

PRIMATE CONSERVATION

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

Number 10

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and the Department of Anatomical Sciences of
the State University of New York at Stony Brook.



Front cover. The white uakari (*Cacajao calvus calvus*) is a rare monkey found only in a very limited area in the *várzea* or flooded forest of the Rio Solimões (= upper Brazilian Amazon) between the Rio Japurá, the Rio Auati-Paraná and the Solimões itself. It has been the subject of an in-depth field study by PSG member José Márcio Ayres (photo by Russell A. Mittermeier.)

A Word from the Editors

This tenth issue of *Primate Conservation* presents material submitted to us between December, 1988 and December, 1989. As with no. 9, there has been a long delay in publication due to moves by members of the editorial team, with PSG Chairman Russ Mittermeier changing position from World Wildlife Fund to Conservation International in July, 1989, and Deputy Chairman Bill Konstant moving from Wildlife Preservation Trust International to Conservation International in 1991. The process of settling into new quarters and re-establishing production schedules has taken time, and we apologize to all our contributors and subscribers for this delay.

We are pleased to announce that as of issue no. 11, *Primate Conservation's* new Editor will be Bill Konstant, now Director of Conservation International's Zoo Outreach/Flagship Species Program. Bill acted as Assistant Editor of *Primate Conservation* for the first six issues, and we are very happy to pass the journal back into his capable hands. PSG Chairman Russ Mittermeier will continue to oversee publication of the journal, and Stephen Nash remains as the person responsible for layout and design. Isabel Constable, because of other commitments, will switch from her current position as editor and become a consultant to *Primate Conservation*. Bill's office will be at the Philadelphia Zoo, through a special arrangement between Conservation International, the Primate Specialist Group and this institution, America's first zoo. We are delighted at this new arrangement, and believe it will help to forge stronger links between the zoo world and those of us involved in conservation of wild populations of primates and other species.

The goal of *Primate Conservation* is to communicate the latest primate conservation news to members of the IUCN/SSC Primate Specialist Group and others interested in primate and tropical forest conservation. These environmental issues are finally taking their rightful place on the global stage, and we look forward to increasing even further our journal's contribution to the discussion.

We are especially grateful to Noel Rowe for his generous contribution to the publication of this issue of *Primate Conservation*. We also thank you all for your contributions and for your patience during our transition period.

Isabel D. Constable
Editor

Russell A. Mittermeier
Chairman, IUCN/SSC
Primate Specialist Group

Estelina L. Dallett
Assistant Editor

John L. Carr
Assistant Editor

Stephen D. Nash
Layout/Design

Ellen Goldberg
Editorial Assistant

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NEOTROPICAL REGION

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ANNOUNCEMENTS

IVth Brazilian Primatological Congress Held in January 1989

The IVth Brazilian Primatological Congress was held during the XVIth Brazilian Zoology Congress at the Federal University of Paraíba, João Pessoa, from 22-27 January 1989. Organized and hosted by Carmen Alonso from the Department of Systematics and Ecology, the program for the Primatology Congress included seven papers and 33 poster presentations. Two roundtable sessions were also held.

The first roundtable session, organized by Lucio Flavio de Sousa Moreira of the Federal University of Rio Grande do Norte, discussed ethics and management of captive breeding colonies. Guest speakers included Anthony Rylands (Federal University of Minas Gerais and author of this report), who discussed the ethics of taking monkeys from the wild, and Maria de Fatima Campos (Federal University of Rio Grande do Norte), who spoke about the use of primates in biomedical research. An important result of this meeting was the decision that the Brazilian Primatological Society should elaborate a policy statement concerning these questions. The document will be presented to major national financing and research institutions involved in primate research.

Conservation in the wild was the theme of the second roundtable. Celio Valle (Federal University of Minas Gerais) organized a group of guest speakers which included Ilmar Santos (Federal University of Minas Gerais) on the southeastern Brazilian primates; Sergio Mendes (Museu de Biologia Melo Leitao) on the primates of the state of Espírito Santo; Carlos Peres (University of Cambridge) and Anthony Rylands on Amazonian primates; and Alfredo Langguth (Federal University of Paraíba) on the severe problems of habitat loss in northeastern Brazil.

At the Congress a new board was elected for the Brazilian Primatological Society:

President, Maria Emilia Yamamoto

Vice President, Carmen Alonso

Secretary, Lucio Flavio de Sousa Moreira

Assistant Secretary, Arrilton Araujo

Treasurer, Maria de Fatima Arruda

Assistant Treasurer, Maria Adelia Monteiro da Cruz

All correspondence for the society should now be addressed to:

Sociedade Brasileira
de Primatologia
Setor de Psicobiologia
Núcleo de Primatologia
Centro do Biociências
Universidade Federal
do Rio Grande do Norte
C.P. 1511
59072 Natal
Rio Grande do Norte
BRAZIL

Second Mexican Primatology Symposium Held in March 1989

The Biological Station of Los Tuxtlas hosted a Second Primatology Symposium from 29-31 March 1989. The Biological Station, under the auspices of the Biology Institute of the National Autonomous Univer-

sity of Mexico (UNAM), is situated in a 700-ha forest in southern Mexico containing wild populations of *Alouatta palliata mexicana* and *Ateles geoffroyi vellerosus*.

The three-day symposium provided an opportunity for researchers interested in Mexico's primates to convene and exchange ideas. Topics were divided between those on native primates and those on imported primates, and sessions included reports on current research as well as discussions of future projects.

For further information, please write:

Alejandro Estrada
Estación de Biología 'Los Tuxtlas'
Instituto de Biología
Universidad Nacional Autónoma
de México
Apartado Postal 176
San Andrés Tuxtla, Veracruz
MEXICO

Conference on Fertility in the Great Apes Held in June 1989

To celebrate their centennials, Zoo Atlanta and the National Zoo of the Smithsonian Institution, together with the Yerkes Regional Primate Research Center of Emory University, hosted a conference entitled "Fertility in the Great Apes" from 15-17 June 1989.

Participants gathered in Atlanta, Georgia to discuss various issues related to the identification and solution of fertility problems, progress in captive and wild propagation, and future problems associated with the maintenance of great apes in zoological and biomedical communities. Session headings included Neonatology, Demographics, Environment, Male and Female Fertility, and Husbandry.

Anyone interested in the results should look for them in *Zoo Biology* and *The American Journal of Primatology*.

Beyond Captive Breeding: A Symposium Hosted by the Zoological Society of London

On 24-25 November 1989, J.H.W. Gipps, Curator of Mammals at the Zoological Society of London, organized a symposium entitled "Beyond Captive Breeding: Re-introducing Endangered Species to the Wild." Sponsored by the Zoological Society in cooperation with the Mammal Society and the Primate Society of Great Britain, the symposium focused on the procedures, problems, and potential of reintroduction, and included a session on reviewing case studies. The papers presented at the symposium will be published by Oxford University Press as No. 62 in the series *Symposia of the Zoological Society of London*. Those interested in purchasing a copy should write to the Assistant Editor:

The Assistant Editor
The Zoological Society of London
Regent's Park
London NW1 4RY
U.K.

The Gorilla Gazette: News About the Great Apes in Captivity

The Great Apes staff of the Columbus Zoo, under the press name "Knuckle News," publishes *The Gorilla Gazette* quarterly (Fig. 1). The

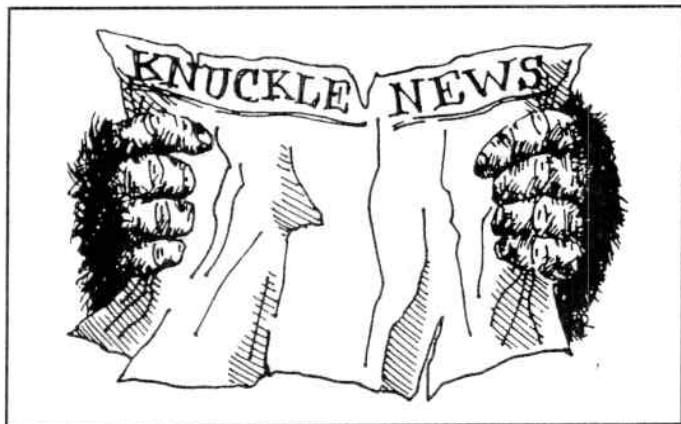


Fig. 1. This logo adorns the banner of *The Gorilla Gazette*, published by the Great Apes Staff of the Columbus Zoo.

newsletter, which includes articles written by and for gorilla keepers from zoos around the world, focuses on the management of captive gorillas. Breeding and rearing programs, socialization procedures, and exhibit design have been discussed in various issues. Notices of births and deaths in the captive population are also regularly published. Contributions are encouraged both from zoo staff and researchers.

The newsletter is sent *gratis* to zoos or other institutions housing gorillas and to individuals directly involved with the care or study of gorillas. Other gorilla amateurs may subscribe for \$10 a year.

To submit a piece or subscribe to the gazette, call the Great Apes staff of the Columbus Zoo at (614) 645-3400, or write to the editor:

Julie Estadt
The Gorilla Gazette
The Columbus Zoo
P.O. Box 400
Powell, OH 43065-0400
U.S.A.

Primatological Society of India Publishes a Newsletter

The Primatological Society of India, which promotes national conservation efforts and strives to increase public awareness of non-human primates and their habitats, now prints a biannual newsletter to serve as an informal medium of communication among its members. Past issues have included reports on international primatological symposia, notes on current studies in India, and recommendations for research and conservation work.

Please direct inquiries and newsletter material to the General Secretary of PSI:

Swadesh Seth
Department of Anthropology
University of Delhi
Delhi-110007
INDIA

Proposed Update of the Brazilian Threatened Species List

During the XVIth Brazilian Zoology Congress, held in Joao Pessoa, Paraiba, 22-27 January 1989, a committee met to propose that the following primates be included on the official list of threatened species to be authorized by the new Brazilian Institute for the Environment and Natural Renewable Resources (IBAMA):

[Note: when a species is listed, all its subspecies are automatically included. Species or subspecies indicated by * are already on the Official List of Endangered Species of the Brazilian Forestry Development Institute (IBDF) — Portaria No. 3.481-DN of 31 May 1973. Species indicated by # are species for which insufficient information is available.]

<i>Callithrix argentata leucippe</i>	<i>Saimiri vanzolinii</i>
<i>Callithrix humeralifer</i>	<i>Pithecia albicans</i>
<i>Callithrix emiliae</i> #	<i>Chiropotes albinasus</i> *
<i>Callithrix aurita</i>	<i>Chiropotes satanas satanas</i>
<i>Callithrix flaviceps</i> *	<i>Chiropotes satanas utahicki</i>
<i>Saguinus fuscicollis acensis</i> #	
<i>Saguinus fuscicollis melanoleucus</i> #	<i>Cacajao calvus</i> *
<i>Saguinus fuscicollis crandalli</i> #	<i>Cacajao melanocephalus</i> *
<i>Saguinus fuscicollis cruzlimai</i> #	<i>Cebus apella xanthosternus</i>
<i>Saguinus labiatus thomasi</i> #	
<i>Saguinus imperator</i>	<i>Alouatta fusca</i> *
<i>Saguinus bicolor</i>	<i>Alouatta belzebul belzebul</i>
<i>Leontopithecus rosalia</i> *	<i>Ateles paniscus</i>
<i>Leontopithecus chrysomelas</i> *	<i>Ateles belzebuth</i>
<i>Leontopithecus chrysopygus</i> *	<i>Lagothrix lagotricha</i>
<i>Callimico goeldii</i> *	<i>Brachyteles arachnoides</i> *
<i>Callicebus personatus</i>	

Opportunities for Studying Captive Macaque and Lemur Populations

Since 1978, the Primatology Unit (UP) of Louis Pasteur University in Strasbourg has maintained and bred primates, primarily for observation and experimental research on behavior. Currently, the UP has seven large, forested enclosures (0.5-1 ha) and five indoor/outdoor cages housing groups of *Macaca mulatta*, *M. fascicularis*, *M. tonkeana*, *M. arcuoides*, *Lemur fulvus*, *L. macaco*, *L. catta*, and *Cebus apella*. The total primate population numbers around 170 animals.

The UP welcomes short-, medium-, and long-term research projects. Studies now underway include comparisons of social systems, communication, learning, and tool-use. Permission for some biomedical research may be granted as long as such work is untraumatic for the animals.

For further information, please contact the Director:

Nicolas Herrenchmidt
Unité de Primatologie
Université Louis Pasteur
7, rue de l'Université
6700 Strasbourg
FRANCE

A New Bulletin on Latin American Primatology

This new bulletin edited by the Argentinian Primate Specialist Group will serve as a means of communication for members of the Latin American Primatological Society and other researchers interested in New World monkeys. The first issue, published in July 1989, provides an overview of the status of primatology in five countries: Argentina, Belize, Bolivia, Paraguay, and Puerto Rico. Forthcoming issues will present similar introductions to the field of primatology in other Latin American countries. The *Boletín Primatológico Latinoamericano* will subsequently focus on topics such as conservation strategies and primate trade. A section of announcements at the end of each issue lists upcoming meetings, new publications of interest, and society news. Articles appear in the language in which they are submitted: English, Spanish or Portuguese.

For information on contributing or subscribing, please write to the editor:

Alejandro D. Brown
 Dto. de Manejo Integrado de Cuencas
 y Recursos Naturales
 Facultad de Agronomía
 Universidad Nacional de La Plata
 Diagonal 113. No. 469 (61 y 118)
 (1900) La Plata
 Buenos Aires
 ARGENTINA

The Primate Information Center: Banking Knowledge for Conservation

The Primate Information Center (PIC) at the University of Washington Regional Primate Research Center (UW-RPRC) aims to efficiently provide comprehensive bibliographic information to primatologists. The service, started 25 years ago by Dr. Theodore C. Ruch and presently funded by the National Institutes of Health, provides information about literature on nonhuman primates both in their own right and in their use as an analog or biomedical model of the human organism. The current collection of more than 80,000 fully indexed citations includes all known references since 1940.

The PIC obtains citations from large bibliographic services and supplements them with in-person library searches. When a copy of an article is obtained, it is scanned for pertinence, recorded in uniform bibliographic style, and indexed. The PIC indexing system of about 4,000 terms is the key to its services, permitting retrieval on levels from the general to the precise, and by discipline, country, or species. The list of terms is dynamic in that it permits the addition of new terms, but constant in that each term must be consistently defined.

Once an article has been indexed, it is banked in the computer and can be retrieved under any term in the indexing set, any of the author's names, any key word in the title, or the name of the journal or book in which it was published. The article may then appear on one of the following PIC lists:

Current Primate References (CPR) is a monthly publication listing newly indexed references on nonhuman primates. Each issue features about 450 citations of articles less than four years old, with authors' addresses given to facilitate reprint requests.

Topical Bibliographies (Topicals) are generalized lists on a particular subject over a given time period. Species indexes, and sometimes indexes to subordinate subjects, are provided. There are 50 to 300 citations in each Topical, and topics of continuing interest may be featured in two or three editions. The PIC has published approximately 130 Topicals.

Custom Retrospective Bibliographies (Retros) are compiled for individuals who want citations on specific subjects, species, and time periods, by a literature analyst who specializes in the field of study. Service is usually provided by return mail, and by airmail to overseas addresses.

Monthly Custom Bibliographies are compiled regularly by matching the client's specific interest against new acquisitions. Some clients prefer this focused listing to the general CPR.

Primate Supply Information Clearinghouse (PSIC) is a conservation program which helps reduce the numbers of primates imported and used in research by publishing weekly a bulletin of needed and available primates, tissues, cadavers, equipment, and services. There are some restrictions on listings, and the PSIC takes no role in negotiations or the establishment of prices. This service promotes an optimal sharing of primates already in the U.S.A.

The timely and expert provision of all these services by the PIC has made a significant contribution to primate conservation. The collection has been used to prepare books and articles on conservation and ecology and to provide material for analyses of trends in field work and funding. Authors can help the PIC build on these successes by mailing their reprints directly to the center.

For more information about the PIC publications or custom services, write to the manager:

Benella Caminiti
 Primate Information Center
 Regional Primate Research
 Center SJ-50
 University of Washington
 Seattle, WA 98195
 U.S.A.

A New Book and Video for PSG Members

Many new items of relevance to primate conservation are now available. Below are two that may be of interest to you. We have included prices and ordering information where available.

The Deluge and the Ark: A Journey into Primate Worlds by Dale Peterson (1989)

Peterson is an English professor who one day read an article about the Brazilian muriqui and embarked on a course of study and travel that resulted in this book: a vivid, comprehensive, and reflective story of his quest for glimpses of twelve endangered primates. Peterson's work will enlighten and entertain all audiences, from laymen just becoming familiar with the problems of human overpopulation and habitat destruction to specialists looking for a context in which to integrate their own experiences. The 379-page book, illustrated with color plates, is available in hardback from the publisher for \$24.95:

Houghton Mifflin Company
 2 Park Street
 Boston, MA 02108
 U.S.A.

Edward O. Wilson: Reflections on a Life of Science produced by Bruce Baird-Middleton for the Film Study Center, Harvard University (1989)

In this 60-min video, E.O. Wilson talks about his work and philosophy, from his childhood interest in ants to his later and continuing studies in ecology, biogeography, sociobiology, and environmental conservation. He makes an eloquent plea for preserving biodiversity and engagingly offers insight into the scientific process, comparing scientists to mythmakers and examining the role of imagination in scientific inquiry.

The video, in two 30-min parts, is available from the Harvard University Press for \$39.50:

The Harvard University Press
79 Garden Street
Cambridge, MA 02138
U.S.A.

Request for Materials for Vietnamese Scientists

The U.S. Committee for Scientific Cooperation with Vietnam requests assistance providing recent books, journals, and research materials to Vietnamese scientists, who have access to almost none of the relevant literature on wildlife conservation and ecology published in the last thirty years. In particular, the Faculty of Biology of Hanoi University has requested help in building a library on these subjects. The Committee is sure other institutions are also in need and would welcome help in identifying them. Examples of ecology teaching materials for primary and secondary schools would be much appreciated as well.

Materials can be sent via the Committee from the U.S.A. to individuals or departments anywhere in Vietnam. Please contact the Chair to arrange shipments, but please do not send materials directly to her:

Judith Ladinsky, Chair
U.S. Committee for Scientific
Cooperation with Vietnam
Dept. of Preventative Medicine
University of Wisconsin
1300 University Avenue
Madison, WI 53706
U.S.A.

Lemur Publicity

Three cover stories on Madagascan wildlife have recently appeared in the popular press. *National Geographic* Vol. 174, No. 2 (Aug 88) features Alison Jolly's "Madagascar's Lemurs On the Edge of Survival," with photographs by Frans Lanting, and two issues of *International Wildlife*, Vol. 18, No. 4 (Jul-Aug 88) and Vol. 19, No. 3 (May-June 89) cover this important island nation as well. The first *International Wildlife* issue includes an article by Russell Mittermeier, "Strange and Wonderful Madagascar," with photographs by Lanting; the second presents a collection of photographs and descriptions by Frans Lanting entitled "On the Trail of Lemurs."

Tanzanian Conservation Society Incorporates the Colobus Monkey into its Symbol

The Wildlife Conservation Society of Tanzania (WCST), which aims to help preserve the plants, animals, and habitats of Tanzania by supporting governmental, international, and local conservation efforts, providing a forum for Tanzanians interested in wildlife conservation, and encouraging conservation through education, has decided to include the colobus monkey in its symbol. The oval symbol (Fig. 2) appears on the WCST's materials, including the quarterly newsletter, *Miombo*.



Fig. 2. The WCST's oval symbol includes an abstract rendition of a colobus monkey. The Swahili motto reads: "Mbega Aliponzwa Kwa Uzuri Wake," or "The colobus was destroyed for its beauty."

For more information on the WCST and its conservation activities in Tanzania, please write to the headquarters:

Wildlife Conservation Society
of Tanzania
P.O. Box 70919
Dar es Salaam
TANZANIA

Primate Posters

Two full-color posters featuring an array of primates have been published since the appearance of the last issue of *Primate Conservation*, one of Madagascar's Indriidae, the other of Zaire Cercopithecidae.

World Wildlife Fund produced the Malagasy poster (Fig. 3), which was designed and drawn by S.D. Nash. The Indriidae is composed of five species and includes the largest and most spectacular of the lemurs. The poster provides standardized drawings for easy identification of the five species and their subspecies: *Indri indri*, *Propithecus verreauxi* (4 spp.), *Propithecus diadema* (4 spp.), *Propithecus tattersalli*, and *Avahi laniger* (2 spp.). A map in the center of the poster shows the distribution of the Indriidae in Madagascar. The text, in Malgache and French,

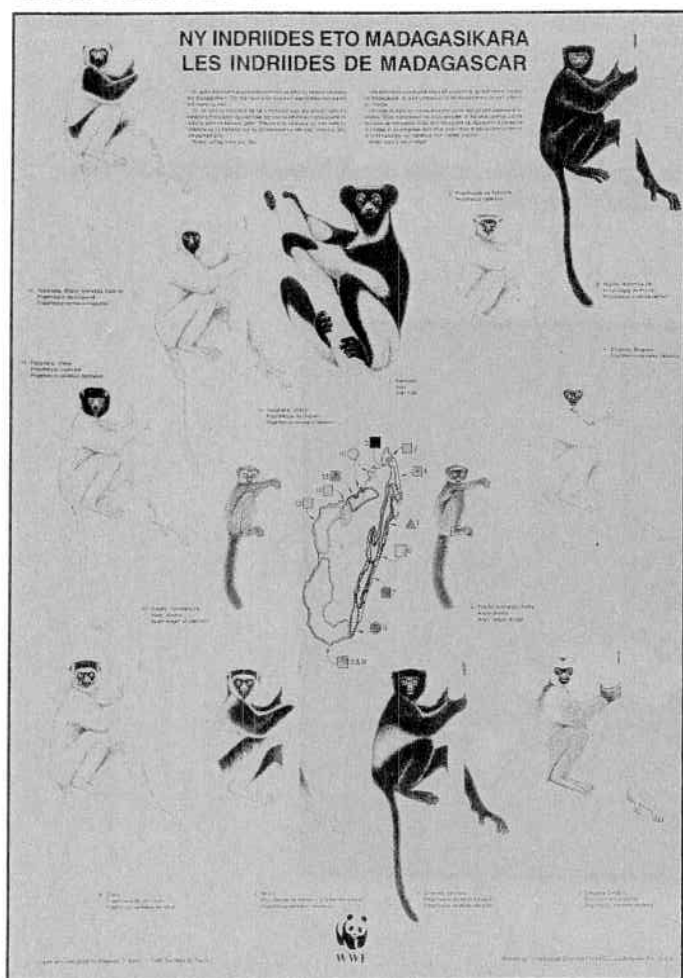


Fig. 3. Indriidae poster providing information about their physical characteristics and natural ranges (drawn and designed by S.D. Nash).

explains the importance of the animals, the threats to their existence from hunting, trapping, and habitat destruction, and says to "Help us protect them."

The Zairian poster (Fig. 4) was produced by the Institut Zaïrois Pour la Conservation de la Nature (IZCN), Conservation International, and IUCN. It shows seven species of Cercopithecidae, painted by P. Dandelot. The French text explains that Zaire has more cercopithecines than any other African country, and must work at maintaining this diversity by supporting conservation work in the national parks of Salonga and Maïko. It calls upon us to "Uphold the conservation efforts of the IZCN, which receives the support of CI and IUCN."

Opportunities for Primatological Research at Majé Island, Panama

The Gorgas Memorial Laboratory (GML) welcomes primatologists interested in studying free-ranging *Saguinus oedipus geoffroyi*, *Aotus lemurinus*, *Cebus capucinus* and *Alouatta palliata* to Majé Island (Fig. 5).

Based in Panama City, the GML is primarily concerned with clinical, laboratory, and field studies of tropical diseases and epidemiological studies of cancer and sexually transmitted diseases. The GML has custody of Majé and maintains a field station on this partially forested 15 km² island (Fig. 6). Research at Majé has so far focused on arbovirus ecology and insect vectors of disease, but the GML wishes to broaden the scope of its investigations.

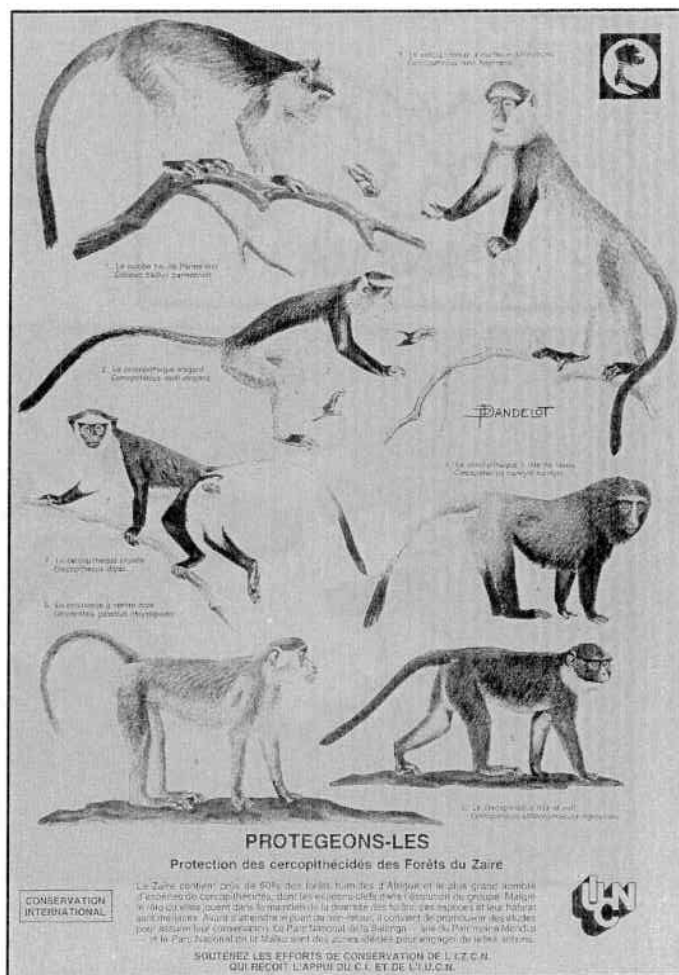


Fig. 4. Cercopithecidae poster calling for the protection of these monkeys in the forests of Zaire. Species depicted include: 1) *Colobus badius parmentieri*, 2) *Cercopithecus wolfei elegans*, 3) *Cercopithecus mitis heymansi*, 4) *Cercopithecus hamlyni hamlyni*, 5) *Cercopithecus (Allenopithecus) nigroviridis*, 6) *Cercocebus galeritus chrysogaster*, 7) *Cercopithecus dryas*. (drawn by P. Dandelot).

The island, 80 km east of Panama City in Bayano Lake, was formed in 1976 when the Bayano River was dammed for hydroelectrical purposes. It is easily accessible from Panama City by driving three hours to the village of El Puente and then taking a 10-min boat ride. The station at Majé has a mosquito-proof dormitory with nine bedrooms and 18 beds, a small laboratory with bench space but limited equipment, a kitchen with an outdoor lounge area, and shower and toilet facilities. Drinking water and food is brought from Panama City every two weeks, and washing water is pumped from the lake. Electricity is available at night, and radio communication is maintained with headquarters Monday-Friday.

The island is a relatively self-contained environment from which primates cannot usually leave (although the mainland may be reached by swimming or clinging to floating vegetation). As with other islands, Majé offers an opportunity to study population dynamics or to harvest animals based on periodic population counts.

The most conspicuous among the tropical islands that contain Neotropical primate populations is Barro Colorado in the man-made Gatun Lake in the Panama Canal. Carpenter's (1934) studies on howler monkeys there were the first detailed accounts of the natural history of any primate. Other islands in the Neotropics important to primatologists include Santa Sofia, used to release squirrel monkeys with the aim of later cropping some of the offspring, and Padre Isla in the Amazon River opposite

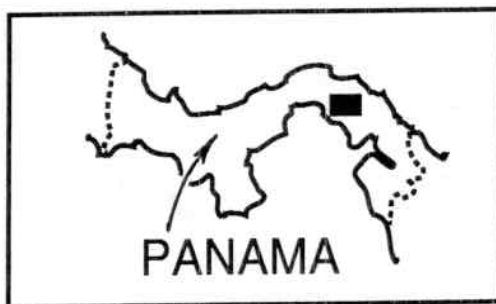
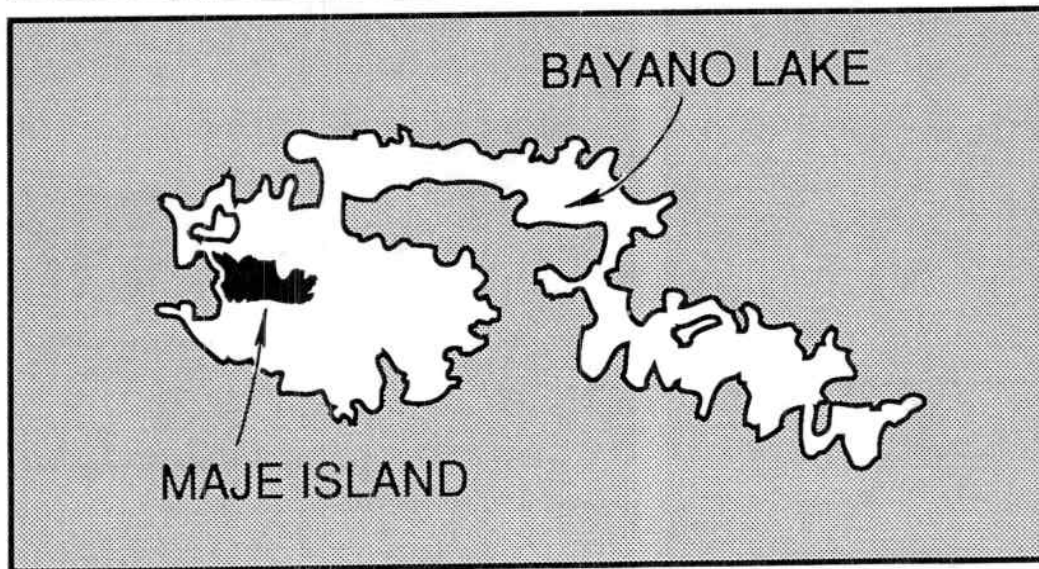


Fig. 5. Map showing location of Majé Island, Panama (map by S.D. Nash based on authors' original).



MAJE ISLAND

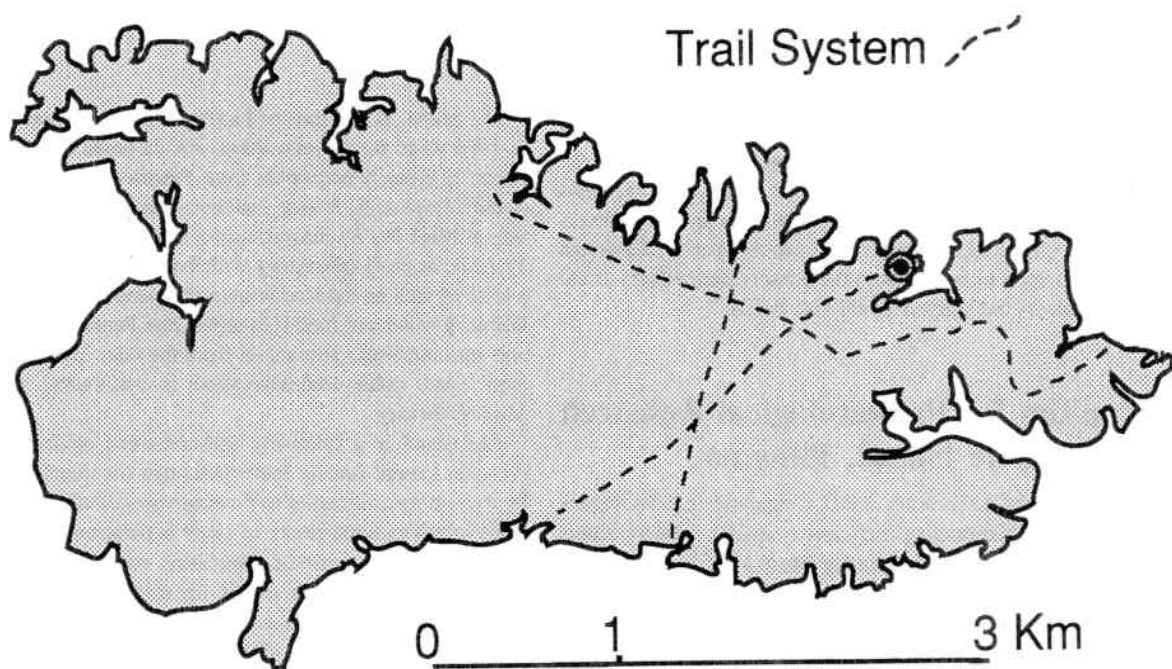


Fig. 6. Map of Majé Island showing the trail system and location of the main camp (map by S.D. Nash based on authors' original).

Iquitos, Peru, where moustached tamarins have been introduced in an attempt to manage populations of this species in areas adjacent to farms and small human settlements.

Mature forests cover approximately half of Majé's 1,500 ha, maturing forests an additional 30%, and grassland the rest (including remnants of areas deforested for cattle ranching). The island has been more or less protected from lumbering and poaching, at least since the filling of Bayano Lake in 1976.

Natural populations of *Alouatta palliata*, *Cebus capucinus*, *Saguinus oedipus geoffroyi*, and *Aotus lemurinus* occurred in the Majé area before it became an island, and *Ateles geoffroyi* are thought to have originally been found there but have since been hunted out. In addition to the pre-existing primates, during the clearing of the forest and creation of Bayano Lake, all the mammals which were recovered were released at Majé. This included 60 night monkeys (*Aotus*), 18 capuchins (*Cebus*) and 44 tamarins (*Saguinus*). Subsequently, an additional 133 *Aotus*, kept in captivity for varying lengths of time for malaria experimentation, were released on Majé.

