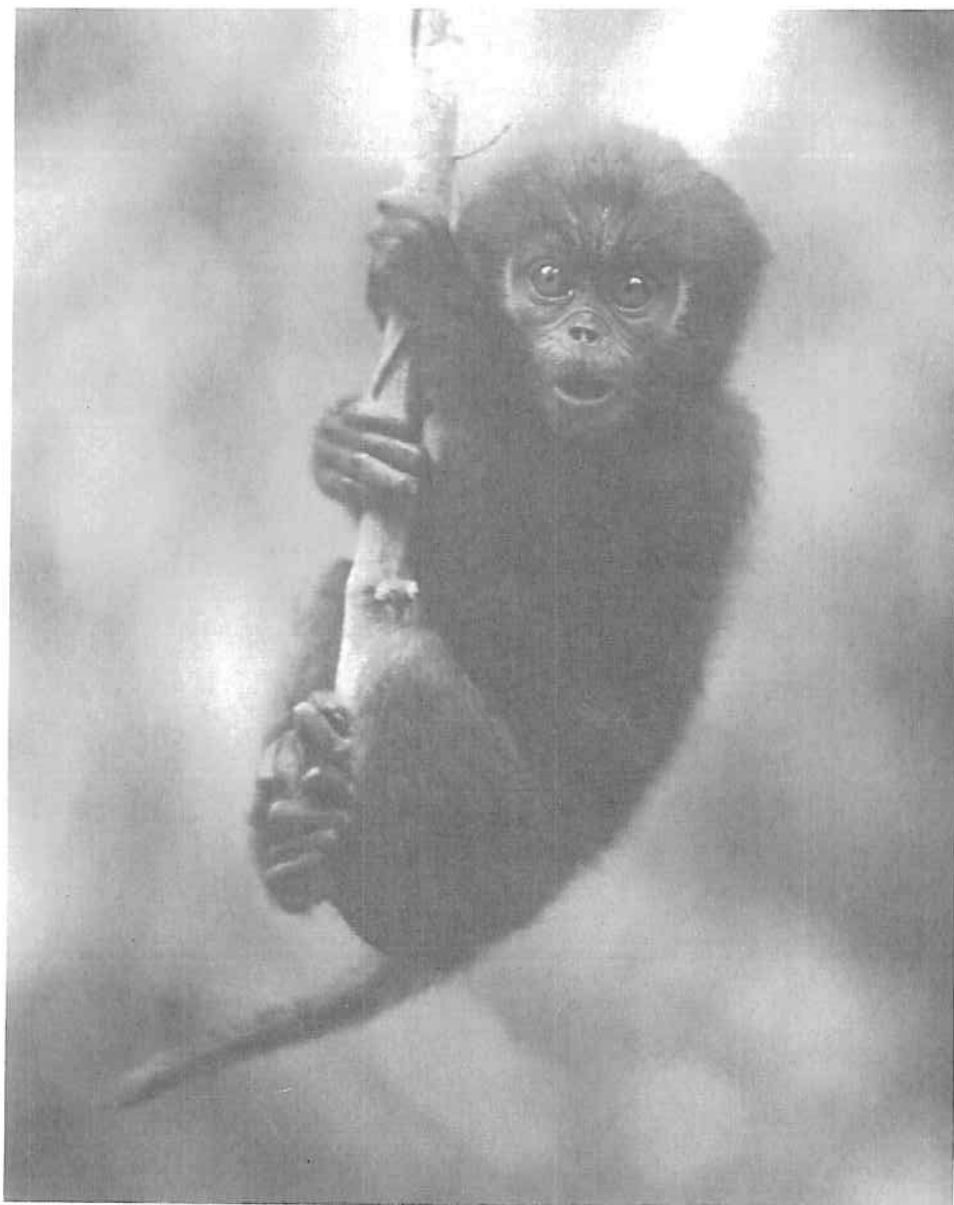


PRIMATE CONSERVATION

The Newsletter and Journal of
the IUCN/SSC Primate Specialist Group

Number 9

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A Word from the Editors

As you have undoubtedly noted, it has been some two years since the appearance of the last issue of *Primate Conservation*, Issue No. 8. This unfortunate delay has been due to a number of factors, among them the fact that the entire editorial team, including Russ Mittermeier, Isabel Constable, and Stephen Nash, moved from World Wildlife Fund to Conservation International in July of 1989. The process of settling in took time, and the publication of *Primate Conservation* was delayed much longer than we would have liked. We apologize to all contributors and group members for this delay.

Since so much material accumulated during this period, we will be publishing Issue No. 9, with all material received up to December 1988, and Issue No. 10, with the remaining material current to December 1989, back to back. As you can see from the wealth of material in this issue, interest in primate conservation and in using our journal as a vehicle for communication is increasing. We look forward to an even greater expansion in the future.

We are pleased to announce the job of editor will be taken on by Bill Konstant, Executive Director of Wildlife Preservation Trust International, and formerly Assistant Editor of *Primate Conservation*. With Bill's involvement, *Primate Conservation* will become a joint production of Conservation International and the Wildlife Preservation Trust International. Isabel Constable will continue to participate as a consultant, Stephen Nash will be responsible for layout and design, and Russ Mittermeier will continue to oversee production of the journal as Chairman of the PSG.

As in the past, we very much welcome your participation and contributions. We plan to begin publishing two issues of *Primate Conservation* each year on a January/July publication schedule. Please send your contributions to: The Editor, *Primate Conservation*, c/o Wildlife Preservation Trust International, 34th Street and Girard Avenue, Philadelphia, PA 19104, U.S.A.

Conservation issues and especially tropical forest conservation are finally taking their rightful place on the global stage. We think that primate conservation has played a key role in this, and that it will play an even greater role in the future. Primates have a central role as flagship species for the habitats they occupy, and also as very special creatures worthy of conserving in their own right. The Primate Specialist Group will continue to do everything possible to make conservation of the world's primate diversity a reality, using *Primate Conservation* as the principal vehicle of communication.

Thank you again for your interest and your patience.

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Table of Contents

A Word from the Editors	3
-------------------------------	---

Announcements

XII th Congress of the International Primatological Society Held in Brasília, Brazil	9
Fifth World Conference on Breeding Endangered Species in Captivity.	9
1988 ASP Conservation Award to Fallet Young	9
Eduardo Pinheiro Receives the First Pieter Oyens Memorial Prize	9
Coimbra-Filho and Mittermeier Recognized by Brazilian Primatological Society	10
Zoological Society of San Diego Conservation Medal Awarded to Russell Mittermeier	10
New Species of Squirrel Monkey from Brazilian Amazonia	10
Two New Lemur Species from Madagascar	10
<i>Saguinus o. oedipus</i> International Studbook Current Through 1985	11
<i>Leontopithecus chrysomelas</i> Provisional International Studbook Established	11
<i>Leontopithecus chrysopygus</i> Provisional International Studbook Established	12
<i>Mandrillus leucophaeus</i> International Studbook Current Through 1985	12
<i>Cercopithecus d. diana</i> International Studbook Proposed in 1988	13
<i>Pygathrix n. nemaus</i> International Studbook Covers 1967-1985	13
The 1988 Threatened Dozen	14
The IPS Conservation Committee	14
New Venezuelan Primatological Society	14
New Francophone Primatological Society	15
The Berggorilla Patenschaft	15
Chimfunshi Wildlife Orphanage for Chimpanzees	15
Gorilla Conservation News	16
New Japanese Series	16
New Reviews of Two Neotropical Genera	16
Report on the Status of Primates in the Netherlands	17
New Books by and for PSG Members	17
Videotapes	19
Air France Promotes Conservation	20
New Primate Stamps	20
Research Opportunities at Karisoke Research Center, Rwanda	22
Obituary — Kalang anak Tot	22

News from the Field

CENTRAL AND SOUTH AMERICA

A Range Extension for <i>Saguinus labiatus thomasi</i>	José de Sousa e Silva Júnior...	23
Preliminary Survey on the Population Densities of <i>Cacajao calvus ucayalii</i>	Rolando Aquino...	24

AFRICA

New Species of <i>Cercopithecus</i> in Gabon Needs Protection	Jean-Pierre Gautier...	27
The Okomu Forest Project	Lee J.T. White...	28
Madagascar's First Biosphere Reserve, Mananara-North	Roland Albignac...	29

ASIA

Preliminary Survey of the Primates of Sibsagar, Assam	Anwaruddin Choudhury...	31
The Present Status of the Lion-tailed Macaque	G.U. Kurup...	34

News from Captivity

Albino Capuchin at Sapucaia do Sul Zoo	Júlio César Bicca-Marques...	37
Six Mountain Gorillas Die	Claude Ramsey...	37
Ecological Assessment for a Chimpanzee Rehabilitation Project in Northern Zambia	Tamar Ron and W. C. McGrew...	37
Minutes from a Lemur Conservation Workshop	Daniel Wharton, Mary Pearl and Frederick Kootz...	41
Conservation of the Cotton-top Tamarin and Medical Research	F. T. Scullion, A. Morgan, A. Terlecki, S. Underwood, B. Robbins and E. Potts...	48
<i>Hylobates concolor</i> International Studbook Established	Jean-Marc Lernoould...	50

Articles

CENTRAL AND SOUTH AMERICA

The Status of <i>Ateles geoffroyi</i> and <i>Alouatta palliata</i> in Disturbed Forest Areas of Sierra de Santa Marta, Mexico	Gilberto Silva López, Francisco García Orduña and Ernesto Rodríguez Luna...	53
Notes on the Biology of <i>Cebus nigrivittatus</i> and <i>Alouatta seniculus</i> in Northern Venezuela	Gerardo A. Cordero Rodríguez and Salvador Boher B...	61
Primate Survey of Eastern Bolívar, Venezuela	Warren G. Kinzey, Marilyn A. Norconk and Eduardo Alvarez-Cordero...	66
The General Status of Monkeys in French Guiana	Christian Roussilhon...	70
Environmental Determinants of Population Densities in <i>Ateles</i>	Meg McFarland Symington...	74
Primates and Ungulates: A Comparison of Susceptibility to Hunting	Richard E. Bodmer, Tula G. Fang and Luis Moya Ibanez...	79
Primate Community Structure in Western Brazilian Amazonia	Carlos A. Peres...	83
On the Status of <i>Ateles belzebuth marginatus</i> with Notes on Other Primates of the Iri River Basin	Eduardo S. Martins, José Márcio Ayres and Maria Beatriz Ribeiro do Valle...	87
Nonvolant Mammals Rescued at the Tucuruí Dam in the Brazilian Amazon ...	Bento Melo Mascarenhas and Giuseppe Puerto...	91
Primate Populations in Northern Bolivia	Ann K. Kohlhaas...	93
Primate Survey of the Estación Biológica Beni, Bolivia	Juan E. Garcia and Teresa Tarifa...	97
Primates of the Rio Jequinhonha Valley, Minas Gerais, Brazil ... Anthony B. Rylands, Wilson R. Spironelo, Valdemar L. Tornisielo, Rosa L. de Sa, Maria C. M. Kierulff and Ilmar B. Santos...		100

AFRICA

<i>Pan paniscus</i> in Salonga National Park	Angela Meder, Paul-Hermann Bürgel and Carsten Bresch...	110
Conservation of Eastern Lowland Gorillas in the Masisi Region, Zaire	Mwanza Ndunda, Tamaki Maruhashi, Takakazu Yumoto and Juichi Yamagiwa...	111
Estimates of Effective Population Size for a Forest Primate, the Tana River Mangabey	Margaret F. Kinnaird...	114
Distribution Survey of the Malagasy Lemurs: Request for Information and Initial Report	Ian Tattersall...	116
Field Reporting of Variation Within Lemur Species	David M. Meyers and Ian Tattersall...	117
Lemur Observations in the Lowland Rainforest of Anandrivola, Madagascar	Chris J. Raxworthy and Peter J. Stephenson...	118

ASIA

Hoolock Gibbons in Arunachal Pradesh, Northeast India	R.P. Mukherjee, S. Chaudhuri and A. Murmu...	121
A Primate Survey in Southern Assam, India	Anwaruddin Choudhury...	123
Ecology of the Capped Langur and Phayre's Leaf Monkey in Bangladesh	Craig B. Stanford...	125
Status Report on Some Chinese Primates	Bangjie Tan and Frank E. Poirier...	129
Status of the Yunnan Snub-nosed Monkey	Qikun Zhao...	131
Notes on the Current Status and Conservation of Primates in Vietnam	Radoslaw Ratajszczak...	134
Status of the Banded Langur in Singapore	Peter W. Lucas, Christopher J. Hails and Richard T. Corlett...	136
Some Observations on the Primates of Kalimantan Tengah, Indonesia	David J. Chivers and Kenneth M. Burton...	138
Status of Primates in the Pagai Islands, Indonesia: A Progress Report	Richard R. Tenaza...	146

GLOBAL

Comments on Conservation Awareness in India	Major General E. D'Souza...	150
Primates, Forest Conservation and Development	Clive Marsh...	150

Appendix

Instructions for Contributors	157
The IUCN/SSC Primate Specialist Group Membership List	158
Subscription Order Form	162

ANNOUNCEMENTS

XIIth Congress of the International Primatological Society Held in Brasília, Brazil

The XIIth Congress of the International Primatological Society was held from 24-29 July 1988 in Brasília. Some 530 people from 38 countries attended the Congress. Seven of the 36 symposia, as well as a conference and a workshop, focused on conservation issues. The roles of zoos and primate centers in conservation, conservation and development, reserves and reserve management, education and public awareness programs, primate conservation in the Neotropics, and nature conservation in Brazil were some of the subjects examined in the symposia. The majority of the abstracts are available in a special October 1988 issue of the *International Journal of Primatology*, and several of the papers presented are published in this issue of *Primate Conservation*.

The PSG would like to thank Milton Thiago de Mello and the other organizers of this Congress for the attention given to primate conservation.

1988 ASP Conservation Award to Fallet Young

The American Society of Primatologists has awarded their 1988 Conservation Award to Mr. Fallet Young, Manager of the Community Baboon Sanctuary for the Belize Audubon Society. This prestigious award, which includes a financial prize, is given to encourage local conservation efforts throughout the tropics where primates are found. Mr. Young was selected for his work in helping to conserve the black howler monkey locally known as 'baboon.' Dr. Robert Horwich of the ASP presented the award.

Mr. Young is the second employee of the Belize Audubon Society to receive an international conservation award in 1988. In February, Mr. Ignacio Pop, Chief Warden in the Cockscomb Basin Wildlife Sanctuary, was presented an award for conservation merit by Prince Philip, the Duke of Edinburgh, in his capacity as President of World Wildlife Fund.

Fifth World Conference on Breeding Endangered Species in Captivity

Captive breeding, but more especially the role of the world's zoological institutions in the conservation of endangered wildlife, was the topic examined and debated at the Fifth World Conference on Breeding Endangered Species in Captivity, held in Cincinnati, Ohio on 9-12 October 1988. The conference was co-sponsored by The Fauna and Flora Preservation Society, The Cincinnati Zoo and Botanical Garden Center for Reproduction of Endangered Wildlife, and Kings Island Wild Animal Habitat.

The Cincinnati conference provided a forum in which to discuss a wide range of subjects relevant to captive breeding programs. Presentations were invited in four categories: Rescue and Status, Management and Reintroduction, Restoration, and Recovery. Rescue and Status received by far the most attention, with 28 of the 53 papers presented falling into this category, an indication perhaps of the current position of propagation programs with respect to wildlife conservation. Organizers hope

that by the time of the next conference, the number of presentations concerning reintroduction, recovery, and restoration projects will rival the number about specific breeding programs.

Presentations by field biologists from conservation organizations, government agencies, and academia provided a broader perspective, and also underscored the fact that conservation programs involving captive propagation must be interdisciplinary to be successful.

A workshop to discuss the situation of the drill (*Mandrillus leucophaeus*) was organized by Michael Böer, the International Drill Studbook Keeper. Other workshops focused on rhinos, bonobos, okapi, Arabian and scimitar-horned oryx, and exotic cats. Only the proceedings of the exotic cat workshop have been submitted for publication.

The conference proceedings were compiled and edited by B.L. Dresser, R.W. Reece, and E.J. Maruska. To obtain a copy or to receive further information about the conference, please write to the Director of Research at the Cincinnati Zoo:

Dr. Betsy L. Dresser
The Cincinnati Zoo
Center for Reproduction of
Endangered Wildlife
3400 Vine Street
Cincinnati, OH 45220
U.S.A.



Fig. 1. Eduardo Pinheiro, holding the first Oyens Memorial Prize plaque which he was awarded at the XIIth IPS Congress in Brasília (photo by Roderic Mast).

Eduardo Pinheiro Receives the First Pieter Oyens Memorial Prize

In 1987, World Wildlife Fund established an annual \$1,000 award in the memory of Pieter H. de Marez Oyens, a young Uruguayan who dedicated the last decade of his life to the preservation of Brazil's flora, fauna, and natural resources. Oyens was the Senior Program Officer for the Brazil Program of WWF-US. He worked hard not only to save wildlife but also to garner support for other young Brazilian conservationists and to foster a strong national conservation ethic. The new prize

in his name has been created to assist those young Brazilian conservationists who embody the spirit of his work and demonstrate determination and resourcefulness in the face of imposing odds, showing creativity, initiative, and perseverance in pursuing their goals.

At the IPS Congress in Brasília, Eduardo Pinheiro, President of the Brazilian NGO, Friends of the Environment (AMA), received the first Pieter Oyens Memorial Prize for his contributions to Brazilian conservation, and especially to conservation of the muriqui and the Mata do Sossego in Minas Gerais (Fig. 1; see *Primate Conservation* 8:18-19).

Anyone wishing to donate to the Pieter Oyens Memorial Fund or to nominate a candidate for the prize should write to:

The Brazil Program
World Wildlife Fund
1250 Twenty-Fourth St., N.W.
Washington, D.C. 20037
U.S.A.

Coimbra-Filho and Mittermeier Recognized by Brazilian Primatological Society

Adelmar F. Coimbra-Filho, the pioneer of Brazilian primatology, and Russell A. Mittermeier, Chairman of the Primate Specialist Group, both received special plaques from the Brazilian Primatological Society (SBPr) at the July 1988 IPS Congress in Brasília. Presentations of the awards were made by Anthony Rylands and Ilmar Bastos Santos, both PSG members, and President and Treasurer respectively of the SBPr. The dedication on the awards reads as follows, "in recognition of your efforts for the conservation of Brazilian primates."



Fig. 2. Russell A. Mittermeier being presented with the conservation Medal of the Zoological Society of San Diego by Betty Jo Williams (photo courtesy of the Zoological Society of San Diego).

Zoological Society of San Diego Conservation Medal Awarded to Russell Mittermeier

Russell A. Mittermeier, Chairman of the Primate Specialist Group, was selected as the 1987 recipient of the Conservation Medal of the Zoological Society of San Diego, an award sponsored by the Society's Center for Reproduction of Endangered Species (CRES). He was presented the award by Betty Jo Williams, immediate past president of

the Zoological Society, at an awards dinner attended by supporters of the CRES on August 22, 1988. The award is made for outstanding "dedication to the cause of wildlife conservation."

New Species of Squirrel Monkey from Brazilian Amazonia

A new species of the genus *Saimiri*, called *Saimiri vanzolinii* after Dr. P.E. Vanzolini, was described in *Papeis Avulsos de Zoologia*, São Paulo 36 (14):147-64 by J.M. Ayres in 1985. Based on field observations and data from 13 specimens now in the mammal collection of the Zoological Museum at the University of São Paulo, the new species is considered a member of the *boliviensis* species group with the characteristic 'Roman arch' facial pattern and thin tail pencil. Some distinctive features of this new species include a black band running from the crown to the tip of the tail and light burnt-yellow fur on the back of the hands, feet and forearms.

The range of *Saimiri vanzolinii* is bordered by the Japurá River to the north and east, the Solimões River to the south, and probably the Paraná do Jaraú River to the west. This 950 km² area is the smallest geographical range for any Neotropical primate known so far. Within this area, the species is common and inhabits seasonally flooded *várzea* forests, preferring the levees but also frequenting the back swamps. Like all *Saimiri*, it is both an insectivore and a frugivore, and lives in large, multimale troops of up to 50 individuals.

Based on its geographical range and ecological preferences, its population is estimated at 50,000 individuals. Although not usually hunted, the species is threatened by selective logging in the area and should be regarded as vulnerable on account of its very small range.

Two New Lemur Species from Madagascar

Two new species of lemur have been described from Madagascar since the appearance of the last issue of *Primate Conservation*.

The first, named *Haplemur aureus* (the golden bamboo lemur) was mentioned in several articles in *Primate Conservation* No. 8 (Meier and Rumpler, pp. 40-43; Wright *et al.*, pp. 84-88) and was described by Bernhard Meier *et al.* in *Folia Primatologica* 48:211-15. This species inhabits the rainforests of the Ranomafana region of southeastern Madagascar, eats primarily giant bamboo, and has a unique golden facial coloring (Fig. 3).



Fig. 3. Golden bamboo lemurs from Ranomafana (photo by R.A. Mittermeier).

The second, named *Propithecus tattersalli* (Tattersall's sifaka) was described in *Folia Primatologica* 50: 143-51 by Elwyn Simons. It comes from northeastern Madagascar and is named after lemur specialist and PSG member Ian Tattersall, who first recognized the distinctness of this animal in 1974 and pictured it in his book, *The Primates of Madagascar* (Columbia University Press, 1982). An expedition headed by Simons succeeded in capturing a pair of these sifakas and transporting them to the Duke University Primate Center in North Carolina, where they are now thriving. The female, which was pregnant at the time of capture, has given birth to a healthy young female.

The addition of these two new species brings the number of lemur species in Madagascar to 30, making Madagascar the fourth richest country in the world in primate species after Brazil, Zaire and Indonesia.

Saguinus o. oedipus International Studbook Current through 1985

The first edition of an international studbook for the cotton-top tamarin (*Saguinus o. oedipus*) has now been completed, thanks to the efforts of many research institutions, zoos, and private individuals. It is available to all participants as an official listing of live animals only, or, by special request, as a total listing of animals live and dead. The studbook includes 3,140 specimens from 95 participating institutions, and is updated through 1985.

The studbook's data has been tabulated in various ways: Table 1 indicates location of live specimens by geographic region and colony type, selected relative to the availability of regional studbooks. Age/sex distribution of the known-age population, the number of founder dams, and the number of live offspring represented by each has also been calculated. Preliminary conclusions suggest that the population has a broad genetic base which can be maintained, with 69.2% of the live population either wild-born or first generation. The authors point out that now is the time to insure that this base be maintained in order to avoid potential problems arising through generations of restrictive breeding.

Table 1. Live *Saguinus oedipus oedipus*
by Colony Type and Geographic Location

Colony Type:	Research	Zoo/Private	Total
Location:			
North America	522	217	739
Britain	40	133	173
Other	112	137	249
Total	674	487	1,161

Table 2. *Saguinus oedipus oedipus* Infant Survival to One Year 1976-1984

Year	No. Born	No. Surviving to 1 Year	Percent Surviving
1976	120	32	26.7
1977	208	53	25.5
1978	139	53	38.1
1979	177	68	38.4
1980	171	69	40.3
1981	187	79	42.2
1982	178	79	44.4
1983	229	106	46.3
1984	172	89	51.7

Table 2 summarizes yearly infant survival to one year for 1976-1984 for those participants providing a complete historical listing. The table

suggests an improvement in infant survival over time. Information concerning rearing experience was so variable that the authors have decided to wait for more systematic data. Comments on the most efficient means to include information on rearing experience will be most welcome.

The studbook provides valuable information on this endangered species endemic to Colombia. No reliable estimates of the wild population exist, but there is no question that the species is critically endangered due to deforestation and live capture. Neyman (1978) estimated that up to 70% of the forest in the species' range had already been replaced with pasture and farmland by 1966, and much of the remaining habitat now consists of patches too small to maintain a population. In addition, it is estimated that 30,000-40,000 *Saguinus o. oedipus* were exported from Colombia, primarily for research use, in the 1960s and early 1970s (Hernandez-Camacho and Cooper, 1976). *Saguinus o. oedipus* became popular as a model in fields of research in which callitrichids are commonly used (viral oncology, immunology, infectious disease, reproductive physiology) because of its easy availability and low cost (Gengozian, 1969; Mittermeier and Coimbra-Filho, 1983). The species was placed on the Colombian Endangered Species List in 1972, Appendix I of CITES in 1973, and the U.S. Endangered Species List in 1976. General use of the species for research was curtailed in the same year. However, two areas have been identified in which *Saguinus o. oedipus* provides a unique research model: the study of Epstein-Barr virus induced lymphoproliferative disease (Epstein, 1984) and spontaneously occurring colon cancer (Lushbaugh *et al.*, 1978; Chalifoux and Bronson, 1981). Research of this nature can now contribute to the conservation of the species by enhancing potential for funding field research and by maintaining a large, diverse captive population.

The studbook was compiled by Suzette D. Tardiff of Oak Ridge Associated Universities, Tennessee, and Rob Colley of Pencynor Wild Life Park, Wales. To obtain a copy, please write to the first co-author:

Suzette D. Tardiff
Oak Ridge Associated Universities
Oak Ridge, TN 37831-0117
U.S.A.

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Hernandez-Camacho, J. and R.W. Cooper. 1976. In: *Neotropical Primates: Field Studies and Conservation*, R.W. Thorington and P. G. Heltne, eds. Natl. Acad. Press, Washington, D.C.
Lushbaugh, C.C., G.L. Humason, D.C. Swartzendruber, C.B. Richter, and N. Gengozian. 1978. *Prim. Med.* 10: 119-34.
Mittermeier, R.A. and A.F. Coimbra-Filho. 1983. In: *Reproduction in New World Primates*, J.P. Hearn, ed. MTP Press, Lancaster.
Neyman, P.F. 1978. In: *Biology and Conservation of the Callitrichidae*, D. Kleiman, ed. Smithsonian Instit. Press, Washington, D.C.

Leontopithecus chrysomelas Provisional International Studbook Established

Jeremy J.C. Mallinson, the Zoological Director of the Jersey Wildlife Preservation Trust, has compiled a preliminary edition of the International Golden-headed Lion Tamarin Studbook on behalf of the International Recovery and Management Committee for the species. Published

on 31 August 1987, the studbook format models that of the official 1986 *International Studbook for the Golden Lion Tamarin* (*Leontopithecus rosalia*), compiled by Jonathan Ballou.

For background on conservation programs and international regulations on behalf of this species, see Mallinson's article "International efforts to secure a viable population of the golden-headed lion tamarin" in *Primate Conservation* 8: 124-5.

For further information about the studbook, please write to Mallinson:

Jeremy J.C. Mallinson
Zoological Director
Jersey Wildlife Preservation Trust
Les Augres Manor
Trinity, Jersey
U.K.

Leontopithecus chrysopygus Provisional International Studbook Established

Faical Simon has compiled a provisional studbook for the black lion tamarin with the hope that it will soon evolve into a comprehensive and authoritative studbook for this rare species.

Leontopithecus chrysopygus was first described from the outskirts of São Paulo. Its former range was probably confined to the triangular area between the Tiete, Paranapanema, and Parana rivers. Due to development in this part of the country, most of the original habitat has been lost. At present, black lion tamarins are known to inhabit only two refuges: Morro do Diabo State Park at Teodoro Sampaio and the Caetetus Reserve in Galia.

For 70 years, the species was presumed extinct. Then, in the early 1970s, a group was discovered at Morro do Diabo (PEMD), and from the small group captured at that time originated the considerable colony now held at the Rio de Janeiro Primate Center (CPRJ). In the mid-1970s, another group was observed at the Caetetus Reserve (EEC).

Due to the species' restriction to small, isolated territories, both wild and captive tamarins face potential inbreeding. The advantages and disadvantages of such closely linked parenthood need to be clearly demonstrated so that generalizations and prognoses are not lightly made. Quantitative studies of the population, its genetic diversity, and any anatomical and physiological peculiarities that may exist must be carried out on as many individuals as possible.

A second captive group, now at the São Paulo Zoo (ZooSP), was formed during the damming of the Paranapanema River, which flooded 5% of PEMD's best forest land. As a result of the trauma caused during deforestation, attacks by predators, and other experiences, many of the captured animals died. The animals' keepers, ignorant of the details of the species' biology and behavior, unsure of the carrying capacity of the adjacent forests and the density of predators, and doubtful of the levels of protection offered by the park and the reactions of the locals (who had been told of the species' rarity and value) decided that any further delays could result in irreparable harm to the animals and moved the population from PEMD to ZooSP.

During the animals' transportation to São Paulo, one of the females aborted twins which she had carried almost to term. On 20 September 1987, this same female gave birth to the only living black lion tamarin born in ZooSP. Successful breedings are more frequent at CPRJ.

Since 35 individuals were captured from an area constituting 5% of the park, an optimistic estimate of the extant wild population at PEMD would be approximately 700 individuals. However, this number assumes the entire reserve is geographically and botanically homogeneous. In fact, the vegetation is variable along the length of the reserve, and, parallel to its southern border, where the Paranapanema River flowed,

both a paved road and a railroad cut across the park, constituting actual artificial barriers to small, arboreal primate species like the black lion tamarin. These factors have surely fractioned the local black lion tamarin population. Knowledge of the remaining wild populations is still scanty, but a proposal for a census has been made.

By the time the Paranapanema River was dammed, a proposal had been made to the Forestry Institute of São Paulo to constitute a black lion tamarin management committee like the ones already existing for the two other *Leontopithecus* species. Such a committee was established by IBDF late in 1986, and the following people are members:

A.F. Coimbra-Filho, CPRJ/FEEMA-Brazil
C.T. de Carvalho, IF/SEMA-Brazil
M. Becker, IBDF-Brazil
D.G. Kleiman, Smithsonian Institution-U.S.A.
J.J.C. Mallinson, Jersey Wildlife Preservation Trust-U.K.
O. Menghi, CITES-Switzerland
F. Simon, FPZSP-Brazil

At the time of the studbook's publication, the IF had been asked to approve the proposed census of black lion tamarins in EEC. A biologist with experience censusing *Saguinus midas midas* in the Amazon had agreed to carry out the survey. In PEMD, censusing is a part of the local project. The committee hopes other proposals will soon be submitted.

Management of the entire population continues to be discussed with administrators of CPRJ and IF, and any proposals will also be submitted to the committee at the proper time.

In 1988, the only sanitary and genetic problem faced by the black lion tamarins was a possible diaphragmatic hernia in one specimen. The condition was noticed by chance when the animal, suffering from a systematic osteopathy resembling hyperparathyroidism, was examined for lameness. The condition had not yet been fully studied at the time of this report, but the whole captive population of black lion tamarins was to be screened for the condition. The screening was scheduled to start after October, when the breeding season ends, so as to avoid stressing the couples or overexposing the fetuses to potentially harmful radiation.

The committee hopes that interested and sponsoring institutions will sign a mutual intentions and management agreement. One can predict that if independent decisions based on conflicting intentions continue to be made, the situation of *Leontopithecus chrysopygus*, which already borders extinction, will only worsen.

For further information about the studbook, please write to the chairman of the Black Lion Tamarin Management Committee:

Faical Simon
São Paulo Zoological Park
Avenue Miguel Stefano, 4241
CEP 04301, Caixa Postal 12.954
São Paulo
BRAZIL

Mandrillus leucophaeus International Studbook Current through 1985

The drill has historically received less attention from zoo keepers than the flashier member of its genus, the mandrill. Recently, however, interest in this endangered baboon has increased and an international studbook is now available.

The approximately 35-page first edition was published in 1987 and includes a description of the current zoo population, current research,

breeding management options, and the situation in the field. A brief ethogram for drills in captivity is also provided and the monitoring of the oestrus cycle of female drills discussed. The studbook also lists pertinent literature.

Anyone interested in obtaining a copy of the studbook or learning more about its compilation should write to the studbook keeper:

Michael Böer
Zoologischer Garten der
Landeshauptstadt Hannover
Hannover
WEST GERMANY

Cercopithecus d. diana International Studbook Proposed in 1988

In 1988, the IUCN/SSC Steering Committee received and approved Miranda F. Stevenson's proposal to upgrade the Diana monkey studbook from regional to international in scope. Dr. Stevenson, the Curator of Animals at the Edinburgh Zoo, Scotland, published the first edition of the *Regional British Isles Studbook of the Diana Monkey* in 1987 and has prepared a second edition for 1988.

Cercopithecus diana, commonly divided into two subspecies, *C. d. diana* and *C. d. roloway*, inhabits the West African rainforest from Sierra Leone to the Volta River in Ghana. *C. d. roloway* occurs to the east of the Sassandra River, while *C. d. diana* occurs to the west in the countries of Sierra Leone, Liberia, the Ivory Coast, and, to a small extent, Guinea.

C. d. diana is one of the most endangered African primate species, and is listed in Appendix I of CITES. Major threats are hunting and forest destruction, since the species seems particularly susceptible to any disturbance of its mature forest habitat.

As of the end of 1987, the total population of Diana monkeys in the U.K. numbered 51, of which 13 were known to be wild-caught. These animals were divided into 14 collections, six of which were breeding. Of the 16 females who had produced offspring, only six were captive-born. Many of the wild-caught breeding animals were then nearing the end of their lives.

The 1986 *Zoo Yearbook* recorded 191 Diana monkeys in 62 collections, with an average of 18 births each year, the majority of these occurring in zoos in the U.K. Supporters of the effort to expand the studbook hope that the additional information will help collection managers in all countries to improve the quality, diversity, and number in the captive population.

Those wishing to contribute data to the international studbook should contact the studbook keeper for additional information:

Miranda F. Stevenson
Curator, The Royal Zoological Society
of Scotland
Edinburgh Zoo
Murrayfield
Edinburgh EH12 6TS
U.K.

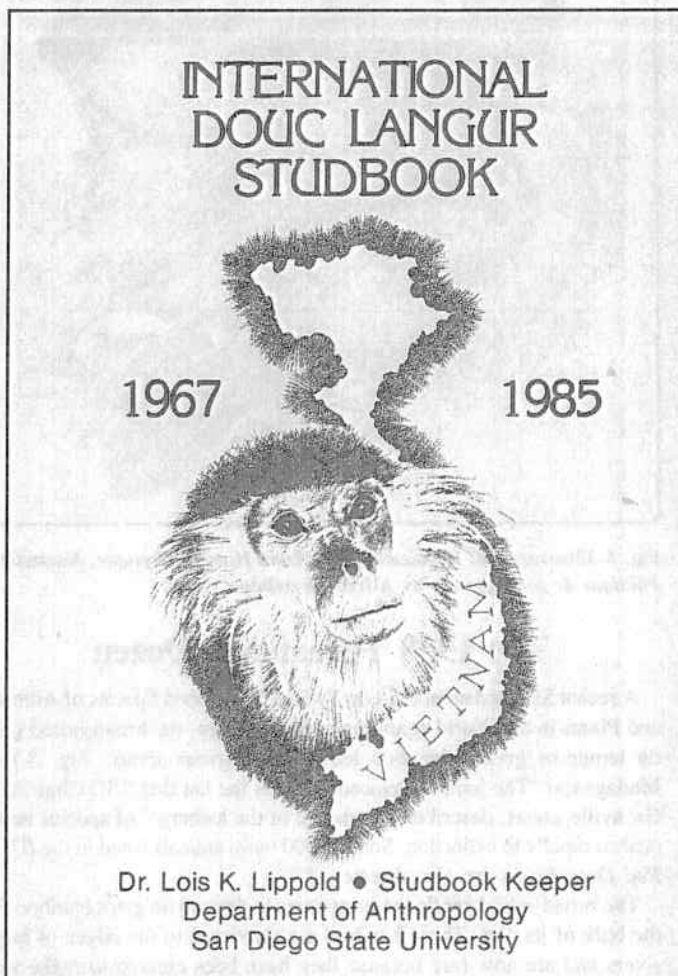
Pygathrix n. nemaeus International Studbook Covers 1967-1985

Since 1975, data on douc langurs have been collected from zoos and private collections throughout the world. While response has not always been prompt or complete, the information that has been collected has proved to be helpful in planning douc management. The compiler and

contributors hope that the continued publication of the studbook will encourage those collections not yet responding to register their doucs.

Since doucs occur naturally in Vietnam and Laos, the status of the wild population is difficult to ascertain. All the doucs in captivity belong to the northern variety, *Pygathrix n. nemaeus*, with prominent white wrist cuffs and maroon or chestnut colored lower legs. The southern variety, *P. n. nigripes*, characterized by entirely black hind limbs, has been long considered extinct but may still exist in southern Vietnam. Subsistence hunting of local fauna continues in Vietnam, and, despite a ban on hunting doucs, some populations have been lost.

The total number of captive doucs registered in 1985 was 58 individuals, comprised of 27 males and 31 females. Upon inclusion in the register, each individual is assigned a five-digit ISIS number, and the following information is recorded if available: sex, zoo number, name, date of birth, date of death, father, mother, and dates of arrival to and names of captivity locations. The studbook keeper maintains an informal captive-life history of each individual, copies of which are available to owners of record only. The information provided to the studbook keeper about an individual's source, cause of death, etc., are confidential and will not be released without the express written permission of the owner of record.



Second generation breeding has occurred at Basel, Cologne, Rome, San Diego, and Stuttgart, so the outlook for doucs appears brighter now than it did in the early years. The population numbers reflect a slight increase each year, and there is some indication that new animals are coming out of Laos. However, efforts to maximize the breeding potential of doucs that are already acclimated to captivity should continue.

The studbook keeper would appreciate any additional information concerning individuals already registered and news of other individuals not

yet included. Please send information by June of each year. To obtain a copy of the studbook or more information about its compilation, write to the studbook keeper:

Lois K. Lippold
Department of Anthropology
San Diego State University
San Diego, CA 92182
U.S.A.

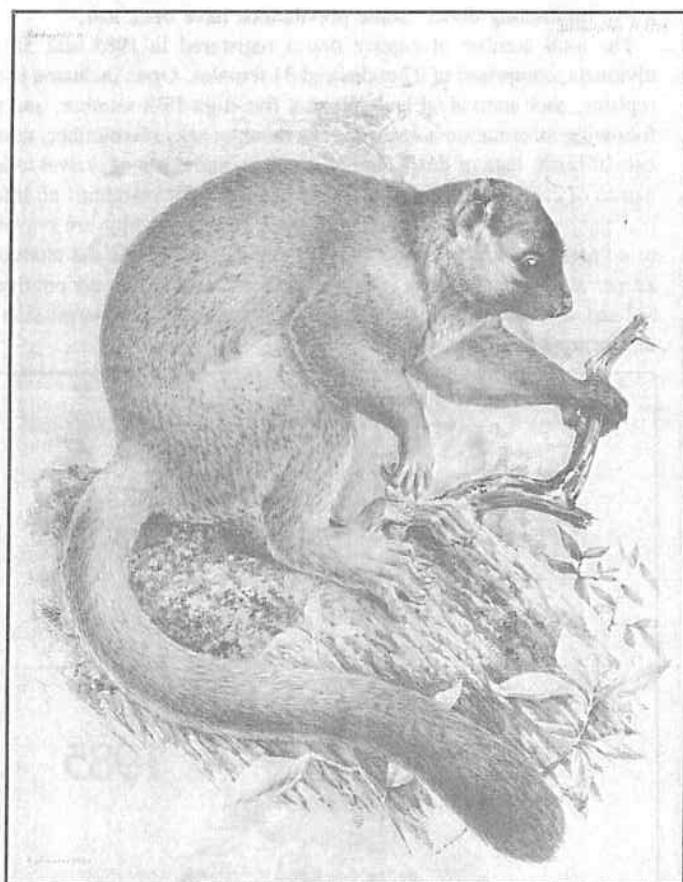


Fig. 5. Illustration of *Hapalemur simus* from *Histoire Physique, Naturelle et Politique de Madagascar*, by Alfred Grandidier, 1875.

The 1988 Threatened Dozen

A recent SSC update of the Top Twelve Threatened Species of Animals and Plants in the World again includes a primate, the broad-nosed gentle lemur or greater bamboo lemur (*Hapalemur simus*; Fig. 5.) of Madagascar. The lemur is placed third on the list that SSC Chairman, Grenville Lucas, describes as "the tip of the iceberg" of species being pushed rapidly to extinction. Some 1,000 more animals listed in the *IUCN Red Data Books* are also threatened.

The broad-nosed gentle lemur appears to depend on giant bamboo for the bulk of its diet. These bamboo are restricted to the edges of large rivers and are now rare because they have been cleared to make way for human settlements and are popular as water containers and fence poles. *Hapalemur* was sighted in two forests in 1986, but the size of the remaining population has not been determined. Unfortunately, the enforcement of laws protecting this animal has also been lax. (For more information on this species see *Primate Conservation* 8: 40-43, 84-87.)

The 1988 Threatened Dozen

1. Black rhinoceros (*Diceros bicornis*) — Africa
2. Kouprey (*Bos sauveli*) — Indo-China

3. Broad-nosed gentle lemur (*Hapalemur simus*) — Madagascar
4. Highland guan (*Penelopina nigra*) — Central America
5. Philippines eagle (*Pithecophaga jeffreyi*) — Philippines
6. Salmon-crested cockatoo (*Cacatua moluccensis*) — Indonesia
7. River terrapin (*Batagur baska*) — Southeast Asia
8. Madeiran land snails (107 species) — Madeira
9. Homerus swallowtail butterfly (*Papilio homerus*) — Jamaica
10. Tanal de Bigotes orchid (*Phragmipedium extaminodium*) — Mexico, Chiapas State
11. Green pitcher plant (*Sarracenia oreophila*) — United States
12. Big-leaf palm (*Marojejya darianii*) — Madagascar

The IPS Conservation Committee

During the 1988 IPS Congress in Brasília, the Conservation Committee decided to reorganize and expand its membership to take advantage of the broad geographic representation and expertise available in the Society. The new committee, chaired by David Chivers, now consists of 16 members grouped into eight sub-committees: (1) Scholarships, concerned with processing applications for training scholarships; (2) Appeal, concerned with promoting the IPS Conservation Appeal and formulating a list of projects for the next phase; (3) Symposium, responsible for planning the format and speakers for IPS Conservation Symposium; (4,5,6) Regional Sub-committees (Africa and Madagascar, Asia, and the Americas), which will work at identifying and collating conservation problems in these regions and providing detailed recommendations for action; (7) International Policy, assigned to plan and implement a strategy to influence major development projects affecting habitat and primates; and (8) Chimpanzees, concerned with monitoring the situation of free-ranging chimpanzees and evaluating the pressures on the species from biomedical research.

The committee also recommended that IPS's conservation priorities should be (1) to make available Conservation Scholarships for training primatologists of habitat countries, and (2), by developing contacts and representation on appropriate committees, to influence policy-makers, funding agencies, and multi-national corporations involved in development projects to promote wildlife (especially primate) conservation in coordination with development. The committee resolved to work to complete the surveys initiated previously on long-term field sites for primate research and institutions with training opportunities for primatologists.

In addition, the committee finalized the leaflet for the Conservation Appeal, which will focus on the four major projects identified in Göttingen in 1986 for IPS support — training scholarships, woolly monkeys in Peru, Thai primates, and gorillas. For the Congress in Japan, the committee is producing information about a larger variety of urgent projects which members might support.

All IPS members interested in the Conservation Committee, please contact the Chair:

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

New Venezuelan Primatological Society

The Venezuelan Primatological Society became an official non-profit association in June 1988 and elected Roberta Bodini de Pepe as its first president. The society's goals are (1) to strengthen primatology as a field of study; (2) to promote the conservation of primates and their habitats in Venezuela; (3) to facilitate communication and cooperation among

Venezuelan primatologists and encourage international collaboration; (4) to advise people and institutions concerned with primate research or management; and (5) to organize an annual meeting to exchange ideas.

The society is also interested in advising or supervising primate field projects. At the moment, members are involved with the development of three projects: an evaluation of the status of *Cebus apella margaritae* on Margarita Island, a population study of *Cebus nigrivittatus* in the coastal region and *Ilanos* near the southern Rio Orinoco, and a survey of primates south of the Rio Ventuari.

For further information about the society, please write:

La Sociedad Venezolana de Primatologia
Universidad Central de Venezuela
Facultad de Ciencias
Instituto de Zoologia Tropical
Apartado 47.058, Los Chaguaranos
Caracas 1041-A
VENEZUELA

New Francophone Primatological Society

In June 1987, a group of French and Belgian primatologists established the Société Francophone de Primatologie. The society aims to promote national and international research in primatology, in particular multi-disciplinary research; to provide a forum for French speakers and others involved in the conservation, breeding, and study of primates; and to foster discussion of the ethical issues involved in such work.

SFDP publishes a biannual newsletter and holds an annual general assembly. The society will host the XIVth Congress of the International Primatological Society in 1992 at the Louis Pasteur University of Strasbourg, France.

