photo by Russell A. Mittermeier).