At the suggestion of D. Rasmussen, a project to estimate the populations of diurnal primates on Majé was initiated in June 1986 with the help of volunteer students who had completed a primatology field course in Panama. Howlers were found to be the most conspicuous primates on Majé. Preliminary observations by T. Hoeffler suggested that at least 10 different troops are found in the eastern section (ca. 200 ha) of the island. J. Greenfield helped with the census, especially studying troop size and composition, while also pursuing her interests in the study of intraspecific competition for food. Additional surveys must be conducted to complete this census.

The priority of GML, however, is the study of the nocturnal *Aotus*, since this primate is used by the laboratory for studies on malaria and other tropical diseases and there is concern for its status in the wild.

The objectives of initial field studies on *Aotus* should include determining the population density and testing the readaptability of captive *Aotus* to the wild. Long-term objectives include determining the feasibility and possible yield of periodic *Aotus* harvests on Majé, studying the factors limiting the density of *Aotus*, and examining the possibility of manipulating their environment (e.g., by planting fruit-bearing trees) to increase the density and thus the yield.

Visitors wishing to do primatological research at Majé are welcome to write to Drs. John Petersen or Alfonso Escajadillo at either of the following addresses:

Dr. John Petersen
Dr. Alfonso Escajadillo
The Gorgas Memorial Laboratory
Box 935
APO Miami, FL 34002-0012
U.S.A.

or

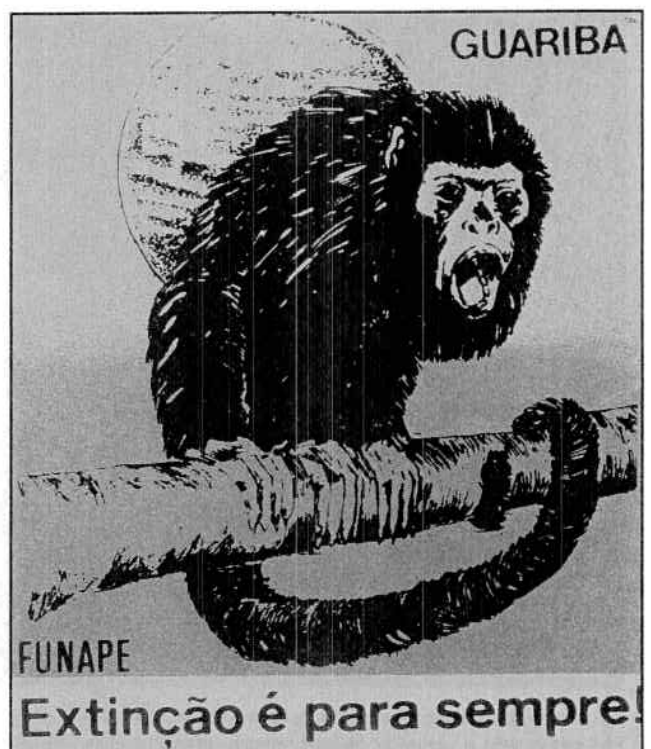
Apartado 6991
Zona 5
Panama City
PANAMA

Campaign for Howler Monkey Begins in Northeast Brazil

Alouatta belzebul, the least studied of the six howler monkey species, is confined to an area south of the Amazon and east of the Madeira rivers in northeastern Brazil. The Department of Systematics and Ecology of the Federal University of Paraiba (UFPB), in association with the Mamanguape Ecological Station under the Secretary of the Environment,



Fig. 7a (above) and 7b (below). Poster and sticker depicting *Alouatta belzebul* being distributed by university students in Paraiba.



has been conducting field studies of this less-known primate. Due to loss of its Atlantic forest habitat and poaching, *Alouatta belzebul* is now threatened with extinction. UFPB students have begun a popular education campaign to conserve the species and its native habitat. With the assistance of an environmental funding agency (GRAMA), they have produced for distribution posters (Fig. 7a), stickers (Fig. 7b) and t-shirts depicting the animal and advocating its cause. It is hoped that a group of *Alouatta* can soon be reintroduced to the Mamanguape Ecological Station, an almost 4,000-ha protected area of Atlantic forest.

More Muriqui Public Awareness Material

The very active Brazilian NGO Friends for the Environment (AMA) of Manhuacu, Minas Gerais, has again produced more promotional materials for its campaign to save the Mata do Sossego, one of the last areas in the state where the endangered muriqui is found. Included among the new materials are stickers, a key chain, and a t-shirt (Fig. 8a, 8b, 8c), all designed by E. Pinheiro, President of AMA and the driving force behind the Mata do Sessego effort.

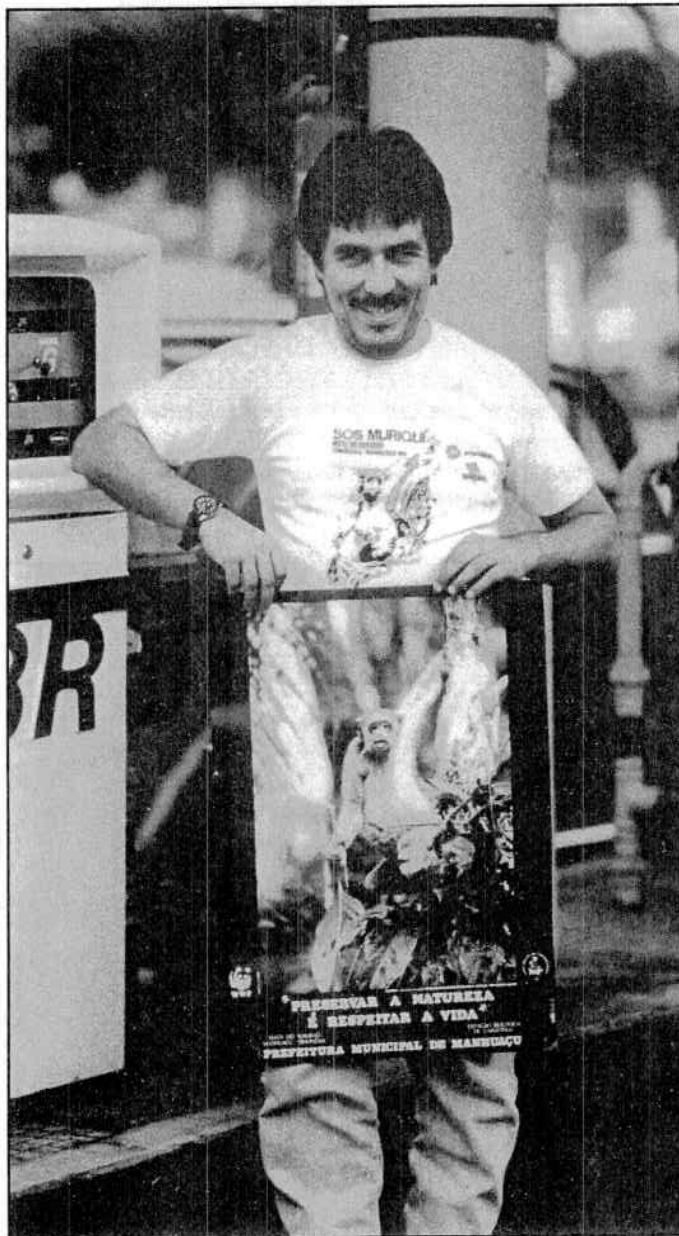


Fig. 8a, 8b, 8c. Materials promoting conservation of the Mata do Sossego. The poster uses a photo by Andrew Young (photo by R.A. Mittermeier)





Fig. 9. The cover of *Ciência Hoje das Crianças*.

Brazilian Magazine *Ciência Hoje* Produces Primate Poster

The Brazilian science magazine *Ciência Hoje* has produced a primate poster for its children's edition. *Ciência Hoje das Crianças* (*Science Today for Children*) No. 9 features a cover photo of the golden lion tamarin (Fig. 9) and a folding poster depicting 13 different species (Fig. 10). Photos were provided by Russ Mittermeier and Andy Young, and the idea for the poster came from Eduardo Marcelino Veadó, Director of the Caratinga Biological Station at Fazenda Montes Claros in Minas Gerais.

Brazilian Research Institute for Nature Preservation

An Institute for the Study and Preservation of Nature has been formed in southern Minas Gerais, within the Horto Monte Alegre on Monte Alegre Farm. The institute will act as an official umbrella under which to continue and expand the conservation activities begun at the horticultural center, which, since its founding in 1978, has focused on reforesting areas in southern Minas Gerais with native plant species.

At the center, researchers conduct seed germination experiments on different native tree species and carry out floristic surveys of the region.



Fig. 10. A primate poster for Brazilian children produced by *Ciência Hoje*.

The herbarium now includes over 1,200 spp. An ornithological survey was conducted in 1981, and so far 230 spp. have been identified. Field research to supply scientific arguments for the conservation of the native forest ecosystems will now be carried out under the auspices of the new Institute. Two projects currently supported by the Institute are a study of forest conservation and the phytogeography of two forest types, and a study of endangered *Callithrix aurita* in forest patches on Lagoa Farm.

The Institute is also very active in promoting nature conservation in the region and members have led several campaigns by writing articles for local newspapers, conducting radio interviews, collecting signatures for petitions, meeting with like-minded politicians, lecturing at schools, and offering forest field trips to students and teachers. The most recent campaign has focused on the issues of poaching and crop raiding.

For more information about the Institute, please direct your inquiries to the Director:

Maria Cristina Weyland Vieira
Fazenda Lagoa
Monte Belo 37132
Minas Gerais
BRAZIL

A Change of Guard at the Gorilla Advisory Committee

PSG Members Sandy Harcourt and Kelly Stewart are to be congratulated on their new positions in the Gorilla Advisory Committee. As of 1 January 1989, they became Chairperson and Newsletter Editor, respectively. The Committee expects to change its leadership every four years in order to encourage an infusion of new ideas and energies and to share responsibilities among committee members.

Stewart and Harcourt may be reached at their address at the University of California at Davis, where they will be until the fall of 1990:

A.H. Harcourt
K.J. Stewart
Dept. of Anthropology
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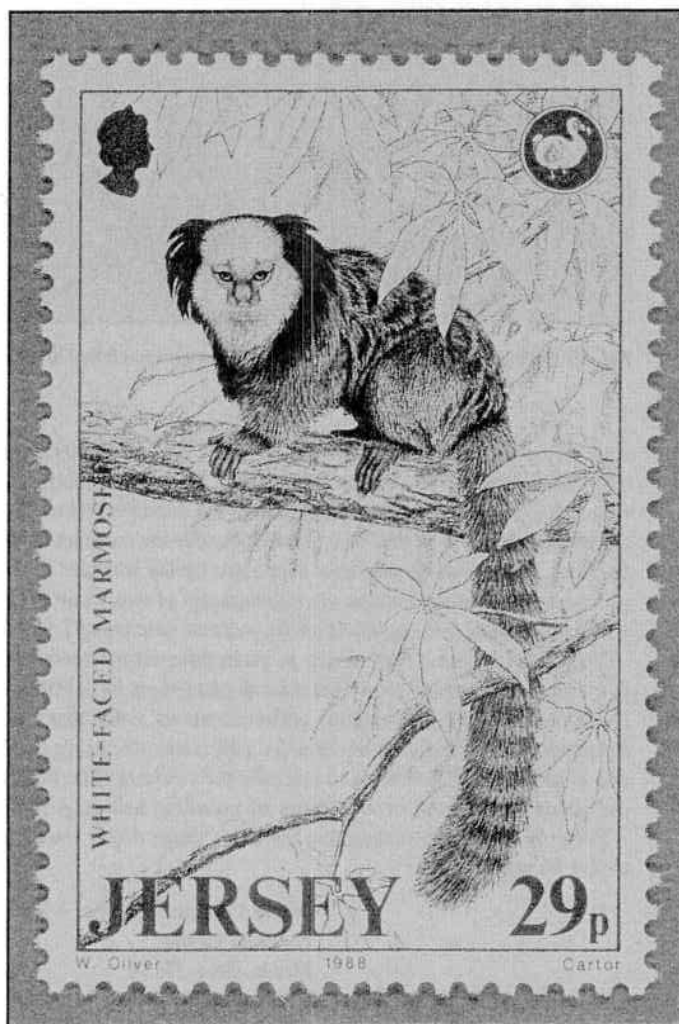


Fig. 11. A new Jersey stamp portrays the white-faced marmoset (*Callithrix geoffroyi*) from the Atlantic Forest region of eastern Brazil.

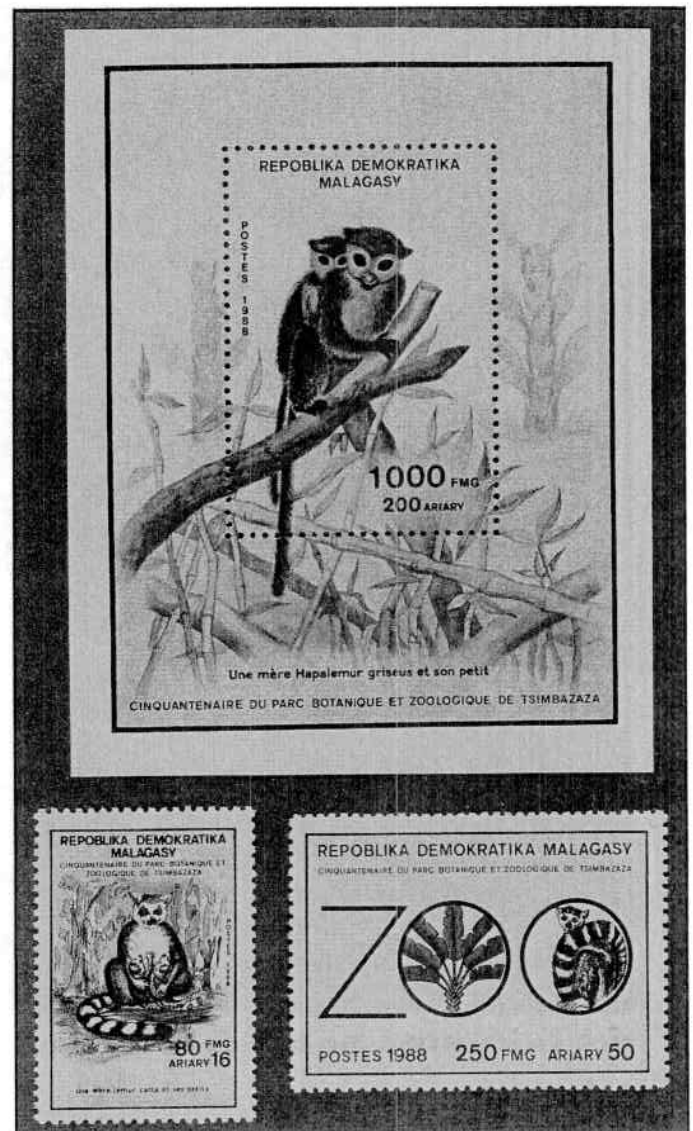


Fig. 12. Three new Malagasy stamps honor the Tsimbazaza Botanical and Zoological Park.

New Primate Stamps

Madagascar produced two new series of stamps in 1988. The first, printed in celebration of the 50th anniversary of the Tsimbazaza Botanical and Zoological Park, includes a souvenir sheet depicting grey gentle lemurs, a stamp of a ring-tailed lemur with twin offspring, and another stamp with a ring-tailed lemur inside the zoo logo (Fig. 12). The second is a four-stamp series of different prosimians: ruffed lemur, indri, diademed sifaka, and broad-nosed gentle lemur (Fig. 13).

The Comoro Islands released four new airmail stamps of mongoose lemurs in various postures (Fig. 14).

In commemoration of the 25th anniversary of the Jersey Wildlife Preservation Trust, the Jersey Post Office released a set of five stamps, one of which portrays the white-faced marmoset (Fig. 11).



Fig. 13. Four new Malagasy stamps feature lemurs.

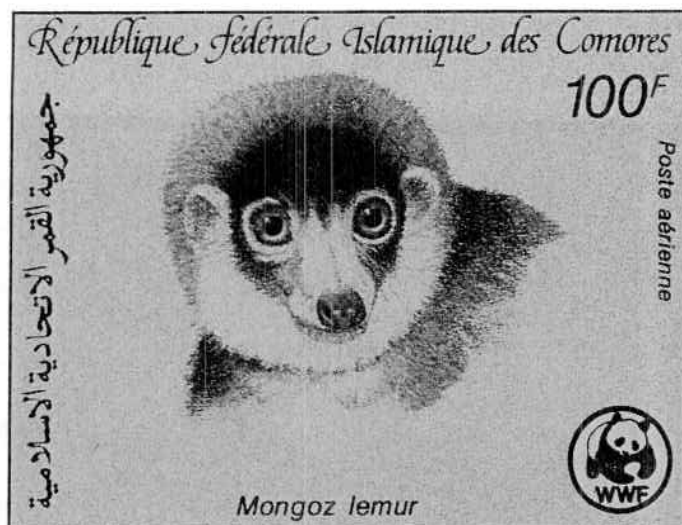


Fig. 14. New airmail stamps from the Comoro Islands depict the mongoose lemur.



Internship Opportunities at Karisoke Research Center, Rwanda

The Digit Fund is dedicated to continuing the program of research on mountain gorillas and their habitat begun by Dian Fossey at the Karisoke Research Center (KRC) of Rwanda. The research center, located in the Parc National des Volcans, was founded by Fossey in 1967 and served as a base for her research and conservation efforts on behalf of mountain gorillas for the next 18 years.

As part of an ongoing effort to expand the scope of research and conservation activities at the center, The Digit Fund regularly makes available one or two internships to qualified individuals who have received a B.S. in behavioral sciences. Preferably, candidates have entered an M.A. program and already have experience working with primates. Each internship appointment is for one full year.

The primary responsibility of the interns is to assist the Director in ongoing behavioral or ecological studies of the gorillas. Interns may also be called upon to assist with periodic censuses of the gorilla population and to collect daily demographic and ranging data on individual study groups. Interns may also have the chance to observe other species or to carry out short-term studies of their own design.

The internship grants include airfare to Rwanda and a basic subsistence allowance for the one-year period of residence. For more information on internship opportunities at the KRC, write to the Executive Director of The Digit Fund:

Claude Ramsey
The Digit Fund
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NEWS FROM THE FIELD

Neotropical Region

On the Presence of *Cebus apella margaritae* On Margarita Island, Northeastern Venezuela

by Ricardo Ottocento, Luis Márquez, Roberta Bodini
and Gerardo A. Cordero R.

Margarita is a Caribbean island located off the northeastern coast of mainland Venezuela (11°11'–10°15' N, 63°46'–64°24' W). Historically, the number of human inhabitants on this island was low (118,830 in the early 1970s) due to emigration to the mainland. The principle occupations of the islanders were fishing, crafts, and, to a lesser extent, farming because fresh water is limited. However, the population has increased rapidly since 1971, due to a resolution issued by the Venezuelan Government declaring Margarita a tax-exempt island and a duty-free port in 1974. It has been estimated by governmental agencies that the island's human population will be greater than a half million by 1990. Local economic activities have changed; duty-free port activities are now the major source of economic development for the island and have to some extent caused a decline in traditional activities. In addition, more and more tourists are attracted by the duty-free business and the natural beauties of the island. The mean number of tourists going to Margarita has ranged from 3,000,000 to 4,250,000 on a yearly basis and from 35,000 to 45,000 on a daily basis (MARNR, 1979).

Among Margarita Island's endemic mammal species, the capuchin monkey (*Cebus apella margaritae*) deserves special attention. *Cebus apella margaritae* (Hollister, 1914) is the only primate species inhabiting the island. Its presence in a place so far from Amazonian forest, the usual habitat for this species, has raised the question of whether or not it was introduced to the island (Rudran and Eisenberg, 1982). However, there have been reports of *C. a. margaritae* on the island since the year 1898 (Robinson, 1898; cited by Allen, 1902), and its taxonomic status has been acknowledged in the twentieth century by Cabrera (1961), Hershkovitz (1949), Hill (1962), and Mondolfi (1976). Specimens have been collected from Cerro Copey, at 300 m, in 1953 (La Salle Museum of Natural History, Venezuela) and in Cerro Matasiete, between 130 and 410 m, in 1965–1968 (Mammals of the Smithsonian-Venezuelan Project, Handley, 1976). Since then, information about its presence at either of these locations is anecdotal.

Cerro Copey, the largest (7,130 ha) and highest (100–988 m) mountain on the island, was declared a national park by a government decree issued in 1974. Cerros Matasiete and Guayamuri were declared a natural monument in 1974. This 1,672 ha monument is located near Cerro Copey and includes elevations up to 600 m. The main vegetation types reported for these two protected areas are tropical dry forest, tropical very dry forest, and premontane humid forest.

Over the past 15 years, rapid and unplanned changes in land-use have seriously affected both protected areas. An increasing human population has developed what once was farming land and pushed farmers up to the borders of the reserves. This movement is such that a large number of people have been reported living within the park at altitudes up to 500 m. The moister soils of Copey have also encouraged excessive timber cutting for small plot plantations locally called *conucos*. These

developments present a two-fold threat to *Cebus*: reduction of optimal habitat, and augmentation of hunting by farmers who consider the monkey a pest in their maize and sugar cane plantations. The monkey has, therefore, withdrawn to the higher parts of the park. The *Cebus* population has probably been reduced by poaching, and this may be the reason that Bisbal (1983) could not record its presence on the island.

R. Ottocento and L. Márquez recently made a three-day preliminary survey of the presence of the capuchin monkey on Margarita Island. On 10–12 October 1988, we visited three towns near Cerro Copey National Park and interviewed 10 farmers who had either seen, captured or were keeping capuchin monkeys in captivity.

We also examined four specimens maintained as pets: (1) A subadult male was captured about three years previously as an infant when his mother was chased away from a small plot of corn, avocado, and *mamey*. The plot was in a forest within the borders of Copey National park and near the town of Tacarigua. The specimen, living in San Sebastian town near Tacarigua, was kept tied to a tree with a 1.5 m chain. His external body measurements were: total length, 75 cm; tail, 42 cm; hindlimb, 11 cm; and ear, 3 cm. His body weight was estimated to be 1.5 kg. (2) An adult female also held in San Sebastian was captured on the same site as Specimen 1 while foraging on the same fruits. This female was kept in a small bird cage (1 x 1 x 1.5 m) and fed fruit and beef. (3) An adult male was bought in a pet shop on Margarita Island; its capture site is unknown. Maintained in Santa Ana town, 4 km north of San Sebastian, this male was restricted to a bird cage even smaller than Specimen 2; .60 x .50 x .80 m. His diet was similar to Specimen 2, but he also foraged on spiders that come near the cage. (4) A subadult female was given as a present to a Santa Ana farming family; its capture site was unknown. This female was usually kept in a homemade cage measuring 1 x 1 x 2 m and was sometimes let free in the family's backyard. However, she was fed inside the cage. Her diet was similar to Specimen 2, but she also foraged on tree leaves.

Body measurements for Specimens 2–4 were not recorded because the owners would not allow any handling of the pets. On some occasions, we tried to get close to the monkeys, but the animals behaved very aggressively. Nevertheless, we took several pictures of all the observed specimens and noted differences in hair color pattern on subadult and adult individuals. In subadults, the pelage of the body is blackish brown, the lateral surfaces of the forelimbs are buff, and the white color around the pelage of the face is especially conspicuous on the forehead. In adults, the pelage of the body is brown; the lateral surfaces of the forelimbs and the breast are reddish yellow, and the forehead is not conspicuously white. Adults of both sexes exhibit frontal tufts, which grow hornlike from each side of the crown. Both age groups of *C. a. margaritae* have faces that are virtually naked except for a few bristly hairs.

Considering our field data, information provided by local people, and the literature, we think that the capuchin monkey presently inhabits forest and cropland habitats in the northeastern part of the island (Fig. 5). However, its actual presence in Cerro Matasiete-Guayamuri Natural Monument has yet to be confirmed.

We do not know if this monkey is an agricultural pest on the island or not. However, since a maximum of only four specimens have ever been captured at a single site (Handley, 1976), we think that the species group size is probably small, which might limit crop damage.

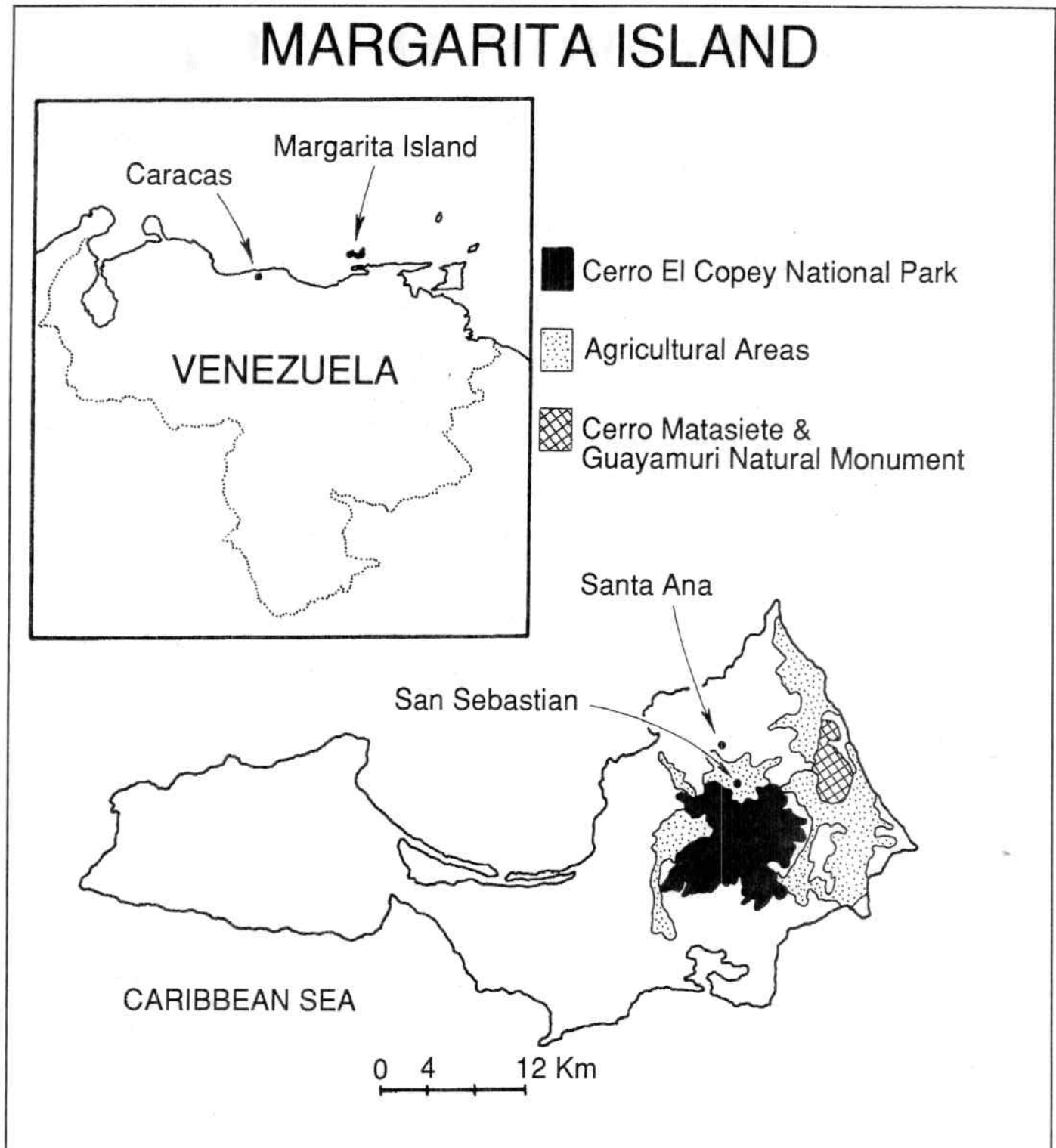


Fig. 5. A map showing the nature reserves and agricultural areas of eastern Margarita Island, Venezuela (map by S. Nash after original provided by authors).

Illegal trading of the capuchin monkey is now a profitable business on the island. On several occasions, farmers tried to sell us monkeys for Bs. 1,500 (US \$41) each. The owners of a pet shop and a plant nursery were also selling capuchin monkeys for the same price. This illegal practice, and rapid changes in land use, are probably the major threats to the survival of this species on Margarita Island.

We plan to carry out in the near future a nine-month field evaluation of this species on Margarita Island. The objectives of our study are to determine the animal's present distribution and status on the island, as well as its exact taxonomic status. We will also record group behavior and evaluate habitat in some locations. After beginning this research, we intend to carry out an education program by publishing information

about the need for the protection and conservation of this monkey endemic to Margarita Island.

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Notes on Monkeys and Habitat in the Northeast of Marajó Island, Brazil

by J. Márcio Ayres, J. Inéz Bonsiepe
and Teresa J. Townshend

Marajó Island is located in the mouth of the Amazon River and is one of the world's largest fluvial islands. The eastern side of the island is characterized by open savannas with small, isolated pockets of forest mainly along river edges; the western side is predominantly forested. Very little information has to date been recorded concerning the primate species which occur on the island.

During a ten-day period between July and August 1988, the authors surveyed Fazenda Santa Maria in the northeast of Marajó Island (Fig. 1) both for primate species and for forest trees. The area consists of extensive open grassland (used for buffalo and cattle ranching), with a narrow belt of taller forest vegetation running along the Amazon delta and along some of the larger inland rivers, all of which are tidal in nature.

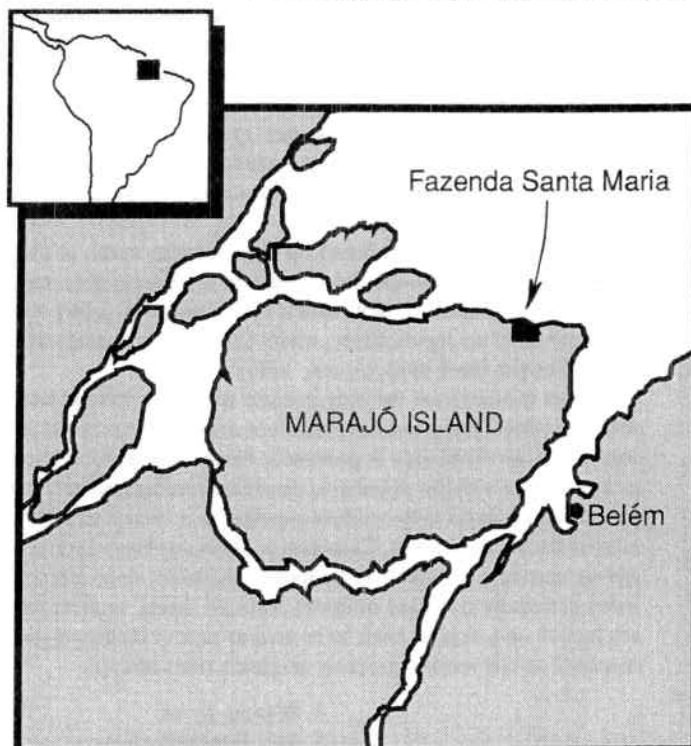


Fig. 1. Map showing the location of Fazenda Santa Maria on Marajó Island (map by S.D. Nash after original provided by authors).

The authors observed only two primate species along a three km stretch of the Rabelo River, beginning at its mouth: squirrel monkeys (*Saimiri sciureus*) and red-handed howlers (*Alouatta belzebul*). Reliable local informants confirmed the presence of only these two primates in this part of the island. A preliminary estimate of group density indicated around 11.6 groups per 10 km surveyed. This is somewhat higher than the usual density for *terra firme* but lower than for *várzea* in the upper Amazon (Ayres, 1986; Johns, 1986). However, over the island as a whole, primate densities are very much lower than elsewhere in Amazonia, since forest represents less than 5% of the eastern part of the island. The majority of primate groups are *Saimiri*; this species accounts for the highest number of individuals but probably, as in other areas, has a lower biomass than *Alouatta*. Group size in *Saimiri* seemed to be smaller (5-15 ind) than in the *várzea* of the upper Amazon (45-50 ind) but this could reflect the foraging strategy being used during the short period of our observations. Groups of 1-4 *Alouatta* were seen, suggesting a similar group size to that typical in the Amazon basin (Milton, 1980). Most groups of *Saimiri* were observed at heights of approximately 2 m, mainly in bamboo thickets. *Alouatta* were seen in trees over 20 m high which occurred in small patches of forest along the river edge.

Vegetation along the Rabelo River consists mainly of bamboo interspersed with patches of forest ranging between 20-30 m in height. For the botanical surveys, three 625 m² plots were established in these pockets of tall vegetation. The plots were located at 100 m(1), 600 m(2) and 2,000 m(3) from the river mouth. Within each plot all trees equal to or greater than 10 cm DBH (diameter at breast height) were recorded.

Of the 64 trees equal to or greater than 10 cm DBH in the 1,875 m² of forest surveyed, only nine species were found. The composition of tree species changed completely from Plot 1 to Plot 3, we found no tree species common to both these plots. The two inland plots, 2 and 3, were closer in species composition. The total basal areas of trees were 2.3, 1.3 and 3.0 m² in Plots 1, 2 and 3 respectively, an average basal area of 2.5 m². This is similar to the mean basal area of 32 plots (two ha) surveyed in Lake Mamirauá, upper Amazon (Ayres, 1986). The most

numerous species in the Marajó plots was the açai palm (*Euterpe oleracea*), with 17 individuals in Plot 3. In terms of basal area, however, the two most important species were *caxinguba* (a *Ficus* sp.) and *ucuuba* (*Virola surinamensis*), though these were not present in Plot 1. *Tapereba* (*Spondias* sp.) was also an important species in Plots 2 and 3. The predominant species in Plot 1 were *siriuba* (*Avicennia nitida*), *jarduba* (unident.) and *mangue* (*Rhizophora mangle*), all plants characteristic of coastal mangrove forest.

Of the nine tree genera found, at least six also occur in the upper Amazon. However, the species diversity in the Marajó plots was much lower than that found in plots of a similar size in the upper Amazon, at the mouth of the Japurá River, which contained an average of around 50 species per three plots (Ayres, 1986).