Anyone interested in the society is encouraged to write to its headquarters at the Paimpont Biological Station:

Société Francophone de Primatologie
Station Biologique de Paimpont
35380 Plélan-Le-Grand
FRANCE

The Berggorilla Patenschaft

In 1982, a small German non-profit society was established to help conservation efforts on behalf of the mountain gorilla (*Gorilla gorilla beringei*) and the eastern lowland gorilla (*G. g. graueri*). Initially, the society contributed equipment such as clothes, sleeping bags, and tents to the park rangers of the Parc National des Volcans, Rwanda. After a great increase in controlled gorilla-viewing tourism, this became unnecessary. The society has since provided Kahuzi-Biega National Park in Zaire with park ranger equipment including bicycles and publicity materials like slide sets, postcards, and posters (Fig. 6) to advertise the park and generate income. A slide show was also prepared to educate the rangers on the different needs and problems of the park. All the equipment and materials have been purchased or produced by members of the society.

Recently, Berggorilla Patenschaft has begun to support projects in the Impenetrable Forest and the Gahinga Forest in the Kigezi area of Uganda. Equipment is being sent to rangers, and, with the help of Thomas Butynski of the Impenetrable Forest Conservation Project, the society is negotiating to purchase land to widen the narrow Kitahurira Corridor between Kayonza and Bwindi and other endangered sections of the Impenetrable Forest. For more information about the society and

its efforts, please write to the President:

Paul-Hermann Bürgel
Schloss
D 8729 Burgpreppach
WEST GERMANY



Fig. 6. A poster advertising tourism at Kahuzi Biega National Park prepared by the Berggorilla Patenschaft.

Chimfunshi Wildlife Orphanage for Chimpanzees

Although chimpanzees are not native to Zambia, the Zambian government has become actively involved in chimpanzee conservation in recent years due to illegal imports presumably from Zaire. Since 1983, 16 chimpanzees have been confiscated from poachers and smugglers. These immature and often sick animals have found refuge at David and Sheila Siddle's Chimfunshi Wildlife Orphanage in northern Zambia. The Siddles, by personally volunteering and financially supporting the orphanage, have created a well-run and urgently needed facility, the only one of its kind on the continent. However, space is becoming tight for the growing chimpanzees and more animals may be confiscated. Since one of the aims of the Chimfunshi program is to enable the orphans to

live as a normal social group in an open habitat, the outdoor facilities are being expanded, and a 2.8-ha outdoor compound is currently under construction. The Siddles have recently donated 810 ha of their ranch as a sanctuary to be protected by the Zambian National Parks and Wildlife Service for the chimpanzees (see "Ecological assessment for a chimpanzee rehabilitation project in northern Zambia" by T. Ron and W.C. McGrew, p. 37 of this issue).

The Jane Goodall Institute's Committee for Conservation and Care of Chimpanzees, by way of recognizing the Siddles' exceptional contributions has established a special fund for the support of Chimfunshi. For further information, please contact either the CCCC Chairman or Sheila Siddle:

Geza Teleki
CCCC Chairman
3819 48th Street, N.W.
Washington, D.C. 20016
U.S.A.

Sheila Siddle
P.O. Box 11190
Chingola
ZAMBIA

Gorilla Conservation News

In May 1987, the Gorilla Advisory Committee of the PSG published the first issue of *Gorilla Conservation News*. The newsletter aims to facilitate communication among gorilla conservation field workers and to educate others about the status of gorilla populations and the efforts being made to promote the long-term protection of the genus.

The first two issues provided summaries of the seven gorilla conservation field projects currently in progress: Virungas (one project in Zaire and two more on the Rwandan side of the park), Dzanga-Sangho (CAR), Impenetrable Forest (Uganda), Lopé Reserve (Gabon), and Kivu Province (eastern Zaire). These newsletters also included reports on the status of *Gorilla gorilla*, a census of the Virunga population of *G. g. beringei*, and articles on issues surrounding primate trade. Subsequent issues will include listings of recent literature concerned with gorillas and their conservation.

The newsletter appears in the spring and fall, in both English and French. Please direct inquiries to the editor:

Kelly Stewart
Sub-Dept. of Animal Behavior
Madingley
Cambridge CB3 8AA
U.K.

and (until Fall 1990)

Dept. of Anthropology
University of California at Davis
Davis, CA 95616
U.S.A.

New Japanese Series

A new series of monographs entitled *Field Studies of New World Monkeys, La Macarena, Colombia* is being published by the Japan-Colombia Cooperative Study of Primates. The first volume, which appeared in 1988, describes the results of a long-term comparative study on the ecology and behavior of seven sympatric cebids in the Macarena National Park between 1971-1979 by K. Izawa, K. Tokuda, A. Nishimura and M. Yoneda. For more information, please contact:

Dr. Kosei Izawa
Faculty of Education
Miyagi University of Education
Aoba, Sendai 980
JAPAN

New Reviews of Two Neotropical Genera

The fourth and fifth preliminary taxonomic reviews of non-prehensile-tailed cebid genera by Philip Hershkovitz were published in 1987. "Uacaries, New World monkeys of the genus *Cacajao* (Cebidae, Platyrrhini): a preliminary taxonomic review with description of a new subspecies" appeared in the *American Journal of Primatology*, volume 12, pp. 1-53. The diagnostic features of the genus are extensively discussed, as is speciation within the genus. Each species and subspecies is described, the distribution is mapped, and a gazetteer for all known localities is included. Hershkovitz' revised taxonomy for the genus is as follows:

Cacajao melanocephalus
Cacajao melanocephalus melanocephalus
Cacajao melanocephalus ouakary
Cacajao calvus
Cacajao calvus calvus
Cacajao calvus novaesi described as new
Cacajao calvus rubicundus
Cacajao calvus ucayalii

"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" appeared in the *American Journal of Primatology*, volume 12, pp. 387-468. A thorough description of the genus is provided, as well as a discussion of speciation within the genus, and a key to all taxa. Five species are recognized and allocated to two species groups. Each species and subspecies account includes basic taxonomic information and a statement of distribution. Full descriptions are provided only for the new species and subspecies. A complete gazetteer for all *Pithecia* taxa is included. The revised taxonomy for the genus is as follows:

Pithecia pithecia group
Pithecia pithecia
Pithecia pithecia pithecia
Pithecia pithecia chrysocephala
Pithecia monachus group
Pithecia monachus
Pithecia monachus monachus
Pithecia monachus milleri
Pithecia irrorata
Pithecia irrorata irrorata
Pithecia irrorata vanzolinii described as new
Pithecia aequatorialis described as new
Pithecia albicans

Reprinted requests should be addressed to Philip Hershkovitz, Field Museum of Natural History, Roosevelt Road at Lake Shore Drive, Chicago, IL 60605, U.S.A.

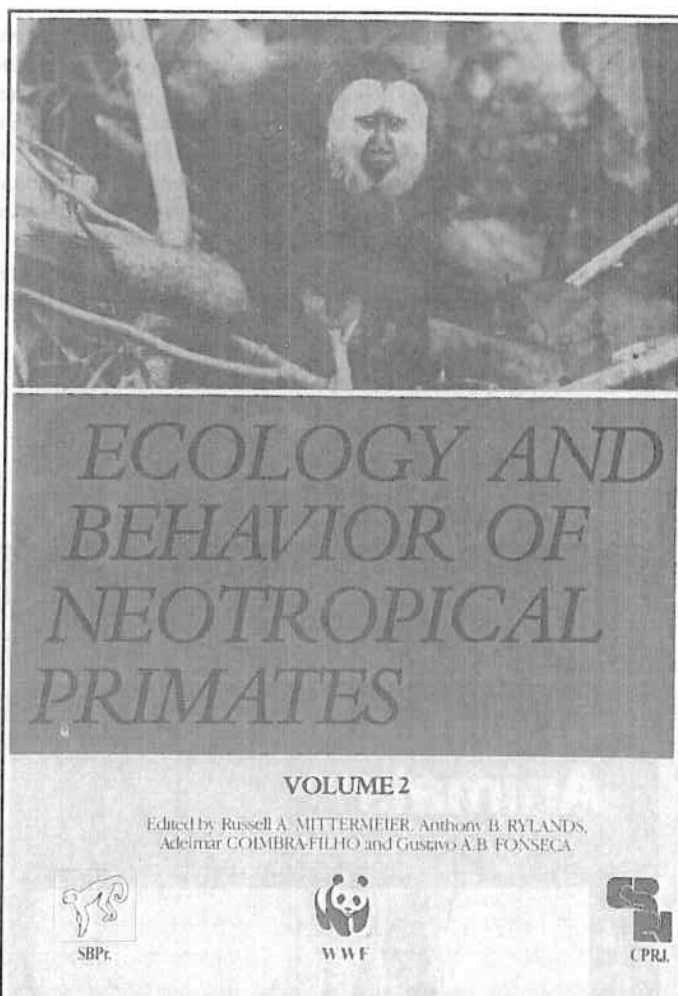
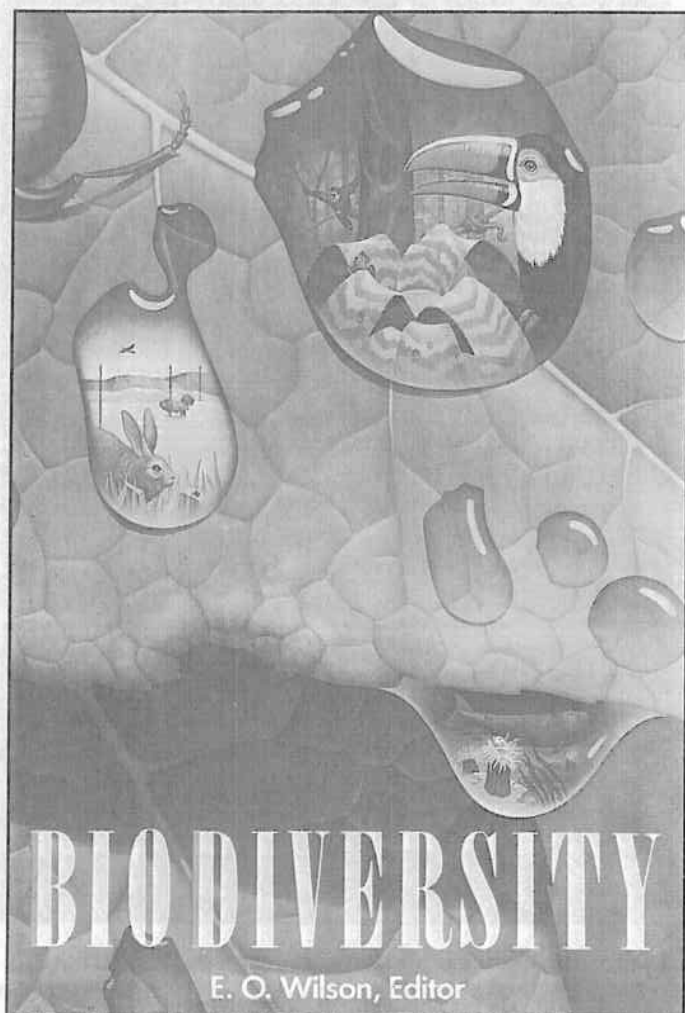
Report on the Status of Primates in the Netherlands

In 1988, TRAFFIC and the IPPL jointly published *TRAFFIC Report No. 6, Non-Human Primates in the Netherlands: A Survey of Import and Export, Ownership and Use*, by Frans A. van der Helm and Ingnaas Spruit. The Netherlands is a major country for primate trade, importing an average of 4,125 primates per year between 1977-1981, primarily from Indonesia and Kenya and then usually re-exporting them to European and Soviet research institutions. The trade is now controlled by CITES (ratified in 1984) and the Dutch BUD Act (1977).

The TRAFFIC report describes the primates which pass through or remain in the Netherlands, explains legislation regulating trade in primates in the Netherlands and the West, investigates the routes and breadth of the trade, identifies the primary users of captive animals, and recommends new methods of keeping records, enforcing regulations, breeding primates in captivity, and educating the public. Because of the extensive data available on primate possession and use in the Netherlands, the report is a near-complete inventory and, therefore, offers exceptional insight into the ways primates are used in a western country and the ways this information can be collected.

Requests for the publication should be directed to TRAFFIC's office in the Netherlands:

TRAFFIC Nederland
Postbus 7
3700 AA Zeist
THE NETHERLANDS



New Books by and for PSG Members

Many new items of relevance to primate conservation have been published in the past year. Below is a selection that may be of interest to you. We have included prices and ordering information where available.

Biodiversity edited by E.O. Wilson (1988)

Based on a major conference organized by the National Academy of Sciences and the Smithsonian Institution, this book explores the many facets of biodiversity and warns of the threat of extinction to countless organisms, many not yet known to science. The lively, non-technical text makes accessible current information on complex issues such as human dependence on biological diversity, the role of science and technology in conservation, the development of economic and conservation policies to influence species preservation, and the perspective of aesthetic and cultural values on biodiversity. Available for \$19.50 in paperback and \$32.50 in hardcover, the book may be ordered from the publisher:

National Academy Press
2101 Constitution Avenue, N.W.
Washington, D.C. 20418
U.S.A.

Ecology and Behavior of Neotropical Primates. Vol. 2. edited by Russell A. Mittermeier, Anthony B. Rylands, Adelmair Coimbra-Filho and Gustavo A.B. Fonseca (1988)

The long-awaited second volume of *Ecology and Behavior of*

Neotropical Primates is now available. This volume contains an update on the systematics of 164 Neotropical species and subspecies of primates, and a review of the ecology and behavior of the eight genera not covered in Vol. 1. As in Vol. 1, each chapter was prepared by experts on the genus in question and the information is organized into a standard format to facilitate comparisons among the various genera. In this volume, chapters are included on *Cebuella*, *Callithrix*, *Saguinus*, *Leontopithecus*, *Alouatta*, *Ateles*, *Lagothrix*, and *Brachyteles*.

The 610-page, soft-covered book is aimed both at students and specialists interested in Neotropical monkeys. For more information on purchasing this volume, please contact:

R.A. Mittermeier
Dept. of Anatomical Sciences,
State University of New York
Stony Brook, N.Y. 11794
U.S.A.

1988 IUCN Red List of Threatened Animals



The IUCN Conservation Monitoring Centre

1988 IUCN Red List of Threatened Animals prepared by The IUCN Conservation Monitoring Centre (1988)

This latest edition of the *IUCN Red List of Threatened Animals* updates the 1986 *Red List* and provides a global overview of the current status of threatened taxa. Prepared by the IUCN Conservation Monitoring Centre in association with the International Council for Bird Preservation, this edition follows the standard *Red Data Book* format, presenting the scientific name, English vernacular name, IUCN threatened category, and a brief description of each threatened species' range. An essay on biotic extinction by Bruce Wilcox of the Center for Conservation Biology at Stanford University is also included. Guest essays will

be a regular feature in future editions.

The book is available for \$12 from:

IUCN Publications Services
219c Huntingdon Road
Cambridge CB3 0DL
U.K.

Perspectives in Primate Biology series edited by P.K. Seth and Swadesh Seth (1987)

This series focuses on primates in relation to current research in the fields of human evolution, molecular evolution, cytogenetics, socio-biology, ecology, and conservation. Compiled as collections of selected and interrelated works previously scattered throughout the literature, the series is designed to provide more comprehensive information in a more effective way. Each chapter ends with an extensive bibliography.

The series is an ideal introduction to the widening field of primatology for scientists and conservation professionals of all kinds.

Vol. 1. (1983) 240 pp.	\$69.00
Vol. 2. (In press, 1987) 325 pp.	\$69.00
Vol. 3. (In press, 1987) 300 pp.	\$69.00

Today and Tomorrow Printer
and Publishers
New Delhi
INDIA

Primate Adaptation & Evolution

John G. Fleagle

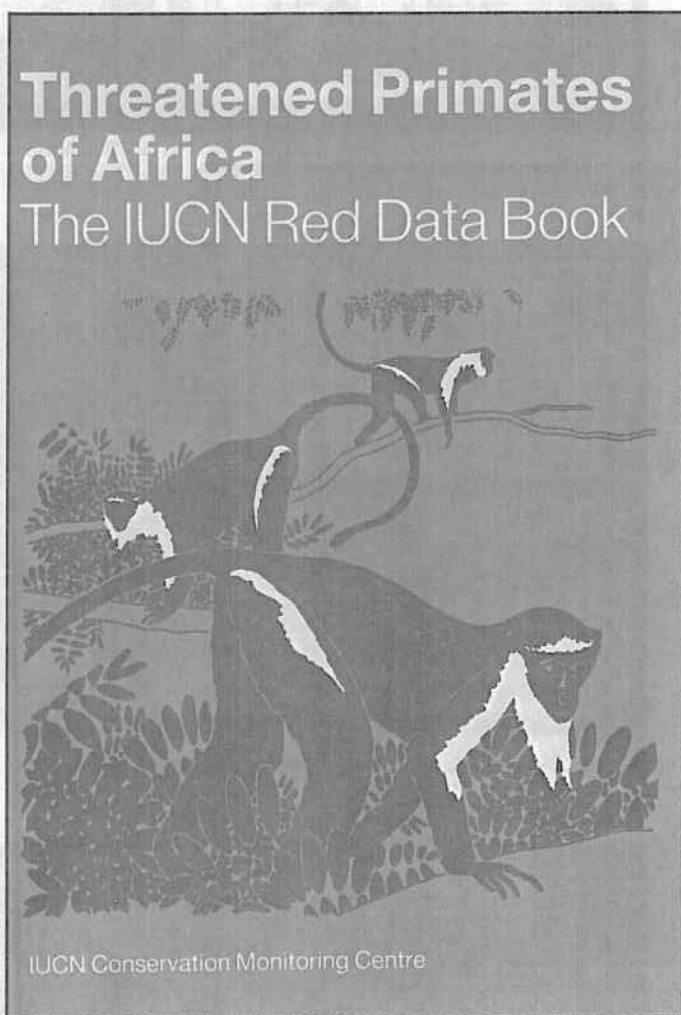
Primate Adaptation and Evolution by John Fleagle (1988)

This textbook combines primate evolution with primate ecology and acts as an excellent introduction to the biology of the Order Primates.

It is designed for students with a general knowledge of biology and evolutionary theory who want to examine the comparative anatomy, behavioral ecology, and paleontology of humans and our nearest relatives. Chapters 1-3 review the basic concepts and terminology of evolutionary biology, primate anatomy, and behavioral ecology. Chapters 4-7 cover the anatomy, ecology, and systematics of each genus of extant primate. Chapter 8 describes major adaptive radiations within the order. Chapters 9-16 discuss the primate fossil record.

The 500-page book, beautifully and lavishly illustrated by S.D. Nash and L. Betti, is available from the publisher for \$39.95:

Academic Press
Harcourt Brace Jovanovich Publishers
Book Marketing Department
1250 Sixth Avenue
San Diego, CA 92101-4311
U.S.A.



A Primate Radiation: Evolutionary Biology of the African Guenons
edited by A. Gautier-Hion, F. Bourliere, J-P. Gautier, and J. Kingdon (1988)

This book synthesizes all that is known of the African guenons to present a case study of evolution in action. Thirty specialists in the fields of primatology, paleontology, genetics, and morphology have contributed chapters arranged in three sections: I. Guenons and the African Environment Past and Present; II. Genetic and Phenetic Characteristics, Their Use in Phylogenetic Reconstruction; and III. Ecology and Social Behavior. The 550-page book, illustrated throughout, is available from

the publisher for \$120:

Customer Services Dept.
Cambridge University Press
The Edinburgh Building
Shaftesbury Road
Cambridge CB2 2RU
ENGLAND

Threatened Primates of Africa — The IUCN Red Data Book compiled by the IUCN Conservation Monitoring Centre, by Phillis C. Lee, Jane Thornback and Elizabeth L. Bennett (1988)

This 155-page volume of *The Red Data Book* provides the most recent data sheets for 79 African primate taxa. Each data sheet gives the common English and scientific names of the animal in question, an assessment of its status according to the IUCN categories (E, V, R, etc.), a brief paragraph about the animal's general situation, and succinct descriptions under the categories of Distribution, Population, Habitat and Ecology, Threats, Conservation Measures, Captive Breeding, and Remarks (about taxonomy). Each data sheet concludes with a comprehensive and up-to-date list of references.

The slim volume represents a comprehensive and meticulous sifting of data and provides an invaluable resource to laboratory scientists, zoo personnel, field workers, and all who make decisions about programs and procedures affecting these animals. To order a copy, please send £12 (\$24) to the IUCN's Publications Services office:

IUCN Publications Services
219c Huntingdon Road
Cambridge CB3 0DL
U.K.

Videotapes

***Biodiversity* (1988)**

This 45-min video adapted from the concluding session of the National Forum on Biodiversity opens with a film clip providing an overview of biodiversity and moves on to lively discussion between the teleconference panelists: Paul R. Ehrlich, Thomas E. Lovejoy, Joan Martin-Brown, Peter H. Raven, Michael H. Robinson and E.O. Wilson. The biodiversity problem is reviewed, causes of the crises discussed, the importance of biodiversity to human welfare established, and the steps being taken and still needed to control the loss of species outlined. It is available from the publishers of Wilson's *Biodiversity* for \$24.50, and at a discount if purchased together with the book:

National Academy Press
2101 Constitution Avenue, N.W.
Washington, D.C. 20418
U.S.A.

***Understanding Chimpanzees* (1987)**

This symposium and international forum was organized by Jane Goodall, sponsored by the Chicago Academy of Sciences, and was held 7-10 November 1986. Videos of each of the seven sessions are available: Current Fieldwork, New Research on Bonobo Social Behavior, Chimpanzee Conservation, Chimpanzees of the Mahale Mountains, Chimpanzees of the Gombe, The Chimpanzee Mind, and Understanding Chimpanzees: Understanding Ourselves. Each session runs between 2½-3½h. Sessions 1-6 cost \$58 each, Session 7 \$40, the complete set \$340:

The Chicago Academy of Sciences
2001 N. Clark Street
Chicago, IL 60614
U.S.A.

Air France Promotes Conservation

Air France, in collaboration with WWF-France, has chosen a series of beautiful, colored illustrations of rare and endangered animals to decorate menus on flights between St. Denis de la Réunion and Paris, via Antananarivo and Jiddah. Each illustration fills the front cover of a menu, and on the back cover, in both French and English, a brief description of the animal is printed with the slogan, "Care for Nature."

Propithecus verreauxi coquereli (Fig. 12), one of the primates featured in the series, is accompanied by the following note: "Coquerel's sifaka is one of the numerous species of the delightful and graceful lemurs . . . They are found in the forests of west and south Madagascar. However, they are becoming increasingly rare in these areas, especially the south, because of fires which have destroyed their forest habitat."

The PSG would like to thank Air France for its conservation education effort. We hope other commercial enterprises will follow this tasteful example.

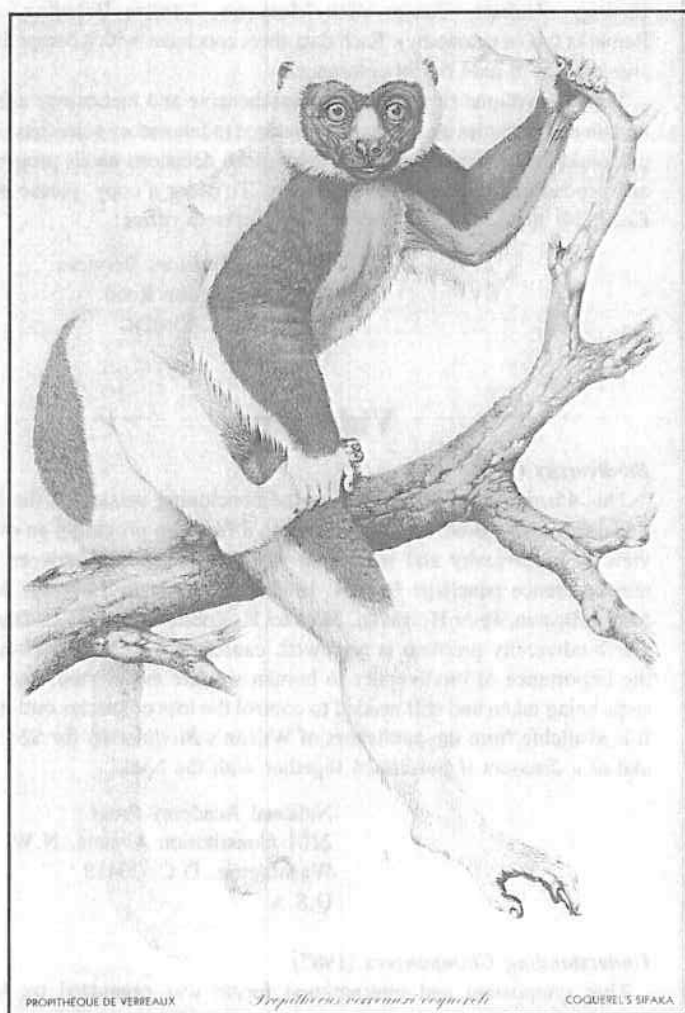


Fig. 12. The cover of a full-color Air France menu depicts a Verreaux's sifaka resting on a tree branch.

New Primate Stamps

Several countries in Africa have recently issued new primate stamps. In 1988, Algeria issued four macaque stamps (Fig. 13), and Cameroon four drill stamps (Fig. 14) incorporating the WWF logo. Guinea released a grivet monkey souvenir sheet (Fig. 15), and Tanzania a series of four bushbaby stamps to accompany a souvenir sheet of the African palm civet (Fig. 16).

In Asia, Bhutan released two new stamps celebrating the endangered golden langur (and the work of WWF; Figs. 13-19). In the Americas, Belize issued a four-stamp 'Primates of Belize' series, and souvenir sheet featuring the howler monkey and the spider monkey (Fig. 19).



Fig. 13. New Algerian stamps feature macaques.



Fig. 14. A new stamp series from Cameroon highlights drills.



Fig. 15. A souvenir sheet from Guinea depicts the grivet monkey.



Fig. 16. Tanzania's new series shows bushbabies and the souvenir sheet features an African palm civet.



Fig. 17-18. Bhutan's new stamps portray the golden langur.



Fig. 19. The new series 'Primates of Belize' features howler monkeys and spider monkeys.

Research Opportunities at Karisoke Research Center, Rwanda

The Digit Fund is dedicated to continuing the research on mountain gorillas and their habitat begun by Dian Fossey at the Karisoke Research Center (KRC) of Rwanda. Located in the Parc National des Volcans, the KRC was founded by Fossey in 1967 and served for 18 years as a base for her pioneering research and conservation efforts on behalf of the mountain gorillas. Many aspects of gorilla behavior and ecology still remain only partially studied, however. Some topics that need further examination are: communication, cognition ethology and the uses of social intelligence, infant development, male-infant relations, and male life-history studies. The gorilla population in the study area has been monitored continuously for over 20 years, and a large body of background data is available on both groups and individuals.

There is also a great need for examination of the other rare and endangered animal species present in the Parc National des Volcans and of the park's unique floristics and ecology. The KRC would like to expand its scope of research so as to obtain basic information on the ecology, behavior, and population dynamics of non-primate species in the park as well as on plant ecology, plant-herbivore interactions, and biophysical ecology.

The Scientific Advisory Board of The Digit Fund reviews all proposals and provides, assists in or advises on the search for funding of accepted projects. All applicants will be expected to apply to one or more other agencies or organizations for financial support of their projects. The KRC offers rustic accomodation, and there are well-equipped laboratory facilities near the park headquarters at Kinigi. Researchers are expected to contribute toward the center's operating and maintenance expenses.

Further information on possible research topics and facilities at the KRC can either be obtained from the Director, Dr. Diane Doran, or from the Executive Director of The Digit Fund, Mr. Claude Ramsey:

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OBITUARY Kalang anak Tot

Primatology in Southeast Asia prematurely lost one of its best friends on 14 April 1987, when Kalang anak Tot died, aged 49, apparently from appendicitis. Kalang, a Jah Hut Orang Asli (aborigine) from Pahang in Peninsular Malaysia, played a crucial part in primate field studies at the Kuala Lompat Post of the Krau Game Reserve for 17 years, starting in 1970.

His knowledge of the tropical rainforest and his ability to identify trees, locate and follow primate social groups, and collect systematic data on feeding, ranging and social behavior contributed significantly to several post-doctoral studies and, perhaps more importantly, to about 12 doctoral dissertations — on squirrels, birds, and trees, as well as primates — submitted to the universities of Cambridge, Oxford, Aberdeen, Malaya, Berkeley, and Harvard and to a master's thesis to Universiti Pertanian, Malaysia. He contributed to about 25 projects in all, some involving travel to other sites in the Peninsula, such as Pasoh, Tekam, and Lima Blas, from which more than 60 scientific papers have resulted. His expertise and energy, and his cheerful disposition, particularly in the midst of adversity, were essential to the success of this work. Our comprehensive understanding of the rainforest community of plants and animals in Peninsular Malaysia simply would not be what it is today without his contribution.

Kalang's collaboration on projects has, perhaps, helped to perpetuate the traditional knowledge and wisdom of the Jah Hut, a proto-Malay people of the central part of the peninsula. Inevitably, as the Jah Hut become more "modern" and more integrated into the mainstream of Malaysian life, much of their heritage of forest knowledge is likely to be lost. Having lived in a rainforest for centuries, they have a rich reservoir of environmental knowledge, and their spiritual beliefs are fascinating. Modern cultural norms tend to bewilder and frighten them; indeed, in refusing to seek modern medical aid before he died, Kalang can be seen as a victim of these stresses.

Ways to perpetuate his memory are now being investigated, and some of his former "students of the forest" have clubbed together to help his family through a difficult time. Kalang leaves a widow, Seri anak Sentol, and two children, Denah (or "Lena") aged 19, and Bahari (or "Amir") aged 12. They share their house with seven other relatives, with whom they split a very small and insecure income.

Kalang was laid to rest in a traditional Jah Hut grave in a rubber garden behind his house.

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NEWS FROM THE FIELD

Central and South America

A Range Extension for *Saguinus labiatus thomasi*

by José de Sousa e Silva Júnior

Saguinus labiatus thomasi was described by Emilio Goeldi in 1907, following his examination of one of the specimens collected by Henry Bates in 1863 and classified as *M[idas] rufiventer* (= *S. l. labiatus*). This specimen, consisting of the skin and cranium of an adult male, is registered as no. 57.10.17.5 in the collection of the British Museum (Natural History) and has been designated as the holotype.

A second specimen was acquired by the Leiden Museum in 1864 and described by Schlegel in 1876 as *Hapale labiatus*. Hershkovitz (1977) regards this specimen as a second individual (a paratype) collected by Bates, even though its locality is given as 'Rio Yavari,' a region in which this form certainly does not occur. This assumption is based on the fact that the museum also holds a specimen of *Saguinus fuscicollis fuscicollis*, which was collected by Bates on the Javari River. In addition to these two specimens, there are two more in the British Museum and one in the Smithsonian Institution.

The type locality is described as being in the vicinity of the town of Tonantins, on the left bank of the Tonantins River, a northern tributary of the Solimões, in the Brazilian state of Amazonas (2°47' S, 67°47' W; Fig. 1). Apart from the individual in the Leiden Museum, all known specimens were collected at the type locality. Until now, the occurrence of *S. l. thomasi* at other sites had not been confirmed.

In 1970, four specimens of *S. labiatus*, which were identified by F.D. Ávila-Pires at the National Museum of Rio de Janeiro, were collected in the area of Barreirinha (2°04' S, 66°20' W), on the left bank of the Auatí-Paraná River (Almeida and Deane, 1970) in the municipality of Fonte Boa, Amazonas State. In 1980, two of these specimens, a male and a female, were donated by the National Institute for Amazonian Research (INPA) to the Goeldi Museum in Belém; the whereabouts of the remaining two individuals is unknown. Before their locality was known, it was possible to identify the two specimens as *S. l. thomasi* on the basis of both the diagnostic features described by Hershkovitz (1977) and the photograph of the sub-species presented in Mittermeier and Coimbra-Filho (1981: 50).

This new site lies 200 km to the east of the type locality (Fig. 1), indicating that the subspecies almost certainly occurs throughout the region



Fig. 1. Hypothesized distribution of *Saguinus labiatus thomasi* (map by S.D. Nash based on author's original).

between the left bank of the Tonantins and Auatí-Paraná rivers (the Auatí-Paraná connects the Solimões and the Japurá). Given the distribution of other *Saguinus* species in the upper Amazon, it seems reasonable to hypothesize that *S. l. thomasi* also occurs as far west as the Içá River and as far east as the confluence of the Auatí-Paraná and the Japurá. The present data do not allow speculations on the northwestern limits of the distribution of this sub-species, although it is interesting to note that Camacho and Defler (1985) did not record the presence of *S. l. thomasi* in the region between the Putumayo and Caquetá rivers, Colombian tributaries of the Içá and Japurá, respectively.

Given the lack of data available on this form, *S. l. thomasi* is given indeterminate (I) status by Coimbra-Filho (1982, 1983). Rylands (1985) has suggested that the subspecies occurs in the ecological station of Juami-Japurá, although this has yet to be confirmed.

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Preliminary Survey on the Population Densities of *Cacajao calvus ucayalii*

by Rolando Aquino

Cacajao calvus has traditionally been divided into two subspecies: *C. c. calvus* and *C. c. rubicundus*, the white and the red uakari respectively. In a recent taxonomic revision of the genus, Hershkovitz (1987) recognizes an additional two subspecies: *C. c. novaesi* and *C. c. ucayalii*, also known as red uakaris.

C. c. calvus is the only subspecies which has been studied in detail, by Ayres (1986) in Brazil. Brief observations have been reported on the other subspecies by Mittermeier and Coimbra-Filho (1977), Aquino (1978), Fontaine (1979, 1981), and, more recently, by Bartecki and Heymann (1987). The following is a report on censuses conducted in the Peruvian Amazon between 1978 and 1986 to obtain more ecological and behavioral data on this little known and seriously threatened species.

The study areas are located in the eastern Peruvian Amazon (approx. 4°00'-6°20' S, 72°30'-73°30' W; Fig. 1) and include the forest of Jenaro

Herrera in the Ucayali River basin, the forest of the Orosa and Blanco rivers in the Amazon River basin, and the forest of the upper Tapiche River. In these areas we observed different floristic compositions growing on similar soil types subject to varying degrees of seasonal flooding of white, black or mixed water.

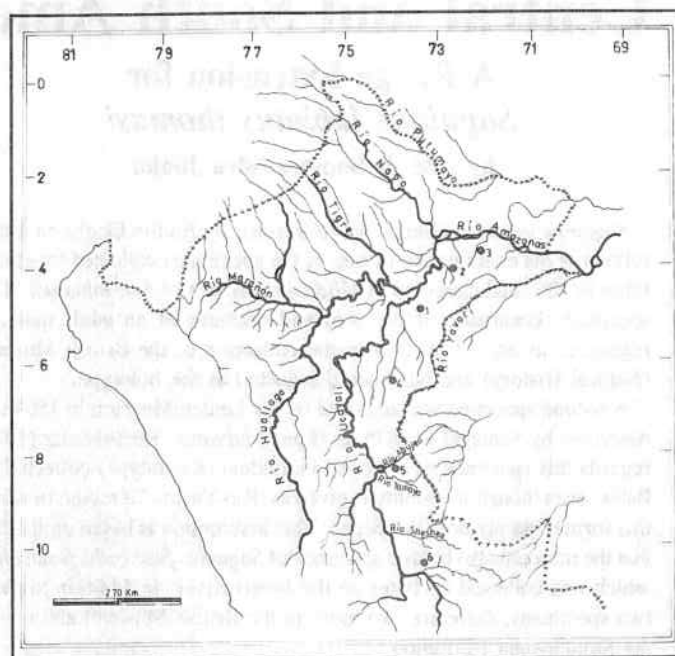


Fig. 1. Map of Peru showing the areas surveyed for *C. c. ucayalii*. (1) Jenaro Herrera, (2) Orosa River, (3) Blanco River, (4) Upper Tapiche River, (5) Abujao River, (6) Inuya River (map provided by author).

In Jenaro Herrera, Orosa, and Blanco, the soil is clayey and the topography is undulating. A great part of the forest is hillside or highland, represented by vigorous vegetation, with narrow-trunked trees that exceed 30-40 m in height. The Jenaro Herrera and Orosa areas show evidence of moderate commercial logging. Monkeys, including *C. calvus*, are commonly hunted in these areas. In contrast, the Blanco River shows increased evidence of commercial logging and the influence of agriculture and cattle ranching on the land. There, hunting pressure seems to be high and affects small-sized monkeys as well as others.

In the upper Tapiche River, the soil is similarly clayey, with a slightly undulating topography inundated during high floods by white and black water. The majority of the forest is swamp forest (*tahuampa*) and includes plant species such as: *Mauritia flexuosa*, *Scheelea cephalotes*, *S. bassleriana* and *Ficus* spp. Selective extraction of several species such as *Chorisia insignis* and *Clarisia biflora* was observed. There was less hunting here than in the other areas, but hunting did include large and medium-sized cebids.

To verify the geographic distribution, we carried out surveys to the southeast, mainly on the Inuya River, a right tributary of the Urubamba River, and the Pachitea and Abujao Rivers, tributaries of the upper Ucayali River (Fig. 1).

In this study, we made periodic surveys between 1982 and 1986, except in the Jenaro Herrera area, which we surveyed in 1978. Three observers conducted each census by walking along forest trails made by hunters and foresters. In the majority of cases censuses were conducted between 0700 and 1300 h. Densities (troops/km²) were calculated applying King's method (in Robinette *et al.*, 1974; *e.g.*, Southwick and Cadigan, 1972; Freese *et al.*, 1982).

Habitat

We found *C. c. ucayalii* to inhabit both the highground forest and the floodplain forest. This is in contrast with the observations of Mittermeier

and Coimbra-Filho (1978) and Fontaine (1979), who describe the floodplain forest as the animal's only habitat. For locomotion and feeding activities, red uakaris occupy the high strata and emergent trees. During the season of plentiful fruit they forage in *aguajales* and *renacales* (swamps of *Mauritia flexuosa* and *Ficus* spp., respectively). Uakaris remain for long periods in these places until the fruits are finished.

All troops were detected well into the forest, more than two km from a river bank. We suppose red uakaris are not dependent on bank vegetation for survival. This characteristic should explain their apparent absence during a previous census on the southern side of the Amazon.

Population Density

During the censuses, a total of four troops were located in 193.5 km of transects. A fifth troop was located outside the census area. With the exception of the Blanco River, the estimated densities varied from 0.07 to 0.45 troops/km², with an average of 0.11 troops/km² (Table 1).

Table 1. Average Population Density for *C. c. ucayalii* in Four Areas Surveyed

Area	Forest Type	Distance Censused (km)	No. Groups Encountered
Jenaro Herrera	high ground	77.0	1
Orosa River	high ground	12.5	1
Blanco River	high ground	81.0	0
Tapiche River	floodplain	23.0	1
Average density estimate for all four sites (troops/km ²)			0.11

The Blanco River was the only survey site where we did not observe red uakaris. However, Bodmer (pers. comm.) in 1984 and Bartecki and Heymann (1987) report some troops in the study site of the Quebrada Blanco Biological Station. These observations and the existence of two juveniles in the Breeding and Conservation Primate Center in Iquitos, are evidence of the presence of this species, but probably at densities lower than in other areas.

The estimated densities reveal the critical situation of red uakaris in areas commonly frequented by people. It would be interesting to do an evaluation in the headwaters of the rivers and streams, where we suppose the majority of the population is located.

Troop Size and Composition

In one troop we counted 42 adults and juveniles, as well as seven infants being carried. Of the other troops sighted, we obtained partial counts that oscillated between 17 and 73 individuals (Table 2). The largest troop we observed was in the Orosa River area and consisted of 100 - 200 individuals, an estimate that coincides with that of Mittermeier and Coimbra-Filho (1977) for *C. c. calvus*.

Although the contacts in some cases lasted for more than half an hour, it was not possible to determine troop composition. Nevertheless, we noted the presence of various adults of both sexes and some females carrying newborn infants. Some of the males appeared dominant and led the group during travel.

Table 2. Troop Size for *C. c. ucayalii*

Area	Obs. Date	No. Inds.	
		Counted	Estimated
Jenaro Herrera	June 1978	20	35-40
Jenaro Herrera	August 1979	26	30-40
Orosa River	May 1982	73	100-120
Tapiche River	March 1986	49	all counted
Tapiche River	March 1986	17	35

Interspecific Associations

Three of the detected troops were associated with other cebids. The first mixed troop, observed in the Orosa River area, was travelling with *Pithecia monachus* in the lead. The second mixed troop was observed eating the fruit of *M. flexuosa* with *Lagothrix lagotricha* in the upper Tapiche River area. While feeding, some of the red uakaris tasted and then threw away immature fruits. This mixed troop maintained the association during the escape. The third sighting, also in the upper Tapiche River area, was with *Cebus apella* and *Saimiri boliviensis* in a levee forest or *restinga*, near an *aguajal*. *C. apella* led the group. The association ended when we were detected, the red uakaris fleeing into the *aguajal*, while *C. apella* and *S. boliviensis* both continued in the *restinga*.

With the exception of the associations observed with *L. lagotricha* and *P. monachus*, which are being reported here for the first time, the others concur with the observations of Mittermeier and Coimbra-Filho (1977) in Brazil and Bartecki and Heymann (1987) in Peru.

Current Distribution

According to Hershkovitz (1987), *C. c. ucayalii* is distributed from the right bank of the Ucayali River in an easterly direction to the Yavari River, and from the Amazon River in the north to the Urubamba River in the south. However, the lack of evidence of red uakaris in recent surveys on the Inuya and Mapuya rivers (tributaries of the Urubamba) leads us to conclude that in this part of the Amazon, hunting has exterminated the species. As a consequence, the distribution to the south extends only to the Sheshea River (Fig. 2). Uakaris are now threatened in an area parallel to the Ucayali and Amazon rivers, where the forest is being logged and the primates heavily hunted. The surviving population is most likely to be occupying a narrow strip of forest between the headwaters of the Sheshea and Tamaya rivers in the Ucayali Department, and the Maquia, Tapiche, Orosa and Yavari-Mirim rivers in the Loreto Department.

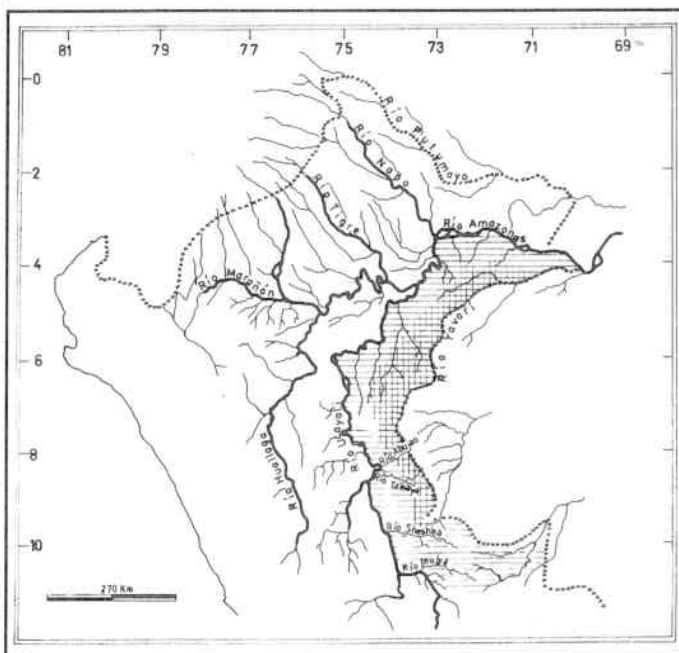


Fig. 2. Map of Peru showing the distribution of *C. c. ucayalii*. The parallel lines correspond with the distribution area provided by Hershkovitz (1987), while the intercrossed lines show the actual distribution (map provided by author).

Current Situation

There are no quantitative data about numbers of uakaris killed, but intense hunting goes on. Monkey meat is popular and hunting can be profitable. Dealers of *carne de monte* solicit a steady supply of bushmeat from hunters and loggers. In March 1986, we found a hunter in the upper Tapiche River transporting in his canoe five recently shot red uakaris taken from a single troop. The hunter told us the meat was destined for the market in Iquitos.

Sometimes men hunt to obtain infants to sell as pets. In September 1986, when I was in Village 28 de Julio on the Abujao River, I met a group of loggers who were also dedicated hunters. Because of my interest in locating red uakaris, they thought I was an intermediary connected with the illicit trade in wild animals. They offered to bring me newborn infants during the high-water season (December - May) when the headwaters of the tributaries of the Abujao River are more accessible. They claimed the majority of red uakaris is located in this area.

The consequences of high hunting pressure are evident, particularly on the Inuya, Abujao and Blanco rivers, where appreciable efforts were made to locate the species with no success. We consider red uakaris seriously threatened and believe measures must be taken now to ensure their future survival.

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Africa

New Species of *Cercopithecus* in Gabon Needs Protection

by Jean-Pierre Gautier

In 1984, in the Forêt des Abeilles in Gabon, M.J.S. Harrison discovered an unknown form of guenon related to *Cercopithecus preussi* from Cameroon and *C. lhoesti* from Zaire. Because of differences in phenotype, morphology, and karyotype, this new form has been recognized as a separate species within the *lhoesti* super species (Harrison, 1984, 1988; Dutrillaux *et al.*, 1988). Harrison named it *C. solatus*, or 'sunstruck,' after its orange-tipped tail.