Howler monkeys are the only primate species in Marajó which are hunted for food, but it was not possible to evaluate the pressure of hunting, as the surveyed area is protected. Since most of Marajó consists of large farms with low population densities, hunting probably does not pose a serious threat to the primate populations in most areas. However, close to the towns of Soure, Cachoeira do Arari and Santa Cruz do Arari, howler monkeys are likely to be more vulnerable, their forest habitat being extremely restricted in extent. Around Soure, squirrel monkeys are hunted on a regular basis to be sold as pets in Belém; most of the monkeys at this market probably originate from Marajó.

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Mona Monkeys of Grenada

by Lois K. Lippold

Two seasons have been spent identifying, censusing and collecting preliminary feeding and behavioral data on the introduced monkeys of Grenada, West Indies. Surveys were conducted during the rainy (1987) and dry (1989) seasons and will continue until a management program can be put into practice for this species.

Allen (1911) and Eliot (1912) identify the species as *Cercopithecus mona* (see also Booth, 1955; Oates, 1988) and our observations confirm this. Both sexes have the characteristic circular to oval white spots on either side of the root of the tail. Their general coloration consists of

white supraorbital band, inner thighs and forearms; black outer arms, legs and tail, and a brown back. The time and method of their introduction to Grenada are topics of present research, although it is generally believed that monkeys were one of several trade items brought with slaves from Africa to the Caribbean in the 17th century (Eaden, 1970).

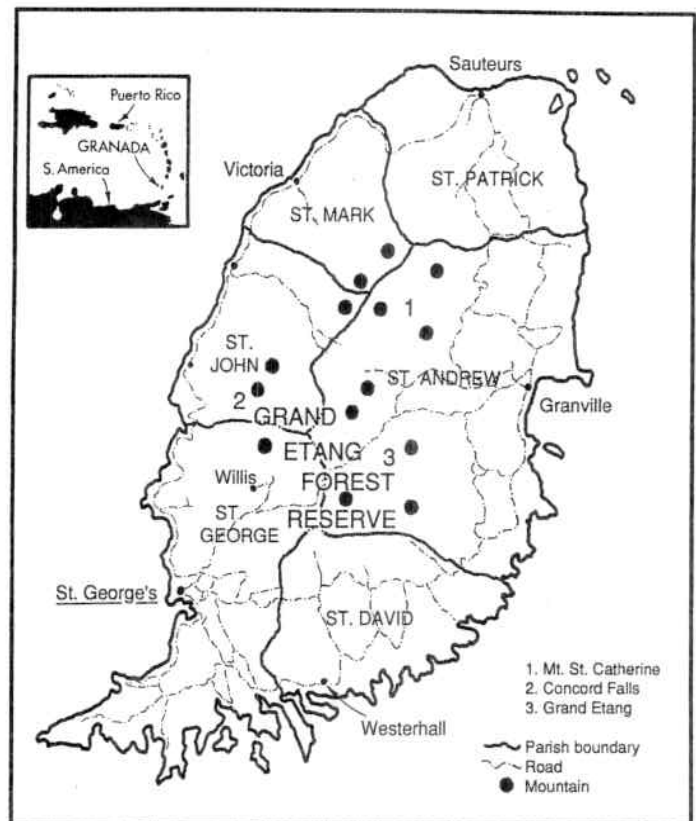


Fig. 1. Map of Grenada showing central mountain chain and locations of mona monkey groups (map provided by author).

Grenada, 34 by 19 km and of volcanic origin, offers various habitats for monkeys, from mangrove forests at sea level to elfin woodland and palm brakes at the highest elevations (907 m). The central mountain chain (Fig. 1) is characterized by a band of tropical rainforest with species such as: *Manilkara zapota*, *Anacardium occidentale*, *Spondias mombin*, *Annona muricata*, *Guazuma ulmifolia*, *Chrysophyllum cainito*, *Artocarpus heterophyllus*, *Calocarpum mammosum*, *Inga laurina*, and *Ficus grenadensis*. Family farms border this band of tropical forest vegetation, and considerable forest areas are cleared as families expand, since it is a Grenadian practice to apportion part of the family farm to a family member at adulthood.

Our surveys were carried out in various locations reported to support monkey groups. Monkeys were sighted on some occasions but heard much more frequently. Attempts were made to count all monkey groups that were encountered. The difficulty of observing monkeys in Grenada's thick rainforest vegetation coupled with the frequent hunting of monkeys made observations and accurate counts of monkey groups difficult.

Groups were found to be confined to the tropical rainforest band where they utilize the middle canopy of the forest. Distribution of groups varied seasonally, with groups closer to forest farm borders in the dry season when forest fruit food sources were scarce. Monkey groups were always close to continuous water sources.

While there are no early estimates of mona populations, Groome (1970) reports that the hurricane of 1955 reduced their numbers significantly. The arrival of Cubans in Grenada brought gun confiscation, which may have allowed the monkey population to regenerate in the heavily wooded mountainous regions.

Groups usually consist of a single adult male, called a *jack* by the locals, and several females with infants and some juveniles. Group size varied seasonally with numbers ranging between 15-30. Hunters indicated that they had seen groups of more than 150, although we never actually located groups of this size. Sex determination of immatures was not possible due to the difficult observation conditions. Hunters reported that solitary animals also occur, usually adult males.

Table 1. Mona Population Estimates from Three Locations

Site	No. Groups	Ind.
Mt. St. Catherine	6	180
Concord Falls	3	90
Grand Etang	5	150

Monkeys have long been a source of food on Grenada, and a hunting season is in effect in the Grand Etang Forest Preserve. In other areas, the monkeys are shot whenever they are deemed pests by the farm owners. If a farmer does not own a gun, he may ask members of the hunting club to come and kill the pests. He could also call upon licensed hunters who make a living killing animals that are considered pests. Generally, though, farmers kill the monkeys themselves since landowners usually are members of the hunting clubs.

Several hunting clubs have formed on the island since the 'intervention' and one of the favorite species to hunt is monkey. Discussions with hunters revealed that each hunter tries to kill one to three monkeys each hunt. Far more disturbing than the number of monkeys taken, however, is the practice of targeting first the adult male leader. Apparently his death disrupts and confuses the group so badly that many more animals can be killed.

Recently there has emerged a new threat to the monkeys' survival. Over the last few years, cruise ships have been docking more and more frequently at Grenada. For some tourists, eating 'bush meat' at local restaurants is an adventure. In at least two establishments, monkey is now served along with *manicou* (*Didelphis marsupialis*) and *tatu* (*Dasyprocta novemcinctus*). A quick calculation shows that if a restaurant served even three monkeys per week, 156 monkeys would be needed per restaurant per year. Our preliminary estimates of the mona population suggest that this harvest cannot continue without severely reducing the monkey population.

Unless a management program is put into action quickly, the mona will meet the fate of several other introduced mammalian species. Research has revealed archaeological evidence (Lippold, 1989) of the presence of agouti (*Dasyprocta leporina*) and rice rat (*Oryzomys* sp.), species which are now rare or extinct on Grenada, undoubtedly as a result of human exploitation.

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Research helped in the exploration of many habitats. This research was supported by two grants from the Foundation for Field Research.

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Primates in Cabo Blanco Absolute Nature Reserve, Costa Rica

by Lois K. Lippold

The tropical forests of Costa Rica contain sympatric primates whose ecology has been studied by several investigators (Chapman, 1988; Clarke, 1982; Fedigan *et al.*, 1985; Fishkind and Sussman, 1987; Freese, 1976; Glander, 1975; Moscow and Vaughan, 1987). The present study was undertaken to collect data from a lowland moist evergreen forest (Hartshorn, 1983), unstudied until now, and to assess the present status of primates in Costa Rica's first reserve.

Cabo Blanco Absolute Nature Reserve was established on 21 October 1963 (*Los Parques Nacionales y Areas Afines de Costa Rica*, 1987) through the efforts of Olaf and Karen Wessberg, dedicated conservationists who had the foresight to locate the land and the energy to raise funds to purchase it. *Alouatta palliata*, *Ateles geoffroyi*, and *Cebus capucinus* were all reported in the new reserve.

Cabo Blanco is located at the southwest tip of the Nicoya Peninsula in Puntarenas Province. Consisting of several steep mountains and rugged cliffs, it is surrounded on three sides (east, south and west) by the Pacific Ocean and on the north by privately owned land (Fig. 1), most of which has been methodically reduced to cattle pasture by years of slash-and-burn farming and logging.

Within the reserve, several spring fed streams provide a year-round water source. The tall (30-40m) forest is dominated by tree species such as: *Calycophyllum candidissimum*, *Haematoxylon brasiletto*, *Muntingia calabura*, *Cassia grandis*, *Bomacopsis quinatum*, *Manilkara zapota*, *Guazuma ulmifolia*, *Anacardium excelsum*, *Inga* sp., *Cecropia peltata* and *Luehea speciosa*.

Census counts were made by direct observation of primate groups (NRC, 1981; Fedigan *et al.*, 1985). Two teams identified, sexed, then counted groups frequently during both seasons. Howling monkeys were first differentiated by age (adult, immature, infant), then separated by size (large and small). Since immature males lack scrotum development (Fedigan *et al.*, 1985), only adults were sexed.

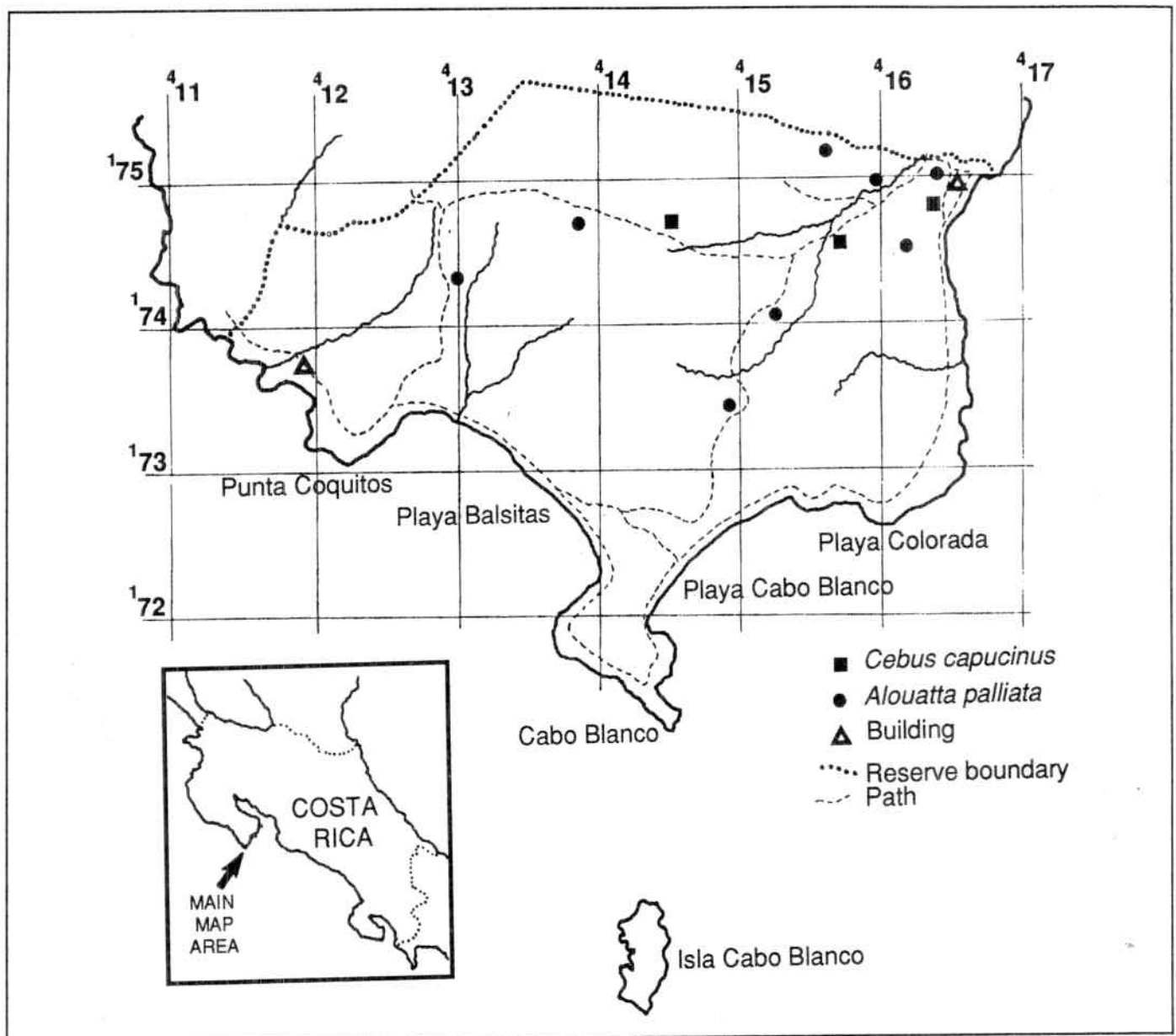


Fig. 1. Map showing the Cabo Blanco Absolute Nature Reserve, Costa Rica (Map by S.D. Nash, based on authors original).

Cebus monkeys were differentiated into the same categories as howling monkeys. Only adults were sexed, using Oppenheimer's (1968) characteristics such as facial hair, head shape and tuft presence. Large immatures were qualitatively differentiated from small immatures based on body size and facial characteristics (Lippold, 1988).

Table 1. Cabo Blanco Primates

Species	No. Groups	No. Individuals	No. Solitary Animals
<i>Alouatta palliata</i>	8	105	14
<i>Cebus capucinus</i>	3	65	8
<i>Ateles geoffroyi</i>	0	0	0

* We were unable to locate any *Ateles geoffroyi* in Cabo Blanco during either season. Discussions with the reserve staff revealed that they had

not located *Ateles* in their tenure at Cabo Blanco. Villagers living around the reserve when it was purchased in 1963, remembered that spider monkeys could be found in Cabo Blanco. They also reported that all (one source said 11) of these monkeys were collected for food and medicinal purposes soon after the reserve opened (Lippold, 1988).

Eight groups of *Alouatta* with a combined total of 105 individuals were counted. Group sizes range from 8 to 19 members with an average size of 14.87 individuals. Fourteen solitary howling monkeys were located; of these, 6 were adult females and 8 were adult males (Lippold, 1988).

Three groups of *Cebus* were located with a total population of 65 and an average group size of 22.66. Eight solitary adult *Cebus* were observed; of these, 3 were female and 5 were male (Lippold, 1988).

From the information presented, it appears that Cabo Blanco Absolute Nature Reserve contains only two sympatric primate species: *Alouatta palliata* and *Cebus capucinus*. All indications are that *Ateles geoffroyi* is extinct and that its loss occurred soon after the reserve opened in 1963.

Study continues at Cabo Blanco to assess the impact of the *Ateles* extinction and other demographic, behavioral and ecological parameters of the remaining primate species. Comparison of Cabo Blanco to other Costa Rican parks with intact populations of *Alouatta*, *Ateles* and *Cebus*, such as Santa Rosa (Freese, 1976; Fedigan *et al.*, 1985; Chapman, 1988) is revealing important aspects of primate population dynamics and adaptation.

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Madagascar

The Mayotte Lemur: Cause for Alarm

by Ian Tattersall

The island of Mayotte, which lies at the northern end of the Mozambique Channel between Mozambique and Madagascar (Fig. 1), is home to the indigenous primate subspecies *Lemur fulvus mayottensis*, a descendant of the Malagasy *L. f. fulvus*. When the island was first surveyed in 1974-5 (Tattersall, 1977a, b) the Mayotte lemur appeared secure, as it still did in 1977 and even (despite some habitat loss) in 1980 and 1982, during a period when the situation of the mongoose lemur (*Lemur mongoz*) on the neighboring islands of Ndzuani and Moili had very severely deteriorated (Tattersall, 1983). A new assessment in 1987, however, revealed an alarming decline in the population of the Mayotte lemur over the past few years. For the first time, we must be seriously concerned for the future of this primate (Fig. 2).

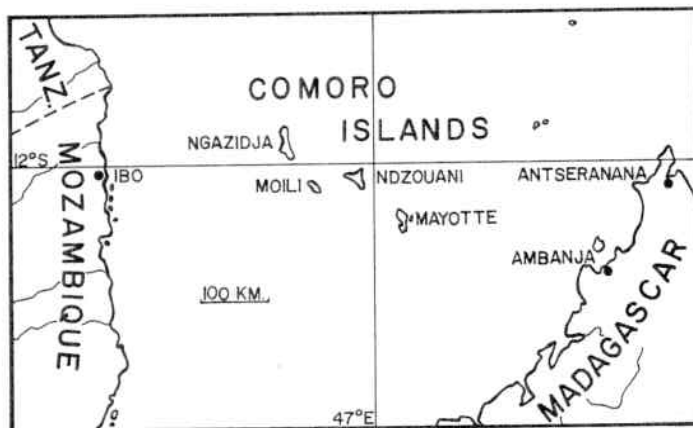


Fig. 1. Map showing the location of Mayotte and adjacent islands in the northern part of the Mozambique Channel (map provided by author).

When first studied, the Mayotte lemur was found to be abundant in the lowland secondary forest formations that covered much of this 375 km² island, occurring in densities of up to 1,000 ind/km² and with a total population in 1975 of perhaps 50,000 individuals (Tattersall, 1977a, b). Since then, its fate has been closely tied in with political developments and the economic changes attendant upon them.

Until the mid-1970s, Mayotte and the three neighboring islands of the Comoro group constituted an internally self-governing Overseas Territory of France. In late 1974, a referendum was held on the future of the archipelago: the other three islands voted for independence, and Mayotte solidly against. A complex series of political events followed, resulting, by the 1980s, in the independence of the three islands, which now constitute the Federal Islamic Republic of the Comores, and Mayotte attaining the special status of a 'foreign territory' of France. Politically this status is somewhat ambiguous, but it has served to bind Mayotte closely to the French Overseas Department of Reunion, and its principal economic effect has been an explosion of infrastructural development in the island. A couple of examples may help to convey the extent of this development: in 1975, there were only thirty motor vehicles on the 'Grande Terre' of Mayotte (though others were driven on the small administrative islands of Dzaoudzi/Pamanzi, a couple of miles offshore). By 1987, vehicle registrations were running at the rate of 700 per year. While a mere handful of expatriates lived on the main island of Mayotte in 1975, hundreds do today.



Fig. 2. Adult female *Lemur fulvus mayottensis*. This primate now faces accelerating loss of habitat, which may already have produced a 50% population decrease over the past 15 years (photo by I. Tattersall).

Particularly worrying from the point of view of the fauna has been the initiation of an extensive road-building program. In 1975 there was only one paved road and this failed to span the island; now the island may be crossed in several places on all-weather roads, and similar roads ring virtually its entire periphery. The result is that, while most of the island was previously inaccessible except on foot or by boat, now there is no area which can really be described as 'remote.'

The direct consequences of this road construction on the vegetation have been severe, with broad swathes of forest destroyed, particularly along the west coast. More worrying by far is the opening of so much more forest area to exploitation of the slash-and-burn kind that impoverishes the soil and in a few years replaces forest with grassland and erosion. During my most recent reconnaissance on the island, in late September 1987, it rapidly became clear that a significant portion of the land which in 1975 had borne lemur-supporting secondary formations has now been reduced to brush and eroding grassland. The rapid increase of the human population of Mayotte, from some 40,000 in 1974 to some 60,000 now, can only hasten this process of destruction.

It is now clear that the lemur population of Mayotte, until so recently stable, cannot simply be left to manage for itself if it is to survive. It is impossible to estimate accurately the present level of the Mayotte lemur population on the basis of the brief survey of September 1987, but my subjective impression is that since 1975 it may have fallen by as much as 50% or more, in step with the decline in its habitat. Urgent action is thus needed while tracts of forest that can be set aside for protection still exist; persuasive hydrological arguments exist for doing this, quite apart from questions of faunal preservation. New surveys to determine which forested areas are most suitable for preservation need to be carried out, since the rapidly changing situation has made my earlier recommendations obsolete. Such surveys could very simply be incorporated into the frameworks of ongoing infrastructural projects, such as that for the construction of a port at Longoni, on the east coast.

Unfortunately, absolutely no political will exists in Mayotte to protect the forests or the fauna of the island. Any initiative to establish and maintain the forest preserves vital to the future of the Mayotte lemur will have to come from France. I urge any Primate Specialist Group members

or others who may have influence in conservation or governmental circles in France to bring the rapid decline of this unique primate to the attention of those who may be able to affect conservation policy in Mayotte. Only intervention from the top can provide the impetus required, and only rapid intervention will ensure that adequate habitat will exist to be saved. As recently as 1983 I was able to write with little sense of urgency that "while it would be alarmist at this point to claim that the Mayotte lemurs are threatened, these primates do face a severe curtailment of their habitat in the longer term" (Tattersall, 1983: 25). Little did I then imagine how short that longer term would be.

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Hairy-Eared Dwarf Lemur Rediscovered (*Allocebus trichotis*)

by Bernhard Meier and Roland Albignac

A population of the hairy-eared dwarf lemur (*Allocebus trichotis*) was rediscovered by Bernhard Meier of the Ruhr-University in Bochum, West Germany. It was found in a remote rainforest of northeastern Madagascar, and marked the first time a live specimen was available for study (Meier and Albignac, 1990).

Previously, our entire knowledge of the species was based on five museum specimens, with virtually no information on its ecology, ethology, or conservation status. *Allocebus trichotis* was described by Albert Gunther in 1875, based on a specimen he found in a consignment to the British Museum (Natural History). But the true origin of the specimen was unknown, labeled simply as coming from "South Madagascar."

Additional specimens were not found until 81 years later when Jean-Jacques Petter and his wife discovered fragments of two other specimens in the Museum d'Histoire Naturelle in Paris. The incomplete skins originated from Humboldt's travels in 1880, and were simply labeled as coming from "Madagascar." The French naturalist André Peyrieras was presented with a live specimen by workers of a French colonial road-building company in 1964. He took it to be a strange looking mouse lemur (*Microcebus*), which was later preserved in Malagasy rum. Only upon arrival at the museum in Paris was it identified as *Allocebus trichotis* by Petter. This was the first specimen of known origin, taken from the coastal rainforest near Mananara.

Three years ago a specimen was found in the Naturhistoriska Riksmuseet in Stockholm by Gene Albrecht of the University of California. This specimen was of unknown origin; a label on the leg reading "Nanaka" was not very informative.

A few years after the Peyrieras specimen was taken, several attempts to find the hairy-eared dwarf lemur were unsuccessful. More recently,



Figure 1. Hairy-eared dwarf lemur (*Allocebus trichotis*) (photo by B. Meier).

Meier found *Allocebus trichotis* in April of 1989 in lowland rainforests of the Mananara region, about 40 km south of where the Peyrieras specimen had been taken. Four specimens (two pairs) were later captured by Roland Albignac and are being maintained as the nucleus of a captive breeding group in conjunction with the UNESCO MAB Project in the Mananara region. This integrated conservation and development project is helping the Malagasy government and local people in efforts to protect a 23,000 ha tract of tropical lowland rain forest, the single largest remaining tract of rainforest in Madagascar.

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Asia

The Status of the Hamadryas Baboon in Saudi Arabia

by Sylvain Biquand, Veronique Biquand-Guyot and Ahmed Boug

The hamadryas baboon (*Papio hamadryas*) is the only nonhuman primate living in Arabia, and the only baboon on the Asian continent. Hamadryas also occur in Ethiopia and Somalia. The Arabian and African populations are now completely separated by the Red Sea. Two hypotheses are proposed for the geographical origin of the species: an Arabian origin (from some African pre-hamadryas ancestor) followed by a secondary move into Africa, or an African origin followed by a later colonization of Arabia. These hypotheses and the role of ancient Egyptians in the importation of the sacred baboon to one or another coast of the Red Sea are discussed in Kummer *et al.* (1981).

The status of *Papio hamadryas* in Saudi Arabia has not been studied in detail until now. Harrison (1964) and Kummer *et al.* (1981) broadly define the shape of this baboon's distribution, but they do not investigate the factors limiting its range. Although the hamadryas is adapted to the semi-desert environments of Ethiopia and Arabia, a rapidly increasing human population has encroached upon its territory and created a new environment which has led the hamadryas to develop commensal behaviors.

Under the auspices of the National Wildlife Research Center, we are conducting a study to survey the hamadryas population, evaluate the significance of commensalism, and propose ways of managing the established commensalism and averting its extension. We present here the first results of a survey conducted from December 1987 to June 1988. Working along four transects which followed main wadis (watercourses) across the Asir Mountains (Fig. 1), we observed and counted baboons,

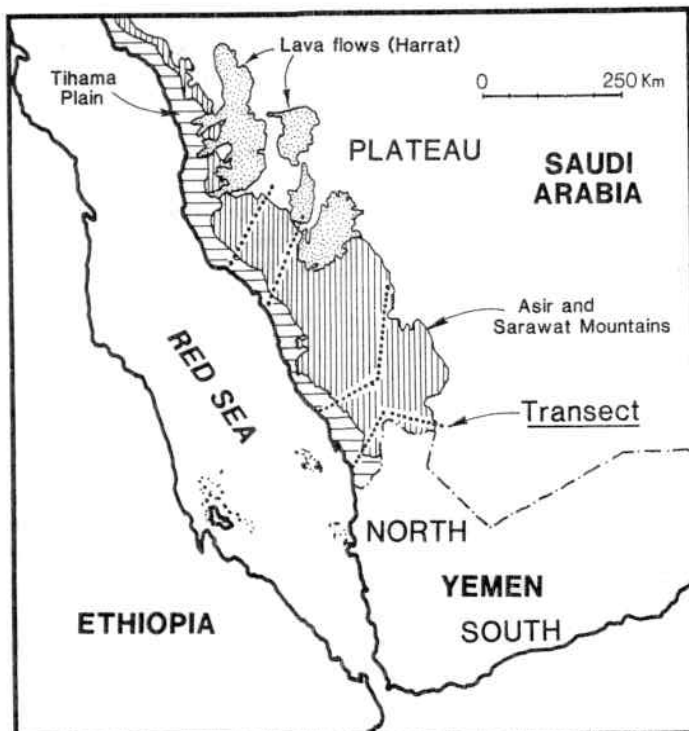


Fig. 1. Map of southwest Arabia showing the transects followed during the study and the main orographic features (map by S. D. Nash).

described vegetation, and interviewed local inhabitants to assess their attitude toward baboons and to gather information on the seasonal presence of the animals, problems with crop raiding, status of predators, and availability of water.

The hamadryas is found throughout the Saudi Arabian Asir and into part of the southern Hijaz (Fig. 2). Its distribution reaches the Yemen border to the south and it is reported to be common in North Yemen. The eastern limit of the distribution is defined by water availability. Foraging groups are found by the large permanent wadis flowing to the desert (e.g. Wadi Turabah; Fig. 2), but they are absent on the dry flat lava flows edging the desert where free-flowing water is not regularly available (e.g. Harat Nawassif; Fig. 2). The western limit varies according to the availability of sleeping sites on cliffs or steep rocks. Where the mountains reach the coast (as in Al Birk; Fig. 2), baboons are usually present. Sleeping sites are not found in the sandy Tihama Plain; groups that wanted to feed during the day on doum palms (*Hyphaene thebaica*) growing on the banks of the Wadi Reem, which flows through the plain, would follow this river as far as 10 km from the mountain edge to do so and then return to the cliffs for the night. The northern limit fixed by Harrison (1964) and confirmed by Kummer *et al.* (1981) should be revised. Hamadryas occur in Wadi Starrah (23°00' N) and may be present even further north (S. Colenette and B. Balman, pers. comm.). We plan to investigate this range extension in the near future. The distribution of hamadryas does not appear to be related to elevation. We encountered animals at sea level and at altitudes up to 2,600 m.

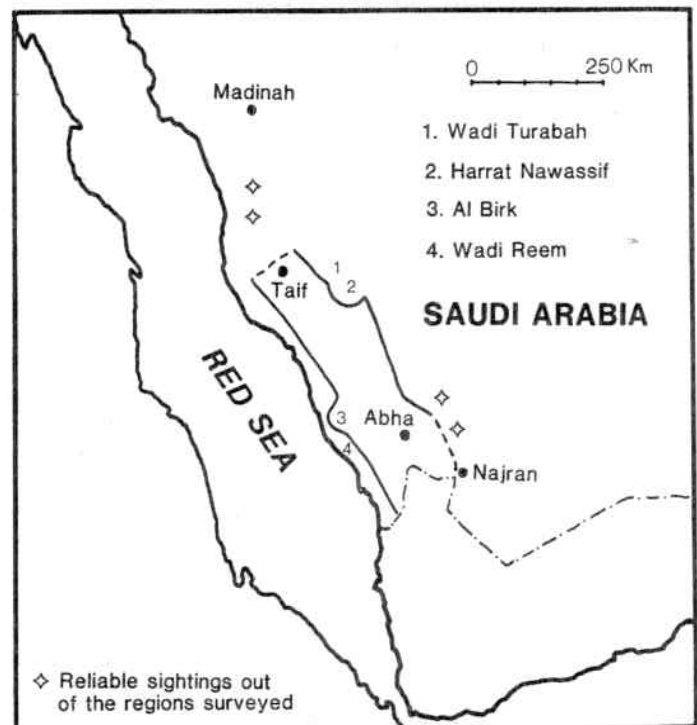


Fig. 2. The distribution of *Papio hamadryas* in Saudi Arabia. (1) Wadi Turabah, (2) Harat Nawassif, (3) Al Birk, (4) Wadi Reem (map by S. D. Nash).

The Problem of Commensalism

Papio hamadryas are commensal with people throughout their range in Saudi Arabia. This close relationship is facilitated by the fact that people seldom hunt baboons and farmers sometimes even feed them when



Fig. 3. A male hamadryas waiting for food near the road (photo by S. Biquand).

wild vegetation is scarce. Local conditions such as the size and behavior of the human population and the number of domestic ungulates give rise to several different varieties of commensalism. In our study area we found four primary feeding strategies, each demonstrative of a different hamadryas-human relationship:

- (1) Feeding on natural vegetation. Wild groups forage in small one-male units (the typical polygynous structure of the species) or in clans (several units together). They flee when people approach and stay in view, barking at the intruder from a distance (giving a two-phase warning sound).
- (2) Raiding crops or gardens more or less frequently and feeding only partially on natural vegetation. The raids, usually very brief, are undertaken by large groups (40-150 individuals) which silently flee as soon as they detect a human presence.
- (3) Scavenging at garbage dumps. Scavenger groups become very large, including as many as 400 individuals. Hamadryas in these groups are not afraid of people and their foraging time is limited only by the abundance and quality of food. Their numbers may increase in a reduced area with no relation to the carrying capacity of the natural environment, making them totally dependent on the dumps.
- (4) Consuming food directly proffered by humans and feeding very little on natural vegetation. Provisioned groups exist in the principal cities of Asir. A troop we observed in Abha had the following daily program: in the morning, the baboons waited near the escarpment road for food thrown to them from cars (Fig. 3); in the afternoon, they took advantage of the human siesta to enter gardens and houses; later in the day, they wandered around the public garden where people fed and teased them as afternoon entertainment. These groups

appear to be a nuisance and are certainly a potential public health hazard (Nasher, 1988).

Conclusion

The hamadryas is still widespread in Saudi Arabia. However, a part of the population has become dangerously dependent on human activities. Since this dependence level varies according to local conditions, solutions to the problem of commensalism must be designed to suit each situation. Our goal is to manage the existing commensal concentration while simultaneously preventing wild populations from shifting to commensalism. In addition to advocating appropriate management of dumps, we are investigating the use of electric fencing around limited areas, and experimenting with aural and chemical deterrents. We will also evaluate the possibility of population regulation by means of fertility control.

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New White Leaf Monkey Observed in Southeast Sabah

Andrew Johns and staff from the Sabah Wildlife Department have observed a white form of *Presbytis* in the Danum Valley Conservation Area and the surrounding Ulu Segama Forest Reserve in southeast Sabah (Fig. 1). Individuals of this new form are entirely white in color and were first assumed to be albinos of one of the two other *Presbytis* spp. present: the red leaf monkey (*P. rubicunda*) or the grey leaf monkey (*P. hosei*). On closer inspection, however, pigmentation was observed in the eyes, face, and exposed skin under the tail. Infants display the same coloration as adults.

The white leaf monkeys were almost always observed associating with either *P. rubicunda* or *P. hosei*. Reds and greys very rarely associate with each other. Up to six whites (including infants and juveniles) have been observed together, although the average number of white animals seen at one time was 3.5 individuals. This is less than the average group

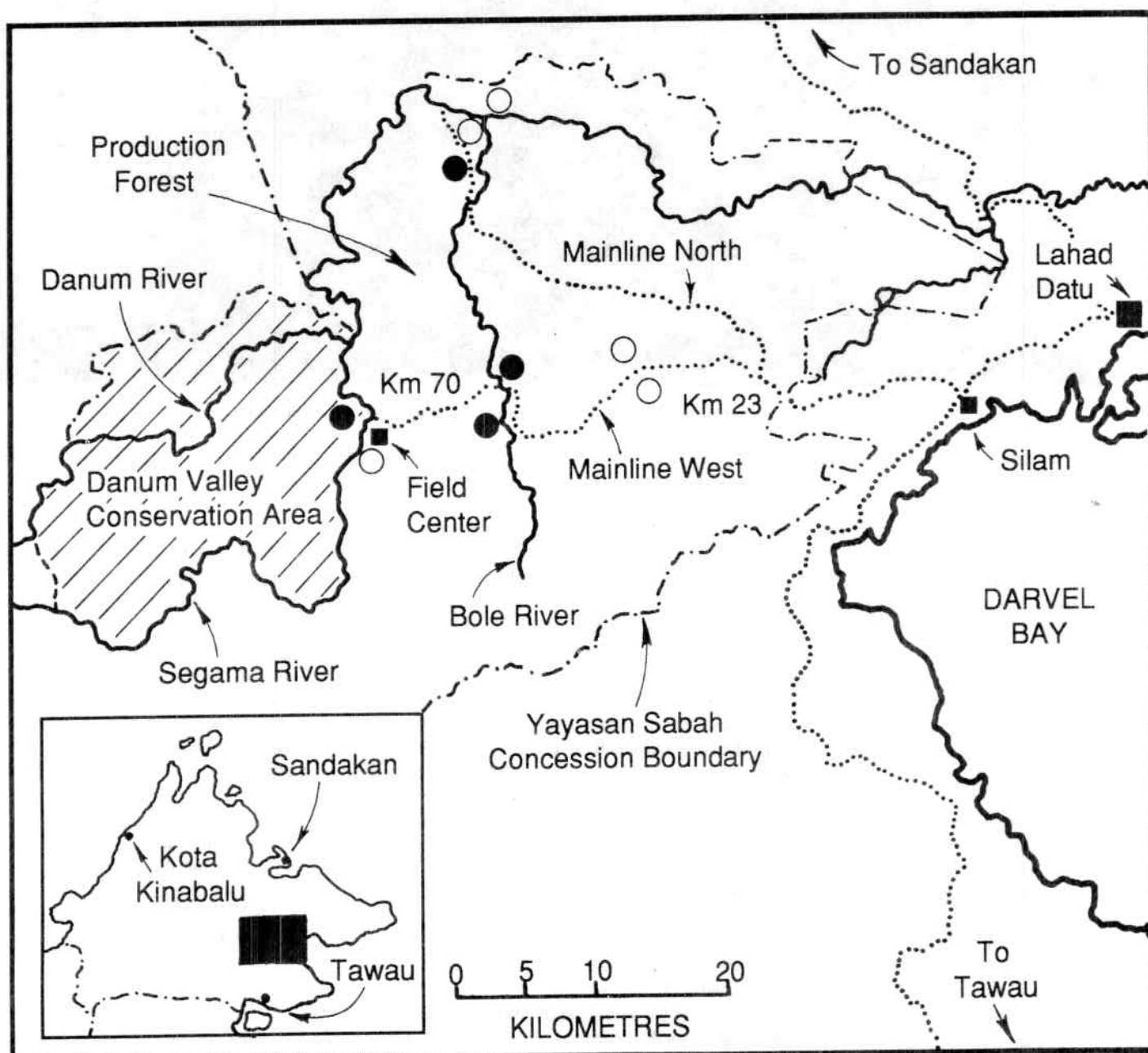


Fig. 1. Map of southeast Sabah showing areas where white leaf monkeys have been observed (closed circles) and surveyed areas where white leaf monkeys have not been observed (open circles; map by S.D. Nash based on original by A. Johns).

size for the other *Presbytis* species. Whites exist in densities of up to 1.2 groups/km² in the region of their occurrence, reds may reach 2.6 groups/km², and greys 1.6 groups/km².

The taxonomic status of these white leaf monkeys is unclear. Their alarm calls are unlike those of either reds or greys. The face patterning of individuals associated with a group of greys, however, matched that of these monkeys. Perhaps the whites represent fertile hybrids of reds and greys (which are of the same subgenus of *Presbytis*), although hybrids have never been recorded previously despite the sympatry of reds and greys over almost the whole of Borneo.

Surveys carried out in the region, supported largely by the Royal Society of London, have found the animals in a number of locations around the Bole River. White leaf monkeys have only once been observed more than a few kilometers from this river. J. MacKinnon, who worked around the mouth of the Bole in the late 1960s, did not observe these animals. However, J. Payne, of the Sabah Wildlife Department, recalls reports of white leaf monkeys from south of the current study area.

Although occupying a very limited range, the monkeys do not appear to be in any immediate danger. The forests over most of their known range have already been logged intensively, and the primates appear to have survived the process remarkably well. Long-term monitoring of the logged-over forests will continue to provide data on the status of primates in the region.

An intensive study of *Presbytis* in southeastern Sabah is planned in 1989 to resolve these taxonomic questions and increase our understanding of the genus' ecology and status.

Johns has sent an open letter to the Chairman of the Danum Valley Management Committee detailing the white leaf monkey's situation.

Golden Langur in the Royal Manas National Park of Bhutan

by Purna Bahadur Subba and Charles Santiapillai

Bhutan has five species of primates: the rhesus macaque (*Macaca mulatta*), the Assamese macaque (*M. assamensis*), the common langur or leaf monkey (*Presbytis entellus*), the capped langur (*P. pileatus*) and the golden langur (*P. geei*). According to Jackson (1981), the golden langur is considered to be endemic to Bhutan. However, it is also known to occur in the Goalpara District of Assam (Mohnot, 1980) and in parts of the Garo Hills, south of the Brahmaputra River (Gee, 1961). It is quite probable that in the past the golden langur had a much wider distribution along the foothills of the eastern Himalayas than it does today. At present, known populations of the langur are restricted to a narrow strip of forest along the Bhutan-India border, extending from the Sankosh River in the west to the western bank of the Manas River in the east (Fig. 1). Despite being well known, this langur is the least studied species of primate found in Bhutan. The information presented here was collected on a survey of the Royal Manas National Park conducted by the Department of Forestry and the World Wildlife Fund in March 1988.

The Royal Manas National Park is situated in the Galygpug Dzongkhag in Bhutan and extends from the Alabari River in the east to the Sukun-taklai River in the west. It covers an area of 658 km², through which flows the Manas River. To the south, the park is contiguous with the Indian Manas Tiger Reserve, which has a core area of 391 km². Thus, the entire Manas ecosystem extends over 1,000 km², making it one of the most important conservation areas on the Indian subcontinent.

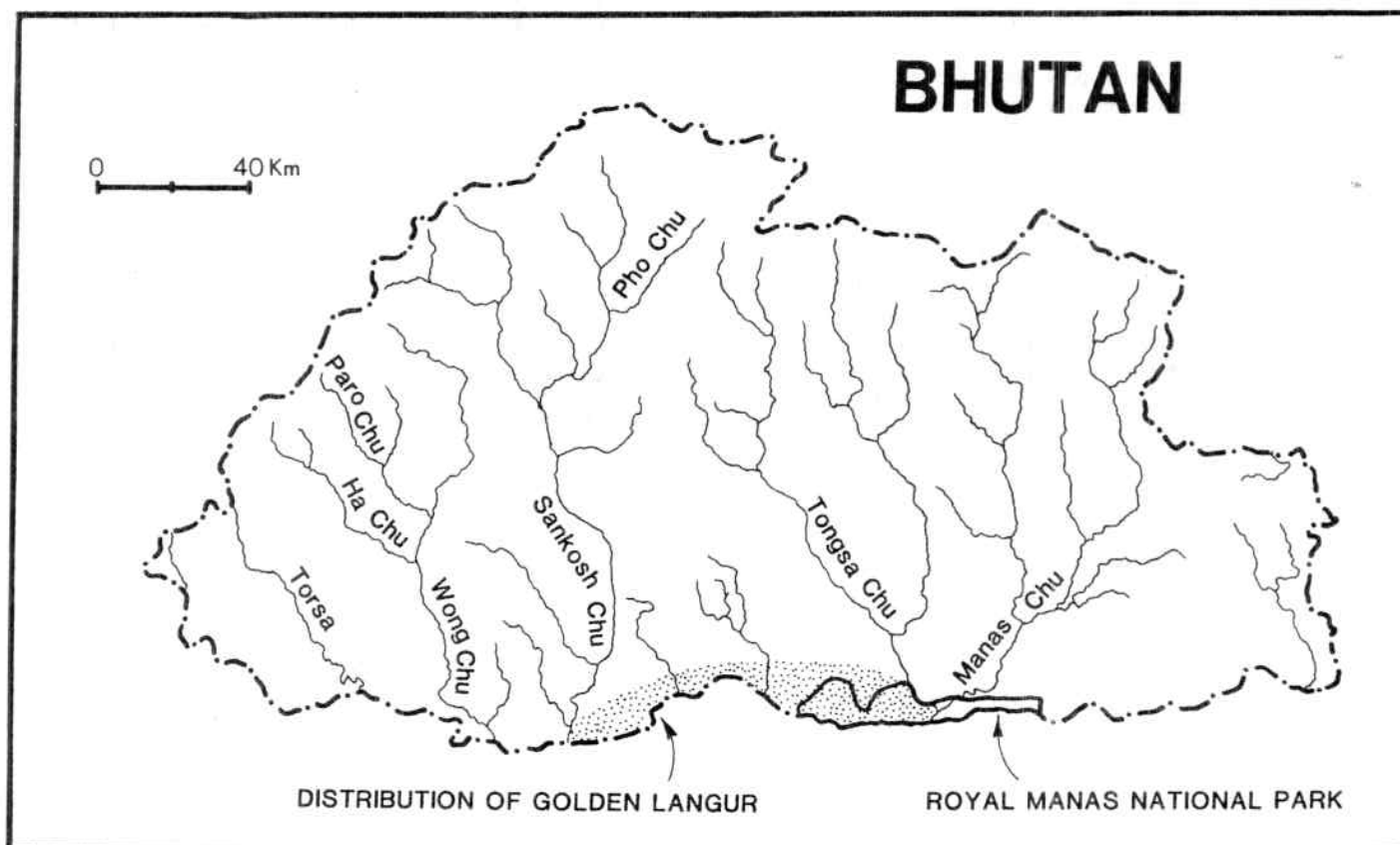


Fig. 1. The current distribution of the golden langur in Bhutan and the location of the Royal Manas National Park (chu in Dzongkha means river; map provided by authors).

The park receives an average of 3,000 mm of rain per year, much of which falls between June and mid-September. The dry season lasts from December to April or May. Vegetation can be divided broadly into three categories: a narrow band of alluvial grasslands along the southern fringe of the park, west of the bend in the Manas River; a broad belt of dry deciduous forest between 1,000 and 2,000 m; and a zone of moist deciduous forest between 2,000 and 3,000 m. The distribution of this langur extends up to an altitude of 1,000 m in the park (Jackson, 1981), although Mohnot (1980) puts the range up to 2,400 m.

Gee (1961) gives a conservative estimate of the total number of golden langurs between the Sankosh and Manas rivers as 540 animals in 36 troops. In the Royal Manas National Park, we observed only five separate troops between the Manas River in the east and the Sukuntaklai River. Troop size varies from 4-40 individuals (Mohnot, 1980). The largest troop observed in Manas consisted of 12 individuals of which there were two adult males, five adult females, one subadult male, two subadult females and two juveniles. No infants were seen in any of the troops in March 1988. The estimated size of the population in the park is about 100 individuals (Santiapillai, 1988), but this must be regarded as a minimum estimate given the fact that many troops could have been missed during the survey, which was aimed at the larger mammals. Troops often frequent the area near the park bungalow and are accustomed to the few visitors who come especially to watch the monkeys.

Feeding starts early in the day and continues until noon, interrupted by periods of rest. According to Gee (1961), the diet consists mostly of flush, tender leaves, and buds and fruits of trees such as *Terminalia belerica*, *Cedrela toona*, *Lanea grandis*, *Albizia lebbek*, *Ficus* spp., *Bischofia javanica*, *Gmelina arborea*, *Oroxylum indicum* and *Salmalia malabarica*. In Manas, golden langurs also feed on the fruits of *Bombax simul*, *Duabanga indica*, mulberry, tender leaves of *Bauhenia* sp. and what is known locally as *siplacane*. However, the animals seem to prefer fruits and buds to leaves. Their food preferences require them to range over a sizeable area during the day, which explains their absence from the park bungalow area after 1000 h.

It appears that breeding is seasonal. Females give birth in July or early August (P. B. Subba, pers. obs.). Given a gestation period of six months, this points to breeding activity in January and February. The golden langurs in Manas are sympatric with rhesus macaques but not with capped langurs.

The long-term prospects for the survival of golden langur are good within the Royal Manas National Park. The park enjoys royal patronage and, therefore, is in a much better position than many other reserves to adopt the necessary protective measures to ensure the survival of its species. However, surveys are urgently needed to determine the whereabouts of viable populations, particularly in areas outside the park which are vulnerable to habitat disturbance and poaching. Given the greatly reduced distribution of the golden langur in Bhutan, it must be realized that even small local populations are valuable and should be protected wherever practicable, not abandoned on the unproven hypothesis that genetic degeneration would set in and automatically eliminate them (Ashby and Santiapillai, 1987).

Of all the countries on the Indian subcontinent, Bhutan has the best prospects for wildlife and nature conservation. The total forest cover is estimated to be 64% (Mahat, 1985), and almost 20% of the land area has been given conservation status (Sargent, 1985). Furthermore, the largely Buddhist population, traditionally averse to killing wildlife, is receptive to conservation ideas. However, the danger may come from slash-and-burn agriculture which has already destroyed large tracts of forest. The overwhelming emphasis in conservation policy must be in maintaining forest cover over large areas uninterrupted by human settlements.

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NEWS FROM CAPTIVITY

Rare Lemurs Born in Captivity

by Bernard Brun, Jean-Marc Lernoald and Yves Rumpler

As part of a joint conservation and research program, several endangered lemur species are housed in the Lemur Conservation Center at Strasbourg University and the Lemur Breeding Unit of the Mulhouse Zoological and Botanical Park. The cooperative program between the institutions concerns in particular *Lemur fulvus albocollaris* (Rumpler, 1975) and *Lemur rubriventer* (Petter *et al.*, 1977; Tattersall, 1982). The only *L. f. albocollaris* pair known outside Madagascar was found captive in a village near Farafangana in eastern Madagascar and was transferred to Strasbourg in 1984. A female was born in 1987 but died two days later of oesophagus stenosis. A male was born in March 1988 and is growing well (Fig. 1).



Fig. 1. The young male *Lemur fulvus albocollaris* with his dam. He shows the characteristic white whiskers of the male (photo provided by authors).

A trio of *L. rubriventer* are housed in Strasbourg and a pair at Mulhouse. In Strasbourg, a female showed a mechanical dystocia and, despite a cesarian section, her male offspring died on 14 March 1988. The other female gave birth to a stillborn male on 9 July 1988. In Mulhouse, a female was born on 26 April 1988 and is growing well (Fig. 2).

Establishing a conservation-oriented captive breeding colony requires at least five pairs of founders exhibiting as much genetic polymorphism



Fig. 2. The young female *Lemur rubriventer* with the characteristic white patches around the inner corner of the eye (photo provided by authors).

as possible. We hope to be able to import other animals from Madagascar according to the dispositions of the 1987 St. Catherine's Convention, and in a few years start long-term breeding programs for *L. f. albocollaris*, *L. rubriventer*, and *L. macaco flavifrons*, similar to those already established with other species.

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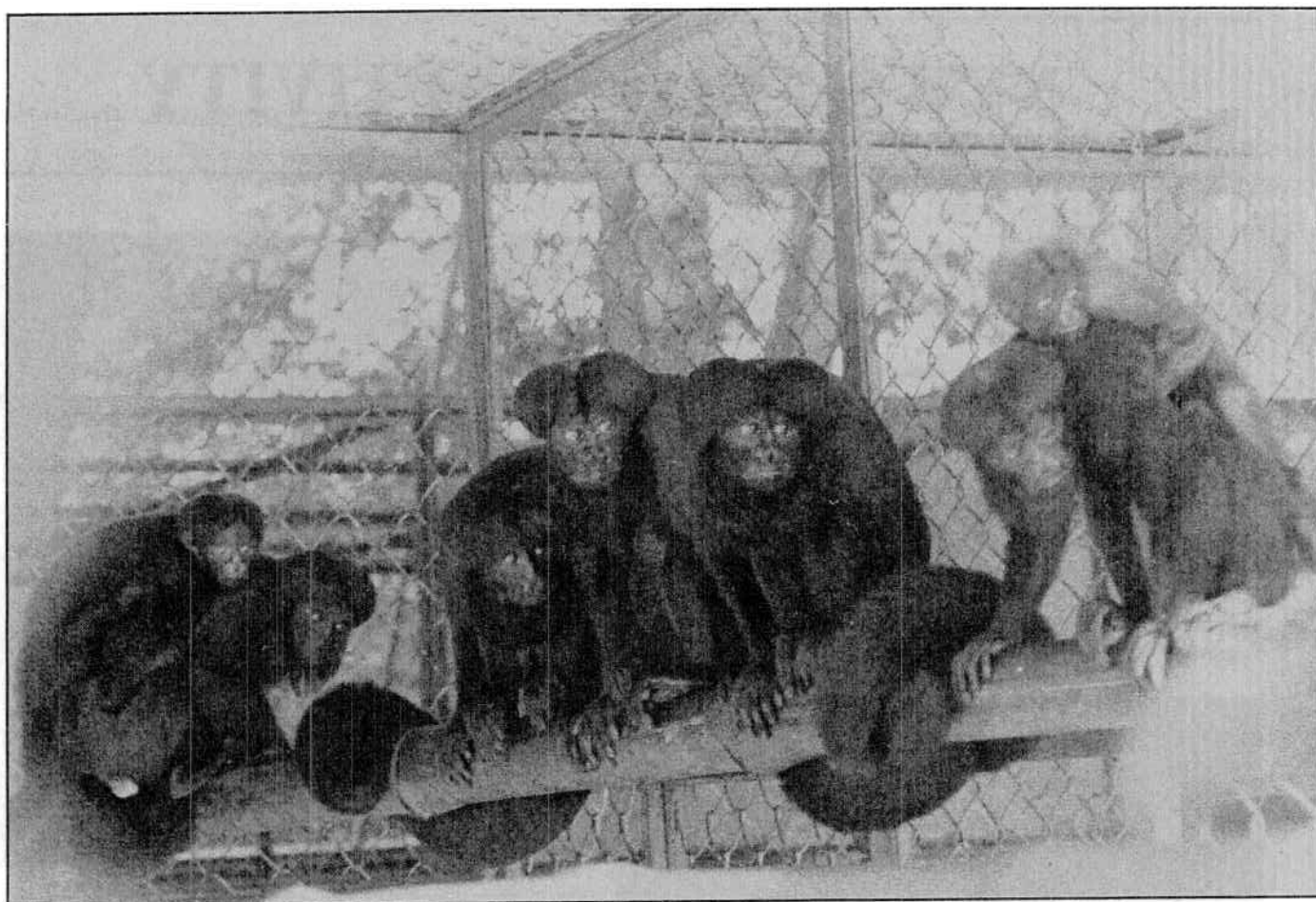


Fig. 1. Group of *C. s. utahicki* caged at the National Primate Center (photo by A. Correia).

Captive Colony of Brown Bearded Sakis in Pará, Brazil

by Marcos A. F. Malacco and Marcus E. B. Fernandes

Three subspecies of bearded sakis inhabit the eastern Amazon: *Chiropotes satanas chiropotes* in the region between the Amazon and Orinoco rivers; *C. s. satanas* east of the Tocantins River towards the eastern limit of the Amazonian forest in Maranhão, and *C. s. utahicki* between the Xingu and Tocantins rivers (Ayres, 1981; Hershkovitz, 1985). Most of the cattle farming and agricultural projects, as well as dam construction (e.g. Tucuruí and Babaquara), large-scale mineral exploitation, road construction, and colonization programs in Brazilian Amazonia are at present taking place within *Chiropotes satanas*' range. Recent surveys (Johns and Ayres, 1987) indicate that these subspecies are vulnerable to habitat disturbance and that the eastern form is one of the most endangered Amazonian primates included in *The Red Data Book* (IUCN, 1983). Here we report on a colony of wild-caught *C. s. utahicki*, perhaps the only captive group of this subspecies in existence (R. A. Mittermeier, pers. comm.; Fig. 1).

On 19 November 1984, the National Primate Center (CENP), located in Ananindeua, Pará, Brazil, received 4 adult male, 8 adult female, 1 juvenile male, and 1 juvenile female *C. s. utahicki* from Operation Curupira, an animal rescue program undertaken during the filling of the Tucuruí Dam reservoir (see "Nonvolant mammals rescued at the Tucuruí Dam in the Brazilian Amazon" by B.M. Mascarenhas and G. Puerto in *Primate Conservation* 9: 91-93). Each bearded saki was placed in a small wire mesh cage measuring 45 cm x 45 cm x 70 cm for a quarantine period — 48 days for the adults and 32 days for the juveniles. Dur-

ing this period, blood and fecal samples were taken and examined to determine the animals' state of health. No parasites were found. The diet of the animals during this period consisted initially of fruit. Eventually, dog chow was given in the morning and fruit in the afternoon. Water was freely provided.

After quarantine, the animals were divided into two groups. Group A now consists of 3 adult males, 3 adult females, and 1 juvenile female; Group B consists of 1 adult male and 5 adult females. Each group was put in a cage divided into two compartments, measuring 220 cm x 365 cm x 235 cm. The animals are moved between compartments to facilitate cleaning and maintenance. The cages are built of masonry, with the top and sides of 2" x 2" wire mesh. Inside each cage are five horizontal wooden perches and one small platform measuring 50 cm x 200 cm. The cages are located in a concrete breeding room with an open, mosquito-net roof.

The bearded sakis' diet consists at present of dog chow, reconstituted skimmed milk, and vitamin complexes in the morning; and bananas, boiled sweet potatoes, pumpkins, melons, pineapple, boiled eggs, and seasonal Amazonian fruits, chosen according to the list given for this species by Ayres (1981) and van Roosmalen *et al.* (1981, 1988), in the afternoon. Food is offered in stainless steel trays placed in the cage at a height of 150 cm. Water is always available from 500 ml glass bottles with standard, stainless-steel rodent nipples.

The first account of birth in captivity of the genus *Chiropotes* was given by Hick (1968). The animal Hick observed was a hybrid born to a *C. albinasus* female and a *C. s. chiropotes* male. She estimated the maximum possible gestation time to have been about five to five and a half months. Hick also described the development of a young bearded saki: The infant is born open-eyed and immediately searches for the nipple, grasping with its hands and tail, which is prehensile for the first

few months of life. By the age of three months, when the nursing period is almost over, the young animal moves independently and takes solid food. Nonetheless, it still continues to have a close relationship with its mother. Even at the age of one year, the infant is sometimes seen on its mother's back.

Table 1. Birth Seasonality of *Chiropotes*

Species	Birth Season												Source
	J	F	M	A	M	J	J	A	S	O	N	D	
<i>C. albinasus</i>						X	X	X	X				Ayres (1981, field obs.)
<i>C.s. chiropotes</i>	X											X	Van Roosmalen <i>et al.</i> , (1981, field obs.)
<i>C.s. utahicki</i>	X	X		X		X	X					X	Fernandes (in prep., captive obs.)

Observations of *C. s. utahicki* in captivity show that births do not follow the seasonal pattern observed in the wild (Table 1). Reproduction is altered under captive conditions. Captivity also significantly changes the daily activity patterns of the wild-caught animals.

We have recorded six births during the period that the animals have been in CENP. The first infant died by strangling on its umbilical cord during birth, another was stillborn, and the four others are still living (Fig. 2; Table 2).



Fig. 2. Adult female *C. s. utahicki* suckling its infant (photo by A. Correia).

Table 2. Births and Deaths in *C.s. utahicki* Colony at CENP

Date	Birth	Death
15/07/85	—	Juvenile (pneumonia)
10/07/86	—	Infant (strangulation, umbilical cord)
22/02/87	1	—
07/06/87	—	Infant (stillborn)
25/11/87	1	—
07/01/88	1	—
23/04/88	1	—

A juvenile male has also died in the four-year period (1984-1988), and the colony as a whole has only grown to 17 animals (Table 3). In addition to having an apparently low reproductive output, the animals have grown heavier and noticeably paler in color since they were brought into the colony, indicating possible problems with stress or diet.

Table 3. Captive Population of *C.s. utahicki* at CENP

Age/Sex Class	1984	1985	1986	1987	1988
Adult Male	4	4	4	4	4
Adult Female	8	8	8	9	9
Juvenile	2	1	1	—	—
Infant	—	—	—	2	4
Total	14	13	13	15	17

The colony of bearded sakis is currently being studied for karyotype and blood group by researchers from the Department of Genetics at the University of Pará.

A larger, external cage measuring 800 cm x 1,400 cm x 700 cm (h), built around natural secondary vegetation has been donated by Partridge Films Ltd., London, and will be used for captive studies of this subspecies. It is hoped that these studies will provide information about behavioral aspects and reproductive problems, as well as suggest veterinary treatments that may subsequently be applied in the wild.

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ARTICLES

Neotropical Region

Primate Populations in Northwestern Costa Rica: Potential for Recovery

by Colin A. Chapman, Lauren Chapman
and Kenneth E. Glander

Tropical dry forest was once widespread throughout Central America. Today, however, with less than 2% of its original 550,000 km² cover remaining in a relatively undisturbed state (Janzen, 1986), it represents one of the most threatened habitats. The critical need for the conservation of this type of forest is particularly evident when the accelerating rate of deforestation is considered. Only two decades ago, dry forest covered 20% of its original area (Janzen, 1986).

Three species of primates inhabit the dry forest of Costa Rica: spider monkeys (*Ateles geoffroyi*), howlers (*Alouatta palliata*), and white-faced capuchin monkeys (*Cebus capucinus*). The conservation of primate populations in dry forest has received little attention, and few quantitative studies have been conducted to provide the data necessary for the effective formulation of conservation plans. The howler and spider monkeys are presently considered endangered by the U.S. Endangered Species Act (USDI, 1977), while capuchins are not listed. The IUCN lists the spider monkey as vulnerable, but does not list either of the other two species (Thornback and Jenkins, 1982). Wolfheim (1983) considers all three species threatened.

Within Costa Rica, *Ateles* is probably the most threatened of the three species; it is now absent in large sections of the country where it was recently found. Vaughan (1983) and Wolfheim (1983) have suggested that spider monkeys are more restricted to moist forests and are not as adaptable to altered environments as are the other two species. In addition, Vaughan (1983) reports that spider monkeys are often the first species to be exterminated following human settlement. Relative to other New World primates, the spider monkey has a slow reproductive rate.



Fig. 1. White-faced capuchin monkeys (*Cebus capucinus*) (photo by R.A. Mittermeier)



Fig. 2. The Panamanian spider monkey (*Ateles geoffroyi panamensis*) is one of three subspecies of *Ateles geoffroyi* found in Costa Rica (photo by R.A. Mittermeier)

Females do not mature until approximately seven years of age and only give birth approximately once every three years (Chapman and Chapman, in press; Glander, 1980). This slow potential for increase, in addition to high infant mortality, may contribute to the relatively high vulnerability of *Ateles* to human interference.

Presently, northwestern Costa Rica is the site of two major conservation projects. The Guanacaste National Park (GNP) project has focused on the ecological restoration of tropical dry forest. This ongoing project involves the purchase and protection of large sectors of ranch land surrounding the existing Santa Rosa National Park and volcano forests (Janzen, 1986). The second project has focused on the establishment and protection of Lomas Barbudal National Park. This area was designated a national park in 1986, and prior to this time the forest was largely undisturbed. Primate hunting occurred in both areas; however, the relative impact of hunting in the different areas is difficult to evaluate. Today, primates are rarely hunted in this part of Costa Rica.

Here we report the results of a census of Lomas Barbudal and GNP which was conducted to compare primate abundances in areas with different histories of human interference and different forest types. We discuss the effects of historical interference on the primates, evaluate their potential for recovery, and provide baseline data for future studies. We show how demographic parameters vary among the primate groups in different areas and consider the degree to which habitat alterations and conspecific densities may account for the differences.

Study Sites

Lomas Barbudal National Park is 2,500 ha of largely intact tropical deciduous forest containing a number of distinct forest types including a section of riverine forest, lush areas surrounding springs, dry deciduous forest, savanna, and mesic forest (see Frankie *et al.*, 1988, for a complete listing and description of the habitat types). In 1986, the area received protected status as a national park. Prior to this date, the area

was influenced by limited livestock grazing and logging (Frankie, pers. comm.). The major source of habitat disturbance has been the repeated burning of sections of the park. Many fires that are started outside of the park by ranchers as a traditional practice to maintain fields, enter the park. Other fires are deliberately started by hunters to flush animals at night. The climate of the region is highly seasonal, and from mid-December until May little if any rain falls. Rainfall ranges from 1,000-2,200 mm annually (Frankie *et al.*, 1988).

Presently, GNP is approximately 825 km² and extends from sea level to the tops of three volcanoes (1,916 m). The area represents a wide variety of habitats which have been protected for various periods of time, though the majority of the land has only recently been acquired and protected. The core of GNP, however, is Santa Rosa National Park, which has been protected since 1966. GNP contains all of the major dry forest habitats found in Central America. The predominant forest habitat in the park is dry successional deciduous forest, which represents between 20 and 400 years of regeneration (Janzen, 1986). Here the majority of the trees drop their leaves soon after the last rains of the year and remain bare throughout much of the dry season. In other areas of the park, there are patches of semi-evergreen forest which represent either very old regrowth or nearly original forest. The trees in the semi-evergreen forest typically retain their leaves throughout the dry season. In addition, the park contains a number of both temporary and permanent rivers which support relatively lush vegetation throughout the dry season. The slopes of the volcanoes are dominated by nearly undisturbed evergreen forest. The tops of the volcanoes (> 1,000 m) are covered by clouds for much of the year, and cloud forest predominates. For a more detailed description of GNP, see Janzen (1986). As in Lomas Barbudal, in the drier parts of the park fire has played a significant role in determining forest structure.

The climate varies depending on the location within the park, but all regions are characterized by distinct dry and wet seasons. In the lowlands, the dry season extends from approximately December to late May. On average, 98% of the rain falls from May to November (1980-1987, range 96.7-99.2%). The rainfall has averaged 1,527 mm over the last eight years (range 914-2,340 mm; measured at Santa Rosa, Instituto Meteorológico Nacional). Near the volcanoes, the dry season is shorter and annual rainfall increases with altitude (approximately 2,838 mm, Cerro el Hacha Station, 1988).

Census Methodology

The census was conducted between May 1987 and February 1988 and in June and July 1989 for a total of 128 person-days of effort. It is extremely difficult to provide density estimates of primate populations over large areas (Chapman *et al.*, 1989; Defler and Pintor, 1985), but such estimates are required for the formulation of effective conservation plans. The size of the area to be censused and the need to sample as broad a range of habitats as possible precluded the use of repeat transect methodologies or the mapping of group home ranges. As a compromise, routes of known distances were travelled and all primate groups along these strips were counted. In GNP, an extensive network of trails and dirt roads, established when the land was used for ranching, as well as dry riverbeds, were used for the census. Lomas Barbudal has few trails, but since it is a strip of forest (approx. 10 km x 2 km), we systematically censused the area by walking across the park every 500 m and surveying all existing trails. When a primate group was encountered, the following data were recorded: the number of animals in the group, the age and sex of each member, location, habitat type, and, when possible, the group's activity prior to its seeing the observer, the distance between the observer and the animals when they were first seen, and the animals' reaction to being observed (National Research Council, 1981).

Many of the routes were sampled a number of times during the study. For *Alouatta* and *Cebus*, we attempted to minimize the error associated with duplicate counts by identifying individual animals whenever possible

so that they could be recognized as belonging to a specific group, and by determining if each new sighting was within the area encompassed by the average home range size (Chapman, 1988). The counts of neighboring groups were rarely similar, and we believe that repeat counts were not a serious problem. However, if two neighboring groups were similar in composition, an attempt was made to recensus the area and locate both groups on the same day.

Spider monkeys have a social organization which is characterized by a flexible pattern of association in which subgroup size and composition are extremely dynamic (Chapman, in press; Klein and Klein, 1977). As a result, the problem of repeat counts of the same individuals could not be dealt with in the same fashion as for the other two species. Thus, when repeat visits were made along the same route, the sizes of the *Ateles* subgroups were averaged. The counts for *Alouatta* and *Cebus* for the Santa Rosa Sector were obtained from Fedigan *et al.* (1985), in which methods very similar to those described here were used.

One of the major objectives of this study was to provide baseline data for comparison with subsequent censuses in order to evaluate the appropriateness of the parks for re-establishing primate populations. We realize that the calculation of actual density estimates by different researchers at different times is difficult. However, to facilitate such a comparison we present the routes used in the census in Figures 1-4.

In addition, we present demographic characteristics of the population which can be reliably compared between researchers even if the entire census is not redone.

Density Estimates

We visited all major forested areas of Lomas Barbudal and GNP with the exception of three areas in GNP: the backside of the volcanoes, Sector Horizonte, and Rincon de la Vieja, the latter two being areas that were incorporated into the park after the majority of the study had been completed. Each of these areas is reported to have populations of all three primate species. The census involved sampling approximately 470 km of trails and transects (excluding repeat visits to areas).

Primate densities were very site-dependent, apparently influenced by both the type of habitat and the history of the area. Within GNP, *Cebus* occurred at the highest density, 5.3 ind/km². The densities of *Alouatta* and *Ateles* were slightly lower, 4.6 ind/km² and 4.5 ind/km², respectively. Figures 1-3 depict the locations of all groups encountered in the areas surveyed in GNP.

The Santa Rosa Sector has been a park since 1971, and efforts have been made to protect the area from poaching and, more recently, from fires. The density of the three species of monkeys was higher in the Santa Rosa Sector than in the rest of GNP (ratio of the density of primates in Santa Rosa to that in the remainder of GNP: *Alouatta* 7.6:1, *Cebus* 5.6:1, *Ateles* 8.1:1). The high densities found in Santa Rosa may be attributed at least in part to the increased level of protection that the area has received over the last 17 years.

Within GNP, but excluding the Santa Rosa Sector, all three primates were most common in the semi-evergreen forest island of Cerro el Hacha. This area is a 2,500 ha series of hills on the northern boundary of the park, part of which has not been cut for lumber or ranch land and consists of relatively pristine islands of forest (Janzen, 1986).