Several reasons account for the length of time it took for this animal to become known to scientists: (1) the Région des Abeilles' historical inaccessibility and lack of communication routes, (2) the species' very limited geographical distribution, and (3) the species' exceptionally secretive behavior.

A survey of the geographical distribution of *C. solatus* (Gautier *et al.*, 1986) has shown it to be present in an estimated area of 3,800 km², limited by the Offoué River to the west, the Ogooué River to the north, and the Ogooué, Lolo, and Bouenguidi rivers to the east. The southern and southwestern limits remain uncertain; they do not seem to correspond with any natural barrier (Fig. 1).

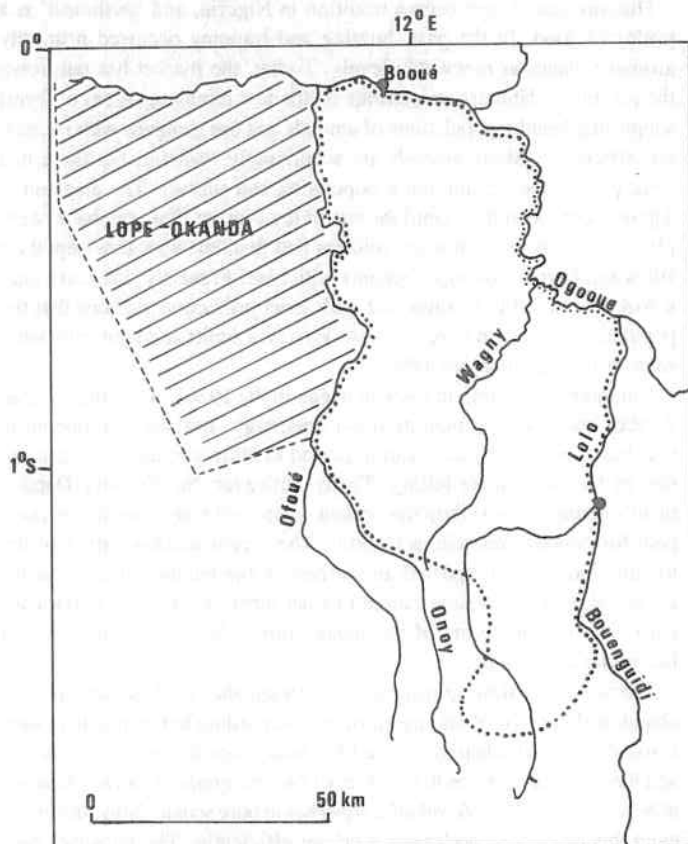


Fig. 1. Distribution map of *C. solatus* (dotted line) in Gabon. The hatched area indicates the Lopé-Okanda National Park (map provided by author).

The discovery of this new primate is of great interest to both the international scientific community and Gabon—especially since *C. solatus* is endemic to this country. The nature of past connections between the

three forms of *lhoesti* and of their speciation patterns are especially worthy of further study.

Like other primates, *C. solatus* is hunted with shotguns (Fig. 2). As a semi-terrestrial monkey, however, it is worse off because it can also be captured in ground snares, particularly those set for antelopes. Six young animals collected in the villages had been snared and bore telling wounds. Adults are also captured in snares but are nearly always killed because they are impossible to maintain in captivity. The mutilations and amputations seen on some animals killed with shotguns bear witness that they had previously been victims of snares.

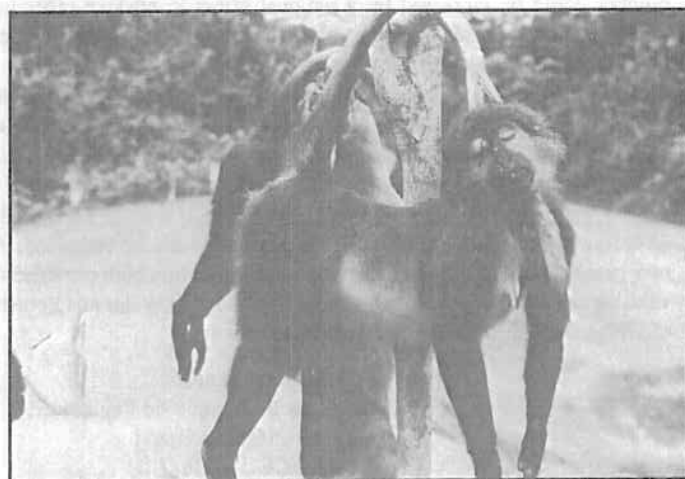


Fig. 2. Adult female *C. solatus*, killed by a hunter together with an adult male and a juvenile; the three specimens' skulls and skins have been deposited at the British Museum, London (photo by J.N. Loireau).

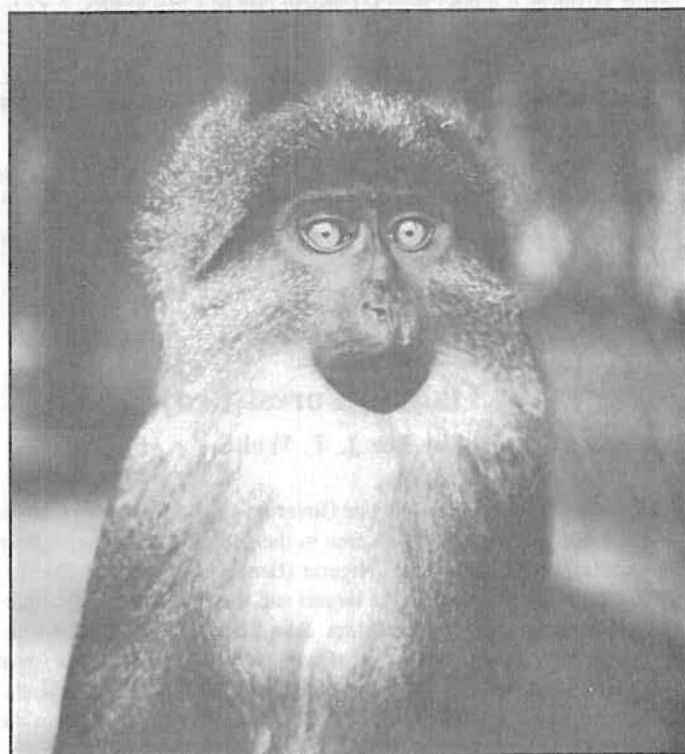


Fig. 3. Adult male *C. solatus* displaying the species' distinctive white throat (photo by J.N. Loireau).

Hunting pressure on *C. solatus*, which already has a very limited geographic distribution, poses an immediate threat to its conservation. With the Directors of Wildlife and Hunting in Gabon, and with help from international conservation agencies, we propose that the following steps be taken:

(1) Provide *C. solatus* with total protection by adding it to the list of internationally protected species and by instituting a total ban on the hunting of the animal in Gabon, either by shotgun or snare, and a ban on the sale or export of live individuals without special permission; officers of the Department of Water and Forests can disseminate relevant information throughout the area concerned.

(2) Create reproductive colonies, starting with animals taken from hunters and trappers. Five individuals are currently in captivity: three at the Primate Center at CIRMF, Gabon, two at the experimental colony of guenons in the Station Biologique de Paimpont, France. This number could be increased by a national effort to retrieve other individuals captive in villages; the collection could be carried out under the direction of Water and Forests officers.

(3) Extend the Lopé-Okanda National Park; the Offoué River is both the western limit of *C. solatus*' distribution and the eastern limit of the park, so an extension of this reserve to the east (up to Wagny; Fig. 1) would protect at least half of the species' current distribution area.

(4) Continue fieldwork on this species. Ecological studies are needed before the size and dynamics of the population can be estimated. A two-year research program to study wild groups could both provide invaluable scientific information and help scientists and Water and Forests officers establish effective protective measures.

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The Okomu Forest Project

by Lee J. T. White

In August 1985, the Bendel State Government constituted the Okomu Wildlife Sanctuary, a 7,000 ha area in the center of the Okomu State Forest Reserve, Bendel State, Nigeria (Bendel State Gazette No. 73, 1986). This reserve is one of the largest and least degraded in the country and covers a total of 108,000 ha. Sponsored by the Nigerian Conservation Foundation (NCF), the Okomu Forest Project (OFP) was launched in October 1987 by HRH Prince Bernhard of the Netherlands. Under the auspices of the project, NCF employees and staff from the Forestry Division of the Ministry of Agriculture and Natural Resources, Bendel State, work together to study and manage the protected areas. The author, an NCF Consultant and Honorary Research Assistant in

the Department of Biology, University College London, acts as the project coordinator. The following report, published in the first issue of the *Okomu Forest Project Newsletter* (April 1988), briefly describes the area and lists OFP's aims.

The sanctuary, a strict category of protected area which does not allow forms of exploitation that are permitted under license within a reserve, was established following a seven-month survey of southwestern Nigeria by P. Anadu and J. Oates (Anadu and Oates, 1982). Due to its exceptional assemblage of species, they concluded that the reserve was uniquely representative of the highly threatened southwest Nigerian rainforest ecosystem. A number of endangered animals which now face possible extinction in southern Nigeria (e.g., forest elephant, *Loxodonta africana*; chimpanzee, *Pan troglodytes*; leopard, *Panthera pardus*; yellow-backed duiker, *Cephalopus sylvicultor*; short-snouted crocodile, *Osteolemus tetraspis*; and royal python, *Python regius*) are present in the reserve. The sanctuary offers the best, if not the only, chance for the long-term survival of the white-throated monkey (*Cercopithecus erythrogaster*, approx. 225 groups), one of Nigeria's two endemic guenons. Other primate species present include: red-capped mangabey (*Cercocebus torquatus*, approx. 85 groups), putty-nosed guenon (*Cercopithecus nictitans*, approx. 85 groups), and mona monkey (*Cercopithecus mona*, approx. 170 groups). In addition, the sanctuary lies only about 100 km from the site where Sclater's guenon (*Cercopithecus sclateri*) has recently been relocated.

Unfortunately, Okomu is also a classic example of the problems conservationists face in the rainforest belt of West Africa. The intensity and the extent of forest exploitation has greatly increased as the human population has risen and technology has improved.

Hunting has always been a tradition in Nigeria, and 'bushmeat' is a preferred food. In the past, hunting and trapping occurred primarily around villages at renewable levels. Today, the market has outgrown the resources. Hunters concentrate on the few remaining areas of forest supporting healthy populations of animals and use shotguns with increasing efficiency. Many animals are surprisingly resilient, but there is a limit to the level of hunting a population can sustain. The elephant is a good example of this. Until the end of the Biafran War, elephants were plentiful in Okomu, but when soldiers fled from the war, they kept their rifles and began shooting elephants with ease. Presently, there are only a dozen or so left in Okomu, but with strict protection we hope that the population will begin to recover. At least two adults and a juvenile were seen in the sanctuary in 1988.

Commercial logging in Okomu began in the 1930s, when the African Timber and Plywood operation got underway. Initially, the operation was based on a 100-year rotation period to allow the natural regeneration of the forest after felling. Today, however, the Forestry Department's management system has broken down, and many contractors compete for concessions within Okomu. The recent mechanization of the logging industry has spurred an increase in the number of tree species exploited, and the damage caused to what forest remains is a major concern. The illegal cutting of undersized timber by armed gangs is also becoming a problem.

The policy of allowing natural regeneration after exploitation has been abandoned in favor of *taungya* farming. According to this practice, land is usually logged, cleared, farmed for food crops for one or two years, and then planted with seedlings of teak (*Tectona grandis*), *opepe* (*Nauclea diderichii*), or *idigbo* (*Terminalia superba*) in pure stands. Now, however, even this practice is no longer working efficiently. The nurseries cannot provide seedlings in sufficient numbers. Farmers prefer to plant plantains and do not fulfill their commitment to plant the seedlings they do receive. The Forestry Department admits that it can no longer control farmers. In 1973 and 1985, when officials attempted to suspend the farming system, their efforts were thwarted by political pressures and angry farmers.

In addition, there has recently been a trend to de-reserve large areas in order to plant tree crops such as oil palm and rubber. The federally owned Okomu-Udo Oil Palm Company was given a concession of 15,600 ha in 1977, of which 4,500 ha were cleared and planted as of early 1988.

Perhaps the greatest problem is a cultural one. In modern Nigeria, the term 'bushman' is a gross insult. For thousands of years the 'bush' has been regarded as an enemy to be fought with axe and fire. Undisturbed forest is now often considered a waste of good land that could be the site for something useful like an oil palm, rubber, or *Gmelina* plantation. Even in the universities' zoology departments, the mention of 'conservation' or 'wildlife sanctuary' brings mocking smiles to many lecturers' faces.

The West African people must now determine the fate of the rain-forest in this area. The challenge is to regulate exploitation at levels that can be sustained and to encourage regeneration in degraded systems. In Okomu, the OFP hopes to develop fish farming, bushmeat domestication, small-scale local forest-product industries, and tourism. The need for conservation education throughout Nigeria and West Africa cannot be overstressed. For conservation projects to succeed in the long term, all parties involved must support them.

Among the OFP's early achievements were:

- (1) renovating and furnishing the Arakuan rest house, which now accommodates the project headquarters and has facilities for a limited number of visitors;
- (2) greatly reducing poaching within the sanctuary as a result of regular daily and nightly patrols;
- (3) raising a few wild-caught primates with the hope of establishing a primate breeding center in the forest;
- (4) censusing wildlife in the sanctuary;
- (5) assessing the status of forest in different sections of the reserve and noting areas that have been affected by farming;
- (6) initiating a survey of hydro-biological resources in the reserve to assess the viability of fish-farming in lakes situated around the sanctuary (Dr. Reg Victor, responsible for this survey, will help supervise the introduction of fish into one of the lakes in May 1988.);
- (7) beginning field research work in the sanctuary by two postgraduate students supervised by Dr. Victor; planning for a larger research program covering many aspects of the reserve's ecology (It was expected that by the end of 1988 at least five research students from the University of Benin would be involved in OFP.);
- (8) hosting a visit to the project by more than 60 members of the Nigerian Field Society; and
- (9) initiating a survey of the small mammal fauna of the reserve, using live traps.

In the spring of 1988, the following developments were anticipated or were under discussion:

- (1) a detailed vegetational analysis within the sanctuary was planned to begin in April 1988 to repeat and update work done by the Cambridge Botanical Expedition to Okomu in 1947/48, to tag trees and shrubs for future analysis, and to establish permanent plots for the study of forest regeneration;
- (2) an expedition group from University College London and a team of Nigerian students from the University of Benin were expected to arrive in July 1988 to help with research in the reserve, to undertake a conservation education program in the area, and to produce an audio-visual package about conservation in southern Nigeria;
- (3) a study of the economic aspects of the various forms of rainforest exploitation seen in Okomu was to be undertaken in August 1988;
- (4) the possibility of a link-up between the University of Benin and the Conservation and Ecology Unit, University College London, whereby staff and students from both universities could visit

Okomu for training and help collect data to produce a management program for the reserve was being explored; and

- (5) it seemed likely that an ODA mini-grant would be given for specialist training of nine Forestry staff from Bendel State in the U.K. over a three-year period, with the plan that after training the staff would become part of the OFP, contributing to the management plan and the training of junior staff, and thus complementing the UCL-UNIBEN link.

The first issue of the *Okomu Forest Project Newsletter* appeared in April 1988. For more information about the details of this announcement and about the current status of the OFP, please contact the Consultant:

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Madagascar's First Biosphere Reserve, Mananara-North

by Roland Albignac

In 1985, the Democratic Republic of Madagascar agreed to adopt a national conservation strategy that includes establishing more protected areas on the island. Consequently, an action plan for a pilot biosphere reserve program in Mananara was drawn up at a workshop in October 1987 and then completed during a regional seminar in September 1988. Taking a step to realize its well-laid plans, the Malagasy government has now begun the reserve program with the support of international organizations like the United Nations Development Program, the World Bank, UNESCO, the European Community, and the French Ministry of the Environment.

Mananara lies in northeastern Madagascar (Fig. 1) and is home to such rare animals as the diademed sifaka and aye-aye. The proposed biosphere reserve area consists of 140,000 ha bordered by the Mananara River to the north; the Mananara, Sandrakatsy, and Fotsialanana rivers to the west; the Anove River to the south; and the Indian Ocean to the east. It protects dry-land, littoral, and marine flora and fauna and encompasses the Verezanantsoro classified forest, which acts as a central conservation area and is surrounded by various multiple-use zones. The proposed national park is presently made up of three land segments of low-altitude primary forest (23,000 ha) and a coral reef (1,000 ha).

The forest in the Mananara area is threatened by slash-and-burn clearing for wet rice cultivation. Farmers typically leave their villages to establish camps in the middle of the forest (Fig. 2) and to clear land for the cultivation of rice during the 4-5 month rainy season (October-January). Villagers also cut timber to construct houses, collect forest plants for medicines and food, and hunt. Hunting is popular because few other protein sources are available, and even the smaller lemurs and tenrecs are eaten.

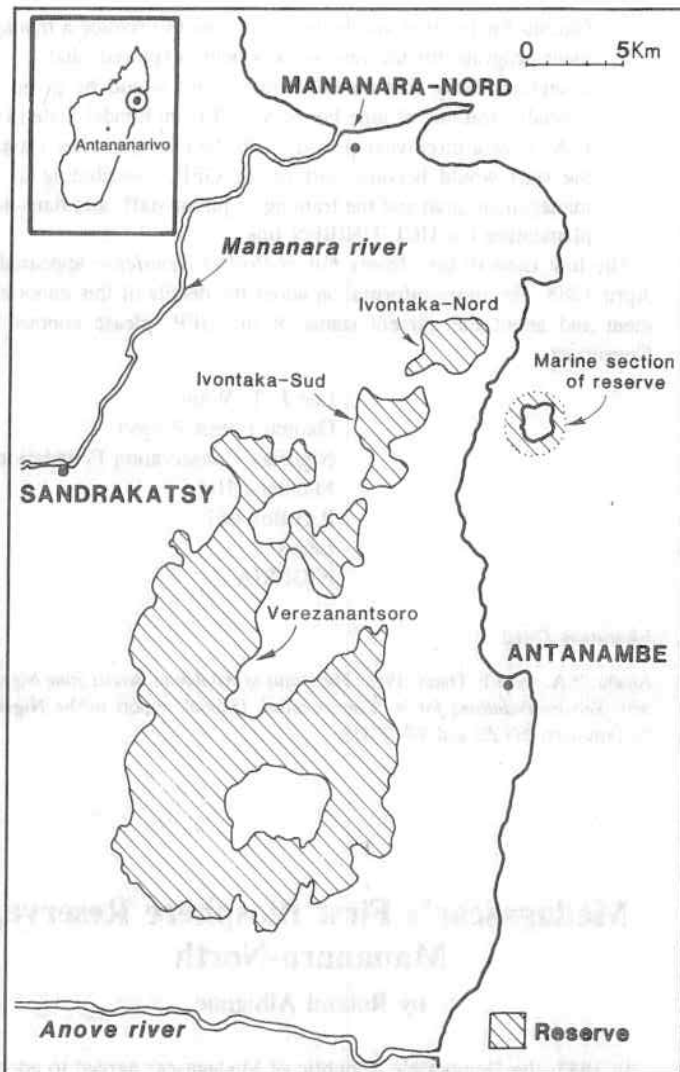


Fig. 1. Map showing the several parts of the Mananara-North Biosphere Reserve (map by S.D. Nash after author's original).



Fig. 2. Temporary camps like this one are built in the forests of Mananara by rice farmers who cultivate their crops during the four-month rainy season (photo by R. Albignac).



Fig. 3. Small farms border sections of Mananara's forest (photo by R. Albignac).

To curtail further forest clearance, managers of the biosphere reserve propose working with a local committee to improve agricultural techniques so that smaller areas can be more intensively and productively farmed. At the moment, a large number of rice fields on the flat land are abandoned because of irrigation problems. Water is abundant (2,000 mm/yr), but because of the fragility of the canals and the lack of irrigation schedules, rice yields are lower than they could be. The success of any such educational program depends on taking the 40,000-odd inhabitants' needs into consideration, proving that conservation is compatible with development, and showing them what direct advantages it can bring.

A research program to help make management decisions for the biosphere reserve is also being planned in cooperation with Malagasy research organizations. Facilities for the program will be constructed within the reserve.

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The park border is no longer as respected as it was, and squatters have begun to occupy and farm an increasing amount of the forest, especially in the north and southeast (Fig. 3).

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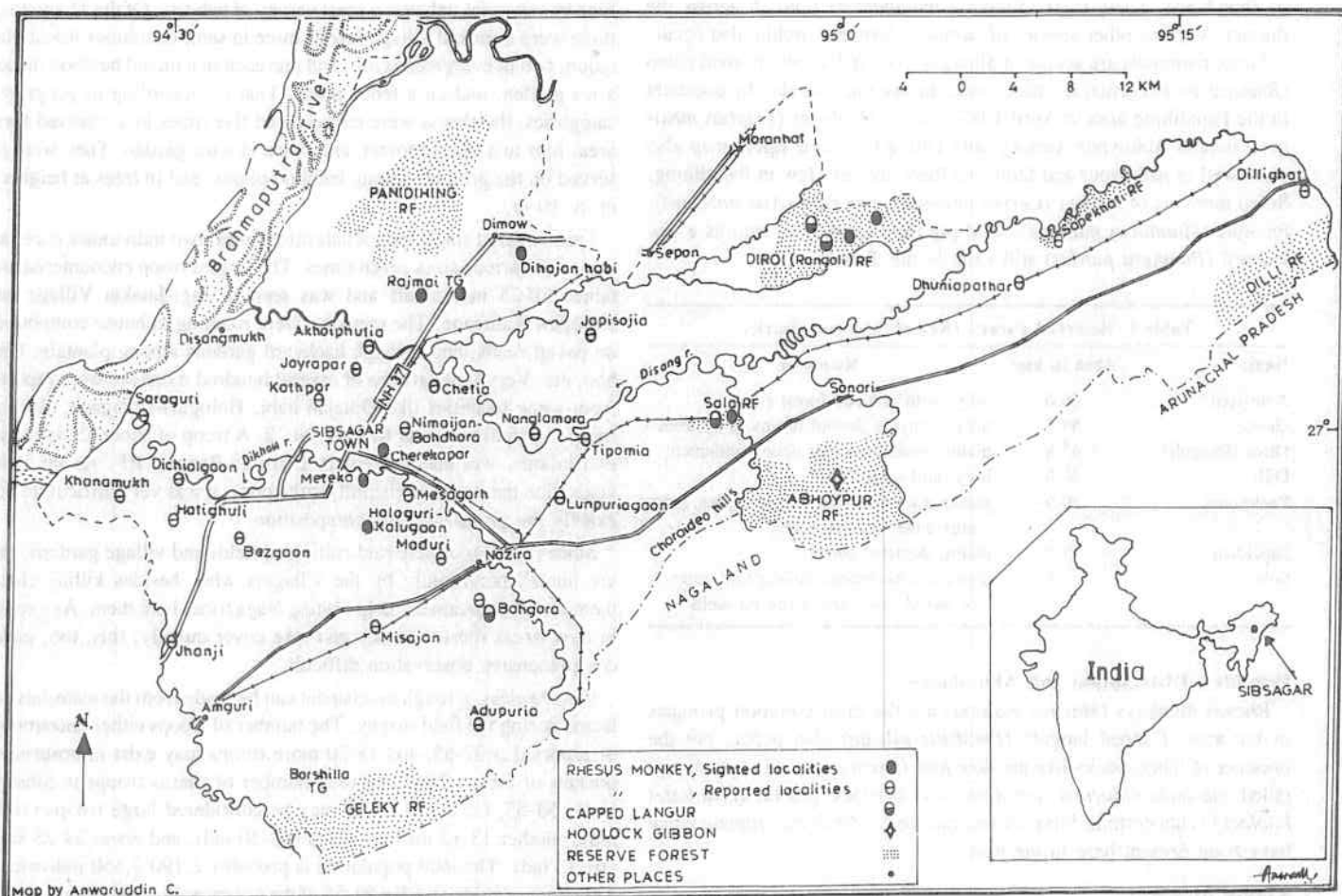


Fig. 1. Map of Sibsagar district of Assam, showing reserve forests and indicating primate localities (map by A. Choudhury).

Preliminary Survey of the Primates of Sibsagar, Assam

by Anwaruddin Choudhury

Located between $26^{\circ}43' - 27^{\circ}16' N$ and $94^{\circ}24' - 95^{\circ}22' E$ in the Indian state of Assam, Sibsagar District covers an area of 2,603 km². In 1988, this area was inhabited by about 1,112,000 people, living at a density of 427 ind/km². Before this study, no information was available about the nonhuman primates in the district. Between 9 March 1987 and 16 February 1988, I spent about nine months visiting almost every corner of Sibsagar to research the distribution and status of the primate wildlife.

Sibsagar, one of the districts included in the area referred to as Upper Assam, forms part of the upper Brahmaputra River valley and its predominant geographic feature is slightly raised plains, 50-150 m in altitude. The only hilly areas are the foothills of the Patkai-Naga Range along the Nagaland and Arunachal Pradesh border, which rise in some places above 150 m. Brahmaputra, the district's primary river, has as tributaries the waterways Burhidihing, Disang, Dikhow and Jhanji.

The area enjoys a tropical climate with hot, humid summers and cool, dry winters. The maximum summer temperature recorded is 42.8° C

in the town of Sibsagar, while the minimum winter temperature is 2.8° C. May to August are the hottest months, and December and January the coldest. The rainy season generally starts in May and continues until September, but winter rain is not uncommon. The average annual precipitation is about 2,000 mm.

Flora and Fauna

The vegetation predominant in the area is tropical wet evergreen forest. However, due to human intervention in the form of clearing, farming, and plantation management, forest grows only in patches. The majority of this forest is semi-evergreen rather than virgin evergreen. Forest covers areas including Abhoypur RF (Reserved Forest), Dilli RF, Diroi or Rangoli RF, Sola RF, Panidihing RF, and Sapekhati RF. Nevertheless, even in these protected areas, large sections of the forest are actually overgrown plantations.

Only 238.5 km² (9.2%) of the total area of the district is protected as reserved forest (Table 1). Good-sized pockets of more than 50-100 ha of forest do exist, among them the forests of Dihajan habi near Dimow, Hologuri-Kalugaon, and Meteka near Sibsagar town. Throughout the district, there are good village forest woodlands. While some are basically evergreen, most are a mix of deciduous species and bamboos.

Sibsagar's main tree species include *hollong* (*Dipterocarpus macrocarpus*), *holock* (*Terminalia myriocarpa*), *ajhar* (*Lagerstroemia flos-*

reginae), *kanchan* (*Bauhinia* sp.) *ramdala* (*Duabanga denticulata*), *Ficus hirta*, various other *Ficus* spp., *Albizia* sp., etc. Interspersed mainly with *nal* (*Arundo karka*), tall elephant grass grows on the banks of the Brahmaputra in the Panidihing area and on islets scattered in the river. Also on the islets, the 1-2 m tall pine-like *jhau* (*Tamarix dioica*) thrives in abundance. *Simul* trees (*Salmaal malabarica*) flourish across the district. Various other species of bamboo, fern and orchid also occur.

Large mammals are scarce in Sibsagar. The Indian one-horned rhino (*Rhinoceros unicornis*) is extinct now; the last one was shot by poachers in the Panidihing area in April 1987. Asiatic elephants (*Elephas maximus*) inhabit Abhoypur, Geleky, and Dilli RFs. Some tigers may also still dwell in Abhoypur and Dilli, but there are very few in Panidihing. Small numbers of sambar (*Cervus unicolor*), hog deer (*Axis porcinus*), muntjac (*Muntiacus muntjac*), wild pig (*Sus scrofa*), as well as a few leopard (*Panthera pardus*) still exist in the district.

Table 1. Reserved Forests (RF) of Sibsagar District

Name	Area in km ²	Remarks
Abhoypur	66.6	hilly, with reduced forest cover
Geleky	59.3	hilly, virtually devoid of any good trees
Diroi (Rangoli)	47.8	plains, more than half under settlement
Dilli	30.0	hilly, still some forest
Panidihing	20.9	plains, a wetland area with few trees, large area under encroachment
Sapekhati	7.4	plains, depleted forest
Sola	6.8	plains, encroachment, railway line, network of paved road, and many oil wells

Primates: Distribution and Abundance

Rhesus monkeys (*Macaca mulatta*) are the most common primates in the area. Capped langurs (*Presbytis pileata*) also occur, but the presence of other species like the slow loris (*Nycticebus coucang*), stump-tailed macaque (*Macaca arctoides*) and hoolock gibbon (*Hylobates hoolock*) is not certain. Silvered leaf monkeys (*Presbytis cristatus*) may have been present here in the past.

Rhesus Monkeys

I encountered this common species at least 11 times on various trips and treks and received authentic reports of its existence in another 23

localities (Fig. 1; Table 2). It is present across the district, but not continuously. Almost all the rhesus populations are isolated, and, except in reserved forest areas and some large village forests, there is hardly any possibility of troops encountering each other.

The very adaptive rhesus, which has been interacting with man from time immemorial, inhabits a great variety of habitats. Of the 11 sightings, three were in mixed village forest, three in semi-deciduous forest plantation, two in evergreen scrub, and one each in a mixed bamboo thicket, a tea garden, and on a fence pillar. That is, according to geographic categories, the rhesus were encountered five times in a reserved forest area, four in a village forest, and twice in a tea garden. They were observed on the ground, among bamboo plants, and in trees at heights of up to 10 m.

I encountered single individuals three times, two individuals once, and troops of various sizes seven times. The largest troop encountered contained 20-25 individuals and was seen in Jugi-Jatakia Village near Hologuri-Kalugaon. The monkeys were roaming in house compounds, on paved roads, and through backyard gardens among plantain, bamboo, etc. Very large groups of several hundred monkeys were reported from some localities like Dihajan habi, Hologuri-Kalugaon, Bahgora (near Ligoripukhuri) and Kathpar No. 2. A troop of about 15, including two infants, was encountered in Diroi or Rangoli RF. As the dense vegetation there makes visibility quite poor, it was very difficult to note exactly the group size and composition.

Since rhesus routinely raid cultivated fields and village gardens, they are hunted persistently by the villagers who, besides killing rhesus themselves, occasionally help visiting Naga tribes hunt them. As a result, in most areas rhesus are shy and take cover quickly; this, too, makes comprehensive observation difficult.

Nevertheless, a rough assessment can be made from the materials collected during the field survey. The number of troops either encountered or reported is 32-35, and 15-20 more troops may exist in unsurveyed pockets of forest. Thus, the total number of rhesus troops in Sibsagar is ca. 50-55. Of these, 13-15 may be considered large troops (100+ ind), another 13-15 medium-sized (40-50 ind), and about 24-25 small (10-15 ind). The total population is probably 2,190-2,550 individuals. The average group size for 50-55 of the troops is 45.1 ind. Many smaller troops exist because large numbers of rhesus are killed annually by Nagas from neighboring Nagaland.

Table 2. Field Observations on Rhesus monkeys in Sibsagar

Date	Time (h)	Locality	Population		Vegetation	Activity
			Actual seen	Probable total		
14/7/87	0430-1730	Dihajan habi	6+	10-15	mixed bamboo	moving, on ground
	c. 1800	Rajmai tea garden, east of National Highway No. 37	1	1	wooden fencing near tea garden	feeding
30/9/87	1305-1335	Diroi or Rangoli RF	12+	15-20	forest plantation, mixed semi-evergreen and deciduous	resting, feeding
	1350-1355	"	4+	8-10	"	"
4/12/87	c. 1200	Near Cherekapar	1	?	village forest	travelling, on ground
	c. 1535	Sola RF	1	1	deciduous plantations near evergreen forest	very shy, fled at sight of person
	c. 1545	"	3+	8-10	evergreen scrub, banks of Suffry River	feeding
	c. 1610	"	troop	8-15	evergreen scrub and deciduous plantation	resting, 3-5 m
13/12/87	c. 1530	Judi-Jatakia, near Hologuri-Kalugaon	20+	c. 25	village forest	feeding, travelling
27/12/87	1055-1100	Rajmai tea garden, west of National Highway No. 37	7	10-15	tea plantations	"
1/2/88	1245-1250	Meteka, near Sibsagar town	2	?	village forest, bamboo	sitting

Capped Langur

The existence of only three capped langur troops was confirmed, one in Sola RF and two in Diroi or Rangoli RF. There are reports of capped langurs from Bahgora area near Ligeripukhuri and Sapekhati RF, and small numbers may also exist in Abhoypur and Dilli RFs. Once common in the largely forested district, this langur has vanished from most localities thanks to poaching and habitat destruction. In Sola and Diroi RFs, there used to be much rich evergreen forest, but now mixed deciduous and evergreen plantations have replaced the bulk of this habitat. Until the early 1980s, there were reports of a few capped langurs near Borshilla tea garden. There are now perhaps none left there, or in Geleky RF. Each of the three known troops has only about 10 members. The capped langur is no doubt very scarce: the total population in Sibsagar may be 50-120.

Hoolock Gibbon

Hoolock gibbons were previously not uncommon in the foothill forests of Dilli, Abhoypur, and Geleky, on the plains of Diroi and Sola RFs, and in other localities like the Charaideo Hills where there were good evergreen forests. However, when settlers, woodcutters, and Forest Department workers wanting to establish mixed plantations moved into these areas, the hoolock population started to decrease. Naga poachers expedite the decline.

The last hoolock vanished from Diroi or Rangoli RF sometime in the mid-1970s, and from Sola RF maybe a few years later. Reports of hoolock in the Borshilla tea garden area near Geleky RF are as recent as the early 1980s. However, their presence in Dilli RF is now doubtful. The only area where a few may still survive is Abhoypur RF. Although no firm population statistics exist, the number is probably very low, perhaps 10-15. On a field trip in Geleky RF, I saw a lone *Ficus hirta* standing like a sentinel amidst the completely denuded hills. I thought of the hoolock gibbon, for the fruits of *Ficus hirta* are greatly liked by hoolocks in other parts of Assam.

Other Primates

No recent sightings of slow loris (*Nycticebus coucang*) have been reported from any corner of Sibsagar, but a few are likely to occur in Abhoypur and Dilli RFs. Extinct in Diroi or Rangoli RF, the loris may also no longer inhabit Sola or Geleky RFs.

The foothill forests of Dilli, Abhoypur, and Geleky RFs once supported populations of stump-tailed macaque (*Macaca arctoides*). However, due to habitat destruction and extensive poaching, there are now perhaps none left in Sibsagar. If a few did still exist there, they would be in Abhoypur and Dilli RFs.

The pig-tailed macaque (*Macaca nemestrina*) also used to live in the foothill forests and, possibly, in the interior forest areas like Sola RF. It has now almost vanished, save from parts of Abhoypur and Dilli RFs, where a careful survey is needed to reveal its exact status.

No reports of the Assamese macaque (*Macaca assamensis*) came in, but Sibsagar is well within its known distribution. This macaque's status, both past and present, is uncertain.

The existence of the silvered leaf monkey (*Presbytis cristatus*) is still unconfirmed. During various field trips to different parts of Assam and adjoining states, I received a number of reports about it being sighted in certain unexplored forest areas. One such report indicated that long-tailed black monkeys with a bluish tinge to their fur had been seen in Abhoypur RF in 1981 by a local forest official.

Discussion

Sibsagar probably once had eight primate species, quite a rich primate fauna. Unfortunately, large-scale habitat destruction and regular poaching has pushed all these species except the rhesus to the verge of extinction.

Table 3. Status of Primates in Sibsagar

Species	Status	Approx. Population	Remarks
<i>N. coucang</i>	not known	—	very few may exist in Abhoypur, Dilli etc., RFs
<i>M. arctoides</i>	not known	—	"
<i>M. assamensis</i>	not known	—	"
<i>M. mulatta</i>	common	3,000	population declining locally
<i>M. nemestrina</i>	not known	—	very few may exist in Abhoypur, Dilli RFs
<i>P. cristatus</i>	not known	—	existence doubtful
<i>P. pileatus</i>	very rare	50-120	may become extinct in next decade
<i>H. hoolock</i>	extremely rare	10-15	"

Illegal lumbering, mostly to supply plywood and saw mills, has made most of Geleky and parts of Dilli and Abhoypur RFs completely devoid of trees. The felling in these forests has been particularly severe because they are located near the Nagaland and Arunachal Pradesh border, and woodcutters from both states take advantage of the disputed status of the territory. The forest officials of Assam hardly dare to move around the area out of fear of Naga guerrillas, who have been engaged in an insurgency for more than two decades.

In the plains, tree felling is followed by further disruption. In Diroi RF, for example, 24 forest villages have been established by the Forest Department, and over 500 squatters are scattered about the 48 km² area. There are hardly 10 km² of compact forest left. In both Diroi and Sola RFs, the Forest Department itself has largely replaced the evergreen forest with deciduous and other trees sown in the name of forest management. One can imagine the plight of the primates and other wildlife in those areas.

Moreover, in Diroi, Sola, and Geleky RFs, forest has been destroyed to make way for oil fields. A large number of wells are now located in forest areas. The tiny Sola RF (6.8 km²) is transected by a main railway line, pocked by several oil wells, crisscrossed by roads, and inhabited by squatters. Villagers and tea garden laborers from the surrounding area also collect their fuel wood here. It is only a matter of time before the whole of Sibsagar will be devoid of any primates except a handful of rhesus in some villages.

Sibsagar has always served as a natural gateway to the northern areas of the Naga Hills (presently in Naga territory). Sibsagar district provides the Konyak and Ao Nagas their main communication links with the outside world, and a number of markets in the border areas cater to the needs of the local Nagas, who relish primate meat. For quite a long time, hunters killed primates with traditional weapons. Even now, in Diroi RF, the local Santhal Christian laborers from a neighboring tea garden often hunt primates with bows and arrows. Since the 1960s, however, firearms have become more available, and poaching easier. Consequently, most primates have gradually vanished from the border areas, and those few that remain where the habitat is in good condition are excessively shy.

With primates in the border areas scarce, the Nagas have switched their attention to interior areas like Sola RF, Rajmai Tea Garden, Hologuri-Kalugaon, and Metaka. In many cases, local villagers willingly assist Naga hunters because the monkeys cause much harm to village crops. Since other primates are either rare or even extinct locally, the rhesus monkey is the most frequently sought after. In January 1988, Nagas killed about 23 rhesus monkeys in the Metaka area near Sibsagar town. After that incident, the monkey population, reportedly a very large one of 400-500 individuals, split into small splinter groups, some of which I saw during a visit.

In Abhoypur RF, the forest cover is slightly better; some Assam police are keeping a vigilant eye on the movement of underground Nagas and, thus, to a certain extent, preventing the woodcutters from both sides from operating illegally. The officials' actions are ultimately helping primates and other animals slowly revive. However, all the existing reserved forests must be protected more carefully, and the Nagas' poaching checked. The local forest officials should also be instructed to watch over the surviving capped langur troops and their habitat so this species does not vanish completely from the district.

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The Present Status of the Lion-tailed Macaque

by G.U. Kurup

In 1978, a report on the status of the lion-tailed macaque based on surveys from 1971 to 1975 (Kurup, 1978) projected a total population of 55 groups, or 825 individuals. Now, more information is available from further surveys of previously covered regions as well as from previously underexplored areas. The 1982 Baltimore Symposium on the lion-tailed macaque reviewed the information gathered after 1975 and stated that the wild population was "in no case over 2,000 animals." Recently, the Karnataka forests, which were previously underexplored, have been surveyed in some detail by Karanth (1985), who gives a large estimate of 200 groups (about 3,000 individuals) — a somewhat surprising figure, given a previous assessment in that state of 2-12 groups.

It is encouraging to be able to report that lately the lion-tailed situation has begun to stabilize and the various significant populations are continuing to hold their own in their respective habitats, especially in protected reserves. In nearly all the states where lion-tails are found, the exploitation of evergreen or rainforests has been more or less discontinued, except for the collection of minor forest produce. In Karnataka state, however, a certain amount of softwood extraction is said to continue in the rainforests. That habitat conversion into cardamom plantations is no longer practiced indiscriminately is a particularly fortunate development for lion-tails in Kerala state, where this used to be a major problem.

The Silent Valley, which formed the core of the largest contiguous rainforest in the Western Ghats, has finally been saved and, together with adjoining rainforests, has been constituted into a biosphere reserve. Consequently, the largest single population of lion-tails has been saved. The central government's Department of Environment and the various state governments are now particularly sensitive about the preservation of evergreen forest and its biota, and it is difficult for any development projects requiring significant destruction of evergreen forest to get clearance from the government. Still, there are no grounds for complacency. The present stabilization in some of the major habitats comes merely from a lull in the assaults on the environment and from only a slight slackening in the rate of decimation. Continued vigilance is necessary.

While in Kerala there is a general awareness of the importance of conserving lion-tails, the same could not be said about other states, notably Karnataka. In a recent report for that state, Karanth (1985) says that

the species is becoming rarer in the majority of its range and has already disappeared from some. Its density has become generally low. Development projects, local community interests, and forestry operations have damaged the habitats. Similarly, the factors working against lion-tail conservation in the previously surveyed regions, *i.e.*, forest clearance, habitat modifications, and poaching (Kurup, 1978), still continue unabated outside preserves. Habitat conversion into monoculture plantations is the only factor that has abated to some extent in these areas, and indiscriminate encroachment upon peripheral forests and clandestine logging (even in interior forests and often with the connivance of low-level officials) have actually increased.

The very nature of the lion-tail's remote, inaccessible, dense evergreen forest habitats makes censusing work arduous and demanding, especially when time pressure is added. Sighting reports, which Karanth (1985) relied on heavily in Karnataka, are helpful, but they have to be used with extreme caution and a good deal of insight and knowledge of lion-tail ranging habits. The only way to arrive at an overall population estimate within a 90% confidence limit would be to examine intensively and extensively each lion-tail habitat, a prohibitively slow process. Except for two or three major contiguous areas, most lion-tail habitat is fragmented. The most important result so far of the lion-tail surveys is not so much the tentative, projected population estimates, which remain intelligent guess estimates at best, but the more or less complete identification of lion-tail habitat segments, which is in itself a commendable achievement.

Population estimates made (Kurup, 1978; Green and Minkorsky, 1976; Ali, 1982) have been the direct or indirect result of extensive surveys on a gross scale. Our subsequent efforts have been, however, on intensive surveys of particular habitat segments. Not only the advantages but also the sheer necessity of this approach was brought home to us during and as a result of the intensive ecological and behavioral studies begun on the species in 1977. Early in the studies, it became evident that a number of environmental and behavioral factors have to be understood and reckoned with before the population size and distribution of lion-tails can be accurately determined. Therefore, this report offers a discussion of some of those factors before presenting our current population estimates.