In Lomas Barbudal, the estimated density of *Alouatta* was 8.5 ind/km², the density of *Cebus* was 3.7 ind/km², and *Ateles* were absent from the park. As in Santa Rosa, the high density of howlers may be a reflection of the protection the forest has received. However, the riparian forests and the lush forest surrounding the numerous springs may also contribute to the high numbers. Such areas with year-round access to water and the associated evergreen forest may be important to the primates, particularly in the dry season. The census was conducted during the start of the rainy season, but we still commonly encountered primates in the forests bordering the springs.

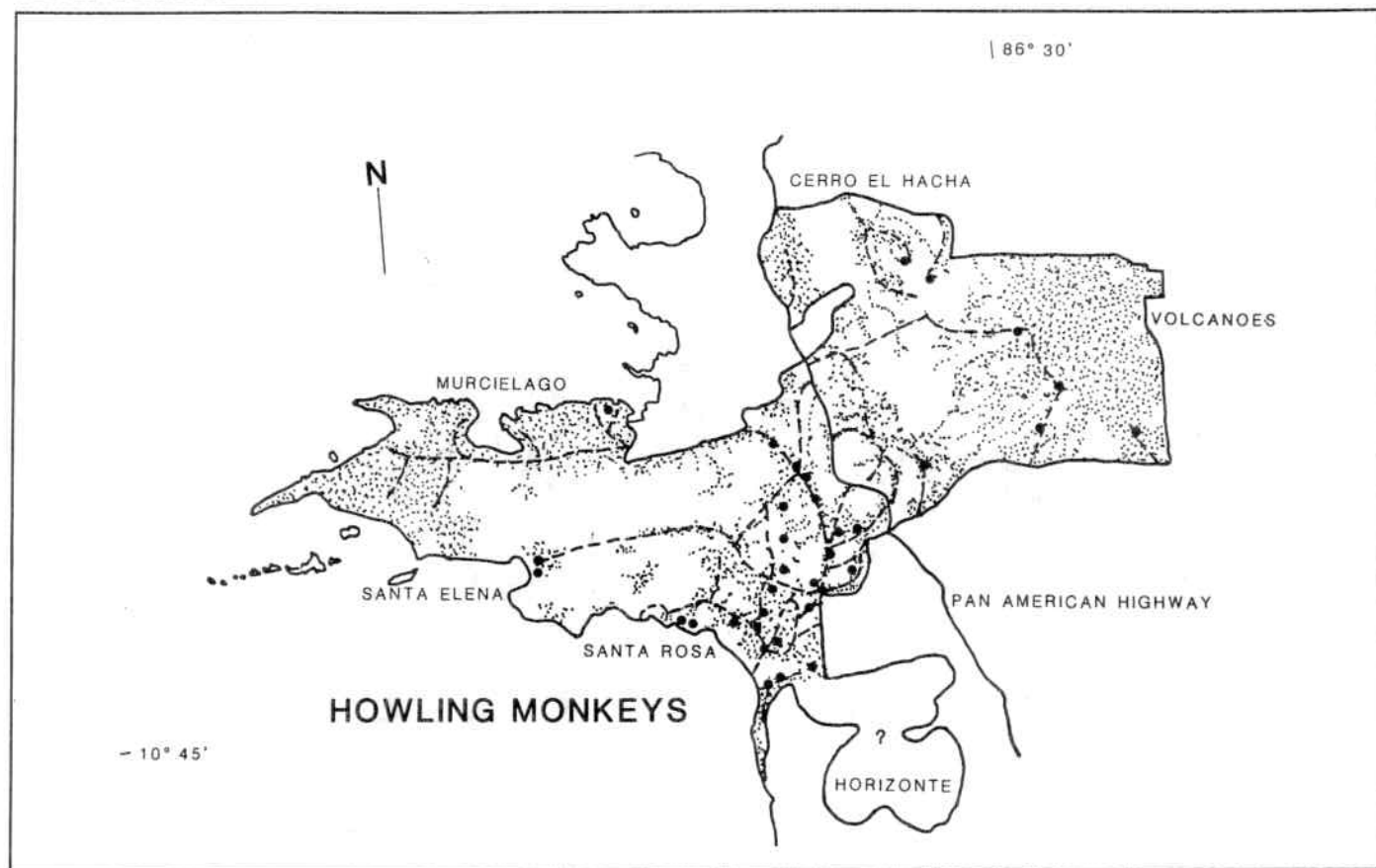


Fig. 1. A map of Guanacaste National Park, Costa Rica depicting routes censused (dashed lines), the location of forest (stippling; adapted from Janzen, 1986) and the location of *Alouatta palliata* groups (map provided by authors).

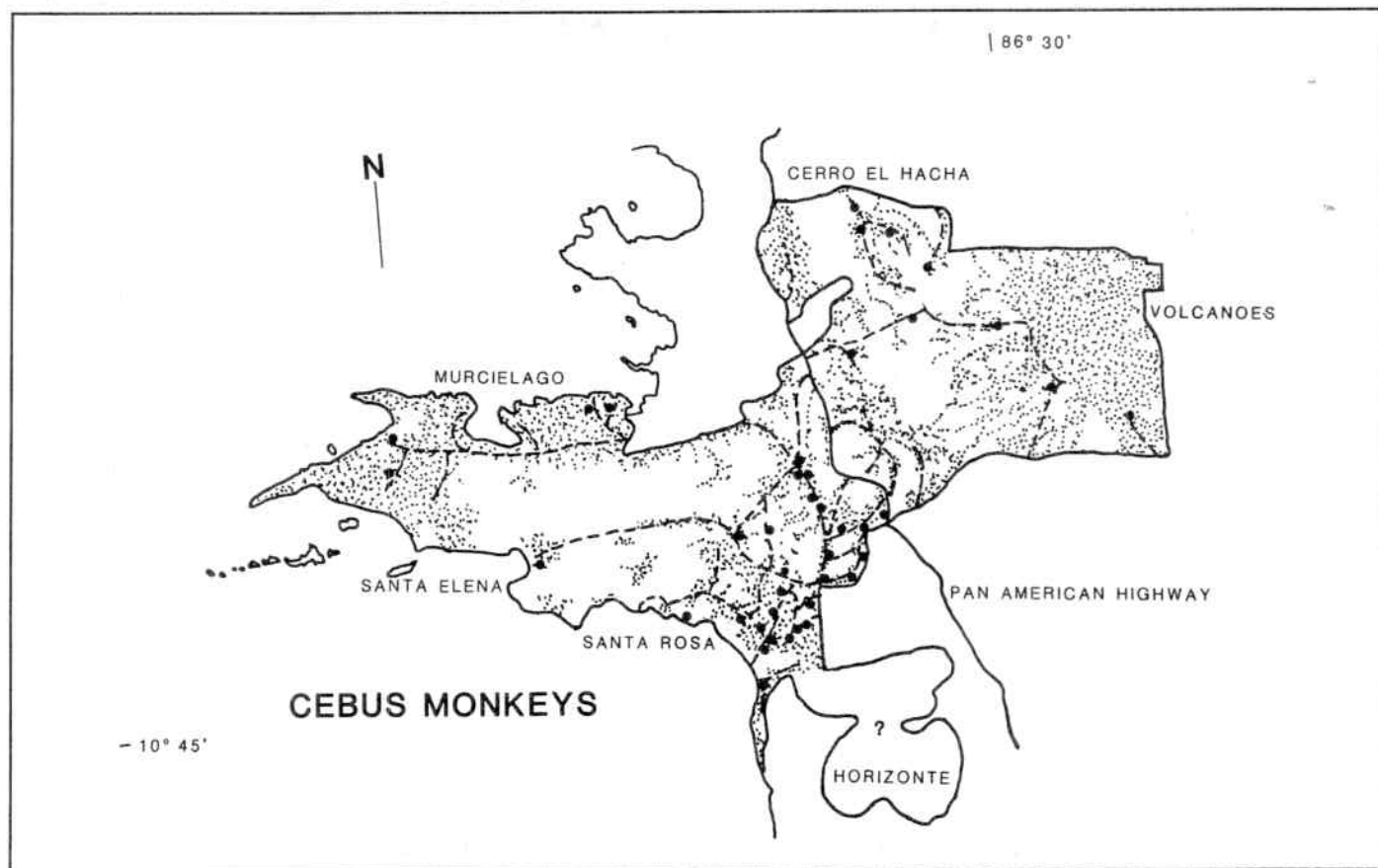


Fig. 2. A map of Guanacaste National Park, Costa Rica depicting routes censused (dashed lines), the location of forest (stippling; adapted from Janzen, 1986) and the location of *Cebus capucinus* groups (map provided by authors).

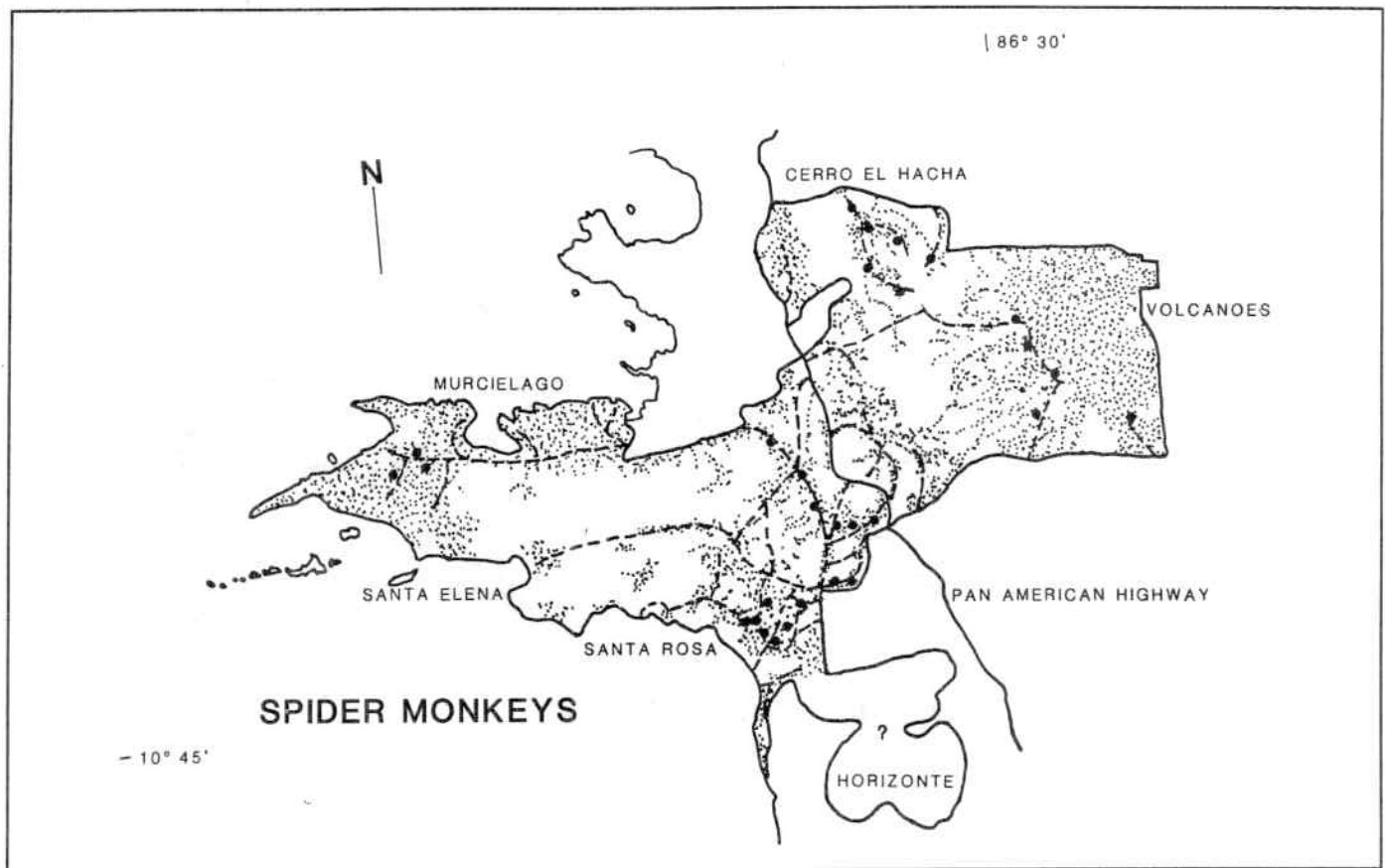


Fig. 3. A map of Guanacaste National Park, Costa Rica depicting routes censused (dashed lines), the location of forest (stippling; adapted from Janzen, 1986) and the location of *Ateles geoffroyi* sightings (map provided by authors).

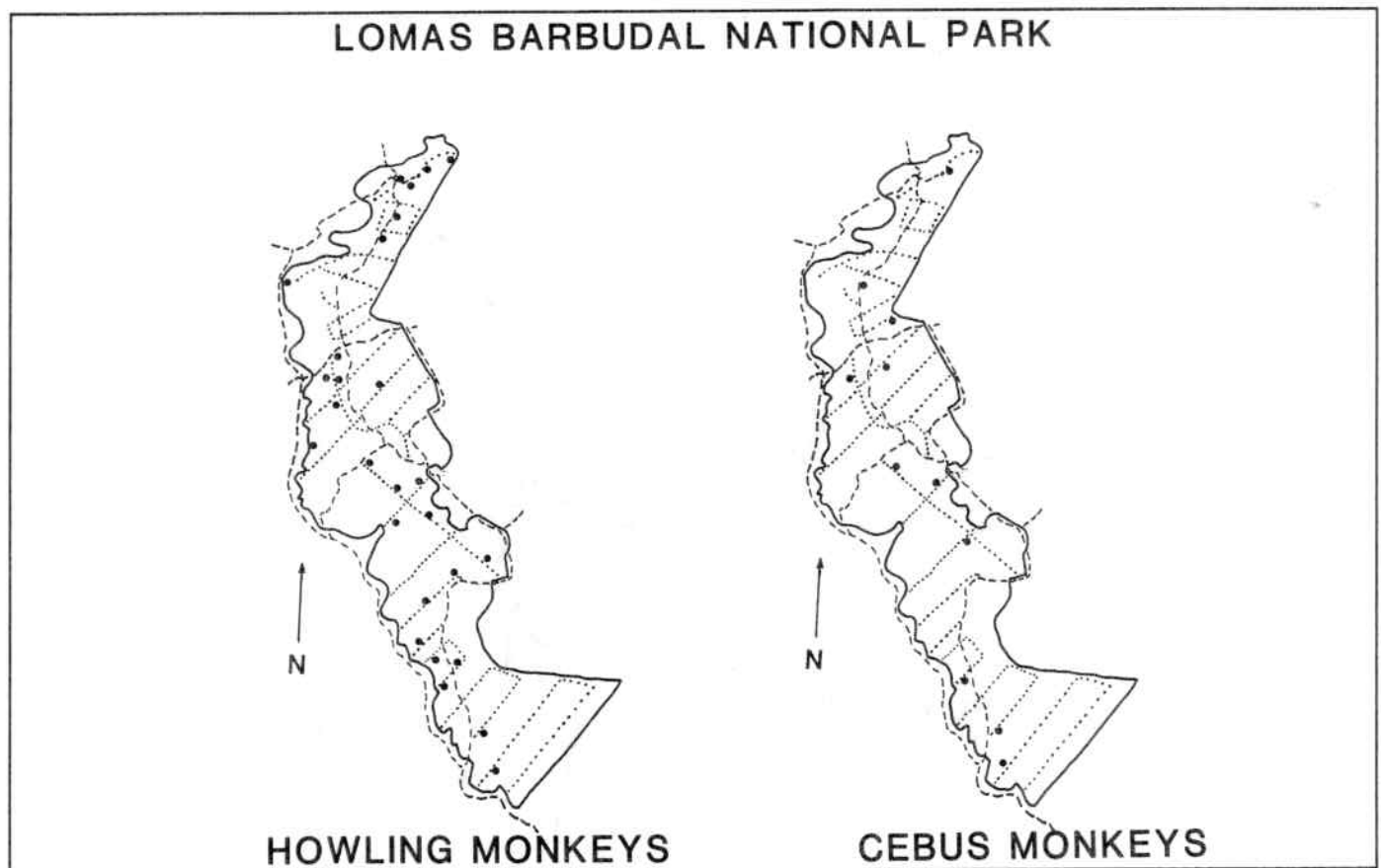


Fig. 4. A map of Lomas Barbudal National Park, portraying the routes travelled (dashed lines representing roads and dotted lines representing transects through the forest) and the location of *Cebus capucinus* groups and *Alouatta palliata* groups (map provided by authors).

There was no apparent ecological reason for the absence of spider monkeys from Lomas Barbudal. The area contains many of the fruiting tree species used by spider monkeys elsewhere. People living near the park stated that spider monkeys were found in the area as recently as 20 years ago. Today *Ateles* are present just south of Lomas Barbudal in Palo Verde National Park. Based on these observations, we suggest that spider monkeys are absent because of historical hunting practices. Hunters consider *Ateles* preferred monkey meat. This preference coupled with their slow reproductive rate and late age at maturity (Chapman and Chapman, in press) makes *Ateles* highly vulnerable to hunting pressure.

Habitat Preferences

Within GNP, spider monkeys were found in all the major forest areas of the park, with the exception of some riverine strips. Riverine areas generally contain relatively high densities of potential spider monkey food trees. Thus, there was no apparent ecological reason to explain why spider monkeys were absent from some riverine strips and not others. As with Lomas Barbudal, we suggest that they have been hunted out and, as of yet, have not re-established viable populations. Surprisingly, in the Murciélagos Sector, spider monkeys were found in young (apparently 20 yr old), regenerating dry deciduous forest not more than 4 m tall. In the Santa Rosa Sector, spider monkeys are commonly found in sections of forest that are thought to represent approximately 75-100 years of regrowth.

Howlers were found throughout Lomas Barbudal and in all major forested areas of GNP with the exception of the west end of the Murciélagos Sector. Howler groups tend to be found in areas that contain at least some semi-evergreen or riparian/spring forest, sometimes as little as one hectare in size.

Capuchin monkeys were found in all forested areas surveyed regardless of forest type. They ranged more widely into young successional forest than the other two monkey species and are known to routinely cross open grasslands. During the height of the dry season, capuchin monkeys typically visit areas with standing water almost daily. It seems probable that the areas used by the capuchin monkeys must contain at least some standing water during the dry season and that this requirement may limit the areas in which they occur.

Group Composition

For a comparison of group composition, we chose to include three areas which have been thoroughly described and which each have different histories of protection: Santa Rosa, protected for 17 years (Janzen, 1986), Lomas Barbudal, relatively undisturbed with the exception of fires and poaching (Frankie *et al.*, 1988); and GNP (excluding Santa Rosa) which is just now receiving protection (Janzen, 1986).

The size of spider monkey subgroups has been shown to change in relation to the availability of food resources (Chapman, in press). Since different areas were censused at different times of the year and the availability of fruit changes between seasons, a comparison of subgroup size between habitats is not valid using the available data. However, neither the sex ratio ($t=0.973$, $p=0.342$), nor the ratio of adult females to infants ($t=0.843$, $p=0.404$) differed between Santa Rosa and the remainder of GNP.

The size of howler groups was larger in Santa Rosa than in either Lomas Barbudal or in the remainder of GNP (Table 1, Scheffe $p < 0.05$). In Lomas Barbudal and GNP, many of the groups encountered were composed of a male/female pair and their offspring (26% and 33%, respectively). In contrast, Fedigan *et al.* (1985) did not observe such pairs in Santa Rosa and further work in the area has revealed very few male/female pairs. There were no differences between the three areas in the sex ratios of howler groups. However, differences were found between areas in the proportion of the adult females which had clinging infants or closely associated small immatures (Table 1). A low ratio of immatures to adults has been suggested to indicate stressed populations

(Estrada, 1982; Helme *et al.*, 1976; see Clarke *et al.*, 1986 for a critique of such indices). The large proportion of females with small infants at Lomas Barbudal suggests that the population is in a phase with a high potential for growth. In contrast, the low proportion of females with young in GNP suggests that these populations may be more stressed.

As with howlers, the size of the capuchin monkey groups was larger in Santa Rosa than in either Lomas Barbudal or GNP (Table 1, Scheffe $p < 0.05$). There was no difference between the three areas in the proportion of females with young. However, the sex ratio observed in Santa Rosa differed from that in the remainder of GNP (Table 1, Scheffe $p < 0.05$).

Table 1. Demographic Characteristics of *Alouatta palliata* and *Cebus capucinus* in Three Areas in Northwestern Costa Rica

	Santa Rosa	GNP	Lomas Barbudal	F value
<i>Alouatta palliata</i>				
Group Size	14.7	4.4	7.5	11.16**
Male:Female	1:1.97	1:1.76	1:1.67	1.77
Female:Immature	1:0.60	1:0.46	1:0.80	3.23*
<i>Cebus capucinus</i>				
Group Size	14.1	8.8	8.1	8.70**
Male:Female	1:2.30	1:1.65	1:2.03	5.16*
Female:Immature	1:0.78	1:0.91	1:0.64	1.31

Key

* $p < 0.05$

** $p < 0.001$

Discussion

Census data can often be used to identify factors which may determine the abundance of species. The identification of such factors is clearly essential for the formulation of an effective conservation plan. Contrasting the observed populations, we suggest that the abundance of the three primate species is influenced by both habitat type and the history of human interference.

To place our findings in a broader perspective we collected published density estimates for each primate genus represented, *i.e.* *Alouatta*, *Ateles*, and *Cebus* (Table 2). Based on this review it is evident that the density estimates we obtained were in general lower than those obtained from other areas. The low density in northwestern Costa Rica may be due, at least in part, to the very dry and seasonal nature of the environment. If this were the only factor distinguishing northwestern Costa Rica from other less seasonal habitats, one might expect densities within certain lush microhabitats to approach the densities observed in similar habitats in other geographical areas. In a number of instances, we did find relatively high densities in lush microhabitats, but not of the magnitude necessary to account for the discrepancy in densities between the areas we surveyed and published accounts. For example, Clarke *et al.* (1986) reported that the density of howlers censused in an area that contained a large strip of riverine forest and sections of dry deciduous forest (77.3 ind/km²) was much higher than the density of howlers in Santa Rosa National Park as calculated by Fedigan *et al.* (1985; 4.9 ind/km²). Our survey of the riverine forest in GNP provides an estimate of 10.1 howlers/km², which is higher than the estimates for the overall density of howlers in Santa Rosa, but clearly far lower than the estimate provided by Clarke *et al.* (1986).

We suggest that much of the remaining difference is related to the history of human interference that the different areas and primate populations have received. The overall density of primates was higher in areas that have received protection (Santa Rosa and Lomas Barbudal) than in surrounding unprotected areas. In some protected areas, spider monkeys were seen using regenerating dry deciduous forest that was less than 4 m tall. Park guards stated that it was only recently that spider monkeys were seen in such areas. These observations are particularly

encouraging to conservation efforts concerning spider monkeys. It has been suggested that this species is rarely seen in altered habitats (Wolfheim, 1983). However, our observations of spider monkeys in such young regenerating forest suggest that these monkeys have the ability to quickly recolonize altered habitats once the area receives protection.

Our results also illustrate interesting differences in the composition of groups among sites. For instance, in some areas, howlers frequently had groups containing only 1 male and female (26% Lomas Barbudal, 33% GNP excluding Santa Rosa), while in Santa Rosa this type of group

structure was very rare. Although Lomas Barbudal has higher densities of howlers than Santa Rosa, the population may be well below its maximum sustainable level. The male/female pairs observed in Lomas Barbudal may be taking advantage of many openings in the habitat to establish new groups. It is common for solitary *Alouatta* males to enter an unoccupied area, call to attract a female, and thus form a new group. The large number of pairs in Lomas Barbudal may therefore represent the formation of new groups and the potential for population growth in the region.

Table 2. Population Characteristics of *Alouatta*, *Ateles* and *Cebus* Derived from a Literature Review

(Citations for these studies can be obtained directly from the authors, density=ind/km², sex ratio=females per male, Imm/F=immatures per female, rainfall=mm.)

Species	Density	Group Size	Sex Ratio	Imm/F	Rainfall	Source and Location
<i>Alouatta</i>						
<i>A. palliata</i>	4.9	13.60	1.97	0.56	1531	Fedigan <i>et al.</i> , 1985; Santa Rosa, Costa Rica
	1.2	8.13	2.20	0.79	1531	Freese, 1976; Santa Rosa, Costa Rica
	89.7	13.77	2.38	0.78	1878	Rodriguez, 1985; Palo Verde, Costa Rica
	—	5.20	1.60	0.21	—	Milton & Mittermeier, 1977; Coiba, Panama
	1050.0	18.90	2.00	0.88	—	Baldwin & Baldwin, 1972/76; Chirique, Panama
	77.3	15.50	2.98	0.57	1450	Clarke <i>et al.</i> , 1986; La Pacifica, Costa Rica
	23.3	9.12	1.37	0.75	4953	Estrada, 1982; Los Tuxtlas, Mexico
	74.3	13.20	4.11	0.54	1450	Heltne <i>et al.</i> , 1976; La Pacifica, Costa Rica
	74.3	10.00	1.16	0.86	1450	Heltne <i>et al.</i> , 1976; La Pacifica, Costa Rica
	74.3	12.50	3.00	0.75	1450	Heltne <i>et al.</i> , 1976; La Pacifica, Costa Rica
	—	15.40	3.00	0.67	1450	Heltne <i>et al.</i> , 1976; Toboga, Costa Rica
	—	13.50	2.78	0.75	1450	Heltne <i>et al.</i> , 1976; Toboga, Costa Rica
	—	10.00	2.92	0.76	1450	Heltne <i>et al.</i> , 1976; Toboga, Costa Rica
	—	08.90	1.88	0.77	1450	Heltne <i>et al.</i> , 1976; Toboga, Costa Rica
	—	13.10	2.13	0.54	1450	Heltne <i>et al.</i> , 1976; Toboga, Costa Rica
	—	10.40	1.68	0.38	1450	Heltne <i>et al.</i> , 1976; Toboga, Costa Rica
	—	10.80	2.89	0.31	1450	Heltne <i>et al.</i> , 1976; Toboga, Costa Rica
	—	11.30	2.18	0.86	1450	Heltne <i>et al.</i> , 1976; Toboga, Costa Rica
	—	9.90	1.94	0.80	1450	Heltne <i>et al.</i> , 1976; Toboga, Costa Rica
	12-19	13.75	—	—	4015	Fishkind & Sussman, 1987; La Selva, Costa Rica
	27.0	17.30	2.74	0.96	2730	Carpenter, 1934, 1965; BCI, Panama
	33.5	17.40	2.74	1.04	2730	Carpenter, 1934, 1965; BCI, Panama
	—	18.20	2.12	1.13	2730	Carpenter, 1934, 1965; BCI, Panama
	16.2	8.00	3.75	0.47	2730	Collias and Southwick, 1952; BCI, Panama
	52.5	18.50	2.76	0.65	2730	Carpenter, 1934, 1965; BCI, Panama
	62.7	14.70	1.79	0.89	2730	Chivers, 1969; BCI, Panama
	75.8	13.80	2.41	0.56	2730	Smith, 1977; BCI, Panama
	62.6	16.20	1.81	1.22	2730	Mittermeier, 1973; BCI, Panama
	91.7	20.80	2.63	0.88	2730	Milton, 1982; BCI, Panama
	—	23.00	2.34	1.16	2730	Milton, 1982; BCI, Panama
	—	21.40	2.18	1.07	2730	Milton, 1982; BCI, Panama
	82.2	20.20	2.55	1.16	2730	Milton, 1982; BCI, Panama
	—	18.90	2.24	1.09	2730	Milton, 1982; BCI, Panama
	—	18.70	2.50	1.09	2730	Milton, 1982; BCI, Panama
	—	20.40	2.30	0.94	2730	Milton, 1982; BCI, Panama
	—	18.90	2.55	0.98	2730	Milton, 1982; BCI, Panama
	—	21.30	2.15	1.14	2730	Milton, 1982; BCI, Panama
	—	16.50	2.30	0.93	2730	Bernstein, 1964; BCI, Panama
	—	9.30	1.71	0.66	2730	Altman, 1959; BCI, Panama
<i>A. pigra</i>	8.1	4.20	1.00	0.73	2032	Bolin, 1981; Belize
	22.0	6.22	1.27	—	2030	Horwich, 1983; Belize
	—	6.33	1.60	1.08	2032	Horwich & Johnson, 1986; Belize
	—	4.67	2.00	0.83	—	Horwich & Johnson, 1986; El Joval, Mexico
	—	5.00	2.00	1.00	1350	Horwich & Johnson, 1986; Guatemala
	5.0	6.25	1.16	1.71	1350	Coelho <i>et al.</i> , 1976; Tikal, Guatemala
	4.0	5.00	1.33	0.75	1350	Schliche, 1978; Tikal, Guatemala
	13.0	5.50	2.50	0.80	—	Schliche, 1978; Coban, Guatemala

Table 2. Population Characteristics of *Alouatta*, *Ateles* and *Cebus* Derived from a Literature Review (Continued)
 (Citations for these studies can be obtained directly from the authors, density=ind/km², sex ratio=females per male, Imm/F=immatures per female, rainfall=mm.)

Species	Density	Group Size	Sex Ratio	Imm/F	Rainfall	Source and Location
<i>A. seniculus</i>	23.0	5.75	1.14	1.00	2100	Defler, 1981; Colombia
	27.0	6.80	1.15	0.75	—	Defler, 1981; Colombia
	114.0	7.50	0.71	1.00	—	Neville, 1972; Trinidad
	15.0	9.00	1.25	1.80	1947	Gaulin & Gaulin, 1982; Colombia
	21.9	3.30	1.97	0.56	2705	Green, 1978; Colombia
	20.4	3.30	—	0.00	2705	Green, 1978; Colombia
	30.0	—	—	—	2080	Terborgh, 1983; Manu, Peru
	15.0	5.00	—	—	3050	Neville, 1976; Peru
	2.7	5.40	1.20	0.60	—	Izawa, 1976; Upper Amazon
	—	5.40	1.59	0.79	—	Izawa, 1976; Upper Amazon
	30.5	5.40	—	—	—	Freese <i>et al.</i> , 1982; Peru/Bolivia
	24.0	5.40	—	—	—	Freese <i>et al.</i> , 1982; Peru/Bolivia
	8.0	8.00	—	—	—	Freese <i>et al.</i> , 1982; Peru/Bolivia
	120.0	19.00	—	—	—	Freese <i>et al.</i> , 1982; Peru/Bolivia
	20.3	5.00	1.43	0.80	—	Klein & Klein, 1977; 1976 Colombia
	25.6	6.30	—	0.92	1424	Breza <i>et al.</i> , 1981; El Frio, Venezuela
	36.0	7.70	2.08	—	1693	Crockett, 1984; Hato Masaguaral, Venezuela
	50.0	8.30	2.26	—	1693	Crockett & Eisenberg, 1987; Venezuela
	53.0	7.80	1.93	—	1693	Crockett & Eisenberg, 1987; Venezuela
	85.0	8.70	1.80	—	1693	Eisenberg, 1979; Hato Masaguaral, Venezuela
	150.0	8.90	1.47	1.64	1693	Rudran, 1979; Hato Masaguaral, Venezuela
	112.0	10.50	1.81	—	1693	Crockett, 1984; Hato Masaguaral, Venezuela
	115.0	9.70	1.70	—	1693	Crockett & Eisenberg, 1987; Venezuela
	180.0	9.10	1.83	—	1693	Crockett & Eisenberg, 1987; Venezuela
	—	6.90	1.62	1.00	1693	Neville, 1972, 1976; Hato Masaguaral, Venezuela
	—	8.50	1.60	1.38	1693	Neville, 1972, 1976; Hato Masaguaral, Venezuela
	—	8.80	1.50	1.33	1693	Neville, 1972, 1976; Hato Masaguaral, Venezuela
	—	7.90	1.78	1.44	1693	Neville, 1972, 1976; Hato Masaguaral, Venezuela
	—	9.00	1.08	1.57	1693	Neville, 1972, 1976; Hato Masaguaral, Venezuela
	—	9.00	2.12	1.29	1693	Neville, 1972, 1976; Hato Masaguaral, Venezuela
<i>A. caraya</i>	130.0	8.05	2.02	—	1400	Thorington <i>et al.</i> , 1984; Argentina
	—	7.90	0.88	0.69	—	Pope, 1966/68; Argentina
	0.8	2.00	—	—	—	Pope, 1966/68; Argentina
Ateles						
<i>A. geoffroyi</i>	1.5-2.2	3.80	—	—	1531	Freese, 1976; Santa Rosa, Costa Rica
	0.7	4.70	0.50	0.50	1878	Rodriguez, 1985; Santa Rosa, Costa Rica
	6-11	—	—	—	4015	Fishkind & Sussman, 1987; La Selva, Costa Rica
	45.0	—	2.23	—	1350	Coelho <i>et al.</i> , 1976; Tikal, Guatemala
	27.8	4.30	1.31	0.77	1350	Cant, 1978; Tikal Guatemala
<i>A. belzebuth</i>	12-15	3.50	3.00	—	—	Klein & Klein, 1976; Colombia
	14.0	—	—	—	—	Bernstein <i>et al.</i> , 1976; Colombia
	20-33	8.40	—	—	—	Izawa, 1976; Colombia
<i>A. paniscus</i>	20-33	3.34	—	—	2705	Green, 1978; Colombia
	6-24	—	—	—	—	Durham, 1971,72,75; Peru
	14-35	3.80	—	—	—	Janson and Terborgh; Manu, Peru
	31.0	3.20	2.53	0.57	2080	White, 1986; Manu, Peru
	8.0	—	—	—	2200	Van Roosmalen, 1980; Suriname
—	—	—	2.82	1.16	2080	Symington, 1987; Manu, Peru
Cebus						
<i>C. capucinus</i>	5.6	14.0	2.30	1.16	1430	Fedigan <i>et al.</i> , 1985; Santa Rosa, Costa Rica
	3.5-5.0	15-20	—	—	1430	Freese, 1976; Santa Rosa, Costa Rica
	5.0-6.0	11.0	—	—	1878	Rodriguez, 1985; Palo Verde, Costa Rica
	79.2	27-30	—	—	—	Baldwin & Baldwin, 1972, 1976; Panama
	4-6	15.0	—	—	—	Fishkind & Sussman, 1987; La Selva, Costa Rica
	—	5-20	—	—	—	Milton & Mittermeier, 1977; Coiba, Panama
<i>C. albifrons</i>	3.8-15.3	5.3	—	—	2705	Green, 1978; Colombia
	0.2-24	2.4	—	—	—	Freese <i>et al.</i> , 1982; Peru/Bolivia
	10-34	7.5	—	—	—	Janson and Terborgh; Manu, Peru
	—	19.0	—	—	—	Izawa, 1976; Peru
<i>C. apella</i>	6-10	—	—	—	—	Klein & Klein, 1975; Colombia
	0.2-36	7.5	—	—	—	Freese <i>et al.</i> , 1982; Peru/Bolivia
	20-35	5.6	—	—	—	Janson and Terborgh; Manu, Peru

Conclusions

(1) A census of primate populations in protected areas in northwestern Costa Rica suggests that both the history of the region and the type of habitat play important roles in determining primate densities.