Fragmentation, Discharge and Loaded Distribution

Due mainly to the south-west monsoon wind pattern and the north-south layout of the mountain ranges, *shola* (evergreen forests) in the Western Ghats have always been restricted to a narrow band lying mostly on the western slopes (Fig. 1). This probably once continuous band was broken up into segments due to biotic interference, but these segments, being large and contiguous within themselves, were still viable. In the latter half of this century, however, most of these segments rapidly fragmented into patches that are inviable unless strictly protected. The rate and level of biotic interference in these fragments varied. Those opened up by roads, plantations, and development projects became uninhabitable for the lion-tails, which therefore moved into adjoining but less affected habitats. The result of such a move was the overpopulation of these latter fragments, which then reflected densities bolstered by the artificially discharged populations. Thus, as a result of human environmental manipulation, a skewed distribution developed with high densities in small habitats and low or zero densities in adjoining large habitats. An example of this comes from the Anamalai region, where we did most of our work. The evergreens there grow now in at least 20 patches, but lion-tails inhabit not more than three or four. Of these, the Varagaliyar Shola, our study site, covers about 10 km² but supports at least five groups, if not a sixth recently arrived one also. Consequently, home ranges are small — one particular group has only 100 ha — especially in comparison to the ranges in the Agasthya Hills, where Green (1976) reported the average home range as 5 km², a figure which has been adopted blindly by many to determine the separate identities of

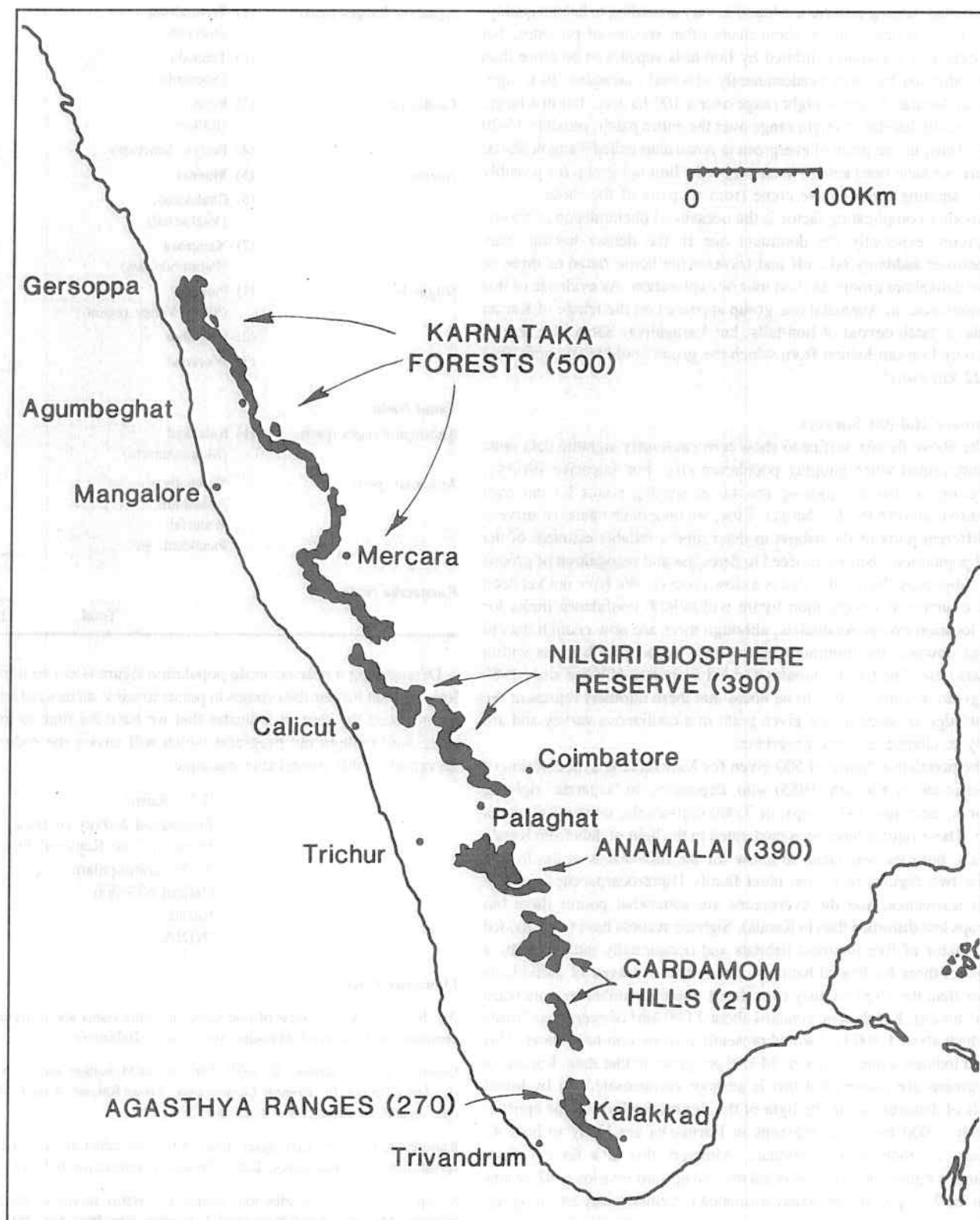


Fig. 1. Map showing the segments of rainforest in the Western Ghats, Kerala state, India, with estimates of lion-tail populations in parentheses (map by S.D. Nash from author's original).

sighted groups. This high density, small home range situation must be balanced against the low or zero densities of much larger tracts elsewhere.

Spatially Specific Ranging

Lion-tail ranging patterns are found to vary according to habitat quality. This is, of course, known about many other species of primates, but the extent of variation exhibited by lion-tails appears to be more than that exhibited by other predominantly arboreal macaques. In a high-density habitat, a group might range over a 100-ha area, but in a large, low-density habitat, it might range over the entire patch, possibly 15-20 km². Thus, in one patch of evergreen in Anamalais called Vengoli Shola, where we have been able to locate only one lion-tail group (or possibly two), sighting reports have come from all parts of the *shola*.

Another complicating factor is the occasional phenomenon of travel. A group, especially the dominant one in the denser habitat, may sometimes suddenly take off and traverse the home range of three or more cohabitant groups as if on tour or exploration. As evidence of this phenomenon, in Anamalai one group appeared on the fringe of Karian Shola, a patch devoid of lion-tails, but Varagaliyar Shola, the nearest and only lion-tail habitat from which the group could have come, was 15-22 km away!

Intensive Habitat Surveys

The above factors suffice to show how cautiously sighting data must be interpreted when gauging population size. For intensive surveys, therefore, we use the sighting records as starting points for our own extensive surveys inside a habitat. First, we undertake intensive surveys in different parts of the habitat to determine a reliable estimate of the total population; then we proceed to detection and recognition of groups and subgroups. Naturally, this is a slow process. We have not yet been able to arrive at a population figure within 90% confidence limits for any location except Anamalais, although there are now enough data to revise upwards the minimum figures in a majority of habitats within Kerala state. The latest estimates derived from data gathered since 1980 are given in Table 1. It is to be noted that these numbers represent the knowledge amassed at one given point in a continuous survey and are likely to change as work progresses.

The population figure of 500 given for Karnataka is a moderation of the estimate by Karanth (1985) who, depending on 'separate' sighting records, estimates 200 groups, or 3,000 individuals, inhabit Karnataka state. These figures have been moderated in the light of data from Kerala forests, but care was taken to allow for the differences in the forests of the two regions (*e.g.*, the plant family Dipterocarpaceae is absent from Karnataka, and the evergreens are somewhat poorer there but perhaps less disturbed than in Kerala). Sighting records have to be divided by a factor of five for most habitats and occasionally multiplied by a factor of three for loaded habitats. Group size averages 12 individuals rather than the 15 previously considered (but the number may increase in the future). Kerala state contains about 2,000 km² of evergreen forests of which about 1,800 km² would presently provide lion-tail habitat. This would indicate a mean range of 24 km² per group in that state. Karnataka evergreens are poorer, but this is perhaps compensated for by lower levels of disturbance; in the light of the figures for Kerala, the approximately 1,000 km² of evergreens in Karnataka are likely to hold 42 groups, or about 500 individuals. Although this is a far cry from Karanth's figures, it should be noted that the upward revision to 42 groups from the 2-12 groups previously estimated is tremendously encouraging.

Table 1. Lion-Tail Population Estimates for the Western Ghats, India

State	Forest Areas	No. Individuals
Kerala State		
Agasthya Ranges (part)	(1) Trivandrum (Neyyar)	70
	(2) Tenmala (Shengoli)	40
Cardamom Hills	(3) Ranni (Kallar)	60
	(4) Periyar Sanctuary	150
Anamalai	(5) Munnar	30
	(6) Chalakkudi (Vazhachal)	40
Nilgiri Region	(7) Nemmara (Parambikulam)	120
	(1) Palaghat (Silent Valley region)	300
	(2) Nilambur	60
	(3) Wayanad	30
		900
Tamil Nadu		
Agasthya Ranges (part)	(1) Kalakkad (Mundanthurai)	160
Anamalai (part)	Varagaliyar Anakunthi Waterfall Panakkad, etc.	200
		360
Karnataka State		500
Total		1760

Determining a near-accurate population figure is not so important as long as what further data comes in points towards an upward trend. This having been the case, it indicates that we have the time to implement some well thought out programs which will ensure the enduring conservation of this remarkable macaque.

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NEWS FROM CAPTIVITY

Albino Capuchin at Sapucaia do Sul Zoo

by Júlio César Bicca-Marques

An albino male *Cebus apella*, which originated from the Roca Sales region of Brazil, was taken to the Sapucaia do Sul Zoo in the state of Rio Grande do Sul on 9 April 1979 and has thrived there. It was mated to a female with normal coloring, and on 30 January 1986, a male offspring with normal fur was born. The albino male, two adult females, and the offspring are housed in an enclosure 1.8 x 4.2 x 1.9 m.

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Six Mountain Gorillas Die

by Claude Ramsey

In 1986, the mountain gorilla population was estimated to be 279 individuals. In the spring of 1988, six members of the population inhabiting the Parc National des Volcans (PNV), Rwanda, succumbed to various illnesses, despite a great international scientific effort on their behalf. The Morris Animal Foundation, which operates the Virunga Veterinary Center in Rwanda, joined forces with various African, American, and British organizations and laboratories to diagnose and treat the animals, whose illnesses were aggravated by extremely cold, rainy weather. Tissue and serum samples were obtained from all the sick animals indicated. In most cases, intestinal parasites and respiratory diseases were diagnosed, though in one case measles was suggested. At least one of the deaths occurred in a gorilla group not experiencing the respiratory outbreak.

The first gorilla to die was a one-month old infant, which died on 27 February 1988 of streptococcal pneumonia. Between March and July 1988, five other gorillas in three families died and 27 gorillas received veterinary attention. The deceased gorillas and causes of death were: (a) from Group 13: the aforementioned infant; a second individual, of pneumonia and meningitis, and possibly measles; and a third, of parasite infection and pneumonia; (b) from the Susa Group: an older adult female, of chronic kidney failure; and (c) from Group 9: an adult female, from vegetative endocarditis; and her offspring, from pneumonia.

Available evidence from captive lowland gorillas and a test group of free-ranging mountain gorillas indicates no adverse reactions to measles vaccinations. Therefore, given the contagious nature of measles, the probable existence of one case of measles in the PNV gorilla population has prompted the Virunga Veterinary Center and the Mountain Gorilla Project to design and implement a vaccination campaign with vaccines donated by UNICEF, Rwanda.

For further information about the PNV gorilla population and conservation activities on its behalf, contact the Executive Director of the Morris Animal Foundation:

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Ecological Assessment for a Chimpanzee Rehabilitation Project in Northern Zambia

by Tamar Ron and W.C. McGrew

An ecological study was done to assess the prospects of a chimpanzee (*Pan troglodytes*) rehabilitation project planned for northern Zambia. We seek to give a comprehensive description of the habitat of the area proposed for the release of the chimpanzees and to compare it with findings from studies of habitats where chimpanzees live naturally (see Spellerberg, 1981, for rationale).

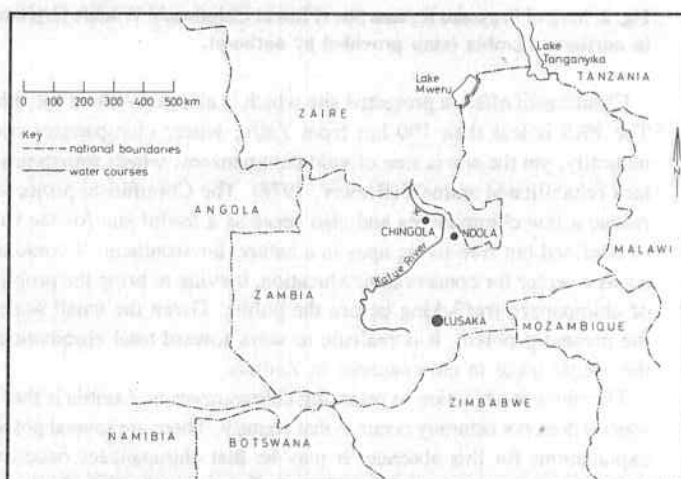


Fig. 1. Map of Zambia, showing Chimfunshi Wildlife Orphanage (marked as X; map provided by authors).

The Proposed Release Site (PRS) is an area of 6.5 km², on David and Sheila Siddle's farm, Chimfunshi Wildlife Orphanage, 80 km by road from Chingola in northern Zambia (12°23'S, 29°32'E; elevation 1,200-1,300 m; Fig. 1). The area was surveyed twice in 1986: first, toward the end of the dry season, and again during the rainy season. It comprises about 4.5 km² of *miombo* woodland, surrounded by 2 km² of seasonally flooded grassland (Fig. 2). It is bounded by the farm's main dirt road on the west, by the Kafue River on the east, and by two small and intermittently flowing rivers, the Muchishi and the Changwe, on the south and the north respectively. The western and northwestern boundaries of the PRS have not yet been finalized. Except for the Kafue River, the other boundaries will need to be enclosed by a canal or a wall, in order to keep the chimpanzees inside. Presently the area is subject to human interference, mainly from cattle-grazing, wood-cutting, and intentional burning to encourage regeneration of the undergrowth, but these activities will cease before the apes are released.

At Chimfunshi there are presently eight male and seven female wild-born chimpanzees. Their ages, estimated mainly from dental development, range from 1-8 yrs old. All the animals, except one, were captured in Zaire and smuggled into Zambia. When the unlicensed possession of chimpanzees became illegal in Zambia in 1984, these chimpanzees were either confiscated or donated by smugglers or their customers and taken to Chimfunshi with the help of the Zambian police. The apes now live in groups in cages but are taken for daily walks into the bush. The Siddles wish to rehabilitate and return the chimpanzees to the wild, and are willing to donate part of their 40 km² farm to become the PRS.

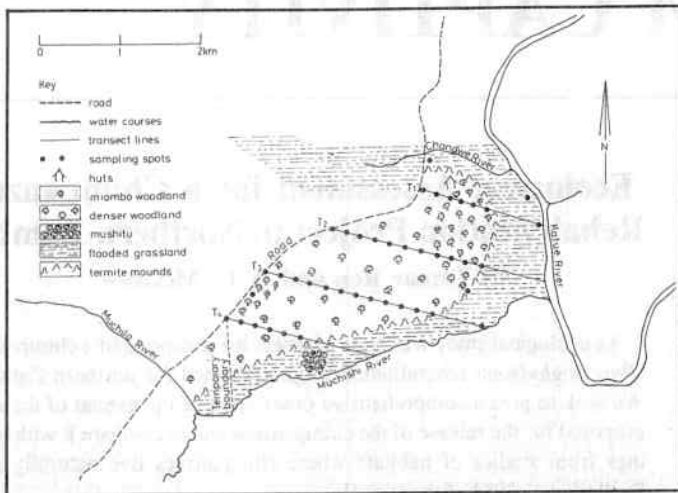


Fig. 2. Map of Proposed Release Site (PRS) at Chimfunshi Wildlife Orphanage in northern Zambia (map provided by authors).

Chimfunshi offers a protected site which is also convenient for study. The PRS is less than 100 km from Zaire, where chimpanzees occur naturally, yet the site is free of wild chimpanzees, which sometimes attack rehabilitated animals (Brewer, 1978). The Chimfunshi project can rescue a few chimpanzees and also serve as a useful site for the study of confined but free-living apes in a natural environment. It could also act as a center for conservation education, serving to bring the problems of chimpanzee trafficking before the public. Given the small scale of the present problem, it is realistic to work toward total elimination of the illegal trade in chimpanzees in Zambia.

The obvious objection to releasing chimpanzees in Zambia is that the species does not naturally occur in that country. There are several possible explanations for this absence: it may be that chimpanzees once lived in Zambia but were later exterminated. Or, it may be that the country had suitable habitat, but zoogeographical barriers stopped chimpanzees from spreading south. Or, it may be that Zambia has no habitat suitable for chimpanzees. The aim of our study was to test this last hypothesis.

Methods

The senior author mapped the PRS using a 1:50,000 scale map (1982) of Chimfunshi, an aerial photograph, and data gathered by walking in the area. She surveyed the area twice, in September and December 1986, along 4 transect lines of varying lengths: T1=1.5 km; T2=2.5 km; T3=2.7 km; T4=1.7 km (Fig. 2). The lines were oriented to maximize the distances between the road and the rivers in an east-southeast direction, and were parallel at a distance of 1 km apart. Thirty-five square plots of 10 m x 10 m each were sampled along these lines at intervals of 200 m inside the wooded area; another seven of the same size were done in the flooded grassland and swamp, in the denser woodland, and in the forest (*mushitu*). In each plot the following were recorded (see Eisenberg *et al.*, 1981, for details of methods): (1) animal spoor, (2) termite mounds (number and basal area covered), (3) genera of woody plants and their numbers, (4) number of layers of canopy (defined by height: 1-2 layers of undergrowth, 1-2 of small trees and shrubs, 1-2 of higher trees), (5) tree heights calculated from the distance in which the top of the canopy was seen at 45° (when height = $\tan. 45^\circ \times \text{distance} + 1.6$ m), (6) tree diameters at breast height (dbh, calculated from the perimeter of the stem, measured with a string), (7) crude estimations of percentages of vegetative ground cover (as opposed to bare earth), of grass cover (as opposed to cover by woody plants), and of light cover (*i.e.*, shaded by vegetation such as leaves and branches). Because the *mushitu* was flooded seasonally, and so was hard to get to, it was sampled only near its edge and only in the dry season.

We compared these data plus *ad libitum* data with findings on habitat and diet from sites where chimpanzees have been studied elsewhere in Africa (*e.g.*, Baldwin *et al.*, 1982; McGrew *et al.*, 1981; McGrew *et al.*, 1982).

Results

The PRS is split into *miombo* woodland (Davies, 1971) covering about 70% of the area, and flooded grassland. Of the woodland, about 30% is dense. Near the southwestern edge of the PRS is a small patch, about 300 m², of dense evergreen forest on swampy land (*mushitu*). The most relevant areas for the chimpanzees are the woodlands, but during the dry season the *mushitu* may serve as a key source of food, water, nest-sites and cover. On the northern side of the woods there is an area of about 200 m² where some of the farm's herdsmen live.

The soil in the woodlands is mainly reddish-brown, sandy and acidic (pH=4-5) and lies on granitic rocks (Davies, 1971). There is a surface layer (0.5-10.0 cm) of leaf litter and humus. Near the rivers, in the grassland, there are gray clayey vertisols of pH=6-7. These are annually flooded for 3-4 months. The ecotone between these two habitats is densely covered with termite mounds. During the rainy season there are many puddles and temporary streams in the woodland, but during the dry season only the rivers provide drinking water.

Table 1 gives all the genera of woody plants that were found in the PRS, ranked by relative frequency of occurrence. Genus was chosen for ease of comparison with other studies and because species identification was not always possible. Local Bemba names are also given (Fanthaw, 1965; White, 1962). One Bemba name can refer to more than one species, and sometimes more than one name can refer to the same species. Nine of the 52 genera were not identified. Relative frequency is the proportion of each genus in the total sample of 800 trees. Density is the mean number of trees of each genus per 1 m², in the 38 plots of wooded habitats. The dominant family of trees in the *miombo* woodland was Leguminosae, as expected (Lawton, 1978), but in the *mushitu*, *Syzygium* (Myrtaceae) dominated.

Of the 52 genera found in the PRS, 29 were of trees known to provide food for chimpanzees (Goodall, 1968; McGrew, *et al.*, 1982; Nishida and Uehara, 1983; Sugiyama and Koman, 1987; Table 2). So far, the chimps at Chimfunshi have been observed eating 11 of these 29 genera. They predominately select fruit over other plant parts, as do other chimpanzees observed in the wild. For each plant genus which provided seeds or fruit, we have noted the fruiting season in Zambia, and for those which provided flowers, the flowering season (see White, 1962).

Table 3 shows the mean overall density to be 2.1 trees/m², with a range of 0-6. About 30% of the trees were over 10 m tall, but more than 40% of these were only young shoots, since the forest is regenerating from human disturbance. Despite the relative dominance (80%) of food tree species, fewer than half of these were mature enough to provide food. There was almost 0.7 tree/m² of ≥ 10 m high and ≥ 20 cm dbh suitable as a nest site.

The chimpanzees at Chimfunshi ate herbaceous plants similar to their wild counterparts elsewhere (*e.g.* Nishida and Uehara, 1983). The most important of these was bush ginger (*Aframomum*, Zingiberaceae), of which fruits, stems and leaves were all eaten. The fruits were available in August-September, and the foliage remained throughout the rainy season from December-April. The average density of herbaceous plants in the woodland was 2 stems/m².

Many invertebrates were available as potential food in the PRS, the most important of which are likely to be the large, mound-building termites. Termite mounds had a mean density of 0.1/m² and covered 4.2% of the total area. Their highest concentration was in the ecotone between the woodland and the flooded grassland.

Many large mammals lived in Chimfunshi and its environs in the recent past, including big cats and elephants. Now, after heavy hunting, fewer species and of smaller mammals remain, e.g. small cats (*Felis*), jackals (*Canis*), bushbucks (*Tragelaphus*), duikers (*Cephalophus*), bushbabies (*Galago*), and vervet guenons (*Cercopithecus aethiops*). The antelopes and smaller primates provide potential prey for the chimpanzees. There are also many bird species which chimpanzees hunt or eat the eggs of. The sole potential predators and hazards are crocodiles (*Crocodylus*) in the Kafue River and venomous snakes (*Bitis*).

Table 4 compares the climates and vegetation types of the PRS to natural chimpanzee habitats at dry sites in Tanzania and Senegal. Data for the PRS are from Davies (1971) and Griffith (1972) and refer to Ndola (Fig. 1). Data for Kasakati are from Suzuki (1969), Kano (1972), and Griffith (1972); those for Mt. Assirik are from McGrew *et al.* (1981). The climatological data include means and ranges for annual rainfall and for temperature. The number of dry months in the year is given as an indicator of the most demanding seasonal 'bottleneck' in the yearly cycle. The proportions of the various vegetation types are also compared across the three sites. Because the grassland in the PRS is flooded seasonally, there is no clear difference between swamp and grassland.

Table 1. Dominant Tree Genera in the PRS at Chimfunshi Wildlife Orphanage

Rank	Genus	Common Name	Family	Relative Frequency (%)	Density (trees/m ²)
1	<i>Brachystegia</i>	(ka)putu, (mu)samba	Caesalpiniaceae (Leguminosae)	14.5	0.30
2	<i>Combretum</i>	(mu)fuka, (mu)lama	Combretaceae	14.0	0.29
3	<i>Albizia</i>	(mu)koso, (mu)sase, (mu)petansuf	Mimosaceae (Leguminosae)	12.4	0.26
4	<i>Uapaca</i>	(mu)suku, (ma)konkola, (mu)sokolowe	Uapaceae (Euphorbiaceae)	7.2	0.15
5	<i>Strychnos</i>	(ka)tonga (mu)shimbilily	Strychnaceae (Loganiaceae)	6.3	0.13
6	<i>Syzigium</i>	(mu)finsa, (mu)safwa	Myrtaceae	5.7	0.12
7	<i>Hymenocardia</i>	(ka)pempe	Hymenocardiaceae	5.5	0.12
8	<i>Isobertlinia</i>	(mu)tobo	Caesalpiniaceae (Leguminosae)	5.2	0.11
9	<i>Rothmania</i>	(chi)wowo	(Rubiaceae)	4.0	0.084
10	<i>Pterocarpus</i>	(n)dombe, (mu)lombe	Papilionaceae (Leguminosae)	2.2	0.046
11	<i>Parinari</i>	(mu)pundu	Rosaceae	2.1	0.044
12	<i>Anisophyllea</i>	(mu)koranfura, (mu)fungo	Rhizophoraceae	1.8	0.038
13	<i>Garcinia</i>	(ki)songwa, (mu)kukwe	Guttiferae	1.4	0.029
14	<i>Diplorhynchus</i>	(m)wenge	Apocynaceae	1.3	0.027
14	<i>Ficus</i>	(mu)lembalemba, (mu)sua, (mu)taba	Moraceae	1.3	0.027
16	<i>Pericopsis</i>	(mu)banga	Papilionaceae (Leguminosae)	1.2	0.025
17	unident.	(mu)gumba		1.1	0.023
18	<i>Azalia</i>	(mu)pape	Caesalpiniaceae (Leguminosae)	1.0	0.021
18	unident.	(mu)chinanda	?	1.0	0.021
18	unident.	(mu)salia	?	1.0	0.021
21	<i>Dombeya</i>	(mu)kole	Sterculiaceae	0.9	0.019
22	<i>Ochna</i>	(mu)niango	Ochnaceae	0.7	0.015
22	<i>Ziziphus</i>	(ka)nkona	Rhamnaceae	0.7	0.015
24	<i>Vitex</i>	(mu)futuginka, (mu)futu	Verbeceae	0.6	0.013
24	<i>Acacia</i>	(mu)nga, (chi)bombo	Mimosaceae (Leguminosae)	0.6	0.013
24	unident.	(mu)nundu	?	0.6	0.013
27	unident.	me	?	0.5	0.010
28	<i>Azani</i>	(mu)lumbulumbwe	Malvaceae	0.4	0.008
28	<i>Carissa</i>	(n)komfwe	Apocynaceae	0.4	0.008
28	<i>Diospyros</i>	(mu)chenga	Ebenaceae	0.4	0.008
28	<i>Memecylon</i>	(mu)fishameno	Melastomataceae	0.4	0.008
28	<i>Monotes</i>	(chi)mpampa	Dipterocarpaceae	0.4	0.008
28	<i>Piliostigma</i>	(ki)fumbe	Caesalpiniaceae (Leguminosae)	0.4	0.008
34	<i>Erythrophloeum</i>	(ka)jimb	Caesalpiniaceae (Leguminosae)	0.3	0.006

Table 1. Dominant Tree Genera in the PRS at Chimfunshi Wildlife Orphanage (continued)

Rank	Genus	Common Name	Family	Relative Frequency (%)	Density (trees/m ²)
34	<i>Dalbergia</i>	(mu)tondo	Caesalpiniaceae	0.3	0.006
			(Leguminosae)		
34	<i>Julbernardia</i>	(mu)fundu	Papilionaceae	0.3	0.006
			(Leguminosae)		
34	<i>Psorospermum</i>	(ka)pota	Guttiferae	0.3	0.006
38	unident.	finanda	?	0.2	0.004
39	<i>Protea</i>	(mu)soso	Proteaceae	0.1	0.002
39	<i>Ambligonocarpus</i>	(m)wayeye	Mimosaceae	0.1	0.002
			(Leguminosae)		
39	<i>Boscia</i>	(m)wembembe	Papaveraceae	0.1	0.002
39	<i>Khaya</i>	(mu)lulu	Meliaceae	0.1	0.002
39	<i>Mimusops</i>	(mu)bungabunga	Sapotaceae	0.1	0.002
39	<i>Oldfieldia</i>	(ka)songa	Euphorbiaceae	0.1	0.002
39	<i>Phyllocosmus</i>	(mu)gamba	Ixonanthaceae	0.1	0.002
39	<i>Swartzia</i>	(n)dale	Caesalpiniaceae	0.1	0.002
			(Leguminosae)		
39	<i>Terminalia</i>	(mu)bobo	Combretaceae	0.1	0.002
39	<i>Vangueriopsis</i>	(mu)filu	Rubiaceae	0.1	0.002
39	<i>Ximenia</i>	(mu)songwasongwa	Olaceae	0.1	0.002
39	unident.	pupwe	?	0.1	0.002
39	unident.	kengya	?	0.1	0.002
39	unident.	basansa	?	0.1	0.002

Table 2. Tree Genera in the PRS Known to be Eaten by Chimpanzees

Genus	Eaten at PRS	Eaten Elsewhere	Part(s) Eaten	Fruiting Season
<i>Acacia</i>	—	+	seeds	May-Oct.
<i>Azelia</i>	—	+	seeds	Feb.
<i>Albizia</i>	—	+	fruit, leaves, bark, gum	April-Oct.
<i>Anisophyllea</i>	+	+	fruit	Sept.-Dec.
<i>Azania</i>	—	+	fruit, flowers	April-Aug. fls: Nov.-Jan.
<i>Brachystegia</i>	+	+	seeds, leaves, bark, gum	May-Sept.
<i>Carissa</i>	+	—	fruit	Sept.-Nov.
<i>Combretum</i>	—	+	seeds, flowers, leaves, gum	Feb.-May fls: Aug.-Sept.
<i>Dalbergia</i>	—	+	flowers, leaves	fls: Aug.-Sept.
<i>Diospyros</i>	—	+	fruit, leaves	May-Sept.
<i>Diplorhynchus</i>	—	+	seeds, flowers, leaves	Feb.-April fls: Sept.-Nov.
<i>Dombeya</i>	—	+	flowers, leaves	fls: April
<i>Ficus</i>	+	+	fruit, leaves	Aug.-Nov., Jan.-April
<i>Garcinia</i>	+	+	fruit	Dec.-April
<i>Julbernardia</i>	—	+	seeds	July-Aug.
<i>Mimusops</i>	—	+	fruit	Dec.
<i>Monotes</i>	—	+	flowers, gum	fls: Jan.
<i>Parinari</i>	+	+	fruit, leaves	Aug.-Nov.
<i>Piliostigma</i>	—	+	seeds	April-July
<i>Protea</i>	+	—	flowers	fls: June
<i>Pterocarpus</i>	—	+	seeds, flowers, leaves, bark	Sept.-Oct. fls: June-July
<i>Rothmania</i>	+	+	fruit, leaves	Aug.-Jan.
<i>Strychnos</i>	+	+	fruit, leaves	July-Sept. Jan.-Feb.
<i>Syzgium</i>	+	+	fruit	Nov.-March
<i>Terminalia</i>	—	+	leaves, shoots	—
<i>Uapaca</i>	+	+	fruit	July-Feb.
<i>Vitex</i>	—	+	fruit	April-June
<i>Ximenia</i>	—	+	fruit	Sept.
<i>Ziziphus</i>	—	+	fruit	March-Sept.

Table 3. Summary Profile of Vegetation in the PRS

Feature	Woodland		Dec. 86		Other Habitats	
	Sept.-Oct. 86		(dry season)	(wet season)	Flooded	Forest
	mean	range	mean	range	grassland	(mushitu)
					mean:dry + wet	mean:dry
Overall tree density (t/m ²)	2.1	0.6	2.1	0.6	0	4.6
Relative tree density > 20m	10%	0-45%	12%	0-50%	0	—
Relative tree density 10-20m	17%	2-45%	20%	5-50%	0	—
Relative tree density 2-10m	24%	5-55%	26%	5-60%	0	—
Relative tree density > 2m	49%	15-80%	42%	10-80%	0	—
Overall tree height	7.6m	0.1-30m	8m	0.1-30m	0	12.5m
Overall tree dbh	18cm	1-60cm	20cm	1-60cm	0	25cm
Ground cover	35%	5-80%	90%	80-100%	90%	80%
Grass cover	15%	5-70%	70%	65-80%	90%	40%
Light cover	30%	5-75%	60%	5-90%	0	90%
Layers of canopy	3	1-5	3	2-5	2	5

Table 4. Comparison of Environmental Features at the PRS with Open Habitats of Wild Chimpanzees

Feature	PRS(Ndola)		Kasakati	Mt. Assirik
	Zambia		Tanzania	Senegal
Annual rainfall (mm)	mean	1200	977	954
	range	1000-1500	639-1363	824-1224
Ratio wet:dry months		6:6	8:4	5:7
Temperature (°C)	mean max.	27	28	35
	highest max.	33	34	44
	mean min.	13	19	23
	lowest min.	6	8	16
Vegetation type	woodland	70%	59-60%	37%
	forest	0.5%	3-10%	3%
	grassland	29.5%	32-36%	60%
	swamp		4%	0%

Discussion

Compared to natural chimpanzee habitats, the PRS seems surprisingly suitable. The most important qualities of habitat for chimpanzees are probably temperature, rainfall, food, cover, and water (McGrew *et al.*, 1981). The PRS has higher mean annual rainfall and lower temperatures than do open habitats in Tanzania and Senegal. Both of these contrasts are advantageous: higher rainfall means higher primary productivity, and lower maximal temperatures mean less heat stress. Of the crude vegetation types, the ratios in the PRS differ from those in the natural habitats: the PRS has more woodland and less grassland and forest. More than a third of the trees provide food, and about a third provide sites for nests. The woods contain trees of all ages. There are many termite mounds that could be a staple food source for chimpanzees. The range of prey, both invertebrates and vertebrates, equals that of some natural habitats (Goodall, 1968). On the other hand, there are almost no potential predators and fewer than usual competitors like baboons.

During the wet season there is enough food and water in the woodland (Suzuki, 1969). In the dry season the chimpanzees will probably have to focus on other types of habitat, *i.e.*, riverbank, swamp and forest, for water and food. Extra food may need to be supplied in October–November, at the peak of the dry season.

In nature, chimpanzee densities range from 0.1–10 ind/km², depending on the ecotype (Baldwin *et al.*, 1982). Thus, a group may inhabit an area from 5–560 km²; the smaller the home-range, the higher the density. We believe that in the PRS the present group of 15 chimpanzees at Chimfunshi could subsist comfortably. This crude assessment is based on the area's size, richness of plant and animal foods, and scarcity of competitors and predators.

So, why are there no wild chimpanzees in Zambia? The third explanation hypothesized in the introduction, that the habitat is unsuitable, now seems most unlikely. Of the other two hypotheses advanced, extermination in modern times is also unlikely, but must be tested by historical research. The most intriguing possibility of a zoogeographical barrier in Zaire could be investigated by paleoecological research and field surveys of Shaba and Kivu provinces in Zaire.

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Minutes from a Lemur Conservation Workshop

Compiled by Daniel Wharton,
Mary Pearl and Frederick Koontz

The St. Catherine's Island Foundation and the New York Zoological Society hosted a second workshop on lemur conservation in captivity and in the wild 13–14 May 1987, at St. Catherine's Island, Georgia. This workshop, entitled *Lemur Conservation Strategies for the Future II*, resulted in the signing of an accord for future collaboration with Madagascar's Ministry of Animal Production (Husbandry and Fisheries), Waters and Forests (MPAEF). The participants (Figs. 1–3) also developed a list of priority lemur species, which we announced in the last issue (see *Primate Conservation* 8: 9–10). Because of the importance of this workshop in furthering the cause of lemur conservation, we enclose the minutes of these meetings.

Participants in the workshop whose comments are published below are, in order of appearance:

Frank Larkin, St. Catherine's Island Foundation
Alison Richard, Yale University
Joseph Randrianasolo, Minister of MPAEF
Russell A. Mittermeier, Chairman of PSG, WWF
Roland Albignac, Zoological Park of Vincennes



Fig. 1. Workshop participants during visit to Duke University Primate Center (photo by R.A. Mittermeier).

Joelina Ratsirarson, Chief of the Division of Fauna, Flora and Environment of the Department of Waters and Forests, MPAEF
Berthe Rakotosamimanana, Technical Counselor for the Ministry of Higher Education

Henri Rasolondraibe, Secretary-General of the Ministry of Scientific Research and Technology for Development
Voara Randrianasolo, Director of the Zoological and Botanical Garden at Parc Tsimbazaza

Barthelemy Vaohita, Director of WWF Representation in Madagascar

John Hartley, Jersey Wildlife Preservation Trust

Elwyn Simons, Duke University Primate Center

Jean-Jacque Petter, Zoological Park of Vincennes

Yves Rumpler, University of Strasbourg

Ulysses S. Seal, Chairman of CBSG

Alison Jolly, Princeton University

Dr. Alison Richard expressed thanks to Mr. Larkin on behalf of the conferees, and also welcomed the presence of the translators and Mr. Erik Eckholm from *The New York Times*. She then introduced the first speaker, His Excellency the Minister, Joseph Randrianasolo.

Speech of his Excellency, the Minister of Animal Production, Waters and Forests (J. Randrianasolo)

The Minister stated the goal of the conference: to develop a strategy for ensuring the continued survival of the lemurs of Madagascar. Madagascar is blessed with an extraordinarily diverse endemic flora and fauna, which through its richness has become a global patrimony. He reflected on some problems associated with the conservation of the environment.

The Minister pointed out that the conservation of nature in Madagascar is one thing and its rational use another. However, the need for sustainable development is integral to the concept of conservation in developing and industrialized nations alike. Noteworthy in Madagascar is the recognition at the highest levels of government of the importance of conservation, as demonstrated by the Malagasy Conference on the Conservation of Nature held in November 1985 in Antananarivo which resulted in an action plan for the most rational implementation of the National Conservation Strategy.

The future survival of lemurs inevitably depends on the protection of Madagascar's ecosystems. It is particularly urgent to address the economic and educational needs of rural people living near forests, because of the strong impact these people have on the ecosystem. The

Opening Session, 13 May A.M.

Welcome

Frank Larkin welcomed everyone on behalf of the St. Catherine's Island Foundation, the New York Zoological Society, and Wildlife Conservation International. He mentioned the particular honor of the attendance by the distinguished delegation from Madagascar, led by His Excellency, the Minister of Animal Production, Waters and Forests.

reserves of Beza Mahafaly and Mananara North and the creation of reserves at Ranomafana and Andasibe Perinet are the start of a whole generation of similar projects made possible by international cooperation.

Captive breeding programs are also important to lemur conservation. However, such programs will only be fully successful if animals are kept under conditions approximating those in their natural environment. Lemurs will only be considered for export to those who have demonstrated the expertise needed to breed them, and the exportation of lemurs for breeding must be linked to husbandry infrastructures in Madagascar. These guidelines imply a transfer of technology, the donation of materials and funds, and the development of a spirit of mutual understanding.

The Minister encouraged conferees to discuss the practical applications of these guidelines. He commented on the deep commitment on the part of the conservation leaders of Madagascar, namely, the Ministry of Scientific Research, the Ministry of Higher Education, and the Ministry of Animal Production, Waters and Forests, and their willingness to promote wildlife conservation without any consideration of eventual hegemony.

The Minister concluded his remarks by thanking the meeting's organizers and offering the hope that the meeting would lay the basis for a new form of cooperation and mutual aid.

Dr. Richard thanked the Minister for his inspiring remarks, and suggested that discussion of the issues he raised be held following all the opening presentations.

A Review of the Conservation Status of Lemurs in Their Natural Habitat (R.A. Mittermeier and R. Albignac)

The primate fauna of Madagascar is one of the highest conservation priorities of the world. The country ranks among the top five countries in terms of numbers of different primate species, and is the very highest in terms of endemism, with 93% of its species found nowhere else. The conservation urgency is clear: of 43 species and subspecies, only four are in no immediate danger of extinction. Threats to the survival of lemurs include human cultural traditions such as hunting, but are primarily due to the destruction of primate habitat through clearing for agriculture and tree cutting for firewood and charcoal production.

Mittermeier and Albignac reviewed the status of lemurs in each of Madagascar's major biomes: the southern spiny desert, the western dry deciduous forest, and the eastern rainforest.

Southern spiny desert. Much of Madagascar's wildlife is endemic not only to the nation, but also within a particular region. Amongst the plants in this zone, 95% are endemic to the south. Fewer lemur species are present, and none are endangered at this time. Species include: *Microcebus murinus*, *Lepilemur leucopus*, *Cheirogaleus medius*, *Lemur catta*, and *Propithecus verreauxi*.

Western dry deciduous forest. This zone is moister than the south and drier than the east. The top priorities for conservation are those primates in the most humid portion of this zone, including *Lemur mongoz*, *L. macaco flavifrons* and *Propithecus verreauxi coquereli*. The latter is endangered due to habitat fragmentation, and Albignac noted that it should be translocated to nature reserves. *Lemur mongoz* does not breed well in captivity.

True rainforests. Primates found here include a mouse lemur, two species of *Lepilemur*, *Cheirogaleus major*, *Hapalemur*, *Lemur fulvus* (*albifrons*, *sanfordi*, *fulvus*, *rufus*, *collaris*, and *albicollaris*), *L. rubriventer*, and the eastern form of *Avahi*. A survey is required for *albicollaris*, since nothing is known of its distribution. Lemurs with more restricted ranges which include the ruffed lemur (*Varecia variegata*) and the indri are of special concern. The red ruffed lemur (*V. v. rubra*) is found only on the Masoala Peninsula. The black-and-white ruffed lemur (*V. v. variegata*) is more widespread but seems to be hunted everywhere.

Also, although it breeds very well in captivity, its taxonomy is still unclear (there may be at least three different subspecifically distinct forms) and hybridization in captivity may be a problem. The indri is of particular importance because of its potential as a 'flagship' species for the promotion of lemur conservation. The most endangered species are *Hapalemur simus* and *Hapalemur aureus*. Yves Rumpler will soon do genetic analysis on this last, recently discovered *Hapalemur* species and *Propithecus diadema perrieri*, for which only 15 confirmed individuals have been sighted. *P. d. edwardsi* is the subspecies of *P. diadema* in the best shape. *P. d. diadema* is of unknown conservation status. The aye-aye is an endangered monotypic primate family and, as such, a high conservation priority. A bizarre creature, it also has good potential as a conservation symbol.

Mittermeier stated that a top priority must be the maintenance and expansion of the network of reserves. WWF and the Department of Waters and Forests have started a joint project to assess the status of current reserves. Bernhard Meier's 'string of pearls' concept of creating corridors from reserve to reserve has much validity. Other priorities include: training, community involvement, public awareness through the distribution of t-shirts and posters, conservation education and the development of international tourism.



Fig. 2. Gerald Durrell explaining a point to Joseph Randrianasolo, the Minister of Animal Production, Waters and Forests, as Lee Durrell looks on (photo by R.A. Mittermeier).

Remarks on the Status of Madagascan National Parks and Natural Reserves (J. Ratsirarson)

Madagascar's very diverse wildlife represents a scientific wealth of inestimable value for the country. This wealth is currently endangered by habitat destruction, and efforts to conserve it must be on two levels: technical and legislative.

Technical Aspects. Over a million hectares of forest are protected by one of the following classifications: Integrated Nature Reserve, National Park, or Special Reserve (Table 1).

National Parks are under public control and play a part in the propagation, protection and conservation of wildlife, as well as the conservation of items of esthetic, geological, prehistoric, historic, archeological or scientific interest. Another goal of national parks is recreation for the general public. Madagascar now has two national parks: Faritany d'Antsiranana, the National Park of Ambre Mountain; and Faritany de Fianarantsoa, the National Park of Isalo.

Within Integrated Nature Reserves the following is prohibited: camping without written authorization, hunting, fishing, mining, logging, agriculture, any activity that might alter the terrain or vegetation or harm a wild animal, and any introduction of species of plants or animals, be

they endemic or exotic, wild or domesticated. There are 12 Integrated Natural Reserves.

Within the 23 Special Reserves in Madagascar, found throughout the different provinces of the country, hunting, fishing, and plant gathering are strictly forbidden. These reserves were created principally to conserve certain species of plants and animals, access is by authorization only.

Table 1. The Protected Areas of Madagascar

	No.	Area (ha)	Province
National Parks			
Montagne d'Ambre	I	18,200	Antsiranana
Isalo	2	81,540	Fianarantsoa
	Total Area =	99,740	
Integrated Nature Reserves			
Betampona	I	2,228	Toamasina
Cap Masoala	II	76,000	Antsiranana
Zahamena	III	73,160	Toamasina
Tsaratana	IV	48,622	Antsiranana
Andringitra	V	31,160	Fianarantsoa
Lokobe	VI	740	Antsiranana
Ankarafantsika	VII	60,520	Mahajanga
Tsingy de Namoroka	VIII	21,742	Mahajanga
Tsingy de Bemaraha	IX	152,000	Mahajanga
Tsimanampetsotsa	X	43,200	Toliara
Andohahela	XI	76,020	Toliara
Marojejy	XII	60,150	Antsiranana
	Total Area =	645,542	
Special Reserves			
Analamera	101	34,700	Antsiranana
Anjanaharibe-Sud	102	32,100	Antsiranana
Ankarana	103	18,220	Antsiranana
Forêt d'Ambre	104	4,810	Antsiranana
Manongarivo	105	35,250	Antsiranana
Kalambatritra	201	28,250	Fianarantsoa
Manombo	202	5,020	Fianarantsoa
Pic d'Ivohibe	203	3,450	Fianarantsoa
Ambohijanahary	301	24,750	Mahajanga
Bemarivo	302	11,570	Mahajanga
Bora	303	4,780	Mahajanga
Kasijy	304	18,800	Mahajanga
Maningozo	305	7,900	Antsiranana
Marotandrano	306	42,200	Mahajanga
Tampoketsa d'Analamaitso	307	17,150	Mahajanga
Ambatovaky	401	60,050	Toamasina
Mangerivola	403	11,900	Toamasina
Nosy Mangabe	404	520	Toamasina
Ambositantely	501	5,600	Antananarivo
Andranomena	601	6,420	Toliara
Cap St. Marie	602	1,750	Toliara
Beza-Mahafaly		580	Toliara
Périnet-Analamazoatra		810	Toamasina
	Total Area =	376,580	
Grand Total of all Protected Areas =			1,022,122 ha

Legislative Aspects. Madagascar has a variety of laws protecting nature. Madagascar's wild animals are legally divided into three categories: Protected, Nuisance, and Edible. Animals in the first category, which includes lemurs, may not be hunted or trapped. Animals in the second category may be hunted anywhere outside the reserves, and those in the last can be hunted only during a designated season, in principle lasting from May to the end of September.

The forests are not well protected. There is currently uncontrolled burning in the eastern forests and the western savannas.

The Role of Universities in Conservation (B. Rakotosamimanana)

The Ministry of Higher Education has under its aegis all the activities of the University of Madagascar, divided into six branches, one in each of the provinces (Faritany), as well as those of the Museum of Scientific Collections in Tsimbazaza Park.