(2) Spider monkeys are the most endangered primate in northwestern Costa Rica. They were previously thought to be unable to survive in areas that had been altered by human activities. We found spider monkeys in protected young regenerating forest, suggesting that as long as they are protected from hunting and provided access to large areas of forest, or potentially connected forest patches, they can flourish in altered habitats.

(3) The observation of a large number of male/female pairs in Lomas Barbudal is consistent with the idea that the density of an animal relative to an area's productivity can alter a group's size, composition, and, potentially, its social structure.

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A General Introduction to Primate Conservation in Colombia

by Claudia L. Alderman

Bridging North and South America, Colombia contains a rich array of flora and fauna. This diversity includes an estimated 50,000 species of higher plants and over 2,800 species of terrestrial vertebrates. Similarly, more than a third of all Neotropical primate species have been found within Colombia's territory (Mittermeier, 1987). Estimates of the number of species found in the country range between 27 and 29. This discrepancy

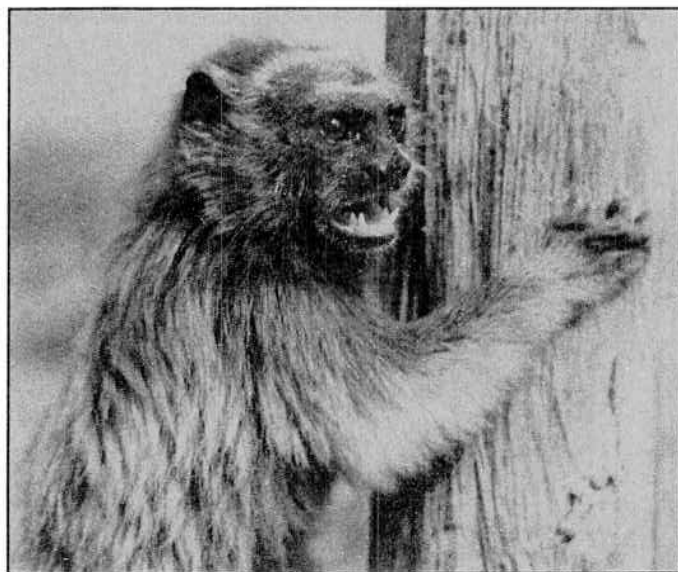


Fig. 1. The white-footed tamarin, *Saguinus leucopus*, is a callitrichid endemic to Colombia (photo by F. Medem)

is due, on the one hand, to incomplete knowledge about geographical distribution and, on the other, to differences of opinion regarding taxonomic classification. The latter goes beyond simple academic knowledge; until 1983 scientists did not recognize that *Aotus trivirgatus*, the preferred model for malaria research, in fact included up to nine species (Hershkovitz, 1983) — which may explain the lack of success of many captive breeding programs. Such incomplete understanding also hampers conservation efforts.

Despite existing gaps in knowledge, however, there is little doubt that Colombia's primates are facing various sources and degrees of threat. Eight primate species in the country are classified by IUCN as 'endangered,' 'vulnerable,' or 'rare.' Of particular concern are the three



Fig. 2. Cotton-top tamarin (*Saguinus oedipus*) (photo by R. Mast)



Fig. 3. Juvenile black-headed uakari (*Cacajao melanocephalus*) (photo by R.A. Mittermeier)

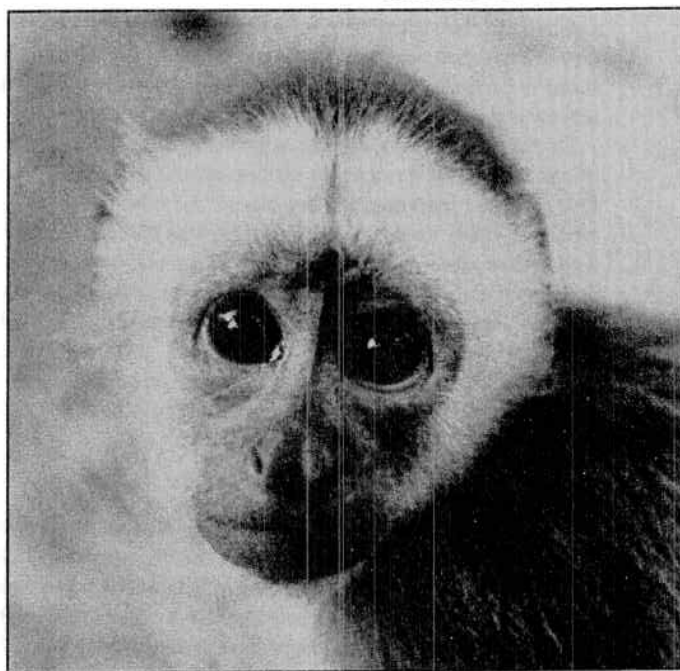


Fig. 4. White-fronted capucin (*Cebus albifrons*), one of the three *Cebus* species found in Colombia (photo by R.A. Mittermeier)

Table 1. List of Primates Found in Colombia

Species	Scientific Name	Common Name	Status	Source
	<i>Alouatta palliata</i>	Mantled howler monkey	1	1
	<i>Alouatta seniculus</i>	Red howler monkey		1
	<i>Aotus brumbacki</i> *	Dourocouli or owl monkey		1
	<i>Aotus nigriceps</i>	"		3
	<i>Aotus lemurinus</i>	"		1
	<i>Aotus nancymai</i>	"		3
	<i>Aotus vociferans</i>	"		1
	<i>Ateles belzebuth</i>	Black spider monkey	V	1
	<i>Ateles fusciceps</i>	Brown-headed spider monkey	I	2
	<i>Cacajao melanocephalus</i>	Black-headed uakari	1,V	1
	<i>Callicebus cupreus</i>	Dusky titi		1
	<i>Callicebus torquatus</i>	Collared titi		1
	<i>Callimico goeldii</i>	Goeldi's marmoset	1,R	1
	<i>Cebuella pygmaea</i>	Pygmy marmoset		1
	<i>Cebus albifrons</i>	White-fronted capuchin		1
	<i>Cebus apella</i>	Tufted capuchin		1
	<i>Cebus capucinus</i>	White-faced capuchin		1
	<i>Lagothrix lagotricha</i>	Woolly monkey	V	1
	<i>Pithecia monachus</i>	Monk saki		3
	<i>Saimiri sciureus</i>	Squirrel monkey		1
	<i>Saguinus fuscicollis</i>	Saddle-back tamarin		1
	<i>Saguinus inustus</i>	Mottle-faced tamarin		1
	<i>Saguinus leucopus</i> *	White-footed tamarin	1,V	1
	<i>Saguinus oedipus</i> *	Cotton-top tamarin	1,E	1
	<i>Saguinus nigricollis</i>	Black-mantled tamarin		1

Key

Species:

* endemic to Colombia

Status:

E = Endangered

V = Vulnerable

R = Rare

I = Indeterminate

1 = Appendix I

IUCN Classification

(CITIES)

Sources:

1 = Hernandez Camacho & Defler (1985)

2 = Thornback — IUCN Mammal Red Data Book (1982)

3 = Defler (1989)

endemic species, since their ranges coincide with the areas of greatest human population density and expansion. Table 1 lists the primate species found in Colombia as reported by various sources, as well as their conservation status as recognized by IUCN and their listing by CITES.

Threats to primate populations in the wild generally reflect the interplay of one or more of three major factors: habitat destruction, hunting for food and other purposes, and live capture for export or local trade (Mittermeier, 1984). In this paper, I will explore how these factors are affecting the conservation of primates in Colombia. I will also discuss the policy and legislative structure governing primate conservation in the country. Finally, I will examine current efforts of the Colombian National Institute of Renewable Resources and the Environment (INDERENA) and private organizations to protect habitats, establish parks and reserves, and conduct research on primate populations and their ecological needs.

Habitat Destruction

Habitat destruction is often listed as the major threat to primate populations throughout the world (Terborgh, 1984; Mittermeier, 1984, 1986, 1987). To understand how primates are being affected by habitat loss and degradation it is useful to refer to Marsh *et al.* (1987), who break down the broad category of habitat destruction into six types, based on its nature, scale, and the level of technology used. This classification is particularly important, since regional differences in cultural practices, traditions, and levels of economic development result in differential impacts on primate species (Terborgh, 1984). Following is a summary of these six categories and a discussion of how they potentially relate to particular Colombian primates.

(1) Removal of selected plant products by traditional means. This includes a broad range of practices which do not involve gross destruction of habitat, but rather require that specific trees be cut. Nonetheless, these activities may affect primate species. For example, the destructive exploitation of *Castilloa ulei* (for latex production) and *Couma macrocarpa* and *Ragala sanguinolenta* (for non-elastic gum production) is common in the Amazonian region (Marsh *et al.*, 1987). These trees provide an important food resource for the bearded saki (*Chiropotes satanas*) and woolly monkeys (*Lagothrix lagotricha*).

Selective exploitation may have both direct effects on dependent species and indirect effects through ecosystem interactions. It is not necessary that the exploited plant species be a major food resource for its removal to have a detrimental effect. Such an effect could result if the harvested trees are key food resources during the more stressful dry season. Terborgh (1984) found that 10 plant species accounted for more than 90% of the non-leaf matter consumed during the dry season by five primate species (2 *Cebus* spp., *Saimiri*, and 2 *Saguinus* spp.). Thus, if forest management practices were to eliminate crucial dry season resources, the carrying capacity for primates could be seriously diminished (Terborgh, 1984). It is likely, however, that with proper management and planning, selected resource extraction can be relatively benign as compared to the other forms of habitat disturbance discussed below. Given the reality of population pressures on forest lands, including parks and reserves, such traditional exploitation may actually have a role in a conservation program, as it offers an alternative to more destructive practices.

(2) Clearance or damage to the understory. This results from activities that clear forest undergrowth but leave the upper and middle canopies intact. In parts of Amazonia, people clear small areas of forest understory to establish nurseries of tree crops such as *guaraná* (*Paulinia cupana*) and rubber (*Hevea brasiliensis*). Another common practice near towns and villages is the cutting of understory trees for firewood and charcoal production. While the consequences of such activities are not yet clear, they are likely to affect those primates that are insectivorous or that spend most of their time in the lower forest (Marsh *et al.*, 1987). Relevant Colombian species include *Saimiri sciureus*, *Cebus apella*, *C. albifrons*, and *Callicebus cupreus*.

(3) Changes in water regime. The building of roads, dams, and irrigation ditches and canals can drastically alter the vegetation of an area. Some species such as squirrel monkeys prefer riverine habitats and are consequently susceptible to such alterations (Marsh *et al.*, 1987). On a larger scale, dams that flood out large areas irreversibly destroy critical habitat. In the northern Atlantic region, two hydroelectric projects have been proposed, in the San Jorge and Sinú river valleys, which would flood 60,000 ha of the Paramillo National Park (Mast and Fajardo Patiño, 1988). In addition to damaging a protected area, these dams would destroy a quarter of the known range of the endangered cotton-top tamarin (*Saguinus oedipus*). While the Colombian government has temporarily halted all hydroelectric projects (due to financial constraints, not on ecological grounds), a reinstatement of these projects could have devastating effects on this and other primate species.

(4) Commercial logging. Even when logging does not result in clear-cutting, it has several detrimental effects on primates (Marsh *et al.*, 1987). First, the noise from the logging operation and the shock of habitat destruction can produce temporary changes in behavior. Second, the removal of food trees and aerial pathways causes changes in diet and foraging behavior. Third, forests take a long time to recover from logging; therefore, long-term changes in abundance and biomass of the primate species may result. Little is known about the specific factors which result in the decline of primate populations after logging. Some suggestions include disintegration of social groups, increased mortality among young due to food shortages, added vulnerability to predators due to opening of the canopy, disease, and falls (Marsh *et al.*, 1987). Often, however, clear-cutting is practiced instead of selective logging and is, of course, more detrimental to biological diversity. Lumbering directly affects the habitat and indirectly leads to colonization, as it opens roads and access to remote areas. In Colombia, large areas which are being exploited for wood and lumber are not being replanted (Hernández-Camacho and Defler, 1985). The northern Pacific coastal rainforests, which until recently were one of the largest remaining undisturbed tracts, are threatened with extensive depletion as lumbering and mining operations enter the area (Myers, 1987). At least five species of primates inhabit the region and may be affected by such activities.

(5) Shifting cultivation and (6) Large-scale clearance for agriculture and ranching. Large- and small-scale agricultural efforts account for over 60% of Colombia's export economy (EIR, 1988-1989). Due to population growth, forest clearing for agriculture has accelerated greatly in the past 20 years. Of an estimated original 678,000 km² of virgin forest in the country, only approximately 364,000 km² remain (Hernández-Camacho and Defler, 1985). Between 1981 and 1985, the annual rate of deforestation in Colombia was 1.7% (Repetto, 1988). Forest destruction has continued despite estimates that only 18% of Colombia's land has soil capable of sustaining agriculture (Hernández-Camacho and Defler, 1985). The remnant forests in Colombia are mainly located in the northern portion of the Pacific Coast (Chocó) and eastern Amazonas.

The wave of colonization of the Colombian Amazonian region is expanding eastward in a wide arc from the Putumayo to the Serranía de La Macarena. Two roads in particular, the Altamira-Florencia and the Pasto-Mocoa, have facilitated this advance towards the western Amazonian region. In addition, a road over the cordillera from Pitalito to Mocoa is under construction, and, if completed, will further integrate Amazonia with the more populated regions. Continuing expansion by colonists into this biologically rich area will have serious adverse effects on many of the 19 species of primate species present there (Defler, 1989).

The degree of human impact, however, varies from species to species, with the largest species being affected the most (Mittermeier, 1987). *Ateles paniscus* is, according to Defler (1989), at great risk, since its distribution coincides with the Amazonian areas most altered by human activities. This conclusion follows from Defler's studies that indicate the distribution of *A. paniscus* is far more restricted than that suggested

by Hernández-Camacho and Cooper (1976), who list all of Colombian Amazonia as its range. Defler considers *Saguinus inustus*, *Saimiri sciureus*, *Aotus vociferans*, *Callicebus* spp., *Cebuella pygmaea*, and *Callimico goeldii* to be least affected by human development, since these species survive well in degraded forest. However, as forest destruction of the Amazonian region intensifies, many of the above species could become threatened. Moreover, a secondary effect of colonization in the Putumayo region could be pollution, resulting from the developing petroleum industry (Moynihan, 1976). How this will affect the primates is not yet clear.

The northern part of Colombia, including the Caribbean coast and the Magdalena and Cauca valleys, is the most densely populated area in the country. Thus, its ecology is the most modified to date. Only three blocks of virgin forest remain there — the Upper Valley of the San Jorge River, the Serranía de San Lucas, and the Sierra Nevada de Santa Marta (Hernández-Camacho and Defler, 1985). The areas of Meta, Boyacá, Casanare, and Arauca retain little of their original piedmont forests or of their formerly rich primate faunas (Hernández Camacho and Defler, 1985).

Agricultural expansion renders previously continuous tropical forests into disjointed segments and leaves forest cover only on the steepest hillsides and areas otherwise unsuitable for cultivation. Primate species are differentially able to adjust to these forest fragments. Bernstein *et al.* (1976) surveyed five species of monkeys in northern Colombia and found marked differences in their ability to survive following the extensive cutting of the forest. They concluded that woolly monkeys are the most adversely affected, but that tamarins may actually thrive in disturbed habitats.

Due to these interspecific differences, the relative abundance of primate species in a cleared region differs greatly from that in the original forest (Bernstein *et al.*, 1976). In the Macarena National Park, Klein and Klein (1976) found that colonists usually selected the highest banks and areas to build their houses and to plant fruit trees and yucca. These were precisely the terrains with the most heterogeneous forest and the most intensively used by many of the primates. The researchers concluded that the clearing taking place in most of the park's areas had a lesser effect upon *Saimiri* and *Cebus* species, due to their broader distribution over different types of forest. Like Defler, they found that *Ateles belzebuth* was the most adversely affected species, due to its locomotion and feeding habits. In both the Macarena and Amazonian areas, *Cebus apella* seems to benefit to some extent from small-scale agricultural practices by making a habit of raiding crops (Klein and Klein, 1976; Mittermeier, 1987). Indeed, a name commonly used for this species is *maicero* or 'corn-eater.' Neither *C. apella*, nor *Saimiri sciureus*, which occasionally raids fruit orchards in Amazonia, appears to be systematically killed by farmers for this habit (Mittermeier, 1987).

Even where species are able to survive in a fragmented forest, the long-term consequences of such isolation are likely to be negative. Among the possible effects are inbreeding depression and the increased probability of local extinctions due to random events or cyclical availability of food. Island biogeography theory presents ample evidence of increased rates of extinction on isolated islands, a concept relevant in this context (Marsh *et al.*, 1987).

Hunting

A second major global threat to primate species is hunting for food and other uses (Mittermeier, 1986, 1987). Colombia, and particularly the Amazonian region, is not excepted from this. While all commercial hunting of primates has been banned since 1978, Colombian law does permit hunting for subsistence and for captive breeding purposes (Lemke, 1981). In addition to these legal ones, other reasons for hunting, such as for pets, ornaments, or bait, still prompt the activity.

Primate meat provides an important source of protein for many colonists, particularly immediately following migration, when crops are not

yet mature (Klein and Klein, 1976; Hernández-Camacho, pers. comm., 1989). While eating monkey meat is considered 'primitive' in urban areas, the practice is prevalent among people who have moved into the Amazonian region (Mittermeier, 1987). Lack of other foodstuffs is an important factor for this; poor or non-existent transportation networks in remote regions make alternative protein sources scarce or expensive. Thus, subsistence hunting is likely to increase proportionately with colonization.

Hunting pressures are not uniform across taxa, but rather increase with the size of the species (Defler, 1989). In the Macarena N.P. area, Klein and Klein (1976) report that hunting had a serious adverse effect on *Ateles* and *Lagothrix*. These are favorite species for hunters in the area, as they are large and easy to shoot. In the Amazonian region, *Cacajao*, *Lagothrix*, and *Saimiri* are favored because they are readily located from canoes, particularly during the early stages of the annual flooding cycle when concentrated and abundant food at the water's edge attracts large numbers of primates (Defler, 1989).

Primates are also occasionally hunted for their skins and body parts. Monkey ornaments are sold in tourist shops in Amazonian towns such as Leticia (Mittermeier, 1987). In Colombia, the skins of *Alouatta*, *Lagothrix*, and *Aotus* are sometimes used as brow bands, horse bridles, and saddle covers (Mittermeier, 1987).

Another reason for hunting is to obtain pets. Although some animals are trapped live or caught by hand, the capture of pets is often a by-product of hunting for food (Mittermeier, 1987). For the larger species, a common practice is to shoot a female for food and keep her infant as a pet (Mast and Fajardo Patiño, 1988). The smaller callitrichids, *Cebuella* and *Saguinus*, however, are generally considered too small to eat but are specifically sought as pets (Mittermeier, 1987). Regulation is only partially effective in limiting such activities. Despite the fact that any hunting of *Saguinus oedipus* has been illegal since 1973, cotton-top tamarins are still found as pets throughout their range in northern Colombia and, to a lesser degree, in the rest of the country (Mast and Fajardo Patiño 1988).

Primates are also used to bait traps for hunting spotted cats in the Meta and Amazonian regions of Colombia (Cassidy, 1976). Despite the international ban on the trade of spotted cats and their skins, there remains a small but lucrative trade in these animals in parts of the Amazon. In this wasteful practice, 10-20 monkeys may be killed for each cat hunted (Cassidy, 1976). The most common species used to bait traps are the larger primates, such as *Lagothrix* and *Ateles* (Mittermeier, 1987) and *Alouatta* (Cassidy, 1976). Primates are also used as fish and turtle bait in Amazonia, and *Cacajao melanocephalus* is sometimes hunted for this purpose (Mittermeier, 1987).

Finally, children sometimes shoot at smaller monkeys, using slingshots and air rifles. The most common targets are the callitrichids found in the secondary forests around villages. Monkeys are also known to be used for target practice, particularly around military posts (Mittermeier, 1987).

The Primate Trade

Fortunately for the conservation of primates in Colombia, the large-scale trade for biomedical research and the international pet market is a matter of history. Not so fortunate is the fact that this trade may have permanently damaged the population viability of some species and has led to some local extinctions (Mittermeier and Coimbra-Filho, 1983). This is certainly true in the case of *Saguinus oedipus*, where the large numbers of animals exported probably exceeded their replacement rate (Mittermeier and Coimbra-Filho, 1983).

Prior to 1974, Colombia was one of the biggest exporters of primates in the Neotropics (Kavanagh, 1984). Between 1964 and 1974, Colombia exported 138,619 primates to the U.S. alone (Mack and Eudey, 1984). In 1971 and 1974, at least 19 species were traded, including 200 pygmy marmosets (*Cebuella pygmaea*); 6,600 tamarins (*Saguinus* spp.); 10,000

squirrel monkeys (*Saimiri sciureus*); 6,100 night monkeys (*Aotus* spp.); 100 titis (*Callicebus* spp.); 5,700 capuchins (*Cebus* spp.); 1,700 spider monkeys (*Ateles* sp.) and 600 woolly monkeys (*Lagothrix lagotricha*; Mack and Eudey, 1984). Hernandez-Camacho and Cooper (1976) estimate that 30,000–40,000 cotton-top tamarins were exported every year at the peak of the trade in the 1960s and early 1970s. These numbers, moreover, reflect only the number of animals that reached the U.S., not the number actually removed from the wild. Indeed, the 1978 figures on shipment-related deaths are astounding. For example, on the average, 37.6% of the *Aotus* died during shipment. The corresponding figures for *Cebus capucinus* and *Saimiri sciureus* were 28.6% and 23.1%, respectively (Mack and Eudey, 1984). In Latin America, during the 1960s, the rate of primate mortality from capture to final delivery, was estimated at 25–80% (Warland, 1972).

Primates were exported for two reasons: to provide specimens for biomedical research and to serve as pets. While the smaller species, particularly the tamarins, were favorite pets, many New World monkeys were, and continue to be, used in laboratory research. Squirrel monkeys (*Saimiri*), night monkeys (*Aotus*) and tamarins (*Saguinus*) are preferred species for certain kinds of research (Mittermeier and Coimbra-Filho, 1983). *Aotus*, in particular, is the prototype model for malaria studies.

This wholesale export of primates came to an end in 1974, with the enactment of the Natural Resources Code, whereby all commercial capture and export of primates was banned (Kavanagh and Bennett, 1984). Since then, the only exports allowed are for documented scientific use, under the direct authority of the President (Donadio, 1982). Since no such licenses were granted between 1975 and 1980, all exports of primates were illegal during those years (Kavanagh and Bennett, 1984). Despite this, the *CITES Report* listed 83 primates exported from Colombia in 1980. Between 1981 and 1986, the *CITES Report* listed 215 animals with Colombia as country of origin. Some discrepancies are found regarding these numbers. For example, Mack (1982), using Department of Commerce data, reports that the U.S. imported 92 primates from Colombia in 1981, while CITES accounts for only 62 animals. From a conservation perspective, however, compared to previous trade figures, these numerical discrepancies are relatively insignificant, and only point out inadequacies in reporting mechanisms.

Following the 1974 ban on trade from Colombia, many animals were 'laundered' through Panama, as evidenced by that country's export of non-native species. Furthermore, Panama did not export any primates to the U.S. prior to 1972, but exported over 3,000 from 1974 to 1978 (Mack and Eudey, 1984). Indeed, the illegal trade in *Saguinus oedipus* flourished until 1976, when it was placed on the U.S. Endangered Species List (Mittermeier and Coimbra-Filho, 1983). Since 1979, when the country's use as a base of smuggling operations became clear, Panama stopped allowing the commercial export of primates (Mack, 1981). Trade is no longer a problem for primate conservation in Colombia.

Colombia was a relatively late ratifier of CITES and did not join the convention until 1981. To a large degree, CITES had little impact upon the protection of primates in the country (Donadio, 1982), partly because the domestic legislation already in place was far stricter than that of CITES. Nonetheless, membership in CITES strengthens Colombia's legal and enforcement mechanisms and makes smuggling of animals through other countries much more difficult.

Primate Conservation Efforts in Colombia

According to Donadio (1982), "Colombia has some of the strictest wildlife laws anywhere, but implementation of these laws ranges from fair to dismal". This section will discuss those Colombian laws, policies and institutions that affect primates. In particular, it will address the institutional and policy factors that result in the current inadequate protection of primates in Colombia.

In 1973, the Colombian Congress passed Law 23, giving the President extraordinary powers to draft the Natural Resources Code. Con-

gress also declared that the goal of the law was "to prevent and control the contamination of the environment, and to promote the enhancement, conservation and restoration of the renewable natural resources, in order to defend the health and well-being of all the inhabitants on the national territory" (Fuller *et al.*, 1985). In 1974, by Presidential Decree 2811, the Natural Resources Code was published. This decree and implementing regulation (Decree 1608 of 1978) are the principal measures governing wildlife in Colombia (Fuller *et al.*, 1985). While Law 23 is unlikely to be fully implemented, given the severe economic limitations of the country, it at least serves as a policy basis for conservation efforts.

The government agency charged with natural resources is the National Institute of Renewable Resources and the Environment (INDERENA), administratively placed under the Ministry of Agriculture. INDERENA has been hampered in the pursuit of its conservation mandate by conflicting political and economic priorities, lack of trained personnel, inadequate funding, and an inability to enforce wildlife policy (Lemke, 1981). In addition to these impediments, INDERENA's role in the conservation of fauna and flora is being undermined by an on-going process of government decentralization. Many autonomous development corporations throughout the country are increasingly receiving responsibility for the management of protected areas and natural resources. Given that the primary goal of these regional corporations is to promote development projects, it is not clear that wildlife interests will be adequately balanced (Donadio, pers. comm.). This fragmentation of authority makes it difficult for INDERENA to implement a comprehensive program of conservation and management of the nation's resources.

INDERENA has not been able to establish an adequate framework of parks and reserves to protect Colombia's nonhuman primate populations. Among the species which are not found in any park or reserve are *Cacajao melanocephalus*, *Saguinus inustus*, *Saguinus leucopus*, *Callicebus torquatus medemi*, and *Callicebus cupreus discolor* (Defler, pers. comm.). Of these, *S. leucopus* is endemic to Colombia and thus should be a high priority for conservation, particularly as its habitat is threatened due to rapid deforestation (Hernández-Camacho and Defler, 1985). The protected status of *Callimico goeldii* is also in question, since its presence in the newly established Cahuinari N.P. is not yet confirmed. *Aotus brumbacki*, another endemic species, is reported by Hernández-Camacho and Defler (1985) as not being protected in any reserves.

Saguinus oedipus, another of the three endemic primates species found in Colombia, is also not yet securely protected by any reserve (Hernández-Camacho and Defler, 1985). Saving this primate species' dwindling habitat is, however, the target of a recent international effort (Mast and Fajardo Patiño, 1988). INDERENA, in collaboration with WWF Conservation International and Fundación Natura, is conducting research on which to base recommendations for establishing protective reserves in key cotton-top tamarin habitat. Expedience of such protection is important, since as mentioned earlier, approval of the proposed hydroelectric projects would destroy a substantial portion of the species' known habitat (Mast and Fajardo Patiño, 1988). The fact that flooding a large part of an existing national park is even contemplated in the project's proposal is a worrisome symptom of the fragility of the concept of preserved land.

Hernández-Camacho and Defler (1985) have identified major biogeographical gaps in the Colombian park system, in particular as they relate to primate conservation. These include:

- (1) the southwestern part of the Intendencia del Putumayo on the Upper Guamues River, an area which contains the highest diversity of primate species in the country;
- (2) the Upper Apaporis River at the border between the Departamento de Caquetá and the Intendencia del Guaviare. This poorly-studied area is a center of high endemism of plants and may contain endemic fauna as well;
- (3) the transitional zone between the Amazon Valley and the Guiana Shield contains at least nine species of primates. Thomas and Sara Defler

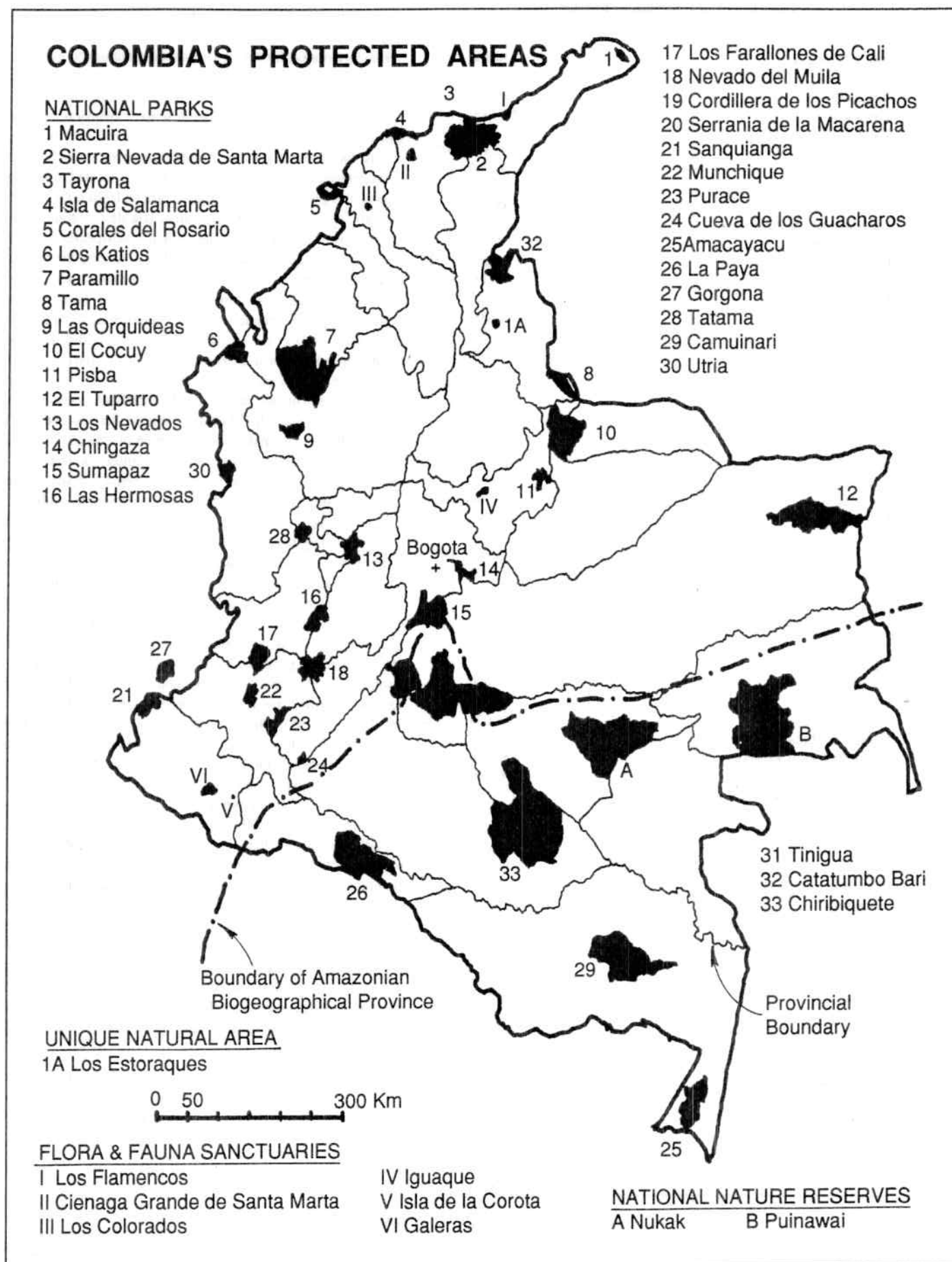


Fig. 5. Map showing location of Colombia's protected areas (map by S.D. Nash, adapted from Republica de Colombia, 1989).