Training in conservation cannot occur without research, both applied and pure, as a point of departure. In November 1985, a conference was held in Antananarivo which brought together wildlife specialists from all the regional universities to evaluate the teaching of natural sciences in Madagascar. There is a school of agronomy, including forestry, in Antananarivo, a marine station at Toliara, and a natural science center (created in 1985) at Mahajanga. There are 120 teachers of natural science in the university system: 42 biologists, 36 botanists, 15 paleontologists and physical anthropologists, 24 geologists, and 3 technical agriculturalists. Between 1968 and 1985, 101 degrees were awarded in animal husbandry, 118 in agriculture and 59 in water and forest management. Normal schools also have produced specialists in these areas. In the last year, four doctorates were awarded. These were made possible through the collaboration of outside universities, with bilateral agreements with French and American universities, or multilateral agreements with NGO's like the IUCN and WWF.

Out of the creation of the International Advisory Group, foreign researchers have initiated a number of projects, including one on lemurs in Berenty; one on the relationship of vegetation, diurnal primates, and domestic livestock in Bealoka forest; one on the indri and other lemurs of the east; and one on *Varecia variegata* of the northwest. Institutions collaborating on these and other non-lemur projects have included the following universities: Oxford, Cambridge, Duke, London, Yale and Washington; and the following institutions: Smithsonian, Philadelphia Academy of Sciences, the Natural History Museum in Paris, and the Alan Fletcher Station of Queensland, Australia.

Foreign universities can help protect Madagascar's wildlife by supporting research that deepens our understanding of the ecosystem. They can also collaborate in the training of a young cadre of engineers, teachers, and Malagasy researchers concerned with conservation.

Our faculty need to be informed of foreign projects which promote conservation. University personnel are now limited by heavy teaching obligations; too few professors must deal with over 37,000 students.



Fig. 3. Joseph Randrianasolo, Henri Rasolondraibe, and Voara Randrianasolo observing free-ranging lemurs in North American mixed deciduous forest at Duke University Primate Center (photo by R.A. Mittermeier).

Research Priorities in Madagascar and Lemur Conservation (H. Rasolondraibe)

Madagascar's first priority must be self-sufficiency in food production, so is lemur research a priority? There are two answers: yes and maybe.

The answer is yes if one considers that such self-sufficiency cannot be achieved in a degraded environment, and that the health of the lemurs is an indicator of the health of the ecosystem.

The answer is maybe for three reasons: first, there are economic constraints. IMF restrictions do not permit the hiring of new researchers, for example. Second, my ministry is junior to other ministries involved in conservation. Third, the University has more people studying the ecosystem; our ministry is primarily concerned with applied work in pharmaceuticals, marine life, and agronomy.

I hope to establish a new data center with the help of the people at this meeting. I hope in the future we shall study ecosystems — marine, rural, urban — as well as forests. The work of the people here has been useful in the past and of high quality; but not as useful as the nationalization of knowledge.

Remarks on Parc Tsimbazaza, Madagascar's National Zoo and its Role in the Captive Breeding of Lemurs (V. Randrianasolo)

Parc Tsimbazaza, in the capital city of Antananarivo, is the only zoological and botanical garden in Madagascar. The floral and faunal collections are of equal importance. Many endemic reptiles and carnivores are exhibited: e.g., *Uroplatus*, *Trachidoptylus*, and *Galidia*. We have *L. catta* in semi-captivity, as well as a 3,600 m² enclosure that permits us to have two or three species together: *L. catta*, *L. fulvus*, and *L. macaco*. Right now, the zoo has about 60 lemurs representing 15 species and subspecies. In 1985, we had 56 lemurs, with 10 births and 2 infant mortalities. In 1986, there were 64 lemurs, with 7 births, all living to date. By 1987, we had 75 lemurs; 8 were acquired from confiscations made by the Directorate of Waters and Forests.

Since 1985, there has been an effort to propagate endangered animals, notably lemurs and reptiles. Tsimbazaza can be considered a center for captive lemur propagation because of its record over the last two years. Births have included members of the species *Propithecus verreauxi coquereli*, *Lemur coronatus* (after ten years in captivity), *Hapalemur griseus* (after seven years), *Lemur macaco flavifrons* (for the first time in captivity), *Lemur catta*, and *Lemur fulvus*.

A lack of space puts limits on our breeding program and expansion is our first priority. Together with the Director of Waters and Forests, we have formulated a plan to create or upgrade many breeding centers in different ecological zones of the island.

Our second priority is to create a public education and information center at the Parc. While there are no statistics, the number of visitors to Tsimbazaza is tremendous, and very broad in terms of age and social class. We aim to sensitize and motivate the public to conserve nature through sustainable development, and to learn about current conservation projects around the country, such as Beza Mahafaly, and the project on *Geochelone yniphora* in Ampijoroa.

Our third priority is to establish a Biological Database Center at Tsimbazaza. The Parc remains a center where much university-level research is conducted on the flora and fauna of Madagascar. Since 1985, at least a dozen students have used the Parc to prepare their theses. We must maintain and upgrade our systematic collections, and make the information they contain more accessible.

The WWF Conservation Program in Madagascar (B. Vaohita)

A WWF program was established by official decree by the President of Madagascar in 1979. The goal of the program is education at the highest level about the importance of wildlife conservation to Madagascar. One result has been Madagascar's participation, along with

that of 30 other countries, in the creation of the World Conservation Strategy. An international conference held in November 1985 and supported by WWF, made concrete the willingness of the Revolutionary authorities to be in the forefront in turning conservation strategy ideas into action. In fact, Madagascar is rare among African nations in having its own national conservation strategy.

WWF has been involved in other activities in collaboration with various ministries, among them the Ministry of Animal Production and Waters and Forests, the Ministry of Higher Education, and the Ministry of Secondary and Primary Education.

As for the future, on 3 July 1986, the Government and WWF-International signed an accord to develop two action plans based on the November 1985 conference. Under the terms of the accord, WWF is authorized to lead two priority activities: the management of two reserves, and public education. The first includes both the creation of a reserve to protect the humid coastal forest and the aye-aye and the management of a model reserve at Andohahelo (Fort Dauphin). WWF-Madagascar directly supervises the education program, and both efforts are underway.

A Review of the Status of Lemurs in Captivity and the Prospects for Long-Term Captive Breeding in American and British Collections (J. Hartley, E. Simons)

Captive breeding is a vital conservation tool, but only if it is begun before a declining species reaches the brink of extinction. All lemurs are declining in numbers in the wild. There are from 2,300 to 3,600 lemurs in captivity outside Madagascar, including 13 species from 4 families, representing 60% of the lemur fauna. Unfortunately, most threatened species are not covered. Only three species in one family (Lemuridae) account for 75% of all lemurs in captivity (*L. fulvus*, *L. catta*, and *V. variegata*). Worse, only seven species are represented in five or more collections — a potentially dangerous situation.

The outlook over the long-term is grim when one considers the sustainability of the captive populations. A simple criterion for a population with enough intrinsic variability for an eventual reintroduction into the wild is 100 individuals. Only five species currently meet this criterion. Only three have over 100 breeding animals. Breeding success is also a problem. Folivorous lemurs have proved difficult to keep and breed in captivity, and proper husbandry of these animals requires further effort. A lack of coordinated population management among collections is also a problem. The Malagasy government should insist that any lemur taken from the wild to a collection be entered into international and regional registers; the government should also urge the creation of studbooks where none exist.

Duke University has many faculty interested in tropical forest habitats, as well as lemurs. The university is, in fact, planning to establish a tropical forest institute. There are 1,500 lemurs listed in ISIS in the USA, a third of which are at Duke; it is unlikely that Duke will be able to house more. In the past decade, the center has sent out 500 lemurs and maintained records of these animals' destinations which could be the basis for starting studbooks. In the future, Duke will shift its emphasis to more endangered species and perhaps participate in reintroduction projects.

The University has discovered difficulties in lemur husbandry. Researchers at Duke found that unless the animals are pregnant on export, *Propithecus verreauxi* requires three years to adjust its breeding cycle to the North American habitat. Lemurs fall into three categories: species that breed well in the wild and in captivity; species that are threatened in the wild but breed well in captivity, like the aye-aye; and species that are declining in the wild and are not in captivity. Efforts should be directed especially at the last category.

A Review of the Status of Lemurs in Captivity and the Prospects for Long-Term Captive Breeding in French Collections (J.-J. Petter, R. Albignac, and Y. Rumpler)

Nearly 30 years ago, Jean-Jacques Petter began a captive breeding program for lemurs at Brunoy. Today located at Vincennes, the collection includes 3 aye-ayes, 2 *Haplorhina simus*, 2 *Cheirogaleus*, some *Propithecus verreauxi coronatus* and over 300 *Microcebus*. By the end of May, there will be a new building for the animals. The zoo at Vincennes is now anxious to set up reserves in Madagascar in two areas to help conserve wild populations of lemurs.

As for the University of Strasbourg, it has a cooperative agreement with the University of Madagascar to study speciation in lemurs. In recent years, the institution has developed a new orientation towards protection of lemur species through captive breeding. Strasbourg created a consortium with three European zoos, which plan to pool their animals to avoid inbreeding.

Second Session, 13 May P.M.

(U.S. Seal, A. Jolly, and R. Mittermeier)

In this session, four points were clarified and discussed:

- (1) The role of the Captive Breeding Specialist Group (CBSG) of IUCN/SSC in facilitating the captive breeding of endangered species;
- (2) Critical factors to consider in launching captive breeding programs for endangered species as well as release and reintroduction considerations;
- (3) A strategy for involving zoological gardens in sponsoring fauna preservation in Madagascar;
- (4) Identification of the 16 most endangered lemurs in Madagascar and some suggested programs for working with these taxa.

The Captive Breeding Specialist Group

U.S. Seal pointed out that the Captive Breeding Specialist Group, like all the specialist groups of the Species Survival Commission, is concerned with species survival and species conservation strategies. Captive breeding is recognized as one of several tools which can be employed to ensure a species' survival. The CBSG is particularly concerned with coordinating zoos toward management of their available space and expertise for captive breeding and species conservation, not just recreation. In this way, local monies earmarked for local cultural institutions (zoos) can have a conservation effect of global significance.

The CBSG responds to any country and group of species specialists who have suggestions for captive breeding programs already in operation or who request assistance in launching captive breeding programs for new species. The group acts as a service organization for organizing people, captive breeding space, and breeding plans, but unfortunately has very little money.

The CBSG recognizes that a critical element in captive breeding programs is good record keeping. The International Species Inventory System (ISIS), which has subscribers in 23 countries, represents a basis of record keeping on wild animals in captivity. ISIS has recently developed a computerized animal record keeping system known as ARKS which can be operated on an IBM PC. ARKS is one of the most successful multispecies record keeping systems developed to date and is the only one which is designed to be easily interactive with ISIS, thereby making animal record keeping and participation in ISIS virtually a one-step process. ISIS managers recently obtained a grant to distribute ARKS software to zoos in less developed nations free of charge. ARKS is being translated into several languages.

In short, the CBSG helps to facilitate responsible management of captive breeding programs for rare and endangered species to create stable captive populations (1) from which predictable numbers of animals can be made available for return to the wild now or in the future, and (2) which can stimulate interest and understanding, through education and exhibition, of the species' plight in nature. Priority is given to assisting in the multifaceted task of preserving species diversity.

Critical Factors to Consider

Through understanding of the principles of genetics and demography, it is possible to provide figures and guidelines which provide a structure for the initiation and design of captive breeding programs. These include:

- (1) Long-term breeding programs (up to 100-200 years) require a minimum of 100 breeding adults. This figure applies to programs for preservation in the wild; however, mortality factors, which are usually higher in the wild, will affect the reproduction rate required if the population is to remain stable. Population distribution also affects prediction of success, since fragmented populations (whether separated in nature or without coordination in captivity) are more prone to extinction.
- (2) The number of 'founders' (wild-caught specimens obtained to establish a captive breeding program) should be at least 20 successfully breeding animals in order to maintain a genetic integrity of the captive population at least roughly similar to that of the wild population.
- (3) Response to a species in crisis should occur before it is too late or too difficult to establish a captive population. The plea for help is often extended when the endangered species' population numbers 10-20 or fewer individuals. Attempts to establish breeding programs when extinction is so close at hand can be extremely expensive, can elicit much emotion from untrained observers, and are usually too late to be effective.
- (4) It is highly recommended that captive breeding programs be initiated for species whose numbers have dropped to 1,000. It is essential that they be launched immediately for species with 200 or fewer individuals. Twenty specimens drawn from a population of 1,000 are more likely to meet specifications for a captive program without affecting the wild population than are 20 specimens drawn from a population of 200 or fewer. Early action is more likely to lead to successful results.
- (5) Regarding release and reintroduction:
 - (a) It is generally accepted that release should not occur, under most circumstances, in areas where the species already exists.
 - (b) Translocation of wild-caught animals from a populated area to a vacated area is preferable to release of captive-bred animals.
 - (c) Captive-bred animals are best considered a resource for reintroduction if, in fact, the species no longer exists in nature (and the factors which caused extinction have been corrected). Occasionally, very small wild populations may need supplementation.

Strategies for Zoological Garden Involvement

A. Jolly suggested that a 'sister cities' concept employed by individual zoological gardens would allow foreign zoos to offer critical support to several species and habitats in Madagascar. Exhibition of captive specimens and publicity regarding a breeding program could provide a showcase for soliciting support for preservation of the same species in Madagascar. A current example is the relationship of the Vincennes Zoo and Mananara which promotes the preservation of the aye-aye.

Zoological gardens are already forming consortia to invest in field research, nature preservation, and captive breeding in Thailand, Indonesia, North Korea, and several areas in Africa. The Minister received this idea with much enthusiasm.

Jolly also indicated that management of 'islands of habitat' could produce a conservation yield by establishing programs which mixed captive breeding (intensely managed populations) and wildlife management skills. Such programs should neither supplant nor be confused with management and preservation of reserves and other more or less intact habitats. Various approaches, however, can be linked in different ways to respond appropriately to the problems of a species and the region in which they occur.

R.A. Mittermeier noted that the Republic of Rwanda realizes millions of dollars in tourism (the second or third foreign exchange earner for the country) from a single reserve. Madagascar has a number of exciting reserves whose stability and effectiveness might be enhanced by tourism, promoted perhaps through the kinds of programs discussed above.

The Most Endangered Lemurs

Most lemur species are not represented in captivity. Below is a list of 16 species and subspecies which should receive highest priority in pursuing captive breeding programs; only four of these 16 are now represented by significant numbers in captivity (Table 2).

Table 2. The 16 Top-Priority Primate Taxa in Madagascar

Highest Priority

Haplemur simus
Haplemur aureus
Haplemur griseus alaotrensis
Propithecus diadema perrieri
Propithecus verreauxi coronatus

Second-Level Priority

Indri indri
Daubentonina madagascariensis
Allocebus trichotis
Varecia variegata rubra
Varecia v. variegata
Varecia v. subcinctus

Third-Level Priority

Propithecus d. diadema
Propithecus d. candidus
Lemur mongoz
Lemur macaco flavifrons
Lepilemur septentrionalis

Mittermeier proposed an outline of model projects for lemur preservation in Madagascar:

- (1) Captive Breeding in Madagascar
 - (a) Continued support of Parc Tsimbazaza.
 - (b) Improvement of the Ivoloana Research Station with special emphasis on the captive breeding of folivorous lemurs, beginning with the non-endangered *Avahi*. A management facility for 50 to 100 animals could be built for \$50,000.
- (2) Establishment of New Reserves in Key Areas.
 - (a) Development of a conservation program for the Ranomafana - Kianjavato area, with special emphasis on establishment of a new reserve and conservation program for *Haplemur simus* and *Haplemur aureus*. This effort should include surveys and captive breeding programs for these two species of *Haplemur*.
 - (b) Development of a conservation program for the Masoala Peninsula, with special emphasis on establishment of a new reserve and program for the conservation of the red-ruffed lemur, *Varecia variegata rubra*.

- (3) Country-wide Survey of the Most Endangered Lemur Species
 A comprehensive program to assess the status of the top priority endangered lemurs to be carried out under the auspices of the IUCN/SSC Primate Specialist Group.
- (4) Translocation Projects
 - (a) Translocation of *Propithecus verreauxi coronatus* to the Ambohitantely Reserve.
 - (b) Translocation/introduction of *Propithecus diadema diadema* to the island of Nosy Mangabe.

Closing Session, 14 May

The entire day was devoted to amending and editing the Accord or *Convention for Collaboration with Respect to Endangered Malagasy Fauna*, which was presented in draft by the delegation from Madagascar. Both French and English versions were produced. Here follows the English version:

Convention For Collaboration with Respect to Endangered Malagasy Fauna

Between representatives of the Government of Madagascar and [The International Participant] the following has been agreed:

Article I: Goal

- I.1. Protection of natural habitats;
- I.2. Conservation of endangered species through captive breeding programs;
- I.3. Basic research on endangered species;
- I.4. Training of Malagasy students, researchers and technicians in order to acquire the necessary skills.

Article II: Reasons

This protocol of collaboration has been established to promote close relations between the Malagasy party and the International participant who commit themselves to the coordination of their activities in order to benefit animal species at risk of extinction through:

- translocation of species from threatened habitats to less vulnerable ones;
- increasing specimen numbers among endangered populations through programs of captive breeding. Subsequently, these animals are to be released in their natural habitats or exchanged with scientific organizations, in order to renew the gene pool through an international breeding program;
- the monitoring and evaluation of scientific programs;
- basic research on these animals to increase our knowledge of the species to which they belong.

Article III: Contracting Parties

The Malagasy Party includes:

- the Ministry of Animal Production (Husbandry and Fisheries) and Waters and Forests;
- the Ministry of Scientific and Technological Research for Development;
- the Ministry of Higher Education.

International Participant: _____

Article IV: General Coordination

Malagasy Party: Interministerial Technical Committee constituted from three ministries: the Ministry of Animal Production (Husbandry and Fisheries) and Waters and Forests; the Ministry of Scientific and Technological Research for Development; and the Ministry of Higher Education.

International Participant: _____

Article V: Technical Coordinators**Malagasy Party:**

- Directorate of Waters and Forests;
- University of Madagascar and Museum of Scientific Collections/Department of Natural History, Tsimbazaza Park;
- Directorate for support for Research on Environmental Sciences.

International Participant: _____.

Article VI: Programs

VI.1. All programs concerned with the implementation of the convention should be decided upon by a mutual agreement between the two parties. They will be the subject of appendices.

VI.2. The capture of specimens in the wild will be undertaken only in the context of captive breeding programs. These programs will take place:

- a) preferably, and if breeding and husbandry techniques have been mastered, in managed forest zones;
- b) in breeding centers in Madagascar, when captive breeding and husbandry have been mastered for the species in question.

In the case of species for which captive breeding and husbandry techniques have not been mastered, priority will be given to the establishment of programs in Madagascar. They will include education programs and will consider the possibility of coordinated activities outside Madagascar.

VI.3. Basic research programs carried out in Madagascar or elsewhere are envisaged in conjunction with captive breeding and husbandry in Madagascar.

VI.4. Programs for the protection of natural habitats and the introduction of species from threatened habitats will likewise be undertaken, as will continued monitoring of programs.

VI.5 All these programs will be undertaken in parallel with conservation education programs.

Article VII: Implementation**VII.1. The Malagasy Party:**

- will examine requests for the export of animals on a case by case basis through the Interministerial Technical Committee envisaged in Article IV above.
- commits itself, following the stipulations enunciated in Article VI above (VI.2, VI.3), to providing in the form of loans the animals needed to ensure the implementation of this program. However, the kind and number of animals to be sent out will be decided by a mutual agreement between the two parties.

VII.2. The International Participant envisions:

- training Malagasy technical staff, researchers and students in order that they may acquire technical management and husbandry skills.
- considering specimens collected in the wild as the property of the Malagasy Government. For species not yet represented in captivity, all specimens will remain the property of the Malagasy Government.
- discussing with the Malagasy Party the coordination of research on animals exported from Madagascar. All publications resulting from that research will be deposited in Madagascar.
- submitting periodic scientific reports concerning the animals exported to the Malagasy Party which reserves the right to visit the holding center.
- providing financial and technical collaboration toward the implementation of programs.
- participating in programs for the conservation of habitats and the reintroduction of animals into these habitats.

- covering all expenses associated with the return of animals on loan, in the event of contract expiration or litigation.

Note: All parties involved will communicate all pertinent information to the International Species Inventory System (ISIS), and cooperate with international and regional studbooks and animal management programs.

Article VIII: Convention Duration

This Collaborative Convention takes effect from the date of its approval by the Malagasy authorities and the international participants. It is valid for five years. It is automatically renewable, with the possibility of annulment by one or other party on six months notice.

Article IX: Financing

The International Participant undertakes to seek the funds needed to implement projects arising out of this convention. However, the implementation of projects mentioned in each appendix will begin only after both parties have determined that the required funds will be available and agreement has been reached concerning the budgeting of those funds.

Article X: Publication of Results

The parties agree to publish jointly the results of research subsequent to the submission of preliminary reports each year to those charged with coordination (including papers, audio visual materials, etc.).

Article XI: Materials and Equipment

The Malagasy Party commits itself to facilitating as far as possible the formalities associated with the importation of technical and scientific materials necessary for the execution of programs arising out of this convention as well as to obtaining waivers of taxes and import duties. Materials acquired in the context of projects described in the appendices to the present convention will remain the property of the Malagasy party.

Article XII: Miscellaneous Items

Conventions and programs already in place between the parties will stay in effect until their date of expiration, subject to amendment to make them compatible with the present convention.

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Conservation of the Cotton-top Tamarin and Medical Research

by F. T. Scullion, A. Morgan, A. Terlecki,
S. Underwood, B. Robbins and E. Potts

The ideal method of conservation for any species is establishing a wild reservation within the animal's natural range. Nevertheless, captive propagation has also recently been recognized as playing an important role in global conservation efforts (IUCN, 1980). However, the applicability of such a method may be restricted, since the costs can be prohibitive for institutions such as small zoos, where the sources of income are

generally limited and predominantly derived from private contributors and admission fees (Knowles, 1977).

In these days of financial constraint, from a conservation standpoint it may now be to the advantage of endangered species to be of use in curing some human disease. The need for animals of a medically important species might then ensure the resources to establish a self-sustaining captive breeding population. One animal has already benefited from such a scheme (Tardif, 1985). In 1978, the cotton-top tamarin (*Saguinus o. oedipus*) was listed as an endangered species by the IUCN. As with other endangered South American Callitrichidae, destruction of this tamarin's forest habitat was leading to a rapid decrease in the wild population (Neyman, 1977), already restricted to a small area of northwestern Colombia. Recent plans by Colombian officials to build hydroelectric power plants and flood the area that contains the remaining wild cotton-top tamarin population serve to emphasize the importance of maintaining a captive population to conserve this species (Cerquera, 1985).

That the cotton-top tamarin is uniquely well-suited for particular types of medical research is well documented (Epstein, 1984; Picus *et al.*, 1985). Recent findings about spontaneous adenocarcinoma and its possible associations with colitis and colon cancer mean that this species can only become more important as a research animal (Lushbaugh *et al.*, 1978; Chalifoux and Bronson, 1981; Clapp *et al.*, 1985; Kirkwood *et al.*, 1986).

In the mid-1970s, the demand for cotton-top tamarins for research prompted the establishment of a number of laboratory breeding colonies, which have been highly successful (Ogden *et al.*, 1978; Brand, 1981; Kirkwood *et al.*, 1985; Snowden *et al.*, 1985). The vast majority of the animals held in these laboratories over the last 10 years have been used for breeding purposes. The cotton-top tamarin, regularly described as a difficult species to breed, now sustains a population which has reached its third generation in captivity.

Although it is important to examine the ethics of using animals in medical research, it should also be realized that the laboratory use of some animals can benefit larger animal populations. When compared to waning reproduction in the wild, the breeding successes of the laboratory colonies confirm this, especially since a large breeding nucleus has to be maintained to provide the subjects for research.

The following points illustrate some of the major benefits brought to conservation by a successful captive breeding program such as the one for cotton-top tamarins:

- (1) successful colonies can be used as models by zoos in their efforts to obtain self-sustaining populations of endangered species;
- (2) increases in the knowledge of disease processes and their successful treatment may be applicable to other populations of endangered species both in captivity and in the wild;
- (3) thoughtful regulation of a laboratory population can perhaps provide animals to be released into the wild.

While it would ultimately be ideal to be free of the need to use animals in biomedical experiments, an ideal still well worth working towards, it is nevertheless the case that at this time, some animals such as the cotton-top tamarin are invaluable for research. The propagation of cotton-top tamarins for research has created an opportunity for tamarin conservation which must be seized. Similar techniques, when applied to

other endangered species used in vital medical research, could also help in their conservation.

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Hylobates concolor International Studbook Established

by Jean-Marc Lernould

In 1986, the IUCN and the International Union of Directors of Zoological Gardens officially endorsed the proposal of the Mulhouse Zoological and Botanical Park to initiate an international studbook for the concolor gibbon (*Hylobates concolor*, also known as the white-cheeked, black, or crested gibbon). The studbook represents the first worldwide census of *Hylobates concolor* in zoos which takes into account the different subspecies, so difficult to distinguish.

Although *H. concolor* probably once had an extensive range, the species is now found in only a few reserves and isolated forests in Yunnan Province and Hainan Island in southern China, and in Indochina east of the Mekong River. Like other gibbon species, *H. concolor* requires undamaged virgin forest, so forest destruction and hunting now threaten the survival of the species in the wild. Brockelman and Chivers (1984) quote Myers, who stated that between 1976 and 1980, 2,850 km² of forest were lost each year to agriculture in Peninsular Malaysia, and Marsh and Wilson, who suggested that this represents the loss of 3,400 siamangs and 31,000 gibbons per year.

H. concolor, and all other gibbons, are listed in Appendix I of CITES, so their importation is authorized only for purposes of research or propagation. The species breeds reasonably well in professionally managed zoological gardens. Unfortunately, incorrect taxonomic identifications have sometimes been made, and, as a result, hybrids have occasionally been produced. The maintenance of an accurate studbook and the provision of reliable taxonomic information to gibbon keepers should reduce the possibility of this occurring in the future.

The continuing effort to understand the relationship of all species of gibbon to each other is vital to the understanding of primate speciation. The study of *H. concolor* is of particular interest because of the distinctive anatomic and genetic characteristics, which at one time were considered sufficient to assign the group to a separate genus, *Nomascus* (a name which has since been relegated to the status of subgenus).

Identification of Subspecies of *H. concolor*

H. concolor gibbons are characterized by changes of coloration during the early years of their life. Young *H. concolor* gibbons are yellowish at birth but turn black when about one year old. Some of these young have white cheek whiskers, others do not. The males retain the black coloration for their entire life, but, at maturity, the females turn buff or yellow and keep only the black spot on the crown of their heads.

Until 1986, most taxonomists recognized six subspecies of *H. concolor* gibbons: three (*leucogenys*, *siki*, and *gabriellae*) are characterized by white or pale-reddish cheek whiskers in the black color phase, and three (*concolor*, *hainanus*, and *lu*) by the lack of such contrasting cheek whiskers in that phase. In 1986, two more subspecies lacking white cheek whiskers were described in China by Ma and Wang: *jingdongensis* and *furvogaster*. These authors, like Dao Van Tien (1983), suggest that the two general groups could, in fact, be considered different species because *concolor* and *leucogenys* are sympatric in two regions of northern Vietnam and one in China, all without hybridization.

In 1980/82, Schilling (1984) recorded 65 *H. concolor* in Europe. Forty-seven of these animals were identified: 37 *leucogenys*, 5 *gabriellae*, 3 *siki*, 1 *concolor*, and 1 *hainanus*. According to various other sources, *leucogenys* is also the dominant subspecies in other zoos of the world, although a few *gabriellae* are also reported. In 1986, ISIS reported 19-18-2 concolor gibbons present in North American zoos, all with white cheeks and probably belonging to the subspecies *leucogenys*.

Published descriptions (Delacour, 1951; Groves, 1972) of adult females (light color phase), based on pelage coloration and the size of the black

spot on the head, are not very helpful in distinguishing the various subspecies. In fact, it seems that one can find all shades of yellow from a pale, whitish or greyish yellow to a bright orange-yellow, that this coloration can change in relation with diverse factors (e.g., age or season), and that it appears more related to the individual than to the subspecies (pers. ob.).

The identification of adult female *leucogenys* and *siki* is difficult without the corroboration of photographs of individuals in the black phase. Regardless of the continuing difficulty in distinguishing *leucogenys* from *siki*, all female *gabriellae* that I have seen alive or in photographs have a unique characteristic which permits their accurate identification: the hairs of the cheeks are oriented differently from those of the other two subspecies, and form a prominent bracket on each side of the mouth. This corresponds clearly to the shape of the male's whiskers, as seen in Figure 1.

A chromosomal study of *leucogenys*, *siki*, *gabriellae*, and hybrids initiated in 1985 by the Mulhouse Zoo is producing exciting results. It appears that each subspecies can be separated on the basis of its karyotype. The results of this work, which will be published soon, will provide a technique for identifying some of the more problematic specimens.

The *International Zoo Yearbook's Census of Rare Animals in Captivity*, classifies concolor gibbons as *H. concolor* or *H. c. leucogenys*. This simplified classification does not take into consideration the precise identification of concolor gibbons in captivity nor provide an effective means for cooperative breeding.

Answers to the studbook questionnaire were received from 43 of the 65 institutions contacted; 36 of these 43 held concolor gibbons. Some of the institutions that did not respond are known to have large collections of concolor gibbons, and it is hoped that they will contribute to making future editions of the studbook more complete.

By the end of 1986, 126 individuals were included in the inventory:

<i>H. c. leucogenys</i>	= 40-38- 1	(16-6-1 captive bred)
<i>H. c. siki</i>	= 2- 2- 0	
<i>H. c. gabriellae</i>	= 8-11- 1	(3-3-1 captive bred)
<i>H. c. hainanus</i>	= 1- 0- 0	
<i>H. c. concolor</i>	= 0- 1- 0	
unidentified subspp.	= 6- 5- 0	(5-5 captive bred)
hybrids	= 5- 5- 0	

The geographic distribution of the subspecies was as follows:

In Europe	22-21- 0	<i>leucogenys</i>	in 17 institutions
	2- 2- 0	<i>siki</i>	in 3 "
	2- 3- 0	<i>gabriellae</i>	in 3 "
	1- 0- 0	<i>hainanus</i>	
	0- 1- 0	<i>concolor</i>	
	0- 1- 0	unidentified	
	6- 5- 0	hybrids	in 5 "
In the U.S.A.	11-12- 0	<i>leucogenys</i>	in 8 "
	4- 4- 0	<i>gabriellae</i>	in 2 "
	5- 4- 0	unidentified	in 1 "
In Australia	3- 3- 1	<i>leucogenys</i>	in 2 "
In Asia	4- 2- 0	<i>leucogenys</i>	in 2 "
	2- 4- 1	<i>gabriellae</i>	in 1 "

The data indicate that only *H. c. leucogenys* now has a zoo population large enough for long-term breeding. It is hoped that the 20 *H. c. gabriellae*, 8 of which are breeding, will soon constitute a viable population. As for *H. c. siki*, a pair was first established in 1986 by the Mulhouse and Munich zoos, and an offspring was born in 1987. In 1988, it was expected that a second pair would be formed, thus coupling all four *siki*



Hylobates concolor leucogenys

(white cheek whiskers)

Hylobates concolor siki

(white cheek whiskers)



Hylobates concolor gabriellae

(reddish cheek whiskers)

Fig. 1. Sketches of the different facial markings of male *Hylobates concolor leucogenys*, *H. c. siki*, and *H. c. gabriellae* (drawings provided by J.-M. Lernoould).

in the census. Unfortunately, it is doubtful that a sizable population of this subspecies will be established in captivity.

The studbook is updated yearly, and all institutions holding *Hylobates concolor* are strongly encouraged to submit data on their animals. Inquiries about the studbook should be directed to the studbook keeper:

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51 rue du Jardin Zoologique
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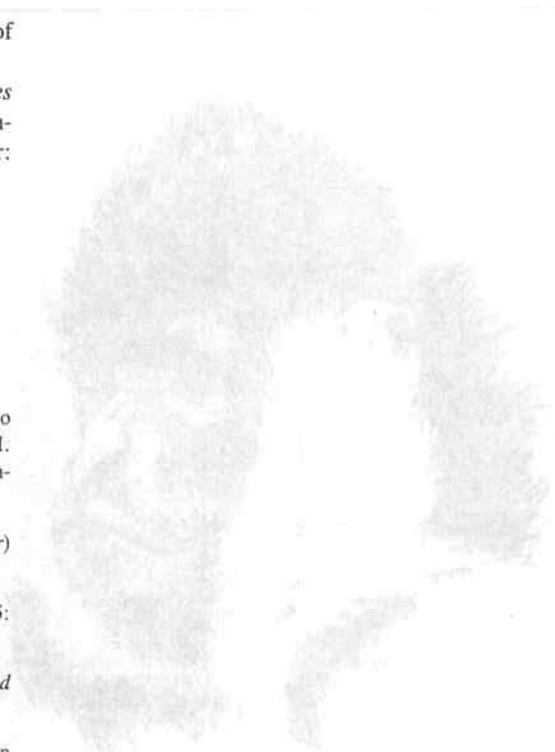
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ARTICLES

Central and South America

The Status of *Ateles geoffroyi* and *Alouatta palliata* in Disturbed Forest Areas of Sierra de Santa Marta, Mexico

by Gilberto Silva López,
Francisco García Orduña and Ernesto Rodríguez Luna

In Sierra de Santa Marta, Veracruz, Mexico, the expansion of agricultural practices and cattle-raising into more remote areas is causing considerable damage to the remaining forest habitat of the native primate species, *Ateles geoffroyi vellerosus* and *Alouatta palliata*. In addition to performing these large-scale, systematic forms of forest exploitation, local people use a variety of plant and animal species for medicine and food. These practices make it urgent to evaluate the status of primates in the region and to gather information on the short- and long-term effects of contemporary forest use. To this end, a survey was conducted intermittently between March 1983 and June 1985 in discontinuous forest areas of the region to examine the distribution, troop size and composition, habitat preferences, and relative population levels of *Ateles* and *Alouatta* (Silva López, 1987; Silva López *et al.*, in press).

Additional data for the study was gathered from governmental offices at Xalapa and San Andrés Tuxtla, as well as from two private ranches, four *municipios* (municipal settlements), and 14 *ejidos* (public land in which every *ejidatario* or family head exploits a proportional part of the *ejido* for his family's benefit; see Rodríguez Luna *et al.*, 1987). In the *municipios* and *ejidos* we interviewed 56 people.

This paper discusses the main results of the study and attempts to determine the responses of monkey populations to forest disturbance.

The Area

Sierra de Santa Marta is a 4,250 km² mountainous region, representing one of the larger tropical rainforest ecosystems at the northern limit of the Neotropics. The Sierra extends along the coast of the Gulf of Mexico through important parts of the *municipios* of Catemaco, Hueyapan, Mecayapan, and Soteapan, south of Veracruz (18°18'–18°26' N, 94°58'–94°56' W). The mountainous massif includes elevations up to 1,500 m (Gómez Pompa *et al.*, 1979). The hydrologic net of the sierra is radially disposed; the rivers and streams empty into the Gulf directly, or indirectly via the Sontecomapan Lagoon (Fig. 1a; Gómez Pompa *et al.*, 1979). The orographic factor is the main factor affecting the generally warm climate, which includes all the subtypes of Climate A identified by Köppen and modified by García (1964). A distinct rainy season occurs from mid-June or early July to mid-February. No climatologic station is presently established in the area; the nearer stations (Coyame, Soteapan, Chinameca, Huazuntlán, and Acayucan), however, suggest that the total annual rainfall varies from 1,500 mm (Soteapan, at S) to 4,600 mm (Catemaco, at N). The temperature ranges from 17–36°C through the year, while the mean annual temperature is about 27.4°C.

The vegetation can be broadly classified into ten forest formations: rainforest; cloud forest; lowland valley and swamp forest; semi-deciduous forest and palm grassland; pine-oak forest; oak forest; gum-oak forest; savanna; forest remnants, tree rows, thickets and open fields; and littoral and mangroves (Andrle, 1964; Gómez Pompa, 1977; Fig. 1b).

Linked to this rich flora is a highly diverse fauna. Although limited in scope, Andrle's investigations (1964, 1967) remain a major source of information on the birds and mammals of the Sierra. He recorded a total of 381 bird species representing 62 families in the region. Additional important ornithological work has now been carried out by members of the Instituto Nacional de Investigaciones sobre Recursos Bióticos (INIREB-Mexico; R. Domínguez Barradas, pers. comm.) The geographic ranges in Mexico of more than 114 mammal species include the Sierra de Santa Marta (Hall and Kelson, 1959). A. González Christen has indicated that 27% of the mammal species that occur at a national level are represented in the Santa Marta, which includes about 66% of the mammal species that occur in Veracruz (pers. comm.; González Christen *et al.*, 1987).

The Presence of Man in the Sierra

The southern and southeastern slopes of the sierra, where most forest fragments occur, are inhabited by two main ethnic groups: the *zoque-popoluca* and, in fewer numbers, the *nahuatl* (Münch, 1983). As with many other rural people in our country, the *zoque-popoluca* and *nahuatl* have had to suffer the impact of the numerous sociopolitical and socioeconomic changes which have occurred in Mexico in the past (Münch, 1983) and in recent times (Ramos, 1988). According to Münch

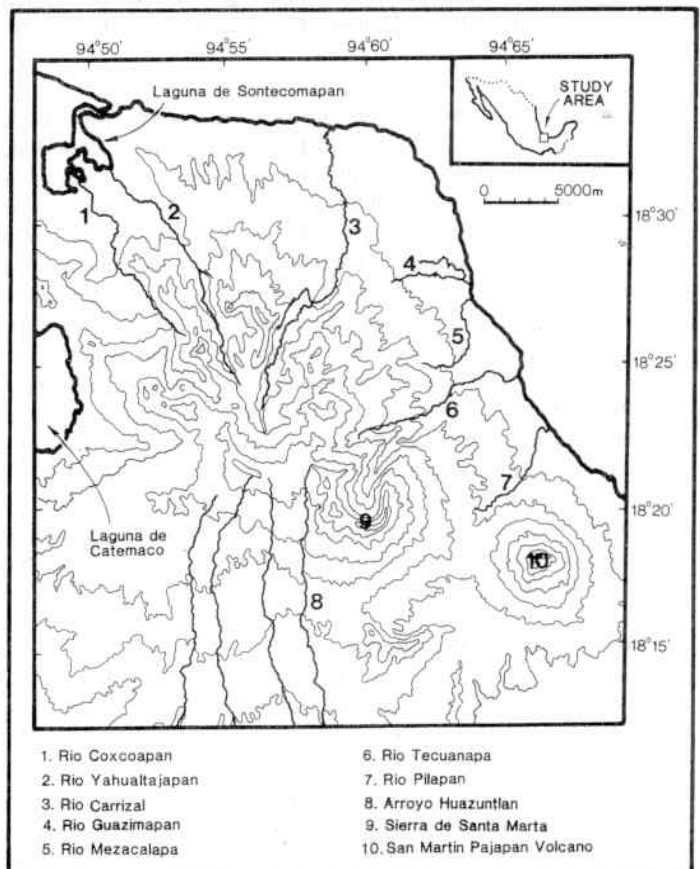


Fig. 1a. Map showing the Sierra de Santa Marta and San Martín Pajapan Volcano, Veracruz, Mexico (map provided by authors based on information from F. Ramírez).

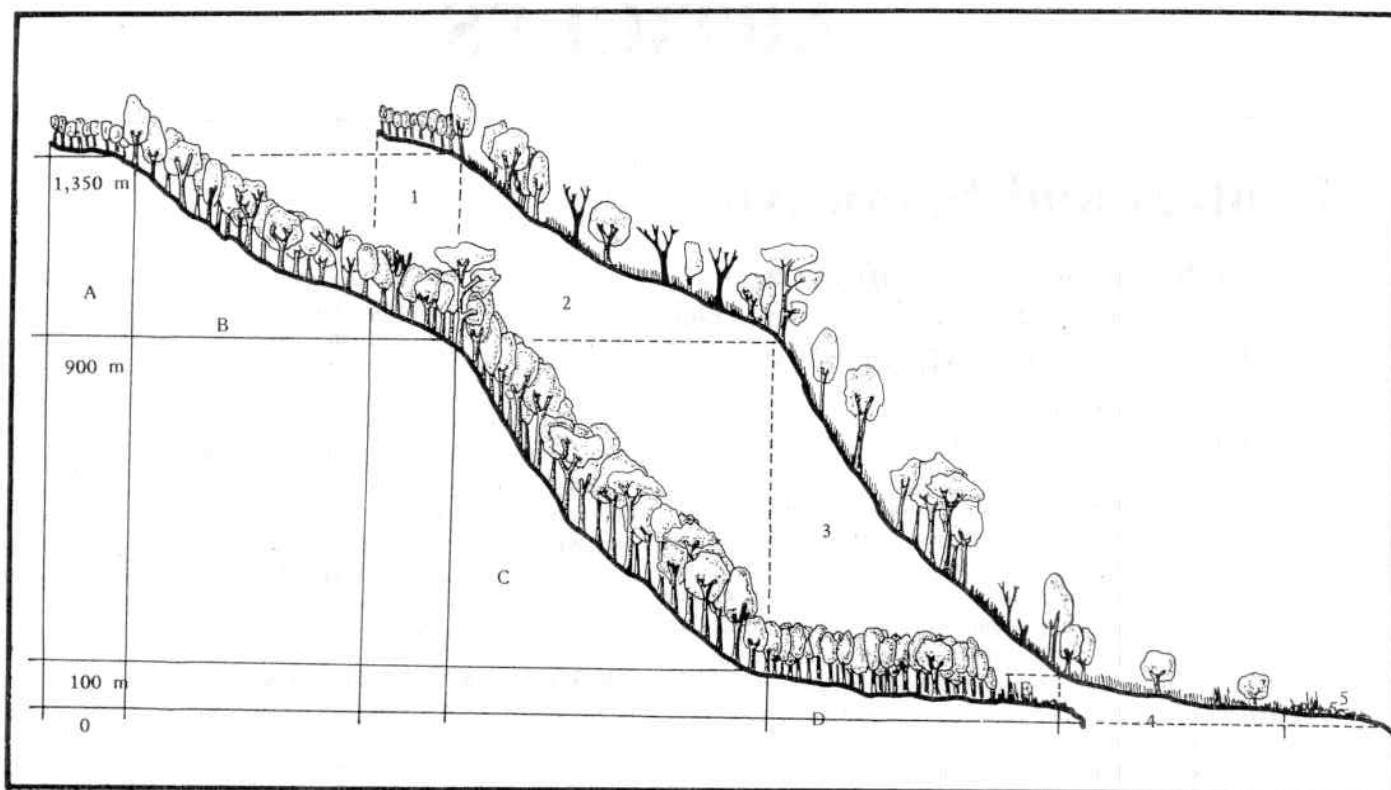


Fig. 1b. Graph comparing the original distribution of vegetation (A-E) to the present distribution (1-5) in the Magallanes area (taken from Silva-Lopez *et al.*, 1986).

Key: (A) low evergreen forest; (B) medium-height semi-deciduous forest with elements of deciduous forest; (C) high evergreen rainforest; (D) medium-height semi-deciduous forest; (E) coastal vegetation; (1) low evergreen rainforest; (2) medium-height semi-deciduous forest spoiled by fire; (3) grassland and small remnants of rainforest; (4) grassland; (5) coastal vegetation.

(1983), the admirable harmony once existing between these people and their environment has severely deteriorated. There is clear evidence, however, of cultural continuity. Münch states, for example, that the transformation caused by all these changes was not total: aspects of the indigenous culture, such as the slash-and-burn system, the sowing of two maize crops every year, the development of particular hunting and fishing practices, the gathering of plants and animals, and the construction and orientation of houses, have survived (Münch, 1983). Unfortunately, all this rich ethnic knowledge may be lost as a result of the continuing economic pressure coming from the big, heavily populated cities that surround the Sierra. The *zoque-popoluca* and *nahuatl* have had to change their traditional, self-sufficient economy into a trade economy dependent on an outside market. The resulting pressure upon the habitats has been remarkable. We found an example of this in neighboring cities such as Minatitlán and Acayucan, where trade in *palmilla* (*Chamaedorea* sp.) is intensive, each stalk selling for US \$0.25-\$0.50.