Table 2. List of Colombia's Protected Areas

Name of Area	IUCN*	Ha	Year
Alto Rio Bojaya	7	50,160	
Amacayacu	2	170,000	1975
Arhuaco	7	195,900	
Cahuinari	2	575,000	1967
Carpanta	1	1,200	1967
Chingaza	2	50,374	1978
Chiribiquete		1,280,000	1989
Ciénaga Grande de Sta. Marta	4	23,000	1977
Cinturón Andino Cluster	9	855,000	1979
Cordillera de los Picachos	2	320,000	1977
Cuenca Q. Mutatá	8	1,500	
Cueva de los Guácharos	2	9,000	1975
El Cocuy	2	306,000	1977
El Tuparro	9	928,125	1979
Farallones de Cali	2	150,000	1968
Galeras	4	7,615	
Haina Cay to Cotton Cay		3,600	
Herencia Verde	1	0	
Iguaque	4	6,750	1977
Isla de Gorgona	2	49,200	1983
Isla de la Corota	4	8	1977
Isla de Salamanca	2	21,000	1977
Isla del Rosario	2	18,700	1977
Kogi-Malayo	7	364,490	
La Macarena	2	501,350	1948
La Paya	2	422,000	1984
La Planada	1	0	
Las Hermosas	2	125,000	1977
Las Orquídeas	2	32,000	1977
Los Colorados	2	1,000	1977
Los Estoraques		5	1988
Los Flamencos	4	7,000	1977
Los Katíos	2	72,000	1977
Los Nevados	2	58,300	1977
Macuira	2	25,000	1977
Merenberg	1	0	
Munchique	2	44,000	1977
Nevado de Huila	2	158,000	1977
Nukak Biological Reserve		855,000	1989
Paramillo	2	460,000	1977
Páramo de Sumapaz	2	154,000	1977
Pisba	2	45,000	1977
Piunawai Biological Reserve		1,092,000	1989
Puracé	2	83,000	1975
Rios Jurubida-Chori y A. Baudó	7	80,350	
Rios Valle y Boroboro	7	21,000	
Sanquianga	2	89,000	1977
Sierra Nevada de Santa Marta	9	731,250	1979
Tamá	2	48,000	1977
Tatamá	2	0	1987
Tayrona	2	15,000	1969
Tinigua		201,875	1989
Utria	2	53,400	1987
Yotoco	1	559	1960

Key

*IUCN Categories:

1=Scientific reserve

2=National and provincial parks

4=Nature conservation reserve

7=Anthropological reserve

8=Multiple use management area

9=Biosphere reserve

have strongly urged that INDERENA declare this region a national park to conserve *Cacajao melanocephalus* and *Saguinus inustus* (see Defler, this issue).

Encouragingly, however, Colombia continues to expand its national parks system (see Fig. 5). In the last decade, new parks have added over 1.5 million hectares to the system. Among these, of particular relevance to primate conservation is the expansion of Tuparro N.P., situated in the llanos bordering the Orinoco River; this park protects at least four primate species. Another important national park is La Paya in the Intendencia del Putumayo; strategically located in the west Amazon region, this park has the potential to protect lands under heavy colonization pressures. Another recent park, Isla de Gorgona N.P., provides easy-to-protect territory for an endemic subspecies of *C. capucinus*, (Hernández-Camacho and Defler, 1985). Among the latest of the new parks, Cahuinari N.P. is the largest protected area in the country. Located in the Departamento de Amazonas, this park's lowland forests are the home of several primate species. Established at the same time as Cahuinari, Utria N.P., on the Pacific coast of Chocó, protects one of the biologically richest areas in the world; this park includes the range of *Ateles fusciceps* and some *Aotus* species.

In addition to habitat protection, INDERENA is also involved in captive breeding research (Mast and Fajardo Patiño, 1988). The agency has established a primate research station in Colosó, containing a small group of confiscated ex-pets, including cotton-top tamarins, capuchins and howler monkeys. The animals are housed in semi-captive conditions and are used for breeding and behavioral studies. Successful breeding programs are key to relieving pressures on wild populations while providing needed specimens for biomedical research. Moreover, captive-bred animals could provide individuals for reintroduction into habitats where species have been eliminated or depleted.

Unfortunately, the establishment of parks is not synonymous with protection of species. Many of the parks in Colombia are under the onslaught of colonization. Due to inadequate funding, the parks are unable to exclude settlers or prevent illegal practices such as hunting or timber extraction. For example, it is estimated that over half of the territory of La Macarena N.P. has been destroyed by colonists (Hernández-Camacho and Defler, 1985). Thus, the long-term conservation of primates and other species will require economic commitments to the parks which go beyond legal denomination and imprecise border demarcations.

Another critical step towards the protection of primates in Colombia entails the allocation of more funds for research into the ecology, distribution, and taxonomy of the various species. This need is evidenced by the addition, since 1983, of at least two, and possibly five, new species to the list of Colombia's primate species. Moreover, concerned parties should devote resources to the training of local individuals, so that this work may be carried out insofar as possible by Colombian people. This will provide a more solid foundation for long-term conservation work.

While primates constitute only a fraction of the many species in need of protection, their aesthetic appeal makes them good 'flagship' species to promote environmental education and to rally support for the goal of conservation in general. If we fail in protecting our evolutionary cousins, we hold little hope in saving the myriad of less 'distinguished' organisms.

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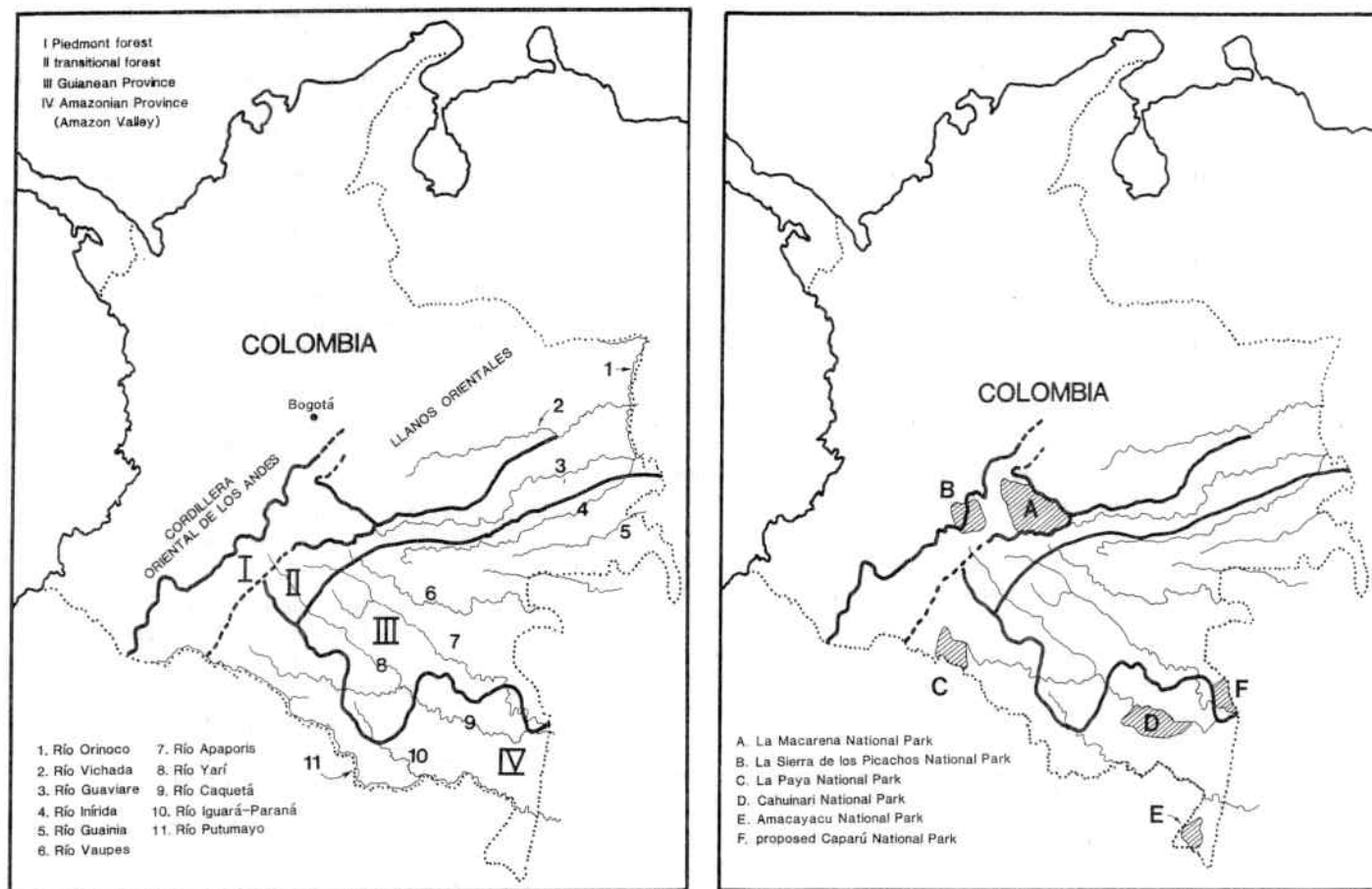
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The Status and Some Ecology of Primates in the Colombian Amazon

by Thomas R. Defler

With the development of the Amazonian region in Brazil, Bolivia, Colombia, Ecuador, Peru and Venezuela, primate populations are increasingly under pressure in what many people have considered to be the last great tropical stronghold. This immense region of more than six million square kilometers of forest has its major portion in Brazil (3,540,000 km²); but a large section is found in Colombia as well (about 403,000 km² before present-day colonization began in earnest). In Colombia, the Amazon is still by far the greatest single block of forest left in the country; however, it is under onslaught from many directions at once. Pressures are building on a variety of fauna, including primates, so that for some species action will have to be taken soon if their survival into the 21st century is to be guaranteed.

In Colombia, the term 'Amazonia' often refers to the major block of lowland forest from the Guayabero/Guaviare River southward to the Peruvian and Ecuadorian border, even though the northern part of the block also includes part of the Orinoco drainage via the Guayabero/Guaviare, Infrida and Atabapo rivers. It serves no biological purpose to differentiate between the two drainages in this region (except to distinguish the two ichthyofaunas). However, it is useful to divide the Colombian Amazon into four major biogeographic regions (Fig. 1), which can then be redivided into 17 subregions (J. Hernández, pers. comm., 1988).



Figs. 1(a) and (b). Maps showing the four major biogeographic regions (left), and protected areas and national parks (right) in the Colombian Amazon (map by S.D. Nash based on author's original).

Region I is the moist piedmont forest bordering the Eastern Cordillera of the Andes and extending up to an elevation of about 500 m. This forest is well developed where it still exists, since it stands on soils washed down from the Andes that are more fertile than the majority of soils farther from the cordillera. In the piedmont forest, precipitation reaches some of the highest levels in Amazonia. The region has been extensively disturbed, however, by increasing human activities, especially in Putumayo and Caquetá. Most of the piedmont along the eastern side of the Andes from Ecuador to Venezuela is now severely disturbed or destroyed. The destruction of piedmont forest is particularly sad since this region is especially diverse biologically. Hernández (pers. comm., 1988) recognizes eight subdivisions in the piedmont of Colombia based on the present-day distributions of many faunal elements. Cordillera de Los Picachos, a new 286,000 ha national park, preserves some piedmont, but the area is not yet guarded.

Region II may be called transitional forest as it is strongly affected by a dry period in January and February. In the north, where the annual dry period is more pronounced, the *llanos orientales* or llanos appear, great grassy savannas cut by rivers and streams lined with gallery forest. Compared to the more southern rain forests, these gallery forests are low in species richness. The transitional forests are dotted with some savannas as well, including the Savanna of Yarí, the most extensive southern savanna in Colombia. There is actually a broad band of transitional forest north of the Guayabero/Guaviare River, but usually the river is described as the formal northern limit of Amazonia. Sometimes La Macarena is included in descriptions of the Amazon, but this national park is perhaps better considered a transition zone for Amazonian, Andean and Llaneran elements.

Region III may also be called Colombian Guiana or the Guianan Province. This forest is strongly affected by extremely leached soils originating from pre-Cambrian, Guiana Shield rock and overlaid by Paleozoic and Mesozoic sedimentary rock, as is evident in the region's plateaus, rocky hills, inselbergs and rock outcroppings. Much of this forest is not as tall or as well developed as forest growing in the actual Amazon Valley. The region gives rise to many so called 'clear water' and 'black water' streams, due in the first case to a complete lack of sediment load and in the second case to the coloring of the water by organic acids and tannins. This region is probably the poorest-known biologically since the many rapids make river travel difficult.

Region IV, the Amazonian Province, is the classical rainforest of the Amazon Valley, and it is here that nature reaches its greatest exuberance in terms of diversity and biomass. The soils in this region are comparatively fertile (although still quite poor overall) compared to those of the Guianan Province. The land bordering the great rivers Caquetá and Putumayo is the most fertile of this province, due to the sediment load brought down from the Andes, which gives these rivers the name 'white water' rivers.

Eighteen or nineteen species of primates are known from the Colombian Amazon, depending on taxonomic classification (Table 1). Species densities increase from the north to the south of this region as has been shown by Hernández and Defler (1985). Human pressures on the different species vary in Colombia. In general, we can say that pressure increases as the size of the animal increases. At the moment *Saguinus inustus*, *S. fuscicollis*, *S. nigricollis* (and *S. graellsii* ?), *Saimiri sciureus*, *Aotus vociferans*, *Callicebus torquatus*, *C. cupreus* (Fig. 2), *Cebuella pygmaea* and *Callimico goeldii* are probably not dangerously

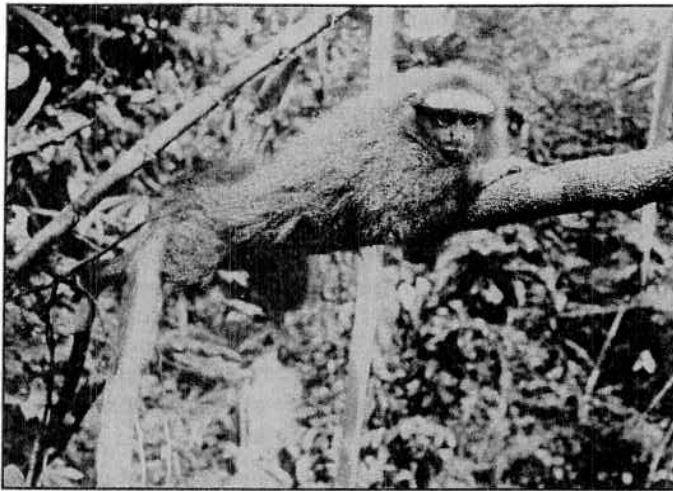


Fig. 2. *Callicebus cupreus* resting (photo by T.R. Defler).

affected by human development, since all of these species survive well in degraded forest and are not frequently hunted by humans in the Colombian Amazon. However, the situation could drastically change. Many of these species and their subspecies could become threatened, especially if human activities begin to include clear cutting the forest without leaving woodlots or secondary forest.

The recent discovery of *Aotus nancymai* and *A. nigriceps* by P. Hershkovitz from material collected in Colombia near Leticia (Hernández, pers. comm., 1988) indicates the pressing need to study Colombian *Aotus* populations much more carefully before we lose some of these 'sibling' species without having realized that they were there. Regarding this genus at least, primatologists are in the position, similar to that of tropical entomologists or invertebrate zoologists, of knowing too little to make the conservation decisions which must be made.

Callimico goeldii also deserves special mention in as much as its distribution is spotty, and the species should be considered 'rare' because the populations are evidently small and, therefore, at risk (IUCN, 1982). Hershkovitz (1977) suggests its distribution in Colombia includes all of the area between the Caquetá and Putumayo rivers. F. Medem, however, cited in Hershkovitz (1977), wrote that the monkey was known in Colombia from the Cahuinari River (where he apparently observed it), upriver on the Caquetá and southward on the Igará-Paraná (where he also observed it), and on the Guamués River, an affluent of the Putumayo. The species is unknown in the region of La Pedrera on the Caquetá close to Brazil, but it is apparently often overlooked by local inhabitants in certain areas where it is known to occur (Hernández and Cooper, 1976; Soini, in Hershkovitz, 1977). The recent establishment of Cahuinari National Park (550,000 ha) and perhaps La Paya National Park (422,000 ha) may help assure this species' future in Colombia. Unfortunately, we have very little first-hand data on which primates may exist in La Paya, and that part of Amazonia is experiencing pressure from colonization (Fig. 1).

Three of the medium-sized (2-5 kg) Amazonian primates are probably 'safe' for the time being, due to their ability to exist in degraded habitat and their wide distribution in Colombia. These are *Cebus apella*, *Cebus albifrons* and *Pithecia monachus*. Nevertheless, their situation could change rapidly if colonists decide that these animals are worth hunting either to eat, to protect crops (*Cebus* learn to raid crops such as corn, cacao, coffee and other fruit) or to collect the furry tail of *Pithecia monachus*, which at times is used as a duster or hat decoration (Mittermeier and Coimbra-Filho, 1977; pers. obs. in Colombia). Fortunately, both *Cebus* species are widely distributed throughout the basin, and Cahuinari National Park will protect good-sized populations of *P. monachus*.

Table 1. Primate Species Known from the Colombian Amazon

<i>Callimico goeldii</i>
<i>Cebuella pygmaea</i>
<i>Saguinus fuscicollis</i>
<i>Saguinus nigricollis</i> ¹
<i>Saguinus inustus</i>
<i>Callicebus torquatus</i>
<i>Callicebus cupreus</i>
<i>Aotus vociferans</i>
<i>Aotus nancymai</i>
<i>Aotus nigriceps</i> ²
<i>Pithecia monachus</i>
<i>Cacajao melanocephalus</i>
<i>Cebus apella</i>
<i>Cebus albifrons</i>
<i>Saimiri sciureus</i>
<i>Alouatta seniculus</i>
<i>Lagothrix lagotricha</i>
<i>Ateles belzebuth</i> (= <i>A. paniscus belzebuth</i>)

Key

¹ According to J. Hernández, *S. graellsii* should stand as a valid species (pers. com., 1988, but see Hernández and Cooper, 1976).

² *A. nancymai* and *A. nigriceps* identified by P. Hershkovitz from study skins from Colombian trapezius (Hernández, pers. comm.)

Another medium-sized monkey, the black-headed uakari (*Cacajao melanocephalus*), must be considered threatened in Colombia (Hernández and Cooper, 1976) due to its extremely spotty distribution, its popularity among hunters in parts of its Colombian range, and its ecological requirement of *igapó*, or flooded forest in black water streams and lakes, as part of its home range. This last factor makes *Cacajao* easy to hunt from a canoe at certain times of the year. At my research site on the lower Apaporis River, for example, this species was almost constantly over the water of the *igapó* at the early stages of the annual flooding cycle in June and July, when a strong flux of fruit is available. During this time of year *Cacajao*, *Lagothrix* and *Saimiri* are easily spotted from a canoe, and *Cacajao* groups seem unusually large. I counted a group of 48 and at another time witnessed a congregation of what must have been about 100 animals (surely two groups intermixed).

As the foods in the *igapó* become exhausted, *Cacajao* begin to forage farther inland. By December and January, they are making wide foraging loops away from the *igapó*; I have seen them up to 1½ km inland from the edge of the *igapó*. These primates choose a wide variety of fleshy and non-fleshy fruits and seeds and are especially adept at breaking open immature *Eschweilera* sp. fruits to eat the seeds.

Ecological density estimates for *Cacajao* in habitat including *igapó* may be high because of the animal's visibility to human observers. However, it is important to realize that this strip of habitat seems to support the only populations of this species. Therefore, the seemingly abundant numbers heretofore reported may represent nearly the entire population, especially if the observations were made during the season of maximum food availability within the *igapó*. Local abundance of food in flooded forest seems to be a common phenomenon in South America. This pattern attracts great concentrations of many primates such as *Alouatta seniculus*, *Ateles belzebuth*, *Lagothrix lagotricha*, *Saimiri sciureus*, *Pithecia monachus*, *Saguinus fuscicollis*, *Callicebus torquatus*, and *Cebus albifrons* (but not *C. apella*, pers. obs.), and makes these species particularly vulnerable to seasonal hunters. Most of these species have inland populations which are less affected by hunting. However, if *C. melanocephalus* (and *C. calvus calvus* and *C. calvus rubicundus*, according to Ayres, 1986; Bartecki and Heyman, 1987) are hunted out of the flooded forest, the species will probably be totally wiped out in the area.

For several years now, Dr. Sara Defler and I have been collaborating with INDERENA (the Colombian government agency in charge of natural resources, parks and reserves) to establish a national park in the lower Apaporis River to protect a good population of *Cacajao melanocephalus*. Presently, *C. melanocephalus* is not protected in any park or reserve in Colombia. Such a park would also protect several other endangered species in Colombia, including the black caiman (*Melanosuchus niger*), the piraracú or arapaima fish (*Arapaima gigas*), the Amazonian manatee (*Trichechus inunguis*), the giant river otter (*Pteronura brasiliensis*), as well as 4-5 species of felids and many other species of fauna widely found in the Amazon. It is probable that the nearby hills of Sierra del Taraira have an endemic flora as well, although there have been no collections made as yet.

Of the three large (8-10 kg) primates in the Colombian Amazon, *Alouatta seniculus* (Fig. 3) is probably not presently threatened because of its large distribution, extraordinary mobility across open treeless tracts of land and wide bodies of water, and ability to utilize degraded habitat. The other two large species, *Ateles belzebuth* and *Lagothrix lagotricha*, are considered 'vulnerable' by the IUCN, but in Colombia *Ateles belzebuth belzebuth* should perhaps be considered 'endangered' or 'threatened' by INDERENA, as is *C. melanocephalus*. Both of these primates need some remedial attention within their Colombian area of distribution if they are to survive. The situation for *A. b. belzebuth* is, however, deteriorating much more rapidly than that of *C. melanocephalus*.

A. b. belzebuth is probably now the primate at greatest risk in eastern Colombia, since its actual distribution is much smaller than has been

suggested by either Hernández and Cooper (1976) who considered the entire Colombian Amazon as part of its distribution, or Konstant *et al.* (1985) who, following Kellogg and Goldman (1944), included all of the Colombian llanos and a great deal of the Colombian Amazon. From the few years of data I have collected on this species in Colombia, I believe that its distribution is not only much smaller than we have assumed, but also that it corresponds with the Amazonian areas that have been most altered by human activities (Fig. 1). Jimeno Santoyo (1987) considers 44,500 km² of forest in the Colombian Amazon colonized (*i.e.*, clear-cut). This is probably a low estimate. It equals 11% of the surface area of the Colombian Amazon, but represents much more in terms of the distribution of *A. b. belzebuth*. I am beginning to suspect that around 80% of *Ateles* habitat in the Colombian Amazon has either been cut or highly disturbed by human activities. Much more field work will have to be done to verify this conclusion, but this primate's imperiled situation should be evident to the reader.

North of the Caquetá River, a major eastern limit for *Ateles* seems to be the Yari River. South of the Caquetá River, the eastern limit has not yet been firmly established, but it must be farther west than the Yari limit, as it does not seem to be present in the Igará-Paraná River. Above the Guaviare River (not in official Amazonia), *Ateles* is found, although spottily, between the Vichada and Guaviare rivers in transitional forest. La Macarena Park has had good populations of *Ateles* and was the location of the only long-term field study to date of *A. b. belzebuth* (Klein and Klein, 1976; Klein and Klein, 1977). However, La Macarena is under a great deal of pressure and at least 20% of its legal area (1,131,350 ha) has been cut and colonized, including the Kleins' study site. Hunting has disrupted *Ateles* populations in a much wider area, since this primate is popular bushmeat. The two other national parks which might protect *Ateles b. belzebuth*, La Cordillera de los Picachos (220,000 ha) and La Paya N. P. (422,000 ha) are not yet well guarded and have not been surveyed well enough to know whether this primate exists within their boundaries. I hope to resolve these distribution questions soon in order to be able to draw a realistic distribution map of *A. b. belzebuth* in Colombia.

Two of the four subspecies of woolly monkey are found in Colombia, *Lagothrix lagotricha lagotricha* (Fig. 4) and *L. l. lugens*. Without doubt, *L. l. lugens* is the more endangered, due to its distribution in parts of the central and western cordillera of the Andes which have been colonized for many years and heavily deforested. This subspecies is protected by law in at least six national parks (Nevado de Huila, Purace, Cueva de los Guacharos, Picachos, Chingaza and Sumapaz), which total 740,374 ha, but much of this area is not woolly monkey habitat and there are grave problems with hunting and forest destruction within some of the parks. Since the great majority of *L. l. lugens* distribution is within Colombia, major efforts to sustain populations of this subspecies will have to be taken within this country.

The subspecies *L. l. lagotricha* has a much more extensive distribution in Colombia; although the species is considered 'vulnerable' by the IUCN and 'threatened' by INDERENA, there are still large areas in the Colombian Amazon where good populations exist uninfluenced by human activity. As with *Ateles belzebuth belzebuth*, it is particularly in the areas near the Andes where there has been great human impact that *Lagothrix* has suffered and is in great decline. In areas where the distributions of both *Ateles* and *Lagothrix* are congruent, often a spotty distribution has been reported (Terborgh, 1983; Durham, 1971; Hernández and Cooper, 1976), suggesting possible competition between the two species which would certainly be of interest to study if any of the areas survive intact. In fact, it is clear that *Ateles* and *Lagothrix* select many of the same fruit types, which often are from tall, primary forest and have a hard outer coat and large seeds to which adhere a pulp which can only be digested by ingesting the seeds entire (Klein and Klein, 1977; van Roosmalen, 1985; Defler, pers. obs.). This certainly must cause much



Fig. 3. Juvenile *Alouatta seniculus* from Colombia (photo by S. Defler).

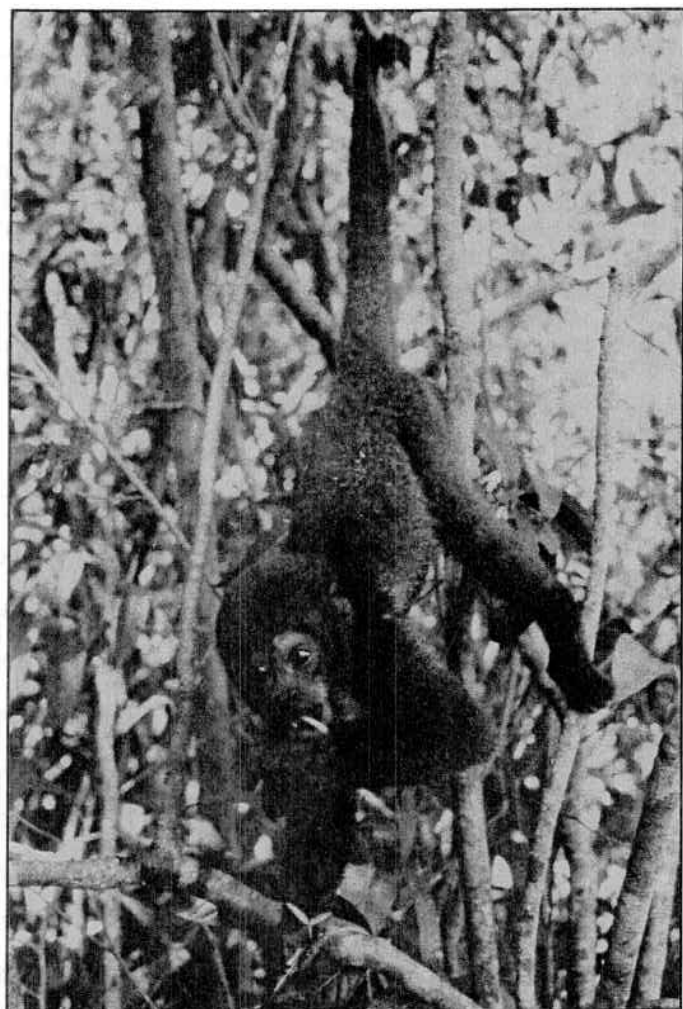


Fig. 4. Infant *Lagothrix* (photo by S. Defler).

direct competition wherever these two species are sympatric. I suspect that a tendency for *Lagothrix* to be a comparatively more generalized primate in terms of anatomy, diet, and locomotion might make *Lagothrix* a superior competitor to *Ateles* in areas where they are sympatric.

I have been studying the behavioral ecology of a group of *L. l. lagotricha* for 5½ years at a research site near the lower Apaporis River in southern Vaupes, and I present here a short resumé of some of this habituated group's salient ecological characteristics. The study group has varied from 21-23 individuals which utilize a home range that includes at least 760 ha. The group often splits up into subgroups equal roughly to one half the size of the united group, but sometimes smaller groups are seen. More rarely, neighboring groups may coalesce amicably so that 40 or 50 animals are in close proximity within several hectares of each other, but these occasions are not common and do not last for more than a few hours. Throughout a day, a group or subgroups travel an average of 3 km, measured along an animal's foraging path.

The main component of *L. l. lagotricha*'s diet is fruit, especially hard and leathery shelled fruits with one or a few large pits which are ingested to digest the tightly adhering fruit pulp, later to be dispersed by defecation about 4½ h later. Leaves are ingested in substantial amounts, especially young leaves not yet expanded to their full size. Insects and other invertebrates are also actively eaten as a minor component of the animal's diet. Occasionally, vertebrates such as frogs (pers. obs.) and birds (suspected, no obs.) are caught and eaten. Woolly monkey groups are multimale and relations both intra- and intergroup seem usually to be remarkably peaceable, although scars on the heads of males and females are not uncommon. I am in the process of preparing more detailed descriptions of movements, foraging, feeding behavior, and locomotion.

In Colombia, the Guianan Province of the Amazon region is, biologically speaking, one of the most poorly known areas. Because of this and the fact that some primate species known for Venezuela are found very near the border, it is possible that more species will be listed for this part of Colombia. The most likely primate species would be *Chiropotes satanas*, *Cebus olivaceus*, and *Aotus trivirgatus*. In the area between the Putumayo and Amazonas rivers, *Cacajao calvus rubicundus* could possibly reach Colombian territory. Whether any additions to Colombia's already rich primate fauna will be made in the future however, depends on continuing support of field studies. Whether the Colombian species known to exist will continue to do so in the future depends on an increasing national awareness of and concern for the value of these species as a heritage which must be conserved and protected.

Postscript

As of October 1989 four new protected areas had been established in the Colombian Amazon: Tinigua N.P. (201,875 ha), Chiribiquete N.P. (1,280,000 ha), Nukak Biological Reserve (855,000 ha) and Puinawai B.R. (1,092,000 ha). Tinigua is located between La Macarena N.P. and Los Picachos N.P.; together these three areas form a conservation unit which extends from east of La Macarena to the páramo of the Eastern Cordillera of the Andes and protects 1,087,875 ha in the biogeographic Guianan Province of the Colombian Amazon. The nine Amazonian units in the Colombian national park system now total 5,454,875 ha, or more than 13% of the Colombian Amazon.

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Two Priority Regions for Primate Conservation in the Brazilian Amazon

by Anthony B. Rylands and Aline T. Bernardes

The federal protected areas in the Brazilian Amazon include national parks and biological reserves, formerly administered by the Brazilian Forestry Development Institute (IBDF) of the Ministry of Agriculture, and ecological stations, created by the Special Environmental Secretary (SEMA) of the Ministry of the Interior. Both IBDF and SEMA were amalgamated in January 1989 to form a new organization within the Ministry of the Interior, the Brazilian Institute for the Environment and Renewable Natural Resources (IBAMA).

Although currently under revision, the statutes for national parks state that their aim is to protect extensive areas of natural ecosystems while permitting educational, recreational and scientific activities within their boundaries (IBDF, 1982). Biological reserves are generally smaller and permit only scientific activities. The emphasis in the creation of biological reserves is more on the protection of a specific ecosystem or an endangered species. Ecological stations, on the other hand, aim to protect representative ecosystems, specifically with a view to the protection of genetic resources and endangered species (SEMA, 1986; Figueiredo, 1988).

The first national park in the Brazilian Amazon, Araguaia National Park, was decreed in 1959; and only in 1974 was a second park, Amazônia (Tapajós) National Park, decreed. Until 1979, these parks, covering an area of a little less than 2 million ha, were the only protected areas maintained in the Brazilian Amazon. The majority of parks and reserves were created in the last nine years, with the major increase occurring in 1979 and 1980, when four national parks and three biological reserves totalling nearly 7 million ha were decreed (Rylands and Mittermeier, 1982, 1983; Rylands, 1985).

The planning of these recent national parks and biological reserves was based on a document written by Gary Wetterberg and co-workers

in 1976, outlining conservation priorities for the Amazon region (Wetterberg, et al. 1976; IBDF, 1982). Their analysis took into account the phytogeographical regions identified by Ducke and Black (1953) and modified by Prance (1977); the Amazonian vegetation types described by Murça Pires (1974); and the Pleistocene refuge areas identified for certain taxa of birds, butterflies, lizards and plants (for review see Prance, 1982). These refuge areas were chosen on the basis of high degrees of endemism, supposedly due to their past isolation which resulted from the contraction of the forest into isolated islands during cool climate regimes. First priority areas identified by Wetterberg et al. included 23 refuge areas which were identified by two or more authors for different taxa. Second priority areas included seven areas identified as refuges by just one author but of significant importance in the protection of Amazonian vegetation types (Fig. 2).

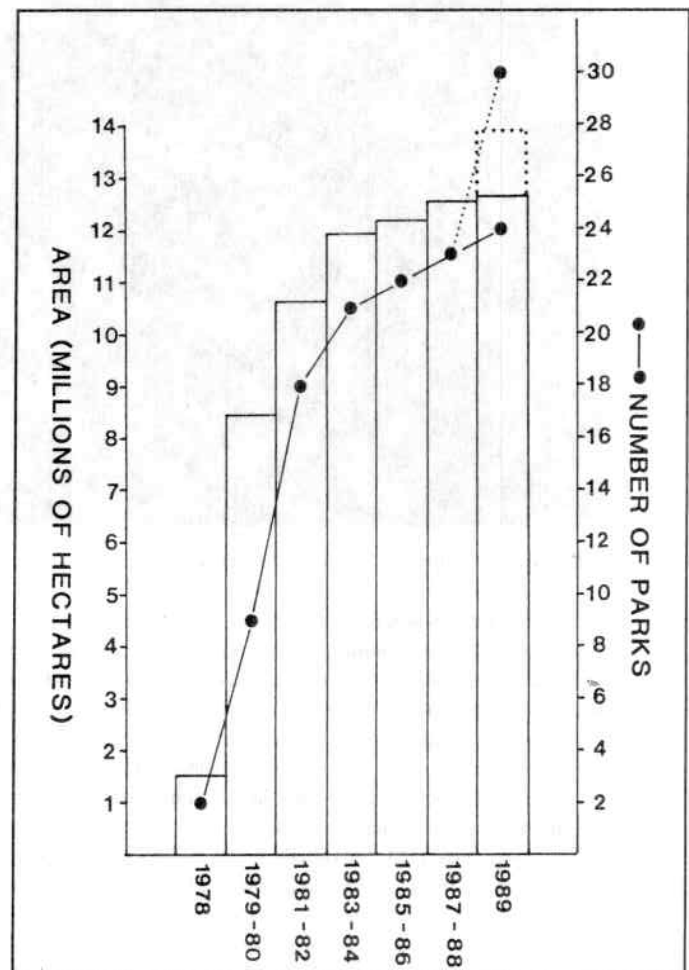


Fig. 1. The number (line) and area (histogram) of national parks, biological reserves and ecological stations in the Brazilian Amazon during the years 1978-1989. The dotted line indicates the number and area including reserves which have yet to be decreed (graph provided by authors).