Forms of Forest Exploitation

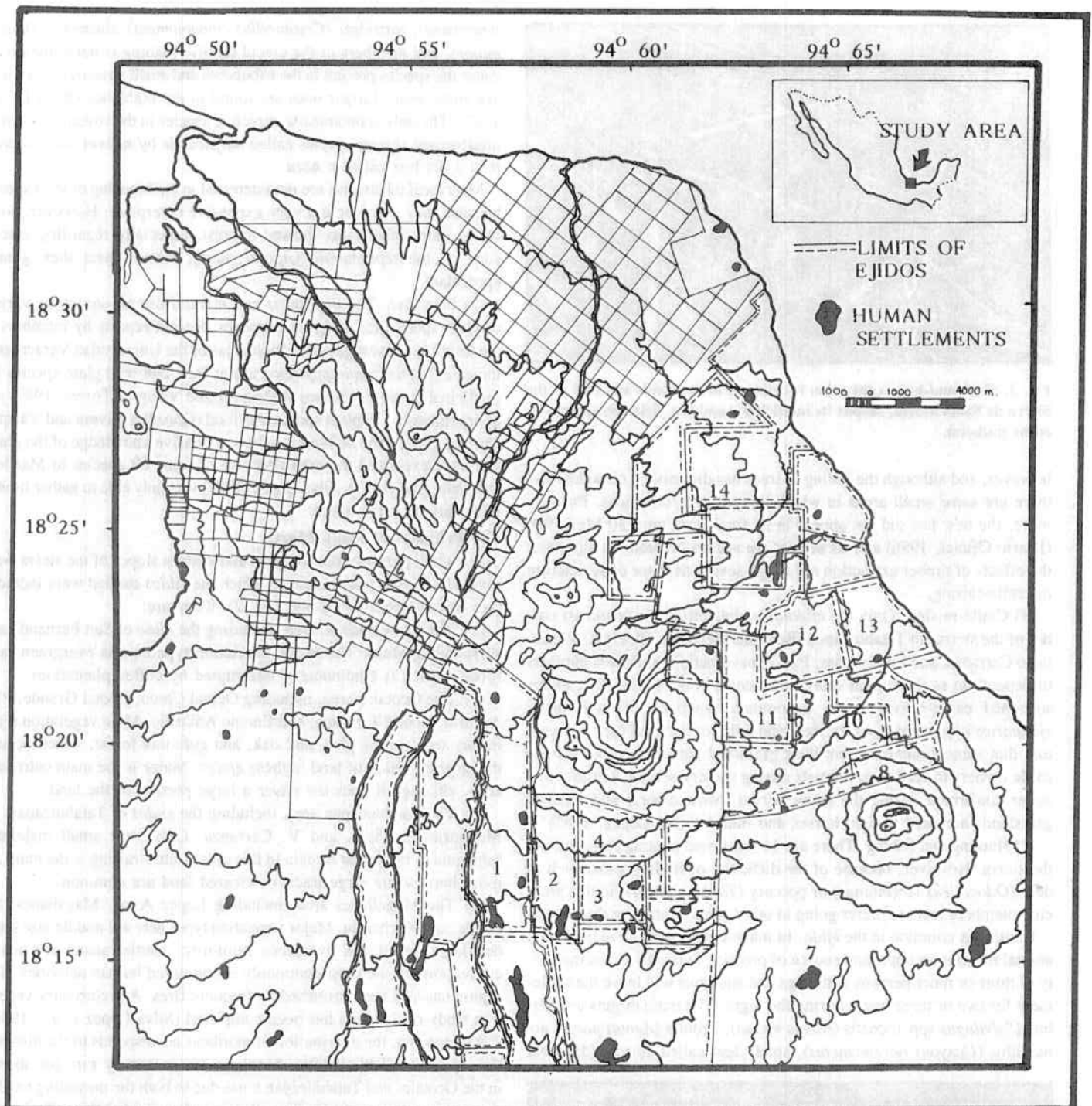
Land use in the *ejido* does not follow a uniform pattern. The *ejido* is divided into common-use land and private land. The first category includes school land, *tierra de agostadero* (grazing land for horses, mules, and cattle belonging to the *ejidatarios*), settlement land, and *monte* (forest). The second category is by far the larger and consists of *tierra de temporal*, which is proportionally distributed among the *ejidatarios* to establish their crops. There is no uniform pattern to land use within an *ejido*. However, the remnants of forest still remaining tend to be located along the *ejidos'* distant boundaries, since most *ejidatarios* prefer to concentrate their crops near the settlement.

Ejidos occupy a large area in the sierra. The relative location of the *ejidos* in which we gathered information is shown in Figure 2. The total area of the 14 *ejidos* studied is about 20,903 ha. Of the Santa Marta range, only a small fraction (approx. 10,000 ha or 18%) which includes the higher portions and dell of the sierra is not included within the socio-political borders of the *ejidos* and private ranches (which lie primarily in the north of the sierra). Most of the forest areas still remaining are located in these 10,000 ha.

Major forms of exploitation in the surveyed *ejidos* are:

(1) Agricultural practices. Farm products are the main source of income for the *ejidatarios*. Major crops are coffee and corn; lesser ones are red beans, chili, rice, and mixed fruits and vegetables. By far, coffee plantations occupy the largest portion of the cultivated land in the south of the sierra. Even when an area is considered of marginal quality, the powerful coffee companies choose to plant it. Veracruz is considered the second most important coffee producing state in the country after Chiapas. To grow coffee, *ejidatarios* cut the herbaceous cover with machetes and axes, leaving only the larger trees as shade for the coffee plants. This traditional method is practiced in both primary and secondary growth areas. To plant other crops, *ejidatarios* practice the slash-and-burn method (Fig. 3). This method demands the continuous clearing of new forest areas to replace areas abandoned due to soil impoverishment. The case of corn is a particularly remarkable one; it has long been one of the most important dietary elements for these people, even though the thin oxisol and andept inceptisol soil types of the slopes of the Sierra are inappropriate for its cultivation (Silva López, 1987).

(2) Timber extraction. *Ocoté* is the local name for a pine tree (from the *nahuatl* word *ocotl*, which means pine), while *ocotal* is the name for a pine plantation. Major areas covered by pines and oaks are located



south of the Sierra, mainly in the *ejidos* of Ocotal Chico, Ocotal Grande, Plan Agrario, Ocotal Texizapa, Encino Amarillo, and Tatahuicapan (Fig. 2). The only sawmill in the area is in Tatahuicapan. Although there are important pine populations in these and other *ejidos*, there are no roads to facilitate systematic exploitation. In addition, the distance between the *ejidos* and Tatahuicapan is too great to attempt the exploitation of these pine populations using only man-power. Therefore, their use is restricted to domestic purposes. There are important oak populations (*Quercus* spp.) in this area as well, but these are less commonly used than pines (Silva López, 1987).

On 28 April 1980, the federal executive declared Santa Marta a forest protection zone and refuge for the wild flora and fauna of the region. One consequence of this was the cancellation of permission to fell trees in the area (Diario Oficial, 1980). The area is not vigilantly patrolled,

Fig. 2. Map showing distribution of *ejidos* and agricultural communities in the Sierra de Santa Marta (map from Ramírez, pers. comm. and Silva López, 1987; provided by authors).

- | | |
|-----------------------|--------------------------|
| Key: (1) San Fernando | (8) Benigno Mendoza |
| (2) Ocotal Chico | (9) El Vigia |
| (3) Ocotal Grande | (10) Venustiano Carranza |
| (4) Plan Agrario | (11) Lopez Arias |
| (5) Ocotal Texizapa | (12) Magallanes |
| (6) Encino Amarillo | (13) Mirador Pilapa |
| (7) Tatahuicapan | (14) Xochiapan |



Fig. 3. Slash-and-burn cultivation is common in the south and east of the Sierra de Santa Marta, despite its inefficiency and low yield (photo provided by authors).

however, and although the felling of trees has diminished considerably, there are some small areas in which this practice continues. Furthermore, the new law did not appear in its final form until 30 May 1986 (Diario Oficial, 1986) and its effects are still to be seen. In any case, the effects of timber extraction are not as severe as those of agriculture or cattle-raising.

(3) Cattle-raising. Only the *ejidatarios* inhabiting the southeast corner of the sierra (in Tatahuicapan, Benigno Mendoza, El Vigía, Venustiano Carranza, and López Arias; Fig. 2) have cattle in sufficient numbers to depend on as their main source of income (Fig. 4). In other *ejidos* sustained cattle-raising is an uncommon practice, although many *ejidatarios* keep some cows for meat and milk for personal use. We were told that some *ejidatarios* rent their grassland parcels to other private cattle owners to feed their animals during the dry season, but this was never confirmed during the study period. Most natural and induced grasslands are used to feed horses and mules (Silva López, 1987).

(4) Hunting and fishing. There are 11 registered hunting clubs around the sierra. However, because of the difficulty of finding game such as deer (*Odocoileus virginianus*) or peccary (*Tayassu pecari*) in this area, club members seem to prefer going to other areas to practice their sport.

Hunting is common in the *ejido*. In many cases *carne de monte* (wild animal meat) is an important source of protein. Typically a hunting party of three or more persons with dogs and shotguns will leave the settlement for two or three hours during the night. The main targets are rabbits (*Sylvilagus* spp.), coatis (*Nasua nasua*), agoutis (*Agouti paca*), armadillos (*Dasyus novemcinctus*), small deer called *mazate* (*Mazama*



Fig. 4. In sections of the Sierra, cattle ranching poses the main threat to the remaining forests (photo provided by authors).

americana), partridges (*Crypturellus cinnamomeus*), tinamous (*Tinamus major*), and members of the cracid family. Fishing is not common because the species present in the tributaries and small streams of the Sierra are quite small. Larger ones are found in the highlands (Silva López, 1987). The only economically attractive species in the streams is a small, unidentified shrimp species called *mayacastle* by natives, who capture it in a net box called a *naza*.

Most local inhabitants are not interested in the breeding of feral species because they consider it a very expensive enterprise. However, some of the older inhabitants showed interest, especially regarding species such as the *tepezcuitle* (*Agouti paca*), whose meat they greatly appreciate.

(5) Plant use. The *popolucas* and *nahuatl* use an enormous variety of plant species for different purposes. Recent reports by members of the Centro de Investigaciones Biológicas of the Universidad Veracruzana indicate that the *zoque-popoluca* use at least 268 wild plant species for medicinal purposes (Santos Rodríguez and Vázquez Torres, 1987) and approximately 134 plant species for food (González Rivera and Vázquez Torres, 1987). The *nahuatl* also have extensive knowledge of the plants and have explained the medicinal use of some 89 species to Martínez and Calatayud (1987). Silva López (1987) was only able to gather limited information on this issue.

The Primates of Santa Marta

For study purposes the southern and eastern slopes of the sierra were divided into four major areas in which the *ejidos* studied were included (see Silva López, 1987; and Fig. 2). They are:

(1) The San Fernando area, including the *ejido* of San Fernando and surrounding areas. The major vegetation type here is evergreen rainforest, which is continuously interrupted by coffee plantations.

(2) The Ocotal area, including Ocotal Chico, Ocotal Grande, Plan Agrario, Ocotal Texizapa, and Encino Amarillo. Main vegetation types in this area are the pine-oak, oak, and gum-oak forest, which occupy the largest portion of land in these *ejidos*. Maize is the main cultivated crop, although it does not cover a large portion of the land.

(3) The Tatahuicapan area, including the *ejidos* of Tatahuicapan, B. Mendoza, El Vigía, and V. Carranza. Only very small disjointed segments of rainforest remain in this area. Cattle-raising is the main activity here where large tracts of cleared land are common.

(4) The Magallanes area, including López Arias, Magallanes, M. Pilapa, and Xochiapán. Major vegetation types here are middle-size semi-deciduous forest and evergreen rainforest. Cattle-raising and maize cultivation are the most commonly encountered human activities. The region has also been disturbed by frequent fires. A preliminary vegetation study of this area has been completed (Silva López *et al.*, 1986.)

As expected, the distribution of monkeys corresponds to the distribution of the available habitat. Monkeys are extremely rare (or absent) in the Ocotal and Tatahuicapan areas due to both the prevailing vegetation types and the considerable reduction of available habitat. In the San Fernando and Magallanes areas, where most contacts occurred, there is moderate to extensive exploitation of the habitat (*e.g.*, fields, cleared areas). In San Fernando monkeys are harassed when parties of young men encounter them, but they are not commonly chased; in the Magallanes area, the animals are harassed by dogs when these are accompanying a hunting party. In the San Fernando area, the monkeys were semi-habituated and only moved away if humans actually approached them. Monkeys are also accustomed to human presence in the Magallanes area, although they usually do not tolerate abrupt movements made by nearby humans. Both areas have an impoverished complement of predators, most major ones having been eliminated.

During the survey, we studied several groups of monkeys in 23 forest remnants, most of which are located near the *ejidos* of San Fernando at 500-1,000 m and Magallanes at 50-600 m (Fig. 5). Most of these remnants are located on hillsides and are surrounded by pasture land,

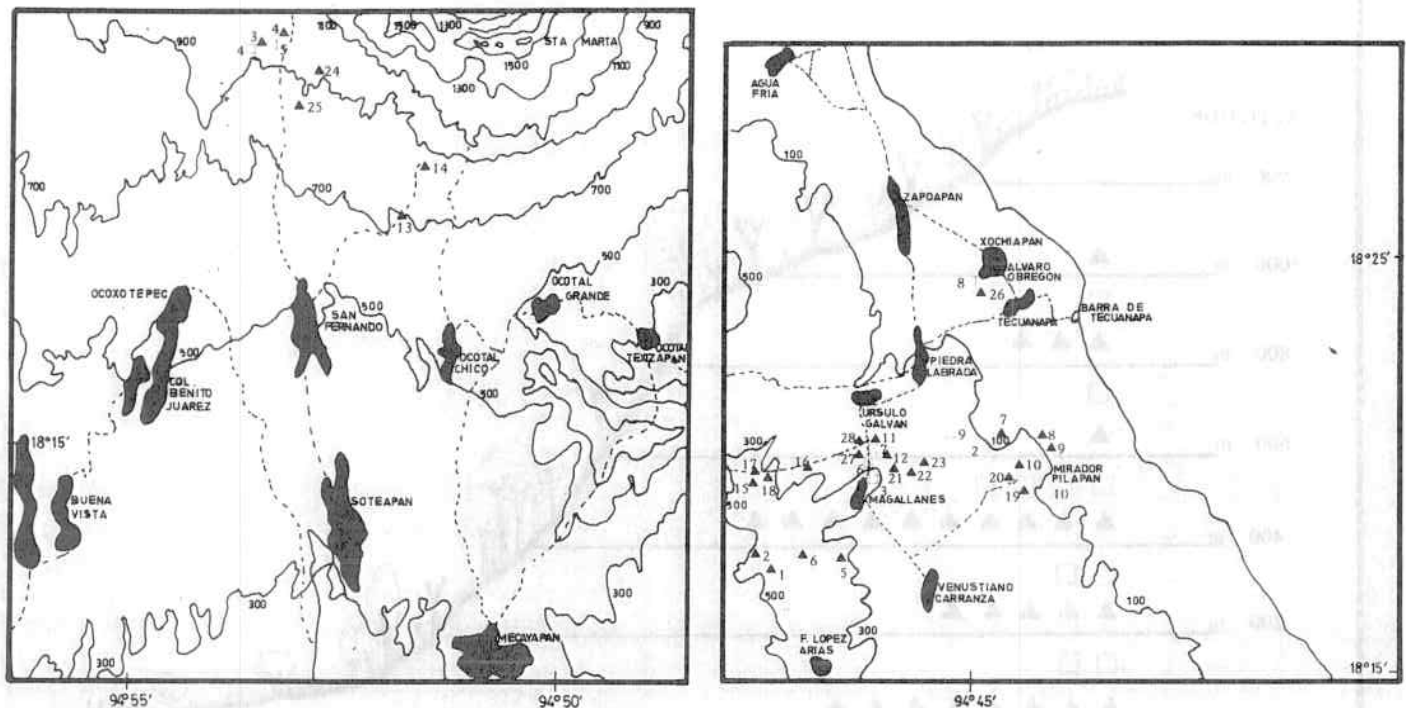


Fig. 5. Maps showing the relative location of the monkey groups studied at San Fernando (left) and Magallanes (right). The numbers indicate the order in which the groups (*Ateles* ▲, *Alouatta* □) were encountered (map provided by authors).

crops, and secondary growth 2-15 years old. Spider and howler monkeys appear to be found in forest fragments containing a remarkable diversity of plant and animal species, and in the vicinity of surface water sources (small streams and ponds) which remain in the 2-20 ha fragments.

Most encounters were recorded in forest patches. Spider monkeys were encountered primarily in the interior of these remnants, but some were encountered in other places. Three *Ateles* groups, for example, were feeding on the forest edge near areas of secondary growth. Groups 17 and 18 were recorded in a large secondary growth area: the first one was feeding and the second one was travelling. No contact between Groups 17 and 18 was recorded during our three-day observation. Group 24 was observed travelling in an abandoned coffee plantation near San Fernando. In May 1984, a fire consumed a considerable extent of secondary growth and pasture land. Group 16 was observed feeding near the burnt area. All *Alouatta* groups were encountered in the interior and edges of forest patches.

Ateles groups were far more extensively distributed than *Alouatta* groups in our study areas. Thirty-one groups from both species (81.58%) were located below 600 m, while 7 groups (18.42%) were located above 600 m (Fig. 6). In terms of study areas, however, Silva López (1987) found 6 groups of spiders (21.43%; $n=28$) and 2 of howlers (20%; $n=10$) in the San Fernando area, and 22 groups of spiders (78.57%; $n=28$) and 8 groups of howlers (80%; $n=10$) in the Magallanes area.

Spider monkeys were encountered most frequently (on 28 occasions) and accounted for 175 of the 216 individual primates observed during the survey. Howler monkeys were encountered 10 times during the study, with a total of 41 individuals counted.

For practical purposes, the term 'group' was chosen so as to include all the individuals which were encountered forming part of a relatively large monkey unit. Two encounters with solitary male howler monkeys were included in this category as well. We believe that some of our records of spider monkeys correspond to temporarily formed small subgroups of the species, but we were unable to confirm this.

Table 1. Composition of *Ateles* Groups (Silva López, 1987)

Group No.*	AM	AF	SA	J	I	Total
1	1	4		2	1	8
2	2	3		1		6
3	2	3		1	2	8
4	1	2		3	1	7
5	1	2				3
6	1	1	1		1	4
7	1	2	1	1		5
8	1	1		1		3
9	2	2		1	2	7
10	2	4		2	4	12
11	1	3				4
12	2	2		1		5
13						6
14						7
15	2	3		2		7
16	2	2	2		1	7
17	1			1		2
18	1	1		2	1	5
19	4	3		3		10
20						2
21						7
22						3
23						11
24	1	2		1		4
25		3		1		6
26	1	3		3		7
27						16
28	1	1		1		3
Total	30	47	4	27	13	121

*Listed in order observed.

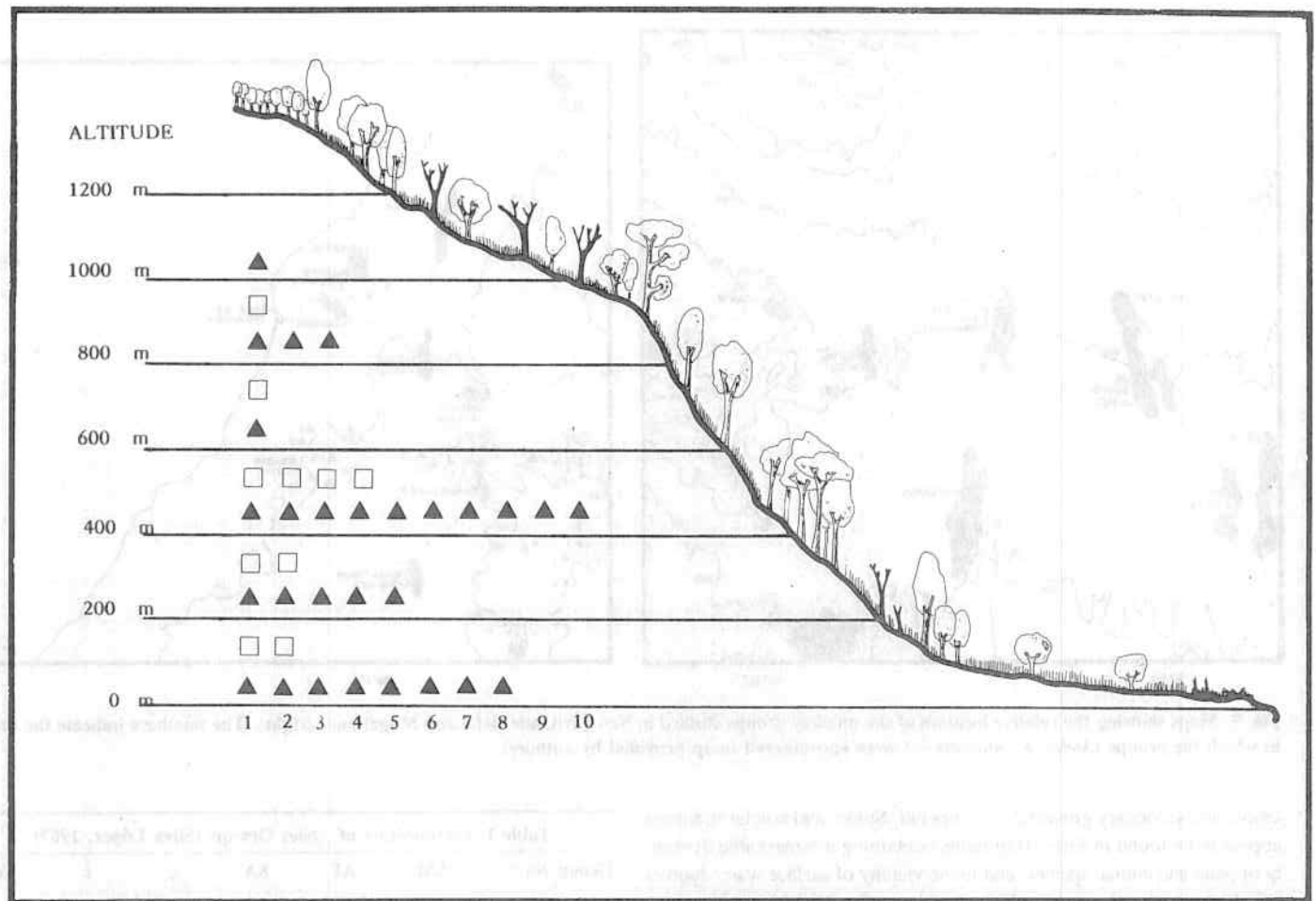


Fig. 6. Graph showing the altitudinal distribution of *Alouatta* (□) and *Ateles* (▲) groups encountered in the disturbed forest areas of the Sierra de Santa Marta (adapted from Silva López, 1987; provided by authors).

Table 2. Composition of *Alouatta* Groups (Silva López, 1987)

Group No.*	AM	AF	SA	J	I	Total
1	1	3				4
2	1	2			1	4
3	1	1	1		1	4
4	1	3				4
5	1					1
6	1	2		1	1	5
7			1			1
8	1	1			1	3
9	1	3		4	1	9
10	1	4		1		6
Total	9	19	2	6	5	41

*Listed in order observed.

Mean troop size ($n=28$) for *Ateles* was 6.25 (s.d.=3.18) while mean troop size ($n=10$) for *Alouatta* was 4.1 (s.d.=2.33; Tables 1-2). Only the age- and sex-classified groups of *Ateles* were used to determine mean troop composition, which was 1.42 AM, 2.33 AF, 0.19 SA, 1.28 J, and 0.619 I. Mean troop composition for *Alouatta* was 0.9 AM, 1.9 AF, 0.2 SA, 0.6 J, and 0.55 I. The mean adult sex ratio (AM:AF) for spiders was 1:1.56 and 1:1.21 for howlers (Silva López, 1987).

Table 3. Plants Eaten by Spider and Howler Monkeys in Santa Marta (Silva López, 1987)

Species	<i>Ateles</i>	<i>Alouatta</i>
<i>Spondias mombin</i>	F	F, FL, YL, ML
<i>Cymbopetalum penduliflorum</i>	—	F
<i>Ceiba pentandra</i>	—	YL
<i>Bursera simaruba</i>	FL, YL, S	FL, YL, ML
<i>Dialium guianense</i>	F	F
<i>Inga</i> spp.	—	FL, YL, ML
<i>Pithecellobium arboreum</i>	—	FL, YL
<i>Byrsonima crassifolia</i>	F	F
<i>Guarea glabra</i>	—	F
<i>Guarea</i> sp.	—	F
<i>Pimenta dioica</i>	F	—
<i>Brosimum alicastrum</i>	F, YL, S	F, YL, S
<i>Cecropia obtusifolia</i>	F	F, YL, ML
<i>Ficus insipida</i>	F	F, YL
<i>Ficus</i> sp. (1)	—	F, YL
<i>Ficus</i> sp. (2)	—	F, YL
<i>Ficus</i> sp. (3)	—	F, YL
<i>Ficus</i> sp. (4)	—	F, YL
<i>Pseudolmedia oxyphyllaria</i>	F	F
<i>Astrocaryum mexicanum</i>	—	F, BU
<i>Coccoloba</i> sp.	—	YL
<i>Manilkara zapota</i>	F	F, FL, YL, ML

Key: F=fruit; FL=flower; YL=young leaves; ML=mature leaves; BU=buds; S=seeds

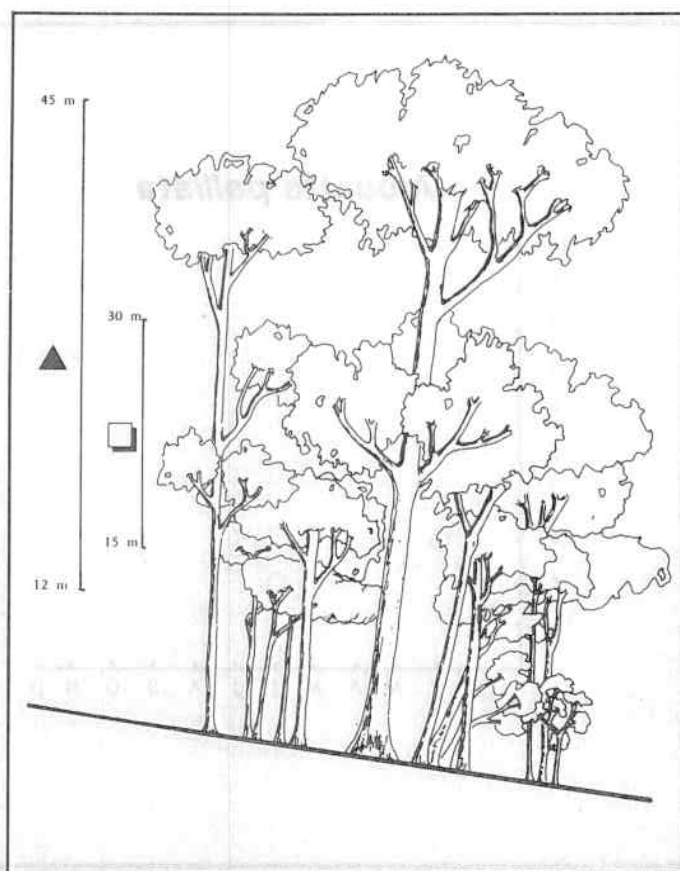


Fig. 7. Graph showing the range of monkeys' heights at first contact: *Ateles* (Δ) $\bar{X}=23.1$ m, ± 7.24 ; *Alouatta* (\square) $\bar{X}=22.5$ m, ± 6.7 (graph provided by authors).

An analysis of the height of the animal when first encountered revealed spider monkeys at the greater mean height ($x=23.10$ m, $s.d.=7.24$) with howler monkeys lower ($x=22.5$ m, $s.d.=6.7$). However, spider monkeys were found to use a wider range of heights, climbing, walking or brachiating through the middle and upper canopy of trees (Fig. 7).

A total of 20 tree species were recorded as elements of the monkeys' diets. Species from the families Leguminosae (like *Dialium guianense*, *Inga* spp., and *Pithecellobium arboreum*) and Moraceae (including *Brosimum alicastrum*, *Pseudolmedia oxyphyllaria*, 5 spp. of *Ficus*, and *Cecropia obtusifolia*) were the most frequently used by the monkeys, which were observed eating leaves, flowers, fruits, seeds, and buds in a discriminatory way. As in many other studies (e.g. Glander, 1975; Milton, 1980), *Alouatta* showed a predilection for both young and mature leaves, while *Ateles* preferred fruits (Table 3). The number of species consumed is low, but with more observations we expect that it will increase.

Activity records were based on first sightings only. Resting was by far the most frequently observed howler monkey activity. It was very common to observe howlers resting or sleeping on the lower (and thicker) branches of trees, about 15-20 m above the ground. In some cases, however, not all the members of a single group were seen resting at the same time. Sometimes juvenile howlers fed in the surrounding trees while adults rested or slept. In contrast, resting periods for *Ateles* were of short duration and were combined with other more active displays such as foraging or playing.

Travelling in howlers was an uncommon activity and was not always related to the search for food. Single-file, slow motion progressions were recorded as the basic pattern. *Ateles* groups, however, were extremely active both searching for food and for a place to sleep during daylight

hours. Several locomotor patterns already described (Mittermeier, 1978) were recorded for this species. Travelling was performed in apparent disorder through the middle and upper tree canopy, the only observed pattern being that both pregnant females and females with infants were always recorded at the end of the progression. Benítez Rodríguez has spent more than 600 h observing spiders in our study area. He has calculated that *Ateles* spends approximately 51.08% of its diurnal time feeding, 27.39% travelling, and 21.53% resting.

Playing was another activity recorded, although it was observed only once, when Group 9 rested in a large tree. On that occasion, two adult females and their offspring played for almost 30 minutes with a juvenile, the juvenile running on the larger branches of the trees while the females and infants tried to seize him.

Howler calls were regularly heard in the morning and afternoon. Local inhabitants associate their calls with changes in the climate.

The presence of both pregnant females and infants was recorded as well. Most infants from both species rode on their mothers' backs. Some infants of *Ateles* and *Alouatta*, however, were carried ventrally by their mothers. Both infants and pregnant females were seen most often in the months of May and June, near the beginning of the rainy season (Fig. 8). On 26 June 1983, we observed a newborn spider monkey being carried ventrally by a pregnant female while the group was travelling. Three other females with their infants were present, in addition to two adult males and two juveniles. It was not possible to observe this group for a longer period of time because of the steepness of the slope where the monkeys were rapidly travelling. In some cases, particularly while the mothers rested, we observed infant howlers exploring neighboring branches, always closely watched by their mother.

Our observations in small forest fragments of the Sierra indicate that *Ateles* and *Alouatta* populations are probably limited by food abundance. Our data also shows that some breeding continues in these fragments.

Status of Monkey Populations in the Lowlands

To assess the status of spider and howler monkey populations in the entire Santa Marta Range, it will be necessary to find out what is happening in the dells and valleys among the mountains. The information we have gathered so far may give us an idea of the problems that are faced by monkeys in this remarkable ecosystem.

Neither spider nor howler monkeys are considered agricultural pests by local people because coffee plants are only eaten by monkeys in December when the coffee fruits are ripe, and then only occasionally. Other crops (such as corn, red beans, chili, etc.) are rarely visited by monkeys, mainly because most of these fields are exposed and near human settlements. Monkeys do eat the fruit or leaves of some shade tree species such as *Brosimum alicastrum*, but primarily use these trees as travelling corridors.

The real agricultural pests are birds and some small mammals such as the *tejon* (*Nasua nasua*) which are immediately killed when encountered because they break the stalks of cultivated plants trying to reach the fruits.

Disease is a serious agricultural problem in the area, and although *campesinos* receive technical support from both the state government and from private coffee companies, this is often inadequate. Technicians do not receive good enough incentives to do their jobs well, and the *campesinos* continue practicing traditional, non-sustainable land-use methods.

Local hunters do not shoot monkeys. Two reasons account for this. The first is cultural: monkeys are considered funny and curious animals by local inhabitants, who like to watch them travelling or playing in the canopy. The morphological similarities between monkey and human bodies are a source of comments and jokes among the *popolucas*. The second is practical: most species are diurnal and are asleep in the canopy at night when most hunts take place. Hunters prefer tracking terrestrial

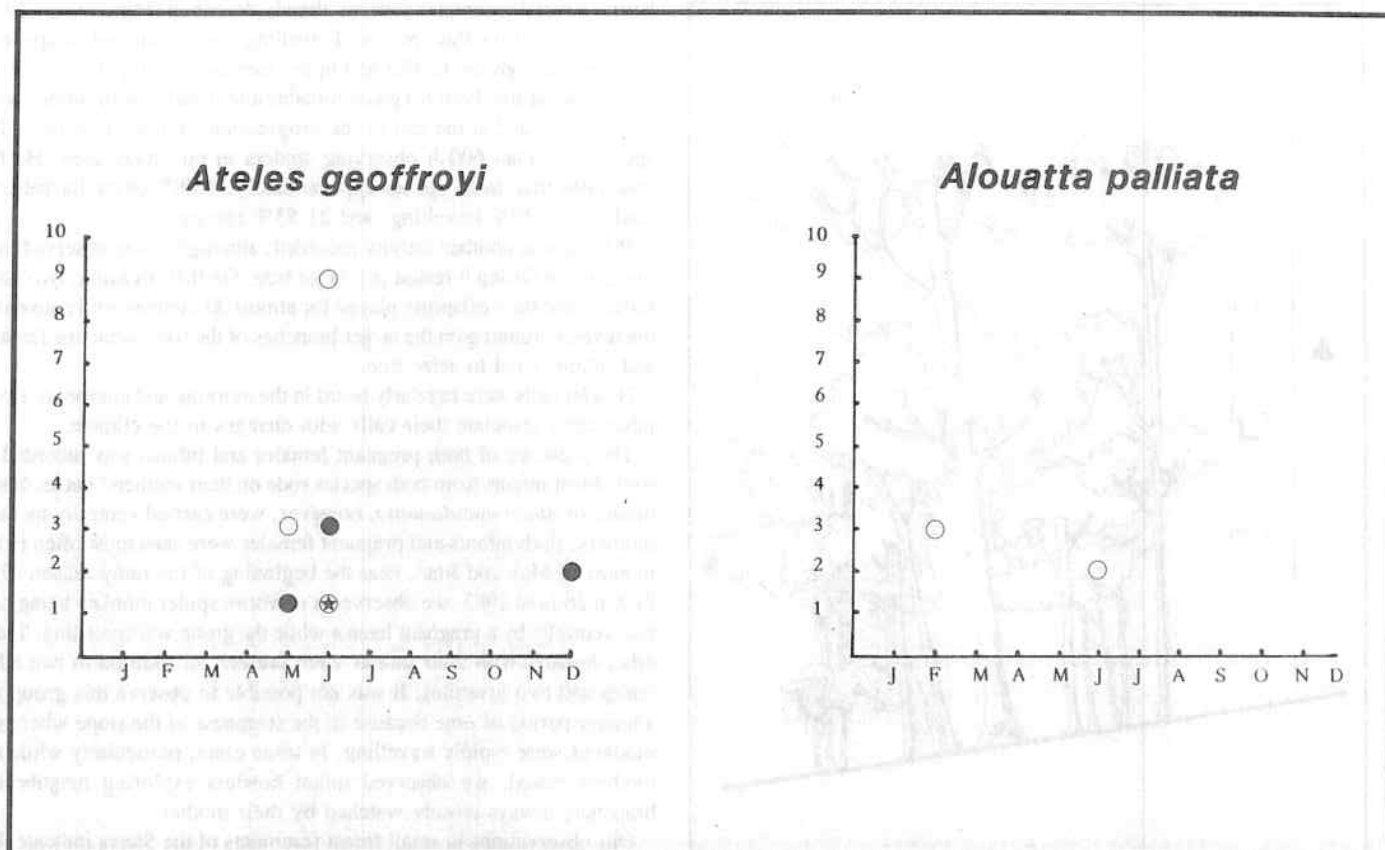


Fig. 8. Graphs showing months and numbers of contacts with pregnant females(●), females with infants(○) and pregnant females with infants(⊗) (graphs provided by authors).

and semi-terrestrial mammals because dogs can find them easily, and because ground animals' eyes clearly reflect the light from a lamp.

Immigrants to the *ejidos*, however, have different and more destructive hunting and fishing customs. Some immigrants kill monkeys to use their meat as bait for trapping *mayacastles*. Others capture the infants to sell as pets. The sale of wild animals is forbidden by law, but the standard of living is low in the area and selling animals brings in extra money. The normal procedure is to kill the mother and then capture the infant. Spider monkeys are sometimes killed for their fat, which is made into an ointment used to soothe certain neck pains. This is practiced in the *ejido* Lopez Mateos, in the north of the Sierra (J. Martinez Gándara, pers. comm.)

Habitat destruction, however, is by far the most serious threat to the monkeys (Silva López, 1987; Rodríguez Luna *et al.*, 1987). Every year, the government grants financial credits to local people to develop food-production and cattle-raising programs. As a result, the once continuous rainforest is rapidly being reduced to small stands, separated by large tracts of cleared land that eventually become unsuitable for the farming and pasture for which they were originally intended.

In any case, along with our census data, our results on geographical distribution, habitat use and breeding, as well as other preliminary behavioral observations, indicate the *Ateles geoffroyi vellerosus* is a flexible species which is more capable of adapting to man-made alterations of natural habitats than *Alouatta palliata*. We believe, however, that both species must be considered extremely vulnerable due to the growing amount of forest disturbance.

With the rapid ecological changes taking place in the Sierra, it may be advantageous to design plans that initially take into account the whole network of remnants (Fig. 9), instead of focusing our attention on individual remnants selected for being 'healthier' or 'less disturbed.'

Together with the cultural setting and the relatively small undisturbed highlands, dells, and valleys, the remnants are an integral part of Santa Marta. Once the relative value of each remnant is identified, it will be possible to fit it into the Sierra's framework, and from this develop objectives and priorities.

The changes occurring in Sierra de Santa Marta are only an example of what is happening in the forest areas still remaining in southern Mexico. Despite several difficulties, however, more and more areas are gain-



Fig. 9. The authors, G.S.L., F.G.O., and E.R.L., enjoying the tranquility of a forest remnant at the *ejido* of San Fernando. Secondary forest such as this was not observed to be exploited by *campesinos* during this study (photo provided by authors).

ing conservation status every year. Also, more students are being trained in conservation-oriented issues both in the country and abroad. Nevertheless, we believe that stronger measures, involving both the people inhabiting the affected regions and the governmental authorities, are needed to preserve our natural patrimony. The continued support from international institutions for the development of conservation programs will be very important.

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Notes on the Biology of *Cebus nigrivittatus* and *Alouatta seniculus* in Northern Venezuela

by Gerardo A. Cordero Rodríguez and Salvador Boher B.

Three species of cebid primates have been reported for northern Venezuela: the capuchin monkey (*Cebus nigrivittatus*), the red howler monkey (*Alouatta seniculus*), and the spider monkey (*Ateles belzebuth*). *Cebus* and *Alouatta* are probably the most widely distributed and common primates in Venezuela. These two species inhabit several habitat types including mainly highland and lowland moist forests, gallery forests, and dry forests (Handley, 1976; Rudran and Eisenberg, 1982). In open, undisturbed habitats, some aspects of the population dynamics, reproductive phenology, behavior, and feeding habits are known for the red howler monkey (Braza, 1980; Braza et al., 1981, 1983; Crockett and Eisenberg, 1987; Mack, 1979; Neville, 1972, 1976; Rudran, 1979) and capuchin monkey (Robinson, 1986; Robinson and Janson, 1987).



Fig. 1. Map of Miranda State indicating the distribution of *Cebus nigrivittatus* and *Alouatta seniculus* in Barlovento Region, northern Venezuela (map provided by authors).

However, the regional distribution and natural history of these primates in their major habitat, the humid forest, are unknown. In this report we present preliminary findings from a study of the age, body size, group size, and breeding activity of capuchin and red howler monkeys in a tropical humid forest in the Barlovento region of northern Venezuela.

Study Area

This study was carried out about 100 km east of Caracas ($9^{\circ}55'-10^{\circ}40'N$, $66^{\circ}25'-66^{\circ}35'W$), in the Barlovento region, which covers a 4,650 km² area (Fig. 1) divided into two major habitat types, the interior and the coastal. In the interior, the mean annual temperature varies between $25-28^{\circ}C$ and the total rainfall between 1,800-2,400 mm which falls mainly during the nine-month wet season, May-January. Along the coast, the mean temperature is $26^{\circ}C$ and the rainfall 898 mm. The main vegetation types in the interior are tropical humid forest, tropical very humid forest, and premontane very humid forest; while along the coast the forest type classifies as tropical dry forest (Ewel *et al.*, 1976).

Prieto and Tughes (1986) studied a sample area of one hectare of tropical humid forest at the Río Negro Experimental Agricultural Field Station (RNEAFS) of the Universidad Simón Rodríguez ($10^{\circ}20'N$ - $66^{\circ}15'W$) in Barlovento. The vertical distribution of individual plants for this forest is as follows: 0.5-0.8 m group — 68.5%; 0.81-2.5 m group — 21.9%; 2.51-12 m group — 6.14%; 12.01-26 m group — 1.84%; 26.01-36 m group — 1.47%; 36.01+ m group — 1%. The density of lianas is 426 ind/ha and of palm trees 78 ind/ha. The terrestrial vertebrate

fauna of Barlovento is composed of 5 amphibian families (18 spp.), 14 reptilian families (66 spp.), 36 non-passerine (152 spp.) and 17 passerine (160 spp.) avian families, and 29 mammalian families (120 spp.; Cordero, 1987).

Materials and Methods

The presence and distribution of the primates in Barlovento were surveyed from July 1981 to February 1988. We made one- to two-day visits to 30 different localities in the interior and 13 in the coastal habitats. We determined the presence of *C. nigrivittatus* and *A. seniculus* by visual and vocal observations, as well as by interviewing local people and reviewing the literature.

At RNEAFS, where G. Cordero has been monitoring marsupial and rodent populations since 1981, observations were made while walking along 510 m transects of a 26-ha trapping grid and 260 m transects of a 6.8-ha grid. Some monkeys were shot and collected in RNEAFS and the towns of Río Negro and Las Toro.

Twenty-two specimens of capuchin monkey were collected between March 1983 and August 1987 (20 skulls, 15 skins, and 13 stomachs) and 20 specimens of red howler monkey between October 1982 and February 1987 (18 skulls, 15 skins, and 15 stomachs). Most of the specimens (86% of the capuchin and 79% of the howler) were taken during the wet season. External body measurements, weight, and breeding condition were recorded for each specimen. Skins, skulls, and stomachs were preserved and deposited in the mammal collection of the

Table 1. Patterns of Tooth Eruption and Wear for *C. nigrivittatus* and *A. seniculus* in Barlovento, Miranda State

Age Class	Sex	<i>C. nigrivittatus</i>		<i>A. seniculus</i>		
		n	Eruption and Wear	Sex	n	Eruption and Wear
Infant	M	1	Complete deciduous dentition	F	1	Complete deciduous dentition.
Juvenile I	F	2	Mixed deciduous and permanent dentition. P ¹ half erupted and M ¹ begins eruption.	M	1	Mixed deciduous and permanent dentition. P ¹ fully erupted and M ¹ begins eruption.
Juvenile II				M	1	Mixed deciduous and permanent dentition. P ^{1,2} and M ¹ fully erupted and M ² half erupted.
Subadult	F	2	Complete permanent dentition. M ³ begins eruption or is half erupted. P ^{1,2} show a light abrasion on lingual side. P _{1,2} and M _{1,2} show a light abrasion on buccal side.	M	5	Complete permanent dentition. P ^{1,2} and M ^{1,2} with or without a light abrasion on lingual side. P _{1,2} and M _{1,2} with or without a light abrasion on buccal side.
Adult	M	7	P ^{1,2} and M ^{1,2} with or without a light abrasion on lingual side. P _{1,2} and M _{1,2} show a light abrasion on buccal side	M	4	P ^{1,2} show light, moderate or full wear on lingual side. M ^{1,2} with a light abrasion on lingual side. P _{1,2} light to moderate wear on buccal side and M _{1,2} with a light abrasion on buccal side
	F	2		F	1	
Old Adult	M	5	P ^{1,2} and M ^{1,2} light, moderate or full wear on lingual side. P _{1,2} and M _{1,2} completely worn on buccal side, and M ₃ show a light abrasion on lingual side.	M	1	P ^{1,2} and M ^{1,2} full wear on lingual side. P _{1,2} full wear on buccal side and M _{1,2} full wear on buccal side and on the middle of crowns.
	F	2		F	4	

Museo de Biología of the Universidad Central de Venezuela (MBUCV). We also examined a sample of 74 *C. nigrivittatus* and 36 *A. seniculus* in Venezuelan mammal collections. The measurements of individual monkeys collected in different sites were pooled in order to estimate the degree of sexual dimorphism in open and forested habitats.

Distribution and Habitat

Capuchin and howler monkeys are widespread in Barlovento (Fig. 1). These monkeys were observed at 26 of the 30 sites in the interior and 11 of the 13 sites near the coast. We found these species living sympatrically in tropical humid forest, tropical very humid forest, premontane humid forest, tropical dry forest, and cacao plantations, and along the periphery of corn and bean fields up to 700 m. The spider monkey is also sympatric with these two monkeys in several localities in the region (Mondolfi and Eisenberg, 1979).

Table 2. External Body Measurements for *C. nigrivittatus*

(Mean measurements are given in centimeters, s. d. enclosed in parentheses.)

Cranial Age Class	Sex	n	Total Length	Tail	Ear	Hind Foot	Weight (kg)
Sub-Adult	M	1	77.7	44.0	4.1	12.1	2.1
Young-Adult	M	9	81.5(3.8)	43.4(3.1)	4.2(0.3)	12.6(0.5)	3.1(0.4)
	F	2	75.0(1.4)	42.0(1.4)	4.2(0.3)	11.8(0.1)	1.8(0.1)
Old-Adult	M	5	82.3(2.7)	43.3(1.7)	4.3(0.3)	12.6(0.4)	3.4(0.4)
	F	1	75.2	42.5	4.0	10.4	2.0
All Adults	M	15	81.5(3.4)	43.4(2.6)	4.2(0.3)	12.5(0.5)	3.1(0.5)
	F	3	75.1(1.0)	42.2(1.0)	4.1(0.2)	11.8(0.4)	1.9(0.2)

Population Parameters

Specimens of capuchin and howler monkeys were grouped in five age classes according to the degree of ossification of cranial sutures and tooth eruption or wear in evidence (Table 1). The classification by degree of ossification of cranial sutures was as follows: suture between parietals unsealed and parietal-supraoccipital suture not fully sealed — infant; parietals suture partly sealed, parietals-supraoccipitals suture almost sealed, and palatine-maxilla suture not fully sealed — juvenile; presphenoid-basisphenoid suture partly sealed and exoccipital-mastoid suture sealed — sub-adult; exoccipital-supraoccipital suture sealed, presphenoid-basisphenoid suture almost sealed, basioccipital-

basisphenoid suture partly sealed, palatine-maxilla suture sealed, and premaxilla-maxilla suture sealed — young adult; basioccipital-basisphenoid and other sutures sealed — old adult.

Individual monkeys were aged as sub-adults when permanent dentition was fully erupted and light wear showed on molar teeth. On young adults, abrasion began to appear on the lingual side of upper molar teeth and on the buccal side of lower teeth. Two very old adult monkeys, a capuchin male and a howler female, had upper and lower molar teeth that were completely worn and showed abrasion throughout the M₁₋₃ crowns on the lingual and buccal sides. Tooth decay was observed in the middle of the crown of molar M¹ and on the whole surfaces of both upper canines of two young adult and old adult capuchin males and on molar M₃ for one old adult howler male.

Body Size and Sexual Dimorphism

Mean external body measurements were calculated for both sexes in each of the age classes established above (Tables 2-3). Male and female capuchin monkeys differ markedly in total length and body mass, but show no difference in the degree of their sexual dimorphism from one habitat to the other. Howler monkeys are less dimorphic in body mass by habitat. Table 4 presents the mensural data and the estimation of the degree of sexual dimorphism for *A. seniculus* in open and forested habitats. No statistical differences were found in total length by sex for each habitat type and in body mass of individuals of the pooled sample for tropical humid forest (t-test, $p > 0.05$).

Table 3. External Body Measurements for *A. seniculus*

(Mean measurements are given in centimeters, s. d. enclosed in parentheses.)

Cranial Age Class	Sex	n	Total Length	Tail	Ear	Hind Foot	Weight (kg)
Infant	H	1	56.1	32.1	2.7	9.5	0.7
Sub-Adult	M	4	114.2(2.9)	60.2(3.9)	3.9(0.4)	14.1(2.4)	5.5(0.3)
	M	4	115.6(3.6)	55.9(4.0)	4.1(0.4)	14.9(0.5)	6.3(0.3)
Young-Adult	F	1	—	—	—	—	5.5
	M	1	122.0	64.5	3.8	15.7	6.5
Old-Adult	F	3	114.9(2.8)	65.2(0.6)	3.9(0.1)	14.3(0.8)	5.7(0.1)
	M	9	115.8(3.8)	58.8(4.6)	3.9(0.4)	15.1(0.5)	6.0(0.5)
Adults All	F	4	114.9(2.8)	65.2(0.6)	3.9(0.1)	14.3(0.8)	5.7(0.1)

Group Size

We encountered troops of *C. nigrivittatus* (79% of all primate encounters) more frequently than troops of *A. seniculus* (21%). The presence of the latter was often detected from howls or scats. Howlers appeared more wary of humans than capuchins, which made it more difficult to make accurate group counts for this species.

Mean group size for 11 troops of capuchins was 8.0 (s.d. 5.7), with groups ranging from 2-20 individuals. A troop of 20 was observed around

a corn and bean field and a troop of 7 in a cacao plantation. We observed solitary animals, which have been described as rare by Robinson and Janson (1987), on three occasions. The group sizes for three howler troops were 3, 4, and 8 individuals.

Breeding Activity

At Barlovento, we observed female capuchin monkeys with infants in February, November and December. A free-ranging troop of capuchins

Table 4. External Body Measurements for Adult *A. seniculus* in Venezuela

Sex	Total Length (cm)			Female/ Male Ratio	Weight (kg)			Female/ Male Ratio	Habitat Type	Source
	Mean	s.d.	n		Mean	s.d.	n			
M	115.4	4.4	10	0.92	6.0	0.6	10	0.69	savanna woodland and deciduous forest	Thorington <i>et al.</i> , 1979
F	105.9	2.5	4		4.5	0.2	4			
M	115.6	6.8	27	0.95	6.0	0.4	27	0.70	savanna woodland and deciduous forest	Braza, 1980
F	109.3	5.3	22		4.2	0.4	22			
M	115.7	7.1	11	0.94	6.5	1.2	4	0.68	savanna woodland and deciduous forest	this study*
F	109.1	5.0	15		4.4	1.4	8			
M	115.8	3.8	9	0.99	6.0	0.5	7	0.95	moist forest	this study
F	114.9	2.8	3		5.7	0.1	4			
M	117.3	7.5	25	0.99	7.1	2.1	16	0.82	moist forest	this study*
F	115.7	6.3	14		5.8	1.1	8			

*A pooled sample of animals collected in several localities by Venezuelan Museums.

Table 5. Age Determination for *Cebus* spp. and *Alouatta seniculus*

Source	Species	Criterion	Age Class	Age
Gilmore, 1943	<i>C. apella</i>	Tooth counts and changes	Infant I	1-8 months with incomplete, deciduous dentition
			Infant II	6-18 months with complete, deciduous dentition
			Juvenile	14-40 months with mixed deciduous and permanent dentition
			Sub-Adult	36-42 months with incomplete, permanent dentition
			Adult	3-18 years with unworn, complete, permanent dentition
			Old-Adult	8-20 years with worn permanent dentition
Oppenheimer, 1968 (cited by Freese and Oppenheimer, 1981)	<i>C. capucinus</i>		Infant	1 year
			Juvenile	1-3 year
			Adult Female	4 year
			Sub-Adult	
			Female	4-7 year
Levy and Bodini, 1985	<i>C. nigrivittatus</i>	Behavior and development of the young	Adult Male	7 or 8 year
			Infant	1-9 months
This study	<i>C. nigrivittatus</i> and <i>A. seniculus</i>	Tooth counts and changes, ossification of cranial sutures	Infant	Age Grade I
			Juvenile	Age Grade II
			Subadult	Age Grade III
			Adult	Age Grade IV
			Old adult	Age Grade V
Mack, 1979	<i>A. seniculus</i>	Behavior and development of the young	Infant I	1-4 months
			Infant II	5-7 months
			Infant III	8-18 months
Braza, 1980	<i>A. seniculus</i>	Tooth counts and changes, ossification of cranial sutures	Infant and Juvenile	Age Grade I
			Sub-Adult	Age Grade II
			Adult	Age Grade III
			Old-Adult	Age Grade IV

(2 infants, 7 juveniles, 3 adult males, and 4 adult females) in Caricuao Zoological Park, near Caracas, was monitored by S.B.B. from February 1986 to April 1988. During the study period, births occurred in January and February 1986, February 1987, and January and April 1988. One female gave birth to infants on both 3 January 1986 and on 22 April 1988, a birth interval of 27 months and 20 days. Howler births may occur any month of the year, since we observed females with infants in January, February, June, and October.

Discussion

Sexual dimorphism in body size is a general feature of primates. Capuchin monkeys are sexually dimorphic in total length and body mass. Howler monkey males have a greater body mass than females. However, female tail length is greater than the male's as pointed out for *A. palliata* and *A. caraya* (Thorington *et al.*, 1979). We have compared the degree of sexual dimorphism for *A. seniculus* for open and forested habitats in several Venezuelan sites (Table 4). The female to male ratio for total length is nearly constant for both habitat types. However, the female to male ratio for body mass is similar within a habitat but different between habitats. The degrees of sexual dimorphism in weight of 0.95 and 0.82 obtained in this study are similar to the 0.84 value determined by Thorington *et al.* (1979) for *A. palliata*.

What is the adaptive advantage of this feature for howlers inhabiting humid forests? If howler monkey troop size and density are lower in humid forests than semideciduous forests, as pointed out by Crockett and Eisenberg (1987), the lesser degree of sexual dimorphism recorded for the former habitat type might provide an advantage in sexual competition or territorial defense. Relations between group size and composition, density, home range size, and sexual dimorphism will have to be better documented before we can answer this question.

The determination of age and sex of animal populations is important to the study of their demographic structure. We divided our sample of 20 capuchin skulls and 18 howler skulls, into five age classes by their cranial sutures and dentition, but we did not have animals of known ages with which to confirm our technique. We have compared the age groups proposed for *Cebus* spp. and *A. seniculus* (Table 5) with our results and assumed that chronological age should be similar in both species. We think that an infant is about 1 yr old and juvenile 1-3 yr old for *C. nigrivittatus*, based on observations of the behavior and development of infants in a captive colony at El Pinar Zoological Park in Caracas (Levy and Bodini, 1985) and on infant and juvenile behavior monitored by S.B.B. in a semi-captive capuchin troop from February 1986 to April 1988 at Caricuao Zoological Park near Caracas. A howler infant should be 1-18 months old, as pointed out by Mack (1979) and based on behavior and development. The chronological ages for juvenile and adult howlers will have to be estimated by comparing our sample with animals of known age.

The troop sizes recorded in this study for *C. nigrivittatus* and *A. seniculus* are usually smaller than group sizes reported for these monkeys in other Venezuelan savanna woodlands, which are mostly undisturbed and privately protected. For *C. nigrivittatus*, groups of 33 and 19 (Oppenheimer and Oppenheimer, 1973, cited by Freese and Oppenheimer, 1981), 20 (Robinson and Janson, 1987), and 12-20 individuals (Allen, 1911, cited by Freese and Oppenheimer, 1981) have been recorded. For *A. seniculus*, groups of 3-13 (Braza *et al.*, 1981), 4-14 (Crockett and Eisenberg, 1987; Neville, 1972), 4-17 (Rudran, 1979), and 7 individuals (Racenis, 1952) have been reported. In Fundo Pecuario Piñero, Cojedes State (8°58' N - 68°02' W), a cattle ranch where the land is also privately protected, troops of 35 capuchins (2 infants, 9 juveniles, and 24 adults), 10 capuchins (1 infant, 1 juvenile, and 8 adults), and five howlers (2 juveniles, 2 adult males, and 1 adult female) were sighted in January 1987 (O. Hernández, pers. comm.) in an undisturbed, open habitat.

We think both species breed throughout the year in our study area. In the llanos of Guarico State, most capuchin births occur from May through August (Robinson and Janson, 1987). In the Venezuelan llanos, the howler can also breed throughout the year. A birth peak in the late dry season was reported by Braza (1980) in northern Apure State, whereas in Guarico State, births appear to occur throughout the year (Neville, 1972), with fewer occurring from May-July than in the rest of the year (Crockett and Eisenberg, 1987).

Conservation in Barlovento

Barlovento is a priority conservation area for Venezuela because of its great variety of plant and animal species and its proximity to the Caracas metropolitan area. Several habitats are threatened in Barlovento due to the loss of land to agriculture, cattle breeding, and the timber and tourist industries. Cordero (1987) has pointed out that rapid changes in land use will soon result in the cutting of timber from large tracts of tropical humid forest and tropical dry forest. This habitat destruction will severely threaten primate populations in the region. However, there are three natural reserves that together make up 13.2% of the region's 465,000 ha: Guatopo National Park (92,640 ha), part of which lies in Barlovento, protects 42,910 ha of interior habitat; the Alfredo Jahn Natural Monument (58 ha) and Laguna de Tacarigua National Park (18,400 ha) together protect 18,458 ha of coastal habitat.

Although primates are not generally considered game animals in Venezuela, rural people in Barlovento hunt howlers to eat and capuchins to keep as pets. We do not know the numbers of hunters in the area or how frequently they hunt. Some subsistence hunters have begun to deal illegally in infant monkeys, selling them as pets in the nearest town or to people in transit from Caracas.

To preserve the primates in Barlovento, wildlife rangers need additional encouragement, education, and support. Wildlife conservation and environmental education programs, addressed both to urban and rural inhabitants, and especially to those people who live in or near localities that are being affected by changes in land use, must also be initiated.

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Primate Survey of Eastern Bolívar, Venezuela

by Warren G. Kinzey, Marilyn A. Norconk and Eduardo Alvarez-Cordero

Despite a recent summary of the distribution of primates in Venezuela (Bodini and Perez-Hernandez, 1987), the exact location of primates in the eastern part of the state of Bolívar (Fig. 1) is poorly known. In order to provide additional information from this area and to find a site for the study of pitheciine primates, we explored the region from 24 May-8 June 1988. By boat we covered 350 km investigating islands in Guri Lake (Embalse Guri), and by jeep we toured 2,000 km in nearby basins east of the Caroni River, from the Supamo River to the Río Grande. We report here on our observations in three areas: (1) on islands in the lake (#1 and #3) and the mainland east of the lake (#2), (2) three areas of the Río Supamo (#4-6), and (3) three areas of the Serranía de Imataca (#7-9) (refer to Fig. 2).

Guri Lake is the result of flooding behind the Raul Leoni hydroelectric power dam, near the town of Guri, on the Caroni River. (The Caroni/Paraguay river system, which drains the Guiana Highlands, is the largest river in Bolívar State.) Construction of the first stage of the dam was completed in 1968, when the lake reached its initial level of 215 m. In January 1978, construction began on the final stage of the dam, reaching the current maximum lake level of 270 m in November 1986. The dam, the 4,240 km² reservoir, and the land immediately surrounding the lake (part of the 95,000 km² of the Caroni River basin) are under the administration of EDELCA (Electrification of the Caroni River). Within the lake are a number of islands of varying sizes that were formerly hilltops on either side of the river.

We surveyed islands by boat and by foot, giving special attention to those previously inventoried by E.A.-C. that were known to have primates. We explored localities on land by following abandoned or recently-opened jeep trails to reach other parts of the forest. In these areas we walked along trails, both day and night, censusing primates. In addition, we questioned local people about primates in the area, including members of the National Guard, lumbermen, and farmers who were familiar with the local species. We encountered four species of monkeys: *araguato* (*Alouatta seniculus stramineus*), *mono capuchino* (*Cebus nigrivittatus*), *capuchino del Orinoco* (*Chiropotes satanas chiropotes*), *viuda negra* (*Pithecia pithecia*), and received reports of a fifth, *mono de noche* (*Aotus* sp.). We summarize our observations below.

Results of the Survey

Alouatta was common in all areas sampled and was the species best known by local inhabitants. In Guri Lake we found groups of *Alouatta seniculus* on practically every island that contained a patch of forest, even islands as small as one hectare or less. We observed both solitary individuals and groups as large as five adult animals. Average group size ($n=14$) observed on islands was 3.2 adult animals (range = 1-5, excluding carried infants). Four of the groups had from 1-4 infants. We assumed that from the boat we could see groups within 100 m of the edge of each island, and we observed one group of *Alouatta* from the boat about every nautical mile. On this basis, the density was computed to be about 5.4 groups/km² or about 17 animals/km². This is about the same density as reported by Mittermeier (1977) for Suriname.

In continuous forest on the mainland, *Alouatta* was more difficult to observe, but easily detected by its calls. In the area of the Río Supamo (areas 4-6, Fig. 2) we confirmed that they ate yellow flowers of the *arbol de Araguaey* (*Tabebuia* sp., Bignoniaceae), one of the most valued hardwoods of the region. Near El Palmar (area 9, Fig. 2), we located an isolated group in a small fragment of secondary forest used to shade

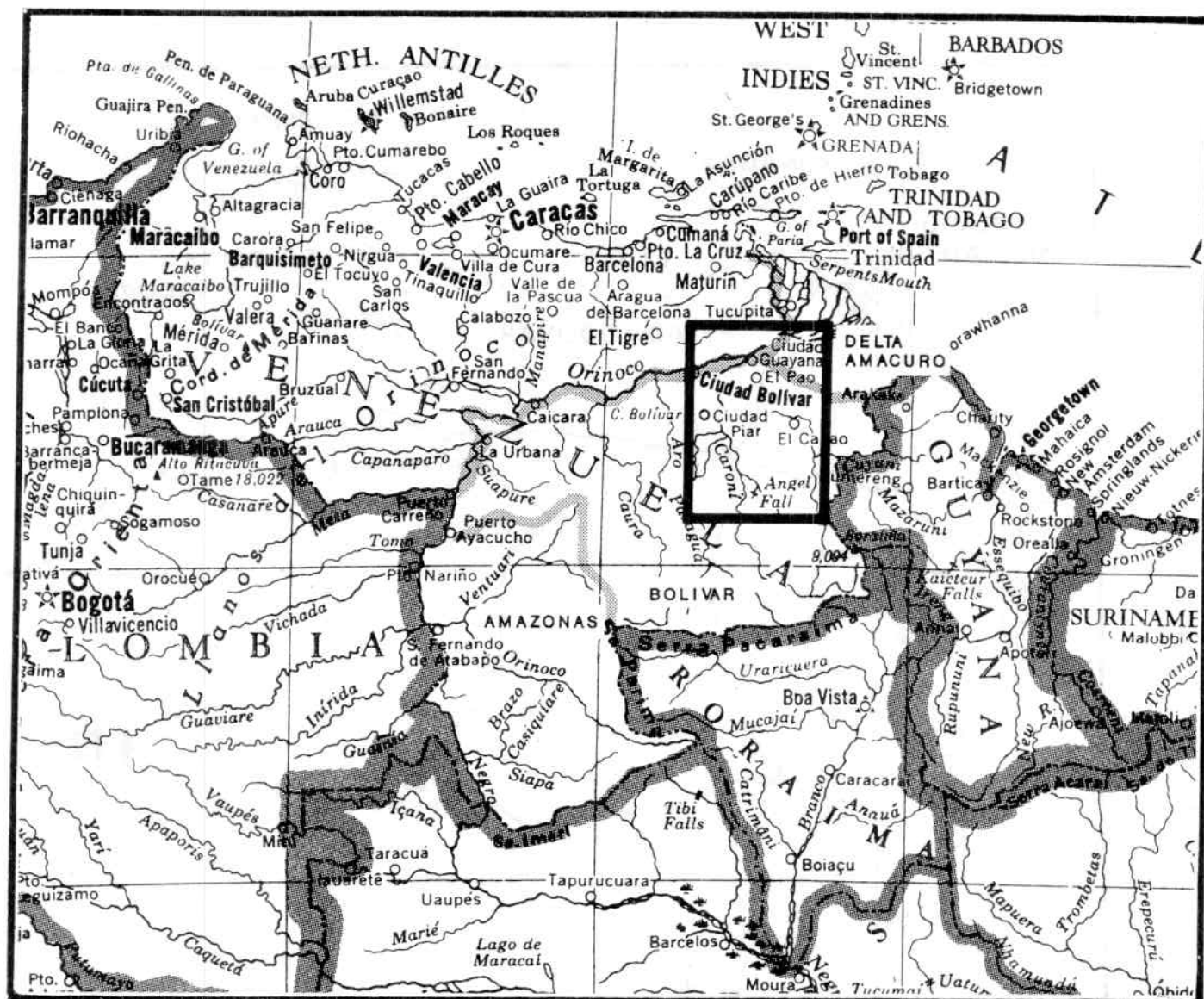


Fig. 1. Map of Venezuela showing the state of Bolívar, and federal territories of Delta Amacuro, and Amazonas. Area of map in Fig. 2 is boldly outlined (map provided by authors).

growing coffee plants. This site was encountered amidst pastureland, low scrub vegetation and farmhouses.

We encountered *Cebus nigrivittatus* less often than *Alouatta*, although we found it to be widely distributed in the region. *Cebus* is locally known as *mono maicero* for its habit of invading planted maize (corn). This behavior made it a persistent target for marksmen and therefore we found it to be very timid in the proximity of inhabited areas and farmland. We found it on islands in Guri Lake, on the east side of the Caroni River, and we saw a large group in the Serranía de Imataca (area 8, Fig. 2). *Cebus* was also seen previously in the forest of the Supamo (area 4, Fig. 2; E.A.-C., pers. obs., March and May, 1987), although we did not see it there during this survey. As described by Bodini and Perez-Hernandez (1987) the Caroni River serves as the boundary between *C. n. apiculatus* to the west, and the darker form of *C. n. olivaceus* to the east.

Our observations of *Chiropotes satanas chiropotes* on two islands that had originally been part of the mainland west of the Caroni River (area 1, Fig. 2) are among the first recorded for bearded saki in this region. One of these groups is now being intensively studied. We have not found any evidence of *Chiropotes* on the eastern side of the Caroni River.

We observed *Pithecia* in Guri Lake on two islands which had previously been part of the mainland east of the Caroni River (area 3, Fig. 2). They had also been observed there in 1983 and 1986 (E.A.-C., pers. obs.). We have three groups on these islands under intensive study. S. Gorzula (pers. comm.) previously collected a female *Pithecia* (currently in the EDELCA collection) from a group seen on the eastern edge of the lake south of El Manteco, but we did not observe *Pithecia* there during this survey (area 2, Fig. 2).

Our queries to local inhabitants of the Serranía de Imataca indicated that an abundant population of *Pithecia pithecia* still exists in fragments of forest a few kilometers north of El Palmar (area 9, Fig. 2). We observed several small groups in the area. One group of at least eight adults was seen moving and feeding together in the same tree. This observation corroborates those of other investigators (Buchanan *et al.*, 1981; Happel, 1982) who have suggested that large groups of *Pithecia* may form, consisting of several monogamous subgroups. After several days of walking through the forests of the Reserva Forestal de Imataca east of the Río Grande (Territorio Federal Delta Amacuro) we saw only a single group of three *Pithecia* (area 7, Fig. 2). On a recent trip to this area (July, 1989) E.A.-C. observed a large group of *Pithecia* (approx-

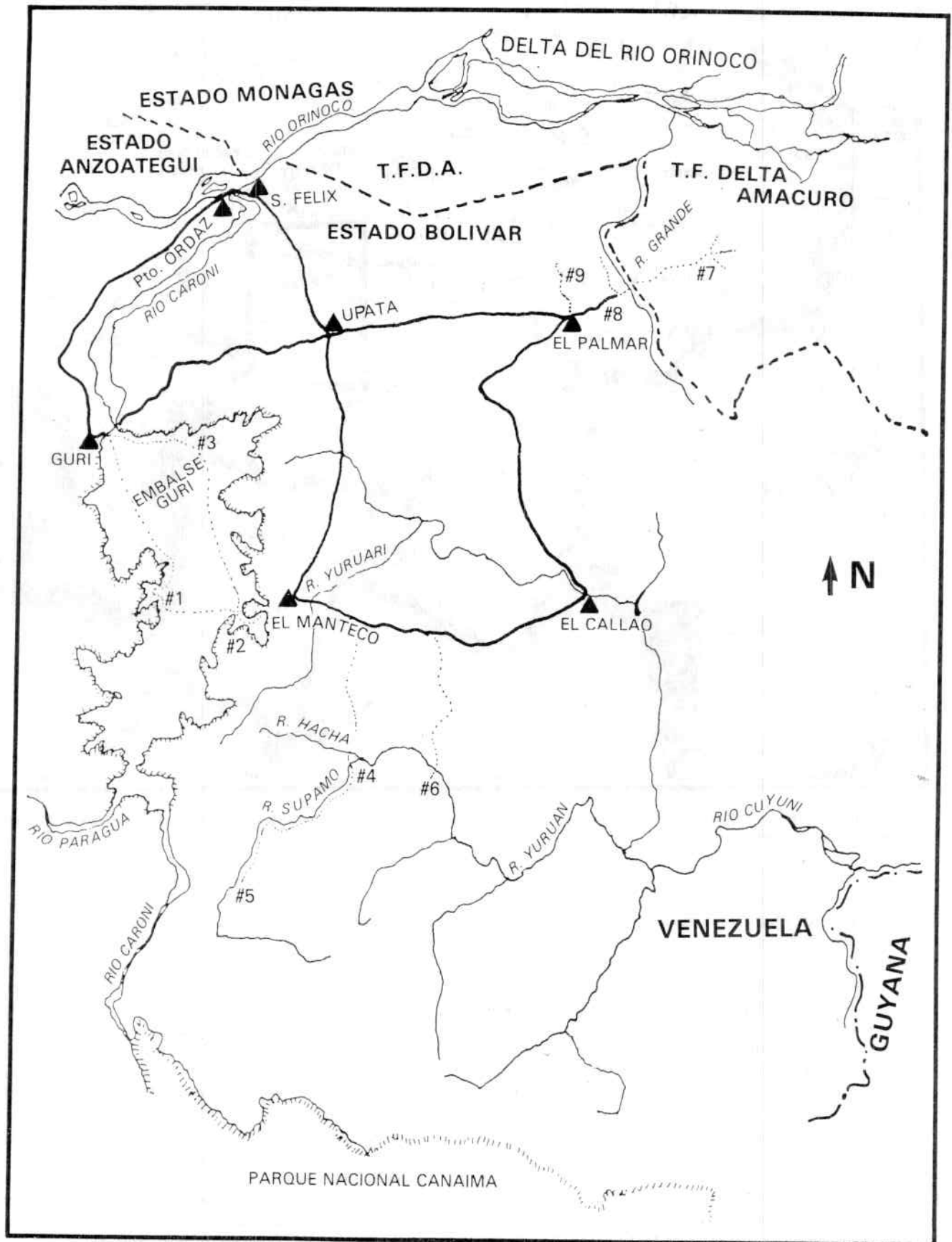


Fig. 2. Map of the area surveyed in Bolívar State and Delta Amacuro Territory, Venezuela. Key: Heavy lines indicate main roads travelled. Dotted lines indicated jeep trails and boat routes travelled. Nos. 1-9 refer to areas surveyed and described in the text. Cities and towns are shown as triangles (map provided by authors).

imately eight animals) in continuous forest that was recently logged.

We heard reports of (but did not observe) *Aotus* in the forest immediately east of the Río Grande (area 7, Fig. 2). A chain saw contractor reported cutting a hollow tree during the day about two months earlier and seeing *mono de noche* exit from the tree. Also, local hunters reported that they had seen *Aotus* in the area, and near the Supamo River (area 5, Fig. 2) as well. If confirmed, this would be the first report to document the distribution of *Aotus* east of the Caroni River in Venezuela.

We inquired about the presence of *Ateles* (*mono araña*) everywhere we went. A few people we interviewed described a monkey resembling *Ateles* in the area of El Miamo, north of El Callao. In the state of Bolívar, *Ateles* has only been seen in the Caura River basin (Wolfheim, 1983), and we know of only a single specific locality record — on the Río Nichare at the confluence of the Río Caura (6°33'N, 64°49'W) (S. Strahl, pers. comm.).

Discussion

The observations made during this survey suggest that we do not fully understand the geographic distribution and dispersion of cebid primates in the Guayana region. The term "Guayana" is used in Venezuela to refer to one of the original provinces of the country and currently includes the state of Bolívar, and the territories of Amazonas and Delta Amacuro (Fig. 1). The term should not be confused with that of the country, Guyana, on the eastern boundary of Venezuela.

We found the distributions of *Pithecia* to be as reported by Bodini and Perez-Hernandez (1987) and by Hershkovitz (1987). Contrary to the distribution maps in Hershkovitz (1979) and Wolfheim (1983), there was no evidence of *Pithecia* west of the Caroni River. This river appears to form the western boundary of its distribution in the state of Bolívar. We did not find them on islands in Guri Lake that had previously been hills on the western side of the Caroni River, nor are they reported west of the Caroni by Bodini and Perez-Hernandez (1987), nor by Hershkovitz (1987). In the territory of Amazonas to the south, however, *Pithecia pithecia* does occur as far west as the Río Cunucunuma at Belén (3°30'N, 65°55'W; Handley, 1976). In addition, *Pithecia pithecia* appears remarkably more adaptable than previously supposed. They occur in moist evergreen forest, dry deciduous forest, tropical moist and wet forest, and subtropical moist forest (Handley, 1976). Hershkovitz states (1987:391) that "sakis are unknown from gallery or scrub forest," yet we found them surviving nicely in small scrub forest fragments near El Palmar, as well as in tropical dry forest on islands in Guri Lake.

This survey, and that of Alvarez-Cordero (1987), are the first reports of the bearded saki on islands in Guri Lake, and support the recent observation of *Chiropotes* on the nearby western mainland (Alvarez *et al.*, 1986). A single specimen of *Chiropotes satanas chiropotes* (cat. #1341), collected by L. Balbas on 15 January 1984, is in the Museo de Ciencias Naturales, UNELLEZ, Guanare (Estado Portuguesa). It was collected 18 km northwest of San Pedro de las Bocas (7°02'N, 63°03'W) just west of the confluence of the Caroni and Paragua rivers. Previously *Chiropotes* had not been reported east of the Caura River (Hershkovitz, 1985; Bodini and Perez-Hernandez, 1987). *Chiropotes* has thus spread farther east and north in Venezuela than previously recognized. Presumably it spread southwest from Suriname, through northern Brazil, into the headwaters of the Río Caura, to the eastern side of the river, and has migrated north between the Caura and the Caroni rivers. Thus, the Guiana Highlands have allowed the dispersion of *Chiropotes* and have not acted as a filter barrier in the sense of Eisenberg and Redford (1979). To the best of our knowledge *Chiropotes* has not crossed to the right bank of the Caroni River, and is not found east of the Caroni until one reaches the right bank of the Essequibo River in Guyana.

Aotus may have also spread farther east than previously reported

(Hershkovitz, 1983; Bodini and Perez-Hernandez, 1987). *Aotus* has not previously been reported east of the Caroni River. Cabrera (1958), Hill (1960) and earlier authors suggested that *Aotus* occurred in the Guianas, but since no museum specimens have been reported, this was regarded as questionable by Thorington (1975). Also, Muckenhirn *et al.* (1975) did not find any evidence of *Aotus* in their survey of Guyana. If reports to us are reliable, *Aotus* crossed the Caroni in the region of its headwaters in southern Bolívar State and spread north along the right bank of the river. Additionally it crossed the Serranía de Imataca, since it was reported in forests immediately east of the Río Grande. These reports obviously require further verification.

Much more needs to be done regarding the conservation of these animals in the state of Bolívar. We have several suggestions:

- (1) These surveys should be repeated regularly, taking seasons into account, to continue monitoring the status of primates in the area. This is in keeping with priority 4.2.3 in the Venezuela Action Plan for Conservation (FUDENA, 1988).

- (2) Primates appear to be surviving on disjunct islands in Guri Lake and every effort should be made to conserve them. They present an immense potential for scientific study and future tourism, thereby justifying the efforts for their conservation. The area that surrounds Guri Lake, and especially the islands in the lake, must be protected and managed in order to maintain a viable population of animals, to prevent hunting or capture of the animals, and degradation of the habitat.

- (3) The extraordinary capacity to adapt and survive demonstrated by *Pithecia* and *Alouatta* in very small forest remnants close to human habitation means that — somewhat surprisingly for *Pithecia* — they can survive in relatively disturbed conditions. Their adaptability and our accessibility to these forest fragments provide an exciting opportunity to investigate how we might contribute to their future conservation. We suggest immediate concrete action to preserve the remaining forest fragments near El Palmar and to initiate studies of the primates on islands of various sizes and vegetational configuration in Guri Lake. Every effort should be made to protect these small forest tracts from further deterioration, and to protect the primates living in them.

- (4) The majority of forests in the areas sampled on the mainland are in various stages of large-scale deforestation. This is mainly due to logging and, as previously pointed out in the Venezuela Action Plan for Conservation (FUDENA, 1988), to expansion of agriculture and extensive cattle ranching in much of the tropical lowland forest south of the Orinoco River. The effects of different forms of forest management on primate populations should be investigated.

As a result of this survey, we have inaugurated a research project on the ecology of primates on islands in two areas of Guri Lake (Kinzey and Norconk, 1988). The larger of the two islands (the area of Danto Machado; #1 in Fig. 2) is about 365 ha in size and supports a group of *Chiropotes* (currently 10 adults plus two infants) plus two groups of *Alouatta* and at least one group of *Cebus*. Virtually the entire island is forested.

The smaller island (the area of Las Carolinas; #3 in Fig. 2) is about 70 ha, and has several small patches of tropical dry forest interrupted by savanna. It supports a group of *Pithecia* in each of two patches, a group of *Alouatta* in a third patch, and *Cebus* that move among patches. A second group of *Alouatta* was decimated by a predator in late 1988 (pers. ob.).

Current research on the islands (*Proyecto de Primatología Ecológica de la Guayana Venezolana*) centers on the following activities: (1) study of feeding behavior of *Chiropotes* and *Pithecia*, emphasizing mechanical and chemical properties of foods eaten; (2) vocalizations and communication in *Pithecia*; (3) comparison of locomotor behavior in *Pithecia* and *Chiropotes*; (4) social behavior of *Chiropotes*; and (5) social behavior

of *Pithecia*. The project is international in character, currently including participation of American, Venezuelan, and German students.

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The General Status of Monkeys in French Guiana

by Christian Roussillon

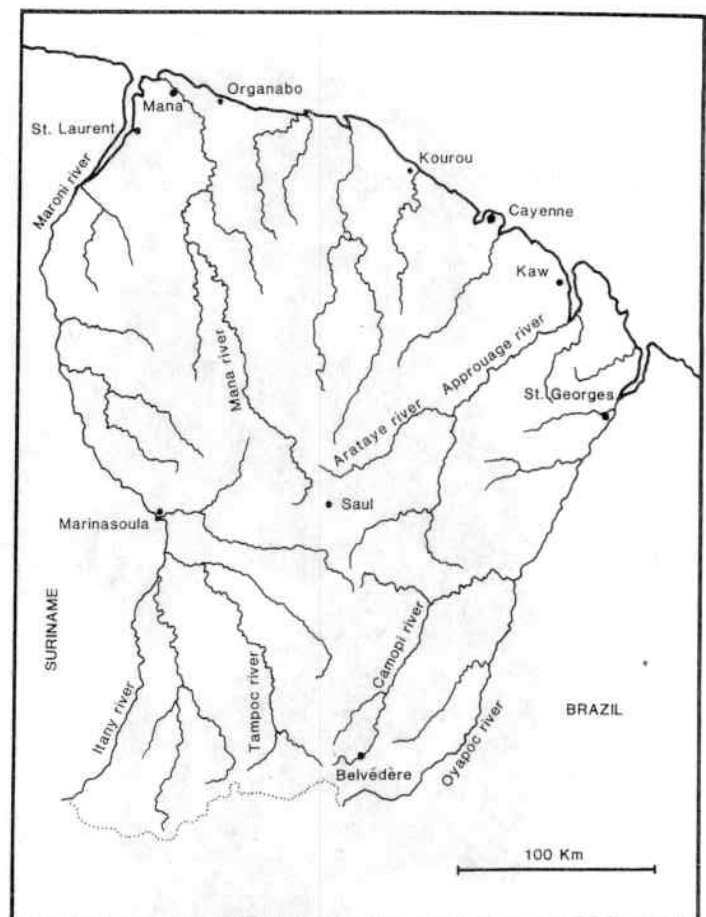
French Guiana, situated 7,000 km from metropolitan France, is the largest French department but the least developed in terms of agriculture and forestry (Fig. 1). The small human population (80,000) is concentrated along the coast, so the vast, inland forests (90,000 km²) have been left relatively undisturbed. Because of geographic distance and historical relations between the two continents, the local government is exceptionally independent of France. French regulations protecting wildlife are rarely enforced (see Mahouy and Milhaud, 1978, for regulations concerning primates). Hunting licenses are often not required in French Guiana, hunting seasons are not restricted, and the use of any weapon is permitted. The right to hunt year-round has come to be considered an inalienable 'ancestral right' of all Guianese people. Thanks to French subsidies, the standard of living in French Guiana is high compared to neighboring countries, so people have money to spend on guns and cartridges. Primates are particularly at risk, since they are both relatively easy to hunt and good to eat.

Hunting in French Guiana

The apparent wildness of some parts of French Guiana is misleading. Since the beginning of this century, people have penetrated deep into the forest, following even the smallest rivers, mapping and naming most of the country.



Fig. 1. Map showing principal towns and rivers in French Guiana. Localities mentioned in the text are also marked (map by S. Nash from original provided by author).



More recently, researchers and engineers have entered the forest to live there for months, often with the help of native people. Many army troops are sent each year to patrol the frontier rivers and maintain a French presence. These newcomers have countless opportunities to hunt birds and monkeys. It has become a lucrative custom to bring back smoked meat to sell in villages where game is now rare. Another new threat to wildlife is the increasing number of adventurers or so-called 'pioneers,' who come directly from Europe without any knowledge of or concern for the fauna and hunt in order to survive. The most spectacular example of this is a plan to develop survival raids in the remotest parts of the forest.

The interior forest has, so far, not been overly exploited, and, despite successive gold rushes, very few inland villages have more than one hundred inhabitants. Nevertheless, the people who do live in the forest — native Indians, gold-diggers, farmers, explorers, and adventurers — hunt to live. Others go to the forest to hunt for sport and profit. Game animals are sold in the markets of Cayenne, Kourou, and Saint Laurent du Maroni, and are offered as speciality dishes in many restaurants.

French Guiana allows professional hunting, but the loosely managed practice presents a serious threat to wildlife. Under a single shooting license issued to one hunter, dozens of people may be recruited to hunt deep in the forest. In 1986, eight professional shooting licenses were granted, but no regulatory control was exerted over the recipients. Hunters have an immense impact, especially on animals living within 4 km of the rivers, where hunting takes place both day and night, even though night hunting is officially forbidden.

Hunting pressure is great partly due to the high demand for game meat on the Guianese market. Potential profits attract experienced hunters; some Brazilians (who are generally believed to be good hunters) travel up rivers as far as possible to hunt illegally, carrying freezers in their canoes. Neither rapids nor great waterfalls like the Grand Canori, a 19 m waterfall on the Approuague River, seem able to stop them (Delacour and local police, pers. comm.).

French Guiana's frontier is extensive and there are too few customs officers to patrol it adequately. Gold was recently discovered on the Oyapock River, which separates Guiana from Brazil, and hundreds of barges of people have come to work in this area since 1985. A market has developed there for Indians to sell animals killed in Indian territory along the upper part of the river. The government's effort to protect the Indians and their hunting territories from tourism and encroachment, by banning unlicensed access, appears largely ineffective.

Until recently, moreover, customs officials were more concerned with drugs and other high-profile violations than with nature protection. Protected animals from Argentina and Brazil are openly displayed in several Cayenne shops. The most blatant example of this was the sale of eight hyacinth macaws (*Anodorhynchus hyacinthinus*) three years ago. In the past six years, we have seen many other animals brought to French Guiana from remote areas of Brazil, including the following: 9 *Lagothrix lagotricha*, 1 *Cebus apella xanthosternus*, 3 *Callicebus* spp., at least 60 *Callithrix jacchus*, 6 *Callithrix argentata*, 2 *Cebuella pygmaea*, and 8 *Leontopithecus chrysomelas* (Fig. 2), of which 6 have been confiscated. We heard reports of a pair of *Leontopithecus rosalia* being brought in, too, but could not confirm this. Many of these monkeys are young animals, whose mothers have been killed by hunters. Before the recent law forbidding such trade (Decree of 15 May 1986), most of these animals were sold in local pet shops or sent to Martinique and Guadeloupe.

In 1985, the French Ministry of the Environment stopped the illegal trafficking between French Guiana and La Reunion. This trade has certainly been going on for many years (as suspected by Kavannah and Bennett, 1984), and only recently stopped when dead animals (mainly parrots and squirrel monkeys) were discovered in a shipment. At the time French wildlife protection societies were very concerned about the illegal exportation of wild animals.



Fig. 2. A *Leontopithecus chrysomelas* for sale as a pet (photo by C. Roussilhon).

Unfortunately, in practice, many shops can still openly sell protected animals: stuffed specimens of *Alouatta seniculus*, *Saimiri sciureus* (Fig. 3), *Saguinus midas*, and *Pithecia pithecia* (Fig. 4), for example, are displayed side by side with caimans of different species. *Felis pardalis* and *Lutra enudris* were also seen in different souvenir shops and in the Cayenne market at the writing of this report in the end of 1987.

Hunting is a complex and serious problem in French Guiana. There is no effective policy for the country, and not enough people are employed to enforce even the essential points of the current regulations. The impact of SEPANGUY and IBIS, two wildlife protection societies, has been neither sufficient nor efficient. Society membership is low, and many of the current members are hunters who consider it sport to kill tamarins on weekends and macho to hunt bigger primates and large cats.

The Monkeys

To date there have been few studies of the monkeys of French Guiana, and most of the information concerning the eight species encountered there has been obtained from Suriname (Husson, 1978; Mittermeier, 1977; Mittermeier and van Roosmalen, 1981). Nevertheless, monkeys are well known by native Indians, who have depended on them as a food source for generations, and by the Guianese, who are fond of their meat. As a result of this culinary interest, monkeys are becoming scarce and threatened in all areas accessible by boat. This includes most parts of French Guiana, since numerous large rivers meander through the country. It is difficult to find more than five 40 km² zones not intersected

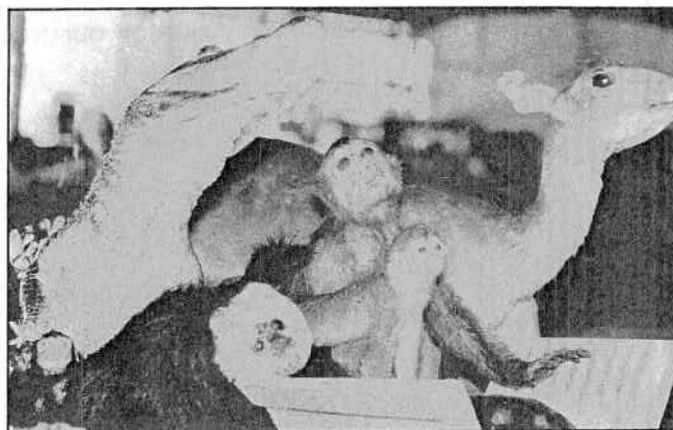


Fig. 3. A stuffed specimen of *Pithecia pithecia* for sale in a Cayenne tourist shop (photo by C. Roussilhon).

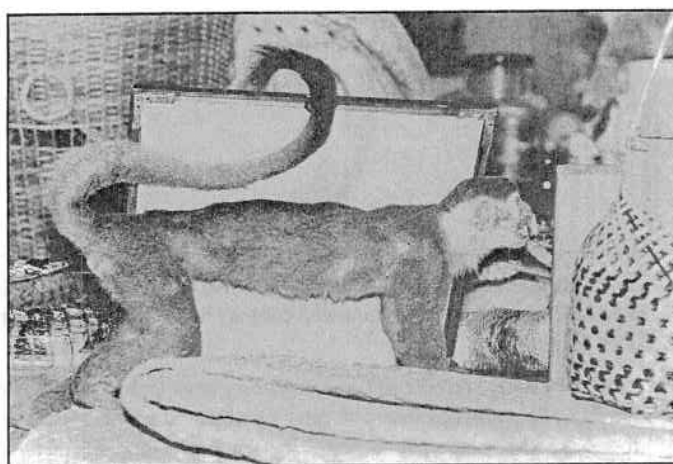


Fig. 4. A stuffed specimen of *Saimiri sciureus* for sale in a Cayenne tourist shop (photo by C. Roussilhon).

by a waterway. The largest uninhabited area is in the far south and is one of the last 100 km² areas of forested surface in the world unexploited by man (Thiollay, pers. comm.).

Eight different species of primates are known to occur in French Guiana (Husson, 1978): *Saguinus midas midas*, *Saimiri sciureus sciureus*, *Cebus apella apella*, *Cebus nigrivittatus*, *Pithecia pithecia pithecia*, *Chiropotes satanas chiropotes*, *Ateles paniscus paniscus* and *Alouatta seniculus*. These last two species are very susceptible to hunting and are likely to be the first to disappear, since many are still illegally offered for sale.

Local people call *Potos flavus* a 'night monkey,' leading French authorities to believe *Aotus* is present in French Guiana. Therefore, *Aotus* is included with *Ateles*, *Chiropotes* and *Pithecia* on the list of primates given complete protection as of May 1986. However, Husson (1978) describes the distribution of *Aotus* as not overlapping the Guianese plateau, and our personal observations lead us to believe the species is not present.

Chiropotes satanas chiropotes is known in the extreme south of Guiana, at least 260 km inland, but is probably not present on the coast because it inhabits forests with high canopies, which do not grow there. In the interior, Indian people eat this species and keep the young as pets. They live in large troops in the periodically flooded forest of the Koulé Koulé River at the head of the Maroni, near the Mitaradca Mountains (Thiollay, pers. comm.), around Belvedere Mountain on the upper part of the Camopi River (Dubost, pers. comm.) and on Saint Marcel Mountain, south of the village of Trois Sauts (Gasc, pers. comm.). However, they

have never been seen nor are they known by local people in Saul, for example (Mittermeier *et al.*, 1977).

Since *Chiropotes* is also known in the Nassau Mountains in Suriname but is not hunted on the Guianese side of the Maroni at the same latitude, we think that the Maroni River represents a natural barrier for *Chiropotes*. It is interesting to consider that the Maroni may present the same kind of barrier that the Essequibo River does between Guyana and Venezuela and that the Oyapock River does, at a lower latitude, between Brazil and French Guiana. Our opinion is that the rivers converging toward the south of French Guiana act as a real obstacle to *Chiropotes*'s northern movement.

There are believed to be two varieties of *Cebus apella* in French Guiana: the classical one and another locally called *macaque cornu* or 'horned capuchin' due to the shape of its head. Personal observations suggest that these are scarcer than the classical type, that they live in specific areas such as flooded zones, and that they are not found in the same troops (obs. of local hunters). The horned capuchin (which resembles in some aspects the tufted capuchin) is considered bigger and more interesting to hunt than the classical variety.

Saguinus midas, with its distinctive red arms, is the only species of tamarin known to occur in French Guiana. However, people living on the French side of the Oyapock River told us that they knew of an entirely black tamarin in the forest. Due to the intense commercial exchange with Brazil, it is possible that these animals, native to forests east of the Oyapock, escaped from a boat and bred there.

Hunting Pressure

While the Mana and Sinnamary rivers, which are sparsely populated and difficult to navigate, remained until recently relatively protected environments for primates, other Guianese rivers have long provided hunters easy access to their prey. Monkeys are heavily hunted along the Maroni, Approuague, and Oyapock, in particular. The Maroni River, in fact, has become the final natural frontier for people escaping the raids of the Suriname army; 8,000 such emigrants were officially recognised as refugees in early 1987. These people are unable to survive without hunting, and their numbers will soon be uncontrollable.

Another area where primates have been excessively hunted and are becoming scarce lies along the Comte River, where many people go for recreation on weekends and where families subsisting on timber sales live permanently. In fact, an increasing threat is the growing village of Cacao whose Asian inhabitants (Hmong refugees) are known to hunt deep in the forest. Game animals have largely disappeared from around the village. During the past six years, more than 300 tapirs have probably been killed (tapir embryos are considered aphrodisiacs due to the mobility of the animal's nose!). Fifteen years ago, howlers could be seen near the Comte; now such an occurrence would be improbable.

Most monkeys have almost disappeared from the environs of other villages, too. This is true for all large animals and is becoming increasingly true for small animals as well. As recently as 5-7 years ago, smaller species were ignored by everyone but coastal Indians, who have always considered them good food and regularly eat squirrel monkeys, for example. Now, other people also take advantage of the protein source they offer.

Exact estimates of hunting pressure are difficult to make, but *Cebus* probably accounts for 55% of all hunted primates, *Ateles* for 25% and *Alouatta* for 20%. We can reasonably estimate that about 200 monkeys are killed and retrieved every month in the coastal area alone. During the same period, 20 tapirs, 50 peccaries, and about 20 deer of all species may be killed. These figures are comparable to those reported in Husson (1978), but *Ateles* is more represented than *Alouatta*. This could be because most people relish *Ateles* meat more than *Alouatta* meat.

The above estimates were based on successive samples taken over several months at different local markets. From these, we cannot ac-

curately estimate the total number of animals hunted in Guiana each year. If our results are biased, they are largely underestimates of the real impact of man on the fauna. We only see the tip of the iceberg. No one can determine exactly the number of animals killed in the interior. The actual total is linked partly to the activities of various tourist (or 'adventure') expeditions deep in the forest, partly to poorly controlled professional hunting (Leduc, 1986), and partly to the number and variety of markets available.

Our current underestimation is largely due to the fact that French Guiana is not the only market. Many dead animals are regularly sold in Martinique and Guadeloupe, others may even go directly to France. International trade regulations do not apply between French Guiana and Martinique, for example, which provides an excellent market of 300,000 people very fond of meat. Commercial hunting is highly destructive (Mittermeier, 1987), and, being insufficiently regulated, allows a few people to profit tremendously at the expense of the fauna.

Changes in ancestral Indian customs are also sometimes having disastrous ecological results. Traditionally, Wayana Indians avoided eating male *Ateles*, and when they used blowpipes, hunters were cautious and conservative with their ammunition, waiting to kill only females. Now, however, they hunt with guns and kill as many monkeys as possible, even if they do not eat the unfortunate males.

Along the new road to Kaw, which is now suitable for all kinds of vehicles, both the *Ateles paniscus* and *Alouatta seniculus* populations have been severely diminished, the latter taken to meet the demand from restaurants. One hunter is known to have killed 64 *Alouatta* in 1985, in order to offer howler pie to guests; he did not see a single *Ateles* while he was hunting that year. The species is known to still be present but has been observed only once or twice during the past years. Considering the ratio of *Ateles*:*Alouatta* killed in other parts of French Guiana, it is evident that the number of *Ateles* in this particular part of Guiana has been drastically reduced.

Land and Forest Management

A further serious threat to the fauna is deliberate land development. Local authorities believe the forest is an obstacle to development, and they gain political popularity with such plans as damming the Sinnamary River and making roads into the interior. The road to Kaw is one such road, and it directly threatens one of the last swamps where the black caiman (*Melanosuchus niger*) can still be found (Condamin, 1976). Proposed and adopted plans have not taken into consideration the impact on the wildlife.

Unfortunately, despite constant efforts on the part of scientists and the submission of plans to the Ministry of the Environment, not even a single representative area in French Guiana is effectively protected. Only one reserve is officially recognized, the forest reserve of La Mirande. Proposals outlining the minimal areas and regulations necessary to maintain the present level of fauna were made by Condamin in 1975 and subsequently by de Granville in 1975 and 1986, but little action has been taken.

Present Situation and Hope for the Future

In the face of this alarming situation, some specific efforts are being made which suggest that the Guianese are beginning to develop a new understanding of and concern for their environment:

(1) Along the Arataye River, the French Museum of Natural History has established a protected scientific study area.

(2) The Iles du Salut, offshore from Kourou, are protected as the private property of the European Space Agency (ESA). In 1986, a group of squirrel monkeys and tamarins was introduced there, and they have now begun to breed. This 'Monkey Mountain' is becoming well known as a natural botanical park and people are visiting in greater numbers each year.

(3) The Ilet la Mère, offshore from Cayenne, was chosen six years ago by the Institut Pasteur as a site for the development of a free-ranging colony of squirrel monkeys as part of a scientific research program on a malaria vaccine. The present size of the colony is about 250-300 squirrel monkeys (Roussilhon and Friscour, 1986). This colony was founded in an effort to avoid further disruptions of wild populations of this species, although *Saimiri* does not seem to be endangered at present either in French Guiana or in most other parts of its natural range (Soini, 1982).

(4) In 1987, for the first time, the mayor of a coastal village asked for the protection of the wildlands surrounding his community. The success of a reserve in the village of Organabo could provide an inspiring example for other villages.

In addition, international pressure from newspaper campaigns and diplomatic sources has been effective. The French government has responded to it by adopting and promulgating new regulations for the protection of wildlife, increasing control over the restaurant business, and educating the local authorities about the need for wildlife conservation. These measures have received an encouraging response from Guiana and have led to the first attempts ever made to combine the efforts of people in the spheres of wildlife, forestry, customs, policy, and justice. One can expect that these efforts will be long-lasting and will have positive effects.

The hunting pressure in French Guiana seems to be largely in excess of what is even minimally acceptable. The wild primate populations are diminishing in the face of general apathy, since local hunters have so far been much more active than local conservationists. At present, a significant part of the natural heritage of French Guiana is seriously threatened.

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Environmental Determinants of Population Densities in *Ateles*

by Meg McFarland Symington

Current rates of deforestation, coupled with severe hunting pressure, will result in most Neotropical primate populations being confined to protected areas by the end of the century. The minimum area required to support a viable primate population will vary between species, depending on a species' particular ecological requirements. Similarly, the number of animals that can be supported by a given area will vary between sites, depending on a number of factors, all of which can be grouped under the general heading 'habitat quality'.

The factors determining habitat quality for most primate populations are poorly understood. Biotic factors (e.g. competition and predation) and abiotic factors (e.g. temperature, precipitation and elevation) may both play important roles in determining population densities in many species. Using data from my study of *Ateles paniscus chamek* in the Manu National Park of Peru, and from three other studies of *Ateles* in Colombia, Guatemala, and Suriname, I will here explore the relative importance of some of these factors in determining spider monkey population densities. This information is likely to be of use to primate conservation workers in the Neotropics for: a) planning parks and reserves, b) engineering translocation and/or reintroduction programs, and c) determining the potential carrying capacity of habitats where hunting has artificially depressed primate population densities.

Our need to know the determinants of habitat quality for *Ateles* is especially urgent. Although the genus is found throughout Central and South America, with representatives formerly ranging as far north as Tamaulipas, Mexico (23° N; Alvarez, 1963), and as far south as Brazil and Bolivia (16° S; Kellogg and Goldman, 1944), the current distribution of viable *Ateles* populations within that range is extremely patchy (Hernandez-Camacho and Cooper, 1976; Neville *et al.*, 1976; Mittermeier and Coimbra-Filho, 1977; Rylands and Mittermeier, 1982; Soini, 1982; Konstant *et al.*, 1985). In fact, three of the four species in the genus (*Ateles belzebuth*, *A. geoffroyi*, *A. paniscus*) are considered 'vulnerable' by the *Red Data Book* (IUCN, 1982), while the fourth species (*A. fusciceps*) is listed as 'indeterminate' at this time.

There are three reasons why spider monkeys are in more immediate danger than most other New World species. First, because of their large body size and tasty meat, spider monkeys are heavily hunted throughout their range. In a survey of 16 southern Amazonian sites, Freese *et al.* (1982) could confirm the presence of spider monkeys at only four sites, all of which were characterized as being under light to moderate hunting pressure. At nine other sites, where spider monkeys were reported or expected to occur but which were characterized as being under heavy hunting pressure, spider monkey densities were too low to be detected.

Second, because of their slow reproductive rate, spider monkey populations are unable to recover from declines caused by hunting or other habitat disturbances as quickly as species with faster reproductive rates. Among the *A. paniscus chamek* I studied in Peru, the average interbirth interval in the population was 34.5 months, ± 5.8 months, mean \pm s.d.

$n=17$ (Symington, in press, a). This is one of the longest interbirth intervals ever reported for a non-ape primate species, yet it is consistent with previous estimates from other populations. The average length of seven interbirth intervals in a reintroduced population of *A. geoffroyi* on Barro Colorado Island, Panama, was 31.9 ± 3.0 months (Milton, 1981), and an average interbirth interval of four years (range 46–50 months) was reported for *A. paniscus paniscus* in Suriname (van Roosmalen, 1980). By comparison, in two species of howler monkeys sympatric with spider monkeys throughout much of their range and of similar body size, interbirth intervals are considerably shorter (*Alouatta palliata*: 22.5 months, Glander, 1980; *A. seniculus*: 17 months, Crockett and Rudran, 1987).

Third, even excluding the substantial impact of hunting, there is now evidence that body size and diet alone may make spider monkeys especially vulnerable to the effects of habitat disturbance. In a recent review examining the responses of a wide variety of primate species to moderate habitat disturbance, primarily the result of selective logging practices or agricultural encroachment (data from sites known to be under heavy hunting pressure were excluded from the analysis), both body size and degree of frugivory were found to be negatively correlated with a species' ability to survive (Johns and Skorupa, 1987). As one of the largest and most frugivorous of the New World monkeys, spider monkeys are thus especially at risk.

The fact that spider monkey populations are so vulnerable to the effects of hunting and habitat disturbance makes it particularly difficult to specify the environmental parameters affecting population density in this species. The gross effects of human intervention can easily overshadow more subtle environmental influences. Fortunately, over the past 20 years, four fairly extensive studies of *Ateles* have been conducted that permit consideration of environmental effects exclusive of human influence. Of course, any conclusions drawn based on data collected at only four sites must be considered preliminary.

All four studies involved spider monkey populations living in national parks or nature reserves reported to be free of human hunting and other habitat disturbances for lengthy periods of time prior to the onset of the study, as well as during the study itself (Fig. 1). Therefore, I will assume that any variation observed in the density of *Ateles* at these four sites

reflects underlying variation in environmental carrying capacities. This assumption might not be justified, however, if different census techniques were used to estimate population densities at the four sites. In that case, any variation observed could reflect the different census techniques rather than different carrying capacities. Fortunately, in three of the studies, individual recognition permitted population densities to be estimated using the accurate home-range mapping technique. The fourth study, by Cant in Guatemala, did not involve individual recognition, and population density was assessed using a transect census technique (Cant, 1977; 1978).

Although it might be argued that Cant's estimate of *Ateles* density is therefore not directly comparable to the figures obtained through home-range mapping at the other study sites, the estimates arrived at by these two techniques are positively correlated (Eisenberg, 1979). There may be a slight tendency for *Ateles* density to be underestimated in transect censuses of heavily forested areas (Eisenberg, 1979), but when both transect censuses and home-range mapping were used to estimate *Ateles* density at my study site in Peru, the results obtained in the transect censuses were equal to and even slightly higher than those obtained by home-range mapping (transect census: 25 ind/km², Terborgh, 1983; 31/km², White, 1986; home-range mapping: 25/km², Symington, 1987a).

The population density of spider monkeys (*Ateles paniscus chamek*) in the vicinity of the Cocha Cashu Biological Station in Manu Park is 25–31 ind/km² (Terborgh, 1983; White, 1986; Symington, 1987a). These figures are considerably higher than Klein's (1972) estimate of *Ateles belzebuth* density in La Macarena, Colombia (12–15/km²) and van Roosmalen's (1980) estimate of *Ateles paniscus paniscus* density at Raleighvallen-Voltzberg in Suriname (8.2/km²). It is comparable, however, to Cant's (1977) figure of 28 ind/km² for *Ateles geoffroyi* at Tikal, Guatemala, especially when Cant's inclusion of dependent infants (i.e., infants still being carried by their mothers) is taken into consideration. If Cant's estimate is adjusted to reflect only the density of independently locomoting individuals (using his own estimate of the percentage of dependent infants in the Tikal population), it drops to 24.5 ind/km². Since, as indicated above, the effects of hunting and habitat disturbance were negligible at all four sites, these results indicate that significant differences exist in the environmental carrying capacity for *Ateles* at these four locations.

Three major effects could mediate these differences in carrying capacity:

(1) **Behavioral Effects:** These would include intersite variation in the size of social groups and in the amount of overlap between adjacent groups. Differences such as these may be ultimately linked to the distribution and abundance of food, but more proximate causes, such as increased or decreased tolerance between individuals in different social groups, also need to be considered.

(2) **Community Effects.** These would include the presence or absence of other frugivores or seed predators at the study site, in particular, species having a high degree of resource overlap with *Ateles*. The presence or absence of predators, such as jaguars (*Panthera onca*) and harpy eagles (*Harpia harpyja*), which are known to prey on spider monkeys (Terborgh, 1983; Emmons, 1987), would also be included in this category.

(3) **Floristic Effects.** Since ripe fruit is the most important component of the spider monkey diet, these would primarily concern the total amount of fruit available over the course of an annual cycle, as well as any seasonal or interannual variation in fruit abundance. Floral diversity or productivity *per se* may not be related to higher *Ateles* population densities as much as the density and dispersion of several 'keystone' species or genera (Terborgh, 1986). Differences between sites in the relative toxicity of available plant species may also affect carrying capacity (Eisenberg, 1979). Variation in floristic factors like these may subsequently be traced back a step further to variation in rainfall or soil quality.



Fig. 1. Location of the four spider monkey studies discussed in the text (map by S.D. Nash based on author's original).

Data from the four studies regarding these factors and others are compiled in Tables 1, 2, and 3, roughly organized to correspond to the three major areas mentioned above. Even in the few cases where the relevant data are missing from all four studies, certain trends are clear:

Behavioral Effects

In all four studies, individuals were observed to forage for fruit in subgroups or parties of variable size and composition. In the three studies involving individual recognition (Colombia, Peru, Suriname), the membership of these parties was drawn from a larger closed social network (Klein, 1972) or group (van Roosmalen, 1980), and rarely, if ever, were all members of a group seen together. Spatial overlap between groups seems to be quite variable, ranging from zero in Suriname to 20-30% in Colombia, but does not seem to be linked to population density. Instead, overlap between groups may be more dependent on the presence or absence of geographic or habitat barriers that act as convenient territorial dividing lines. For example, at my study site in Peru, rivers, lakes and swamps all demarcated home ranges, and in Suriname, granite outcroppings and other areas of unsuitable habitat served a similar function (van Roosmalen, 1980). It is possible that where barriers like these are absent, overlap between groups is greater.

Population sex ratio at all four sites was found to be female-biased, and, in the three studies involving individual recognition, the ratio of adult females to adult males fell within a fairly narrow range (2.67-3.10). For the Peruvian population, there is evidence that this female-biased sex ratio may be present from birth (Symington, 1987b). Since individual males were not recognized in the Tikal population, and male ranging patterns appear to differ considerably from those of females (see below), it is difficult to say if the larger proportion of adult males recorded at Tikal reflects a real difference in the demography of the spider monkey population at this site or is merely an artifact of the different census technique.

Despite the more than threefold variation in population density, average party size differs by only 15% at the four sites, and shows no systematic relationship with population density. This is not what would be expected

Table 1. Social and Behavioral Characteristics of *Ateles* at Four Sites¹

	Suriname	Colombia	Guatemala	Peru
Group Size	18 (n = 1)	22.0 (n=2)	30 ⁽²⁾	34.5 (n=2)
# Adult Males	3	4.0	no data	5.0
# Adult Females	8	11.5	no data	15.5
F/M Ratio	2.67	2.88	1.76	3.10
Group Overlap	0%	20-30%	no data	5-10%
Size of Home Range	2.20 km ²	3.25 km ² ⁽³⁾	no data	1.92 km ²
Size of Female Core Area ⁴	1.00 km ²	no data	no data	0.49 km ²
Average Party Size	3.65	3.50	3.78	4.05

¹ In this and the following tables data are from: van Roosmalen (1980), Klein (1972), Cant (1977), and Symington (1987a), unless otherwise noted.

² Cant did not recognize individuals in his study, therefore the maximum party size he observed is used here as a minimum estimate of social group size.

³ Midpoint of range given (1-1.5 sq. miles).

⁴ van Roosmalen (1980) defined 'core area' as the area which completely contained a female's range during the period of food scarcity. Symington (1987a; in press, a) defined core area as the minimum number of one-hectare grid squares necessary to contain 80% of a female's ranging behavior over the course of a year.

Table 2. Community Characteristics of Four *Ateles* Study Sites

	Suriname	Colombia	Guatemala	Peru
<i>Ateles</i> Population Density ¹	8.2/km ²	13.5/km ²	24.5/km ²	28/km ²
<i>Ateles</i> Biomass ²	0.57 kg/ha	0.95 kg/ha	1.7 kg/ha	2.0 kg/ha
Total Primate Biomass ³	251 kg/km ²	262 kg/km ²	205 kg/km ²	647 kg/km ²
% <i>Ateles</i>	23	36	83	31
# spp Primates ³	8	4	2	10
Size of Park/Reserve	560 km ²	11,000 km ²	576 km ²	15,320 km ²
Natural Predators Present?	yes	yes	jaguar rare	yes

¹ Population densities shown are the midpoints of the ranges given in the text.

² Although *Ateles* weight may differ slightly between species, a mean weight of 7 kg is used here for all four populations.

³ Data from: Mittermeier and van Roosmalen (1981); Klein and Klein (1976); Cant (1977), and Terborgh (1983).

if party formation were the result of random processes; it supports the hypothesis that party size and composition are a result of deterministic processes involving, among other things, the size and density of fruit patches available in the environment (Klein, 1972; Symington, in press, b). This finding also draws into question the validity of conclusions made about population composition and group structure in *Ateles* based only on observations of party size and composition (cf. Durham, 1971).

In two studies, females were found to concentrate their ranging in individual 'core areas' dispersed throughout the group range (van Roosmalen, 1980; Symington, in press, a). These core areas were twice as large in Suriname (100 ha) as in Peru (49 ha). The definition of what constituted a core area differed between the two studies (see Table 1) and, therefore, the reported sizes cannot be quantitatively compared. Yet it is clear that male and female ranging patterns in *Ateles* can differ substantially. This could have important implications for the inferences drawn from transect censuses concerning population composition.

Community Effects

One thing immediately apparent from Table 2, is that the high density of *Ateles* at Cocha Cashu is not a compensatory response to a low density of other, possibly competing, primates. In fact, the opposite is the case, with Cocha Cashu having a primate biomass approximately twice as large as the other three sites, as well as the largest number of primate species.

On the other hand, the much less diverse primate community in Guatemala could be at least partially responsible for the high density of spider monkeys found at Tikal. Only *Alouatta* and *Ateles* occur as far north as Guatemala, and, although howler monkeys usually occur at densities equal to or greater than those of spider monkeys, at Tikal, the situation is reversed, with spider monkeys accounting for over 80% of the total primate biomass. High densities of sympatric frugivorous primates are negatively correlated with howler monkey densities throughout the Neotropics (Eisenberg, 1979), but whether or not direct competition between *Ateles* and *Alouatta* is responsible for the unusual densities at Tikal is unknown. Direct observations of the two species at Tikal indicate that agonistic interactions are common, but that howlers are as likely to win these interactions as are spider monkeys (Coelho et al., 1976).

Howler monkeys are not the only potential competitors of *Ateles*. *Chiropotes satanas* and *Pithecia pithecia*, both members of the Suriname primate community, eat substantial quantities of immature seeds (Mittermeier and van Roosmalen, 1981). Since *Chiropotes* and *Ateles* reach approximately the same biomass at Raleighvallen-Voltzberg (Mittermeier *et al.*, 1977), the amount of ripe fruit available to *Ateles* at that site could theoretically be reduced by half if *Chiropotes* were consuming the immature seeds of the same species of fruits eaten by *Ateles* when ripe. However, recently published data on the diet of *Chiropotes* indicate that the taxonomic overlap in the diet of the two species is only low to moderate (van Roosmalen *et al.*, 1988). Indirect competition with seed predators may also occur at Cocha Cashu where, although there are no primate seed predators, macaws (*Ara* spp.) and parrots (*Amazona* spp.) are abundant and their dietary overlap with *Ateles* is considerable (pers. obs.).

Finally, neither the size of the park or reserve nor differential predation intensity appears to account for the variation in *Ateles* density at the four sites. Manu (ca. 15,000 km²) and Tikal (ca. 500 km²) contain almost equally high spider monkey densities, while La Macarena (ca. 11,000 km²) and Raleighvallen-Voltzberg (ca. 500 km²) contain almost equally low densities. Although actual predation rates were not reported in any of the studies, a number of confirmed and suspected spider monkey predators, including jaguar and harpy eagle, were reported to be present at all four sites. Cant (1977) does report that jaguars were thought to be rare at Tikal, and it is possible that hunting of jaguars outside of the park boundaries had a negative effect on the population density of jaguars at his site. If natural communities are to be maintained, it is unclear whether isolated parks the size of Tikal or Raleighvallen-Voltzberg will be large enough to contain viable populations of top predators such as jaguar and harpy eagle.

Floristic Effects

Annual rainfall and floristic diversity are known to be highly correlated within the Neotropics (Walter, 1973; Gentry, 1982). However, since Tikal and Cocha Cashu support the highest densities despite their strongly seasonal climates and prolonged dry seasons, it seems clear that the amount and seasonality of rainfall alone is not sufficient to explain the differences in spider monkey density at these four sites. Emmons (1984) reaches the same conclusion in her analysis of geographic variation in the density and diversity of non-flying mammals throughout Amazonia.

More support for the conclusion that floristic diversity cannot, in itself, account for the observed differences in *Ateles* population density comes from data on forest composition. The overall density of trees larger than 10 cm diameter at breast height at Cocha Cashu (673/ha, Gentry, 1985; Gentry and Terborgh, in press) is almost twice as great as at Tikal (360/ha; Cant, 1977). Moreover, whereas the ten most abundant species in a one-hectare plot at Cocha Cashu comprise only 33% of the total number of individuals, at Tikal they comprise 70% of the total. Unfortunately, comparably detailed data on forest composition are not available for Colombia or Suriname, but the fact that almost the same density of spider monkeys is supported by the relatively impoverished flora of Tikal as is supported by the taxonomically diverse flora at Cocha Cashu argues that floral diversity is not a necessary condition for high spider monkey density.

Good data exist from all four sites on the identity and variety of fruits eaten by *Ateles* and three of the four studies also incorporated some kind of phenological monitoring to produce an independent measure of fruit tree density. In Suriname, the number of fruit trees available per month was monitored over a seven-month period and ranged from 3-22 sources/ha with an average of 11.9 (Loth, 1981). I gathered analogous data at Cocha Cashu over a 12-month period and obtained somewhat lower numbers, ranging from 2-13 sources/ha and averaging 6.1 (Symington, in press b). Using only the data collected over a seven-month

Table 3. Floristic Characteristics of Four *Ateles* Study Sites

	Suriname	Colombia	Guatemala	Peru
<i>Ateles</i> Population Density	8.2/km ²	13.5/km ²	24.5/km ²	28/km ²
Latitude	4°N	3°N	17°N	12°S
Annual Rainfall	2,200 mm	3,000 mm	1,376 mm	2,000 mm
Length of Dry Season ¹	3-4 months	2-3 months	5 months	4-5 months
Forest Type ²	Tropical Moist	Tropical Wet	Tropical Dry	Tropical Moist
Soil Type	Guianan	Floodplain	Limestone	Floodplain
Soil Fertility	+	++	+++	++++

¹ Corresponding to the number of months with < 100 mm of rain.

² As classified by Holdridge (1967).

period from the middle of the dry season to the beginning of the wet season (to approximate the period the data were collected in Suriname), the number of fruit trees available per hectare at Cocha Cashu is even lower, ranging from 2-11, with an average of 4.1.

However, this finding that the population density of spider monkeys at Cocha Cashu is three times that of Suriname, yet the density of available fruit resources is apparently three times less, may not be as anomalous as it seems. This is because no measure of fruit crop size is included in the density figures given above, and it is quite possible that systematic differences in the average size of available fruit sources exist. One of the most outstanding features of the Cocha Cashu flora is the abundance of large trees, and, in particular, large, free-standing strangler figs (Gentry, 1985; Gentry and Terborgh, in press). The abundance of these large trees at Cocha Cashu is thought to be related to the relatively high fertility of the soil at this site (Gentry and Emmons, 1987; Gentry and Terborgh, in press). In contrast, van Roosmalen (1980) mentions in particular that figs were very rare at his study site in Suriname, and that the single most important fruit source was *Virola melanoni*, a small to medium-sized tree with an average crop of a thousand fruits.

At Cocha Cashu, during the dry season when fruit is least abundant, all of the larger primate species rely on strangler figs to provide most of the fruit portion of their diet (Terborgh, 1983, 1986). Although these trees produce crops at irregular and unpredictable intervals, the crops are enormous, and the density of trees is high enough so that at least a few can be counted on to have fruit during periods when nothing else is available. At Tikal, *Brosimum alicastrum*, another large Moraceae tree, plays a similar role as a 'keystone plant resource' (Terborgh, 1986). It is an unusually common tree at the site (40.0/ha, based on a census of 2.12 ha; Cant, 1977), and the spider monkeys feed on it year-round. When no ripe fruit is available (which is for about five months of the year), they feed on the immature seeds, and, before that, on the flowers. In addition, the young leaves and flush of *Brosimum* appear to be especially palatable to *Ateles* (Cant, 1977; Symington, 1987a). The abundance of this 'all-purpose' tree is almost certainly one of the causes of the high density of *Ateles* at Tikal.

Of course, what is a keystone plant resource for one species may not be for another species. Although the large figs at Cocha Cashu are of critical importance to all of the larger primates, the smaller species (e.g., *Callicebus moloch*, *Saguinus fuscicollis*, *S. imperator*) are frequently excluded from these bonanzas and are, therefore, unable to rely on them to any degree. Perhaps at least partially as a result of this, the density

of callitrichids is considerably lower at Cocha Cashu than at many other locations where they have been studied (Goldizen, 1986).

In conclusion, floral diversity and productivity *per se* may not be as good indicators of habitat quality for spider monkeys (and other species) as the abundance and productivity of particular keystone species or genera which provide critical resources relied upon either year-round or at times of scarcity. For *Ateles*, strangling figs and other large Moraceae trees appear to constitute such a keystone resource, and the abundance and productivity of these trees may depend to some degree on soil quality. As emphasized by Terborgh (1986), the implications of keystone resource theory for tropical forest management are profound, for it means that carefully managed economic exploitation of some forests may be possible without seriously affecting their carrying capacities for higher vertebrates in general, and for primates in particular.

Conclusion

Preliminary results indicate that the abundance and productivity of certain keystone plant resources, which may be affected by soil fertility, are important determinants of population density in *Ateles*. Behavioral and community factors, including intersite variation in the amount of overlap between adjacent social groups and the presence or absence of other frugivorous primates or predators at the different sites, were not found to correlate with the observed pattern of population densities. Nor were climatological factors, such as rainfall and seasonality, which are known to be correlated with floristic diversity, good predictors of *Ateles* density. Censuses of other parks or reserves, or other habitats within the same parks, where *Ateles* populations are thought to be at or near carrying capacity will increase our understanding of the environmental determinants of population density in these monkeys.

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Primates and Ungulates: A Comparison of Susceptibility to Hunting

by Richard E. Bodmer, Tula G. Fang and Luis Moya Ibanez

Primate populations appear to be very susceptible to hunting and show decreases in density, biomass, and diversity in harvested areas, as well as a shift towards greater numbers of smaller-sized species (Freese *et al.*, 1982; Emmons, 1984; Terborgh, 1986). It is less clear how ungulate populations in tropical forests respond to hunting. This study aims to compare primate and ungulate biomass in hunted and non-hunted areas of Neotropical forests to determine whether primates are more susceptible to hunting pressures than ungulates.

Sustainable wildlife utilization by subsistence hunters is a central issue for most tropical countries. Whilst hunting of primates has undoubtedly occurred since prehistoric times, modern hunting techniques, coupled with increasing human populations, no longer make primates a renewable resource. Instead nonhuman primate populations have been declining rapidly in many tropical areas due to habitat destruction, overhunting, and live-trapping (Mittermeier, 1986). Yet, game meat remains an important nutrient source for many people in rural areas (Pierret and Douroujeanni, 1967; Bodmer *et al.*, 1988; Caldecott, 1988) and it appears unlikely that hunting pressures will decrease substantially in the near future. Hence, in order to maintain a sustainable wildlife harvest, subsistence

hunters must know how different species respond to hunting pressure and must select game species in a manner that insures the continued survival of animal populations. Analyses like the one here will provide such information to encourage subsistence hunters to track species other than those vulnerable to overexploitation and local extinction. This knowledge will also help wildlife departments determine which species must be protected and the conditions under which others may be hunted.

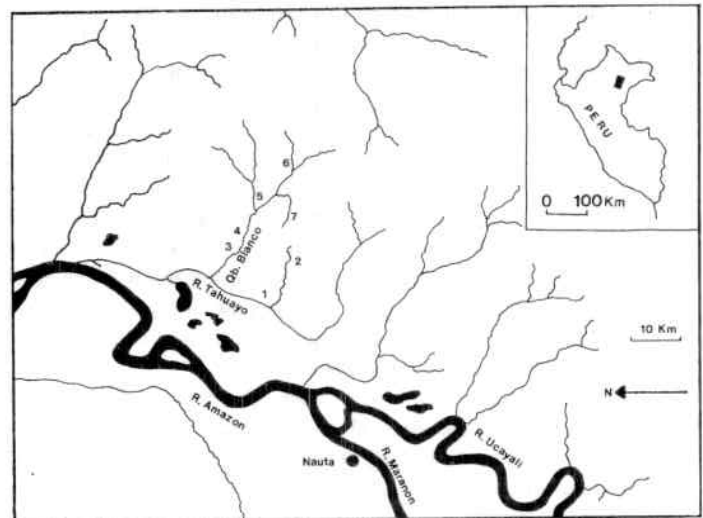


Fig. 1. Map of the Río Tahuayo study area, Peru. The numbers indicate the seven trail systems used during transect censuses (map provided by authors).

Methods

Density and biomass were calculated for diurnal primates and ungulates in the Río Tahuayo study area (Fig. 1), 100 km southeast of Iquitos, Peru, and compared to similar calculations made in the protected areas of Barro Colorado Island, Panama and Manu National Park, Peru by Glanz (1982), Terborgh (1983), and Emmons (1987). The Río Tahuayo site consists of approximately 25% seasonally flooded lowland forest and 75% *terra firme* forest; rainforest habitats very similar to Barro Colorado Island and Manu National Park.

The 500 km² study area included one village with 310 inhabitants living in approximately 44 family groups. Major economic activities included shifting agriculture, fishing, and lumbering. Deforestation was not extensive in the study area and was limited to small gardens along the middle and lower Quebrada Blanco and middle Río Tahuayo. Hunters were common in this area (Fig. 2) and were categorized as lumbermen hunters (c. 20/month), subsistence hunters (c. 20/month), and illegal, commercial meat hunters (sporadic; Bodmer *et al.*, 1988).

Ungulate harvest was recorded by establishing checkpoints and visiting hunting camps for a continuous period from May 1985 to August 1986. Carcasses, skulls, or stomachs of shot animals were examined. Questioning of hunters revealed that 5-10% of ungulate kills were missed per month. Unlike ungulate harvest, primate harvest was not measured directly. From living with subsistence hunters and visiting hunting and lumber camps, the authors estimated the primate to ungulate harvest ratio was approximately three to one in the study area. The harvesting rate was calculated by dividing the annual harvest/km² by density and multiplying by 100 to obtain a percentage.

Primate and ungulate densities in the Tahuayo study area were estimated using line transect censuses. Densities of moustached tamarin (*Saguinus mystax*), saddleback tamarin (*S. fuscicollis*), squirrel monkey (*Saimiri sciureus*), white-fronted capuchin (*Cebus albifrons*), brown capuchin (*C. apella*), titi monkey (*Callicebus moloch*), saki monkey (*Pithecia hirsuta*), red uakari (*Cacajao calvus*), and woolly monkey (*Lagothrix lagotricha*) were estimated from censuses of 120 km of line

transects laid out in seven trail systems throughout the study area (Fig. 1). Densities of red brocket deer (*Mazama americana*), grey brocket deer (*M. gouazoubira*), collared peccary (*Tayassu tajacu*), and lowland tapir (*Tapirus terrestris*) were estimated from censuses of 150 km of line transects in the same seven trail systems.

Transects were censused early in the morning from 0500–1000 h and in the evening from 1600–1900 h. When an animal was sighted, species, group size, time of day, location, and habitat type were recorded. The perpendicular distance of the first sighting to the trail was estimated to within five m. Density estimates of line transects were calculated using Fourier series expansion (Burnham *et al.*, 1980).

Density of white-lipped peccary (*Tayassu pecari*) was estimated by a harvest: density ratio method. This involved calculating the ratio of a species with known density (Dsp) over the number of individuals of that species harvested (Hsp) and equating it to the number of white-lipped peccary harvested (Hsp2) over their expected density (Dxsp2). It was possible to use this method both with harvest data collected from hunters within the study area over a 15-month period and with the number of peccary pelts traded in Iquitos over the past 20 years. Densities of Dsp were calculated from Fourier series expansions of line transects of collared peccaries and red brocket deer.

Body weights of red brocket deer, grey brocket deer, white-lipped peccary, collared peccary, and lowland tapir were collected from animals shot by local hunters. Body weights of primates were recorded from the literature as noted in Table 1. Crude biomass was calculated as body weight \times density.



Fig. 2. Family enjoying game meat for lunch. Game meat is an important protein source in the Río Tahuayo study area (photo by R.E. Bodmer).

Results

Harvesting rates of primates and ungulates were similar in the Tahuayo study site. There were 314 ungulates and approximately 1,000 primates harvested in a 12-month period. The density of primates (excluding *Saguinus* and *Saimiri*) was 26.7 ind/km² and of ungulates 7.6 ind/km² in the 500 km² study area. This results in a 7% harvesting rate for primates and an 8% harvesting rate for ungulates. However, harvested biomass was considerably greater for ungulates (9,215 kg/yr) than for primates (3,500–4,000 kg/yr).

Hunters in the Tahuayo study area rarely sold primate meat, whereas, ungulate meat was regularly salted or smoked for sale in Iquitos. The heaviest hunting pressure was exerted by lumbermen hunters, who consume game meat as an economical alternative to shipped-in food. Subsistence hunters exerted a heavy pressure on primates because they regularly sought meat and spent little time tracking large ungulates. Commercial meat hunters consumed primates in their hunting camps and salted

all ungulate meat to sell in Iquitos.

Nine of the 12 diurnal primate species present in the Río Tahuayo study area were recorded during censuses. The most abundant primates were mixed groups of moustached and saddleback tamarins with an estimated density of 3.1 groups/km². Larger diurnal primates had group densities ranging from 0.9 groups/km² to 0.1 groups/km². Red uakari groups were infrequent; however, their large group size (~50 inds) and relatively large body weight gave them a large biomass. Other species with relatively large biomasses included brown capuchins, white-fronted capuchins, squirrel monkeys, and tamarins. The three species not recorded during censuses were *Cebuella pygmaea*, *Ateles paniscus*, and *Alouatta seniculus*.

The Río Tahuayo study site had considerably lower estimates of crude biomass of diurnal primates than the protected areas of Manu National Park and Barro Colorado Island (Table 1). Crude biomass of diurnal primates in the Tahuayo area was 111 kg/km², whilst on Barro Colorado Island it was 510 kg/km² (from Glanz, 1982) and in Manu National Park 621 kg/km² (from Terborgh, 1983). Primate biomass remained high on Barro Colorado Island despite a greatly reduced diversity compared to the Tahuayo area and Manu National Park.

Ungulate biomass differed only slightly between the Tahuayo study site and the two protected areas (Table 2). Crude biomass of ungulates in the Tahuayo area was 262 kg/km² whilst in the Manu National Park it was 218 kg/km² (from Emmons, 1987) and on Barro Colorado Island 425 kg/km² (from Glanz, 1982). The generally higher biomass of ungulates on Barro Colorado Island appears to be due to a much lower predator pressure (Eisenberg and Thorington, 1973).

Discussion

Protected tropical forests support a greater primate biomass than ungulate biomass because primary production is concentrated in the canopy layers (Eisenberg and McKay, 1974). Primate biomass in hunted areas rapidly declines, and in many exploited habitats primate biomass is now actually less than ungulate biomass. However, density of primates often remains high because of an increase in the smaller species (Freese *et al.*, 1982; Emmons, 1984; Fig. 3).

Both primates and ungulates are major consumers of fruit in Neotropical forests. Ungulates are restricted to fruit fall only after the initial fruit consumption by arboreal frugivores and may be less susceptible to hunting in areas of lower primate density and, therefore, greater residual fruit fall. However, primates also facilitate fruit fall for ungulates which may counterbalance effects of competition. For example, peccaries were observed following groups of *Cebus olivaceus* in Venezuelan forests and eating the fruits dropped by the foraging monkeys (Robinson and Eisenberg, 1985).

Primates have a much lower recruitment rate than ungulates. Robinson and Redford (1986) calculated intrinsic rate of natural increase (r_m) for Neotropical primates and ungulates and found primate species to range between 0.07 and 0.25 with an overall mean of 0.15, whilst Neotropical forest ungulates ranged between 0.2 and 1.25 with an overall mean of 0.64. Primates have lower r_m 's because of long interbirth intervals, small litter sizes, and a late female age at first reproduction (Eisenberg, 1981).

Hunters find diurnal primates more easily than ungulates because many species produce considerable noise when moving through the canopy and in social interactions. In contrast, forest ungulates tend to be solitary and secretive. Primate anti-predator strategies appear less well-suited to human hunting pressures than do ungulate strategies. Furthermore, primates use the canopy to escape from many of their natural predators, but this is ineffective against shotguns. When confronted by natural predators, ungulates on the other hand either hide in thick undergrowth or run, both good strategies for avoiding human hunters, especially in forested areas.

Table 1. Crude Biomass of Diurnal Primates in Three Neotropical Forests

Tahuayo Study Area				Barro Colorado Island ^a		Manu National Park ^b	
Species	Group Density /km ²	Group Size	Crude Biomass kg/km ²	Species	Crude Biomass kg/km ²	Species	Crude Biomass kg/km ²
<i>Saguinus fuscicollis</i>	3.1	7	8.7 ^c	<i>Saguinus geoffroyi</i>	1.4	<i>Cebuella pygmaea</i>	1
<i>S. mystax</i>	3.1	7	13.0 ^c	<i>Cebus capucinus</i>	24.2	<i>Saguinus fuscicollis</i>	5
<i>Saimiri sciureus</i>	0.6	20	9.6 ^d	<i>Ateles geoffroyi</i>	6.8	<i>S. imperator</i>	5
<i>Cebus albifrons</i>	0.7	8	16.8 ^d	<i>Alouatta palliata</i>	478.5	<i>Callicebus moloch</i>	17
<i>C. apella</i>	0.9	10	27.0 ^d			<i>Saimiri sciureus</i>	48
<i>Callicebus moloch</i>	0.6	4	2.4 ^d			<i>Pithecia monachus</i>	2
<i>Pithecia hirsuta</i>	0.7	5	7.0 ^e			<i>Cebus albifrons</i>	84
<i>Cacajao calvus</i>	0.1	50	20.0 ^d			<i>C. apella</i>	104
<i>Lagothrix lagothricha</i>	0.4	3	7.2 ^e			<i>Alouatta seniculus</i>	180
						<i>Ateles paniscus</i>	175
Total			111.7		510.8		621

^aData from Glanz (1982)^bData from Terborgh (1983)^cBody weight used to calculate this value is from Fang (1987)^dBody weight used to calculate this value is from Ayres (1986)^eBody weight used to calculate this value is estimated from Buchanan *et al.* (1981)

Table 2. Crude Biomass and Physiological Biomass of Ungulates in Three Neotropical Forests

Tahuayo Study Area			Barro Colorado Island ^a		Manu National Park ^b	
Species	Density	Crude Biomass	Species	Crude Biomass	Species	Crude Biomass
	/km ²	kg/km ²		kg/km ²		kg/km ²
Red brocket deer	1.8	60.8	Brocket deer	60.0	Brocket deer	78.0
Grey brocket deer	0.8	12.5	Collared peccary	232.5	Peccary	140.0
Collared peccary	3.3	83.2	Baird's tapir	132.5		
White-lipped peccary	1.3	43.2				
Lowland tapir	0.4	62.2				
Total		261.2		425.0		218.0

^aData from Glanz (1982)^bData from Emmons (1987)

Hunting controls are very difficult to enforce in many tropical areas, but every effort should be made to direct hunting pressure away from vulnerable species (Fig. 4) and to prevent the overexploitation of other species. Large tracts of tropical forests are sustaining human inhabitants but will only continue to do so if the areas are carefully managed. Local authorities and multiple land-use programs must take into account primates' susceptibility to overexploitation and be careful in directing subsistence hunters' use of wildlife. Maintaining a sustainable yield of primates appears to be very difficult due to their acute vulnerability to hunting pressures.

It does appear easier to maintain sustainable yields of certain ungulate species, especially the Artiodactyla. Not all ungulate species, however, are suitable for exploitation. For example, lowland tapir are probably susceptible to hunting pressures because of their low recruitment rate caused by a 397-day gestation, long interbirth interval, and extended

development. Sustainable yield in ungulates increases in populations that are held below their maximum densities (McCullough, 1987). Ungulate populations generally show a lower recruitment rate at high population densities because of decreases in body condition and increases in age of first breeding (Clutton-Brock *et al.*, 1982). However, ungulates, like all large mammals, are also susceptible to overexploitation, and subsistence hunters must accept a limited harvest. Examples of overhunting include the dramatic reductions in Cervidae and Bovidae in North America and Europe during the middle and late 19th century, when many populations were reduced to small island refuges (Ueckermann, 1987; Gill, 1987). Ungulates inhabiting open areas, such as grasslands, are more susceptible to overexploitation than forest species. Indeed, refuge populations of grassland ungulates during the mid and late 19th century occurred in forest habitats.