Since 1979, therefore, the number of federally protected areas has increased dramatically from 2 to 30 (including some not yet decreed), with the total area affected increasing from just 2 million ha to nearly 14 million ha (Fig. 1) and including 7 national parks covering 8.1 million ha, 7 biological reserves covering 2.4 million ha and 16 ecological stations covering 3.4 million ha (Table 1; Fig. 3). This represents 2.79% of the region politically defined as the Brazilian Amazon, and known as Legal Amazonia, which covers 58% of the land area of Brazil and of which about 68% is, or was, forested.

Table 1. National Parks, Biological Reserves and Ecological Stations in the Brazilian Amazon

	Decree	Area (ha)
National Parks		
Araguaia, Tocantins	1959	562,312
Amazônia (Tapajós), Pará	1974	994,000
Pacaás Novos, Rondônia	1979	764,802
Pico da Neblina, Amazonas	1979	2,200,000
Cabo Orange, Amapá	1980	619,000
Jaú, Amazonas	1980	2,272,000
Serra do Divisor, Acre		700,000
Total (of 7 parks)		8,112,114
Biological Reserves		
Rio Trombetas, Pará	1979	385,000
Jarú, Rondônia	1979	268,150
Lago Piratuba, Amapá	1980	395,000
Abufarí, Amazonas	1982	288,000
Guaporé, Rondônia	1982	600,000
Gurupí, Maranhão	1988	341,650
Tapirapé, Pará	1989	103,000
Total (of 7 reserves)		2,380,800
Ecological Stations		
Anavilhanas, Amazonas	1981	350,012
Iquê, Mato Grosso	1981	200,000
Maracá, Roraima	1981	101,312
Rio Acre, Acre	1981	77,500
Maracá-Jipioça, Amapá	1981	72,000
Cuniã, Rondônia	1981	104,000
Caracaraí, Roraima	1982	400,560
Jarí, Pará	1984	227,116
Juamí-Japurá, Amazonas	1983/85	745,830
Jutaf-Solimões, Amazonas	1983	284,285
Coco-Javaés, Tocantins		37,000
Niquiá, Roraima	1985	286,600
Mamirauá, Amazonas		215,000
Sauim-Castanheira, Amazonas		109
Samuel, Rondônia		30,000
Balbina, Amazonas		280,000
Total (of 16 stations)		3,411,324
Total (of 30 protected areas)		13,904,238

The most recent taxonomic revisions identify 45 species and 90 taxa and subspecies of primates in the Brazilian Amazon (see Mittermeier *et al.*, 1988; Hershkovitz, 1988). Here we report on an analysis of the occurrence of these primates in the 30 protected areas mentioned above based on their known or supposed distributions. It is important to emphasize that this listing is based largely on supposition or prediction. Firstly, the large majority of these parks only exist on paper. They are not protected, very little research has been carried out in them, and practically nothing is known of their fauna and flora. Secondly, the distributions of many of the Amazonian primates are still poorly known and include a dose of guesswork. Finally, many species show patchy distributions and actually may be absent from large areas within their known distributional limits. Reasons for this patchiness are unclear, but in some cases may be due to habitat specialization, hunting or competition, as in the case of the *Atelinae* and *Alouatta*, for example (Terborgh, 1983; Rylands, 1987).

In order to facilitate an analysis of the distribution of the reserves and the diversity of primates they contain, the Brazilian Amazon was divided into three regions. These are defined by the Rio Amazonas-Solimões, the Rio Negro, and the Rio Madeira. This division was recognized by Wallace in 1853 and is still useful in defining three major groupings of primate species and subspecies in the basin (Avila Pires, 1974). As can be seen from Figure 4, the national parks, biological reserves and ecological stations are not uniformly distributed through these three

regions. In Region 1, north of the Rio Amazonas, east of the Rio Negro to the Atlantic Coast, there are 12 protected areas, covering an area of a little more than 5 million ha. In Region 2, the upper Amazon, west of the Rio Madeira to the south of the Rio Solimões and west of the Rio Negro to the Andes, there are 8 protected areas covering 4.7 million ha. In Region 3, south of the Rio Amazonas to the east of the Rio Madeira to the Atlantic Coast, there are 10 protected areas covering 3.9 million ha. The two principal areas lacking of reserves are the central and lower Amazon, south of the Amazonas, represented only by the Amazônia National Park, and the upper Amazon, south of the Rio Japura, and including the rivers Javari, Jutaf, Tefé, Purús and Madeira.

This coverage is not in accordance with the primate diversity in each region. Twenty species and subspecies occur in the first region, 59 in the second, and 33 in the third. Three species and 10 subspecies are restricted to Region 1, 15 species and 44 subspecies to Region 2, and 8 species and 21 subspecies to Region 3. The different numbers of primates found in these regions are reflected in the numbers of species protected in each region's parks (Table 2). Twelve or more primate species and subspecies occur in six of the eight parks in the species-rich Region 2: the Jutaf-Solimões, Juamí-Japurá, Mamirauá and Rio Acre Ecological Stations; the yet-to-be-decreed Serra do Divisor National Park; and the Abufarí Biological Reserve. This last may contain 19 species and subspecies of primates. Important also in terms of diversity is Amazônia National Park, which potentially protects 16 species and subspecies. The reason for the exceptional diversity in Abufarí Biological Reserve and Amazônia National Park is that both traverse rivers which are important barriers to primate distribution. Amazônia National Park includes a buffer zone (258,000 ha) on the east of the Rio Tapajós, and Abufarí Biological Reserve includes both sides of the Rio Purús. The six reserves in the upper Amazon, along with the Amazônia National Park, are also important because they contain many species which occur in only one protected area (see below). The parks in Regions 1 and 3 containing few species are located in the eastern part of Amazonia, in the states of Pará, northern Goiás and Amapá.

Nineteen subspecies, including seven considered endangered or vulnerable according to the *Red Data Book* (IUCN, 1982), and 12 endemic to the Brazilian Amazon, are not known to occur in any of these protected areas (Table 3). Twelve of these are restricted to the upper Amazon in Region 2, two to Region 1 and five to Region 3. Thirty-one species and subspecies are restricted to just one, or part of one, reserve only (Table 4). Of these, two are in separate reserves in Region 1, 20 are in seven of the eight reserves in Region 2, and nine are in four of the 10 reserves in Region 3. None of the *Red Data Book* callitrichids occur in more than one park.

In conclusion, therefore, it is possible to identify two priority areas for the conservation of primates in the Brazilian Amazon. The first priority area is the entire upper Amazon, more specifically between the Rios Japurá to the north of the Rio Amazonas and the Rio Madeira to the south of the Rio Amazonas. This region has the highest diversity of primates identified in the three regions, and the highest numbers of unprotected primates and primates protected in just one reserve. Twelve of the primates in this region remain without protection and 20 more are restricted to only one reserve. The second priority area is within Region 3, the central and lower Amazon, to the south of the Rio Amazonas. This is an important area for the siting of new parks, as demonstrated by the high diversity of primates in Amazônia National Park, five of which occur in no other protected area. Three *Callithrix* subspecies and two cebids remain without protection in this region, and a further nine primates are protected in only one reserve. Parks in these two areas should aim to cover the subspecies still lacking any protected area (Table 3) and the primates limited to only one (Table 1). Most important for the immediate future, however, will be the establishment of reserves in the states of Acre and Maranhão/Pará (especially east of the Rio Tocantins), which are currently undergoing major, internationally-financed development programs.

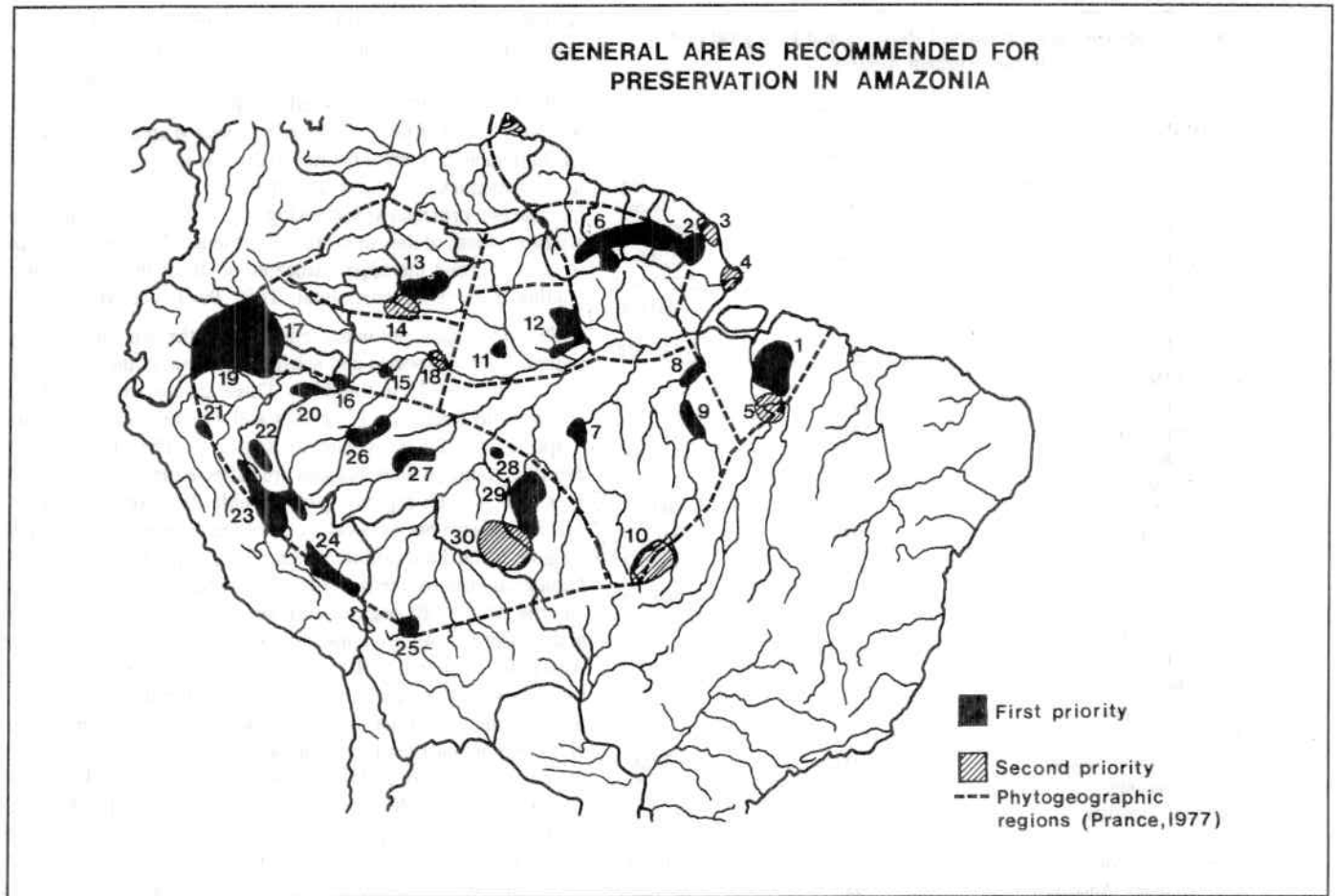


Fig. 2. The general areas recommended for protection in the Amazon basin, proposed by Wetterberg *et al.* (1976). Also shown are the phytogeographic regions identified by Prance (1977; map provided by authors).

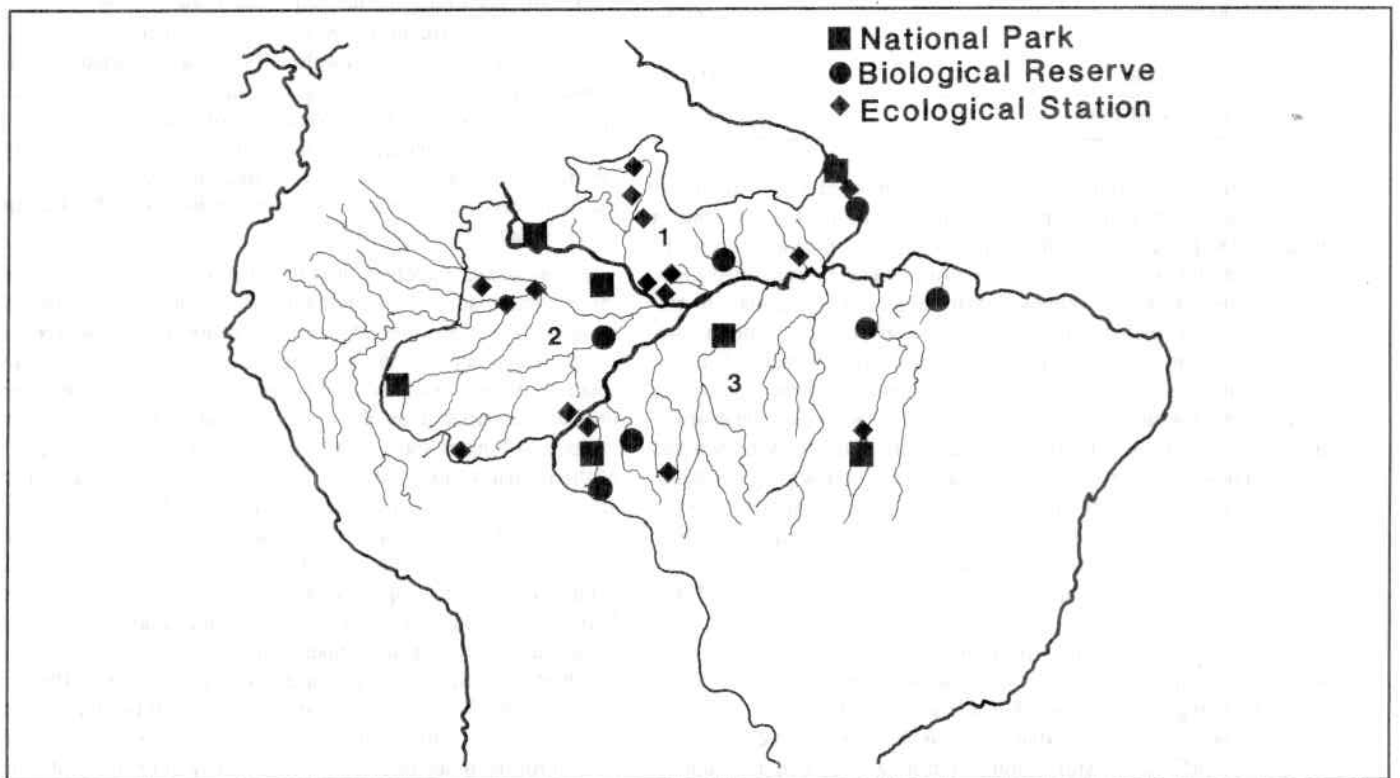


Fig. 3. The location of the national parks, biological reserves and ecological stations in the Brazilian Amazon. The darker lines delimit three regions, numbered on the map, which are used to examine primate diversity in the basin (map provided by authors).

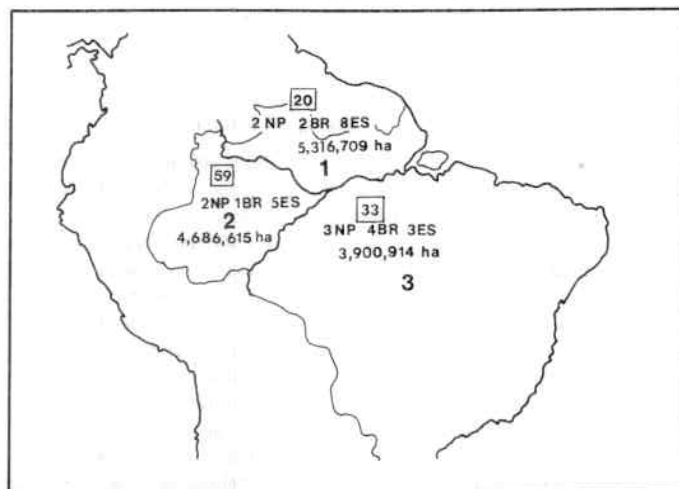


Fig. 4. The number of primate species (in the box), the number of national parks (NP), biological reserves (BR) and ecological stations (ES), and their total area in three regions in the Brazilian Amazon: (1) North of the Rio Amazonas-Solimões from the Rio Negro in the west to the Atlantic Coast, (2) The upper Amazon from the Rio Negro, north of the Rio Amazonas-Solimões, to the Rio Madeira, south of the Rio Amazonas-Solimões, (3) East of the Rio Madeira, south of the Rio Amazonas-Solimões (see Fig. 3, map provided by authors).

Table 2. Primates Occurring in Protected Areas in Brazilian Amazonia

Note: Taxonomy follows Mittermeier *et al.* (1988) except for the genus *Callicebus* which follows Hershkovitz (1988). List is based on known and supposed distributions. ? indicates questionably present. * indicates species occurs in one protected area only.

REGION 1

National Parks	
Cabo Orange, Amapá	Pico da Neblina, Amazonas
<i>Saguinus midas midas</i>	<i>Saguinus midas midas?</i>
<i>Saimiri sciureus sciureus</i>	<i>Saimiri sciureus cassiquiarensis</i>
<i>Cebus apella apella</i>	<i>Aotus trivirgatus</i>
<i>Cebus olivaceus</i>	<i>Callicebus torquatus lugens</i>
<i>Pithecia pithecia pithecia</i>	<i>Cebus apella apella</i>
<i>Chiropotes satanas chiropotes</i>	<i>Cebus albifrons unicolor</i>
<i>Alouatta seniculus</i>	<i>Pithecia pithecia pithecia?</i>
<i>Ateles paniscus paniscus?</i>	<i>Chiropotes satanas chiropotes</i>
Total: 8	<i>Cacajao melanocephalus ouakary</i>
	<i>Alouatta seniculus</i>
	<i>Ateles belzebuth belzebuth</i>
	<i>Lagothrix lagotricha lagotricha</i>
	Total: 12

Biological Reserves

Rio Trombetas, Pará

*Saguinus bicolor martinsi**
Saguinus midas midas
Saimiri sciureus sciureus
Cebus apella apella
Cebus olivaceus
Pithecia pithecia chrysocephala
Chiropotes satanas chiropotes
Alouatta seniculus
Ateles paniscus paniscus

Total: 9

Lago Piratuba, Amapá

Saguinus midas midas
Saimiri sciureus sciureus
Cebus apella apella
Cebus olivaceus
Pithecia pithecia pithecia
Chiropotes satanas chiropotes
Alouatta seniculus
Ateles paniscus paniscus?

Total: 8

Ecological Stations

Anavilhanas, Amazonas

Saguinus midas midas?
Saimiri sciureus sciureus
Aotus trivirgatus
Cebus apella apella
Cebus olivaceus
Pithecia pithecia chrysocephala
Chiropotes satanas chiropotes
Alouatta seniculus
Ateles paniscus paniscus

Total: 9

Jarí, Pará

Saguinus midas midas
Saimiri sciureus sciureus
Cebus apella apella
Cebus olivaceus
Pithecia pithecia chrysocephala
Chiropotes satanas chiropotes
Alouatta seniculus
Ateles paniscus paniscus

Total: 8

Balbina, Amazonas

Saguinus midas midas
Saimiri sciureus sciureus
Aotus trivirgatus
Cebus apella apella
Cebus olivaceus
Pithecia pithecia chrysocephala
Chiropotes satanas chiropotes
Alouatta seniculus
Ateles paniscus paniscus

Total: 9

Niquiá, Roraima

Saguinus midas midas?
Saimiri sciureus sciureus
Aotus trivirgatus
Callicebus torquatus lugens
Cebus apella apella
Cebus olivaceus
Pithecia pithecia chrysocephala
Chiropotes satanas chiropotes
Alouatta seniculus
Ateles belzebuth belzebuth

Total: 10

Maraca, Roraima

Saguinus midas midas?
Saimiri sciureus sciureus
Aotus trivirgatus
Callicebus torquatus lugens
Cebus apella apella
Cebus olivaceus
Alouatta seniculus
Pithecia pithecia chrysocephala?
Chiropotes satanas chiropotes?
Ateles belzebuth belzebuth

Total: 10

Sauim-Castanheira, Amazonas

*Saguinus bicolor bicolor**
Saimiri sciureus sciureus
Aotus trivirgatus
Cebus apella apella
Pithecia pithecia chrysocephala
Alouatta seniculus

Total: 6

Maracá-Jipioca, Amapá

Saimiri sciureus sciureus
Cebus apella apella

Total: 2

Caracarai, Roraima

Saguinus midas midas?
Saimiri sciureus sciureus
Aotus trivirgatus
Callicebus torquatus lugens
Cebus apella apella
Cebus olivaceus
Pithecia pithecia chrysocephala?
Chiropotes satanas chiropotes
Alouatta seniculus
Ateles belzebuth belzebuth

Total: 10

REGION 2

National Parks

Jaú, Amazonas

Saguinus inustus?*
Saimiri sciureus cassiquiarensis
Aotus vociferans
Callicebus torquatus torquatus (southern part)
Callicebus torquatus lugens (northern part)
Cebus apella apella
Cebus albifrons unicolor
Pithecia pithecia chrysocephala?
Cacajao melanocephalus ouakary
Alouatta seniculus

Total: 10

Serra do Divisor, Acre

Cacajao calvus ucayalii?* [although restricted by Hershkovitz (1987) to the west of the Rio Javari in Peru]
Saimiri boliviensis peruviansis?*
Saguinus fuscicollis spp. [Subspecies not identified by Hershkovitz (1977), but a likely candidate is *S.f. fuscicollis*]
Saguinus mystax mystax
Callimico goeldii
Saimiri sp. [Hershkovitz (1984) does not identify the squirrel monkey on the left bank of the Rio Jurua in this region: *S.b. peruviansis* or *S. sciureus macrodon* are candidates]
Callicebus cupreus cupreus
Callicebus caligatus
Aotus nigriceps
Cebus apella apella
Cebus albifrons unicolor
Pithecia monachus monachus
Lagothrix lagotricha poeppigii
Ateles paniscus chamek
Alouatta seniculus

Total: 13 (excluding *Cacajao*)

Biological Reserves

Abufari, Amazonas

*Saguinus fuscicollis avilapiresi** (left bank)
*Saguinus mystax pileatus** (left bank)
Saguinus mystax pluto or *Saguinus labiatus labiatus** (right bank)
*Saimiri boliviensis (jaburuensis?)** (left bank)
*Callicebus torquatus purinus** (left bank)
*Callicebus dubius** (right bank)
*Pithecia albicans** (left bank)
Cebuella pygmaea? (left bank)
Saguinus fuscicollis weddelli (right bank)
Saimiri ustus (right bank)
Aotus nigriceps
Callicebus caligatus
Callicebus cupreus cupreus (left bank)
Cebus apella apella
Cebus albifrons unicolor
Pithecia irrorata irrorata (right bank)
Alouatta seniculus
Ateles paniscus chamek?
Lagothrix lagotricha cana

Total: 19

Ecological Stations

Rio Acre, Acre

*Saguinus imperator imperator**
*Saimiri boliviensis boliviensis**
Cebuella pygmaea
Callimico goeldii
Saguinus fuscicollis weddelli
Aotus nigriceps
Callicebus cupreus cupreus
Callicebus caligatus
Cebus apella apella
Cebus albifrons unicolor
Pithecia irrorata irrorata
Alouatta seniculus
Ateles paniscus chamek
Lagothrix lagotricha cana

Total: 14

Juamí-Japura, Amazonas

Cebuella pygmaea?
Saguinus fuscicollis fuscus
Saimiri sciureus macrodon
Aotus vociferans
Callicebus torquatus lucifer
Cebus apella apella
Cebus albifrons unicolor
Pithecia monachus monachus
Cacajao calvus rubicundus?
Alouatta seniculus
Ateles paniscus chamek or
Ateles belzebuth belzebuth
Lagothrix lagotricha lagotricha

Total: 13

Jutaí-Solimões, Amazonas

*Saguinus fuscicollis fuscicollis**
*Aotus nancymai**
*Callicebus torquatus regulus**
Cebuella pygmaea
Saguinus mystax mystax
Saimiri sciureus macrodon
Aotus nigriceps?
Callicebus cupreus cupreus
Callicebus caligatus
Cebus apella apella
Cebus albifrons unicolor
Pithecia monachus monachus
Cacajao calvus rubicundus?
Alouatta seniculus
Lagothrix lagotricha poeppigii
Ateles paniscus chamek

Total: 16

Mamirauá, Amazonas

*Saguinus labiatus thomasi**
*Saimiri boliviensis vanzolinii**
*Cacajao calvus calvus**
Cebuella pygmaea?
Saguinus fuscicollis fuscus
Aotus vociferans
Callicebus torquatus lucifer
Cebus apella apella
Cebus albifrons unicolor
Pithecia monachus monachus
Alouatta seniculus
Ateles paniscus chamek
Lagothrix lagotricha lagotricha

Total: 13

Cuniã, Rondônia

Saguinus fuscicollis weddelli
Saguinus mystax pluto
Saimiri ustus
Aotus nigriceps
Callicebus brunneus
Cebus apella apella
Cebus albifrons unicolor
Pithecia irrorata irrorata
Alouatta seniculus
Ateles paniscus chamek
Lagothrix lagotricha cana

Total: 11

REGION 3

National Parks

Amazônia (Tapajós), Pará

*Callithrix argentata leucippe** (buffer zone)
*Callithrix humeralifer humeralifer** (left bank)
*Callicebus hoffmannsi hoffmannsi** (left bank)
*Alouatta belzebul nigerrima** (left bank)
*Ateles belzebuth marginatus** (buffer zone)
Saimiri ustus (buffer zone)
Aotus nigriceps (left bank)
Aotus infulatus (buffer zone)
Callicebus moloch (buffer zone)
Cebus apella apella
Cebus albifrons unicolor (left bank)
Pithecia irrorata irrorata (left bank)
Chiropotes albinasus
Alouatta belzebul discolor (buffer zone)
Ateles paniscus chamek (left bank)
Lagothrix lagotricha cana? (left bank)
 Total: 16

Pacaás Novos, Rondônia

Callithrix emiliae
Saimiri ustus
Aotus nigriceps
Callicebus brunneus
Cebus apella apella
Cebus albifrons unicolor
Pithecia irrorata irrorata
Chiropotes albinasus
Alouatta seniculus
Ateles paniscus chamek
Lagothrix lagotricha cana
 Total: 12

Araguaia, Tocantins

Aotus infulatus
Cebus apella apella
Alouatta belzebul discolor
 Total: 3

Biological Reserves

Jarú, Rondônia

Callithrix emiliae
Saimiri ustus
Aotus nigriceps
Callicebus brunneus
Cebus apella apella
Cebus albifrons unicolor
Pithecia irrorata irrorata
Chiropotes albinasus
Alouatta seniculus
Ateles paniscus chamek
Lagothrix lagotricha cana
 Total: 11

Guaporé, Rondônia

Callithrix emiliae
Saimiri ustus
Aotus nigriceps
Callicebus brunneus
Cebus apella apella
Cebus albifrons unicolor
Pithecia irrorata irrorata
Chiropotes albinasus
Alouatta seniculus
Ateles paniscus chamek
 Total: 11

Gurupá, Maranhão

*Chiropotes satanas satanas**
*Alouatta belzebul belzebul**
Saguinus midas niger?
Saimiri sciureus sciureus
Aotus infulatus?
Cebus apella apella
 Total: 6

Tapirapé, Pará

Chiropotes satanas utahicki?
Saguinus midas niger
Saimiri sciureus sciureus
Aotus infulatus
Callicebus moloch
Cebus apella apella
Alouatta belzebul discolor
 Total: 7

Ecological Stations

Iquê, Mato Grosso

*Callicebus cinerascens**
Callithrix emiliae or
*Callithrix argentata melanura**
Saimiri ustus
Aotus nigriceps
Cebus apella apella
Pithecia irrorata irrorata
Chiropotes albinasus
Alouatta seniculus
Ateles paniscus chamek
Lagothrix lagotricha cana
 Total: 11

Coco-Javaés, Tocantins

Aotus infulatus
Cebus apella apella
Alouatta belzebul discolor
 Total: 3

Samuel, Rondônia

Callithrix emiliae
Saguinus fuscicollis weddelli
Saimiri ustus
Aotus nigriceps
Callicebus brunneus
Cebus apella apella
Cebus albifrons unicolor
Pithecia irrorata irrorata
Chiropotes satanas
Alouatta seniculus
Ateles paniscus chamek
Lagothrix lagotricha cana
 Total: 12

Table 3. Primates Not Known to Occur in Any Federal Protected Areas in the Brazilian Amazon

REGION 1

Saguinus bicolor ochraceus Endemic RDB*
Cacajao melanocephalus melanocephalus RDB

REGION 2

Saguinus nigricollis nigricollis
Saguinus fuscicollis acensis Endemic
Saguinus fuscicollis melanoleucus Endemic
Saguinus fuscicollis primitivus Endemic
Saguinus fuscicollis crandalli Distrib. unknown
Saguinus fuscicollis cruzlimai Distrib. unknown
Saguinus imperator subgriseus RDB
Saimiri boliviensis pluvialis Endemic
Cebus albifrons cuscinus Endemic
Pithecia irrorata vanzolinii Endemic
Cacajao calvus novaesi Endemic RDB
Cacajao calvus ucayalii RDB

REGION 3

Callithrix argentata argentata Endemic
Callithrix humeralifer intermedius Endemic RDB
Callithrix humeralifer chrysoleuca Endemic RDB
Callicebus hoffmannsi baptista Endemic
Alouatta belzebul ululata Endemic

* Red Data Book (IUCN, 1982)

The importance of taking into account faunal distributions and the heterogeneity of biologically distinct regions in the Amazon basin has been emphasized by Ayres and Best (1979; see also Ayres, 1983) and Rylands (1980; see also Rylands and Mittermeier, 1983). Ayres and Best (1979) distinguished 12 regions and Rylands (1980) 19 regions which are delimited by rivers and which should be considered not as an alternative but as a refinement of the phytogeographic region/refuge model for the siting of reserves proposed by Wetterberg *et al.* (1976).

However, when considering the priorities for the conservation of these primates, it is important to emphasize that many of the national parks and biological reserves suffer problems of land tenure (for example, IBAMA actually owns only one of the biological reserves and none of the land within the national parks), and also problems of invasion, not only by squatters but also by roadways and mining and petroleum companies. A number of reserves, particularly Pico da Neblina National Park and Pacaas Novos National Park, conflict with the siting of Indian reservations. As pointed out by Fearnside and Ferreira (1984), national parks and biological reserves are easily decreed but remain a very low priority when confronted by government development schemes or mineral and petroleum exploration. The problems and costs of providing an effective protection and infrastructure for these reserves are enormous. Although the creation of new reserves in these key areas of primate diversity is fundamental for the survival of many of the Amazonian species and subspecies, the most important future step will be the elevation of the priority status of protected areas within the framework of Amazonian socioeconomic development.

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Goeldi's Monkey and Other Primates in Northern Bolivia

by Robert Cameron, Christopher Wiltshire, Charles Foley, Nigel Dougherty, Ximena Aramayo and Luis Rea

In July and August 1987, we carried out a six-week survey in the Pando Department of northern Bolivia to assess the status of Goeldi's monkey (*Callimico goeldii*) and other primates in the area.

Callimico is a monospecific genus intermediate between the families Cebidae and Callitrichidae, having three molar teeth and single offspring as do the cebids, but being small in size and having claws on all digits (except the hallux), similar to the callitrichids. Consequently, its taxonomy has been the subject of much debate and is of considerable importance to those studying the evolutionary divergence of New World primates. Further study of the behavior and ecology of *Callimico*, which are thought to be notably different from the behavior and ecology of other New World primates, may yield a wealth of comparative information regarding other species. *Callimico* has, however, largely eluded study, and, despite its wide range from southern Colombia to northern Bolivia, it has been infrequently observed in the wild by scientists. Its scarcity and habits are such that in many areas where it is known to occur, its presence has been overlooked even by Indian hunters.

Callimico is included in CITES Appendix I and is described as 'rare' by IUCN. It also appears on the Brazilian Endangered Species List and is protected by law in Peru and Bolivia. While it is known to be present in Manu National Park, Peru, and Apaya River National Park, Colombia, it is probable that no currently protected area holds a population of sufficient size for long-term genetic viability.

In 1975, having completed a wide-ranging survey of primate populations in Bolivia, Heltne, Freese and Whitesides presented evidence that *Callimico* was to be found in significant numbers along the Rio Acre in the Pando Department (although they did not see any themselves). In addition, Freese considered the area to be the only part of *Callimico*'s known range where it occurred in numbers sufficient for scientific study. From extensive interviews in Colombia, Peru, and Bolivia, Izawa (1979) found the two most suitable localities for studying *Callimico* to be a tributary of the Rio Tapiche, Peru, and the left bank of the Arroyo Nareuda in the Pando of Bolivia. A biological station was to be set up in the Nareuda-Tahuamanua area of the Pando (IUCN Mammal Red Data Book 1982), but as of 1988 this had not been done.

In 1979, Pook and Pook carried out a five-month field study, including an eight-week survey, in the area southwest of the department's capital, Cobija. They also believed the species to be present in considerable numbers, although they saw it only once within the survey and calculated a population density of only 0.5-2.0 ind/km². Pook and Pook considered *Callimico* in the Pando to be under possible threat from commercial trapping and potential habitat destruction due to road construction, govern-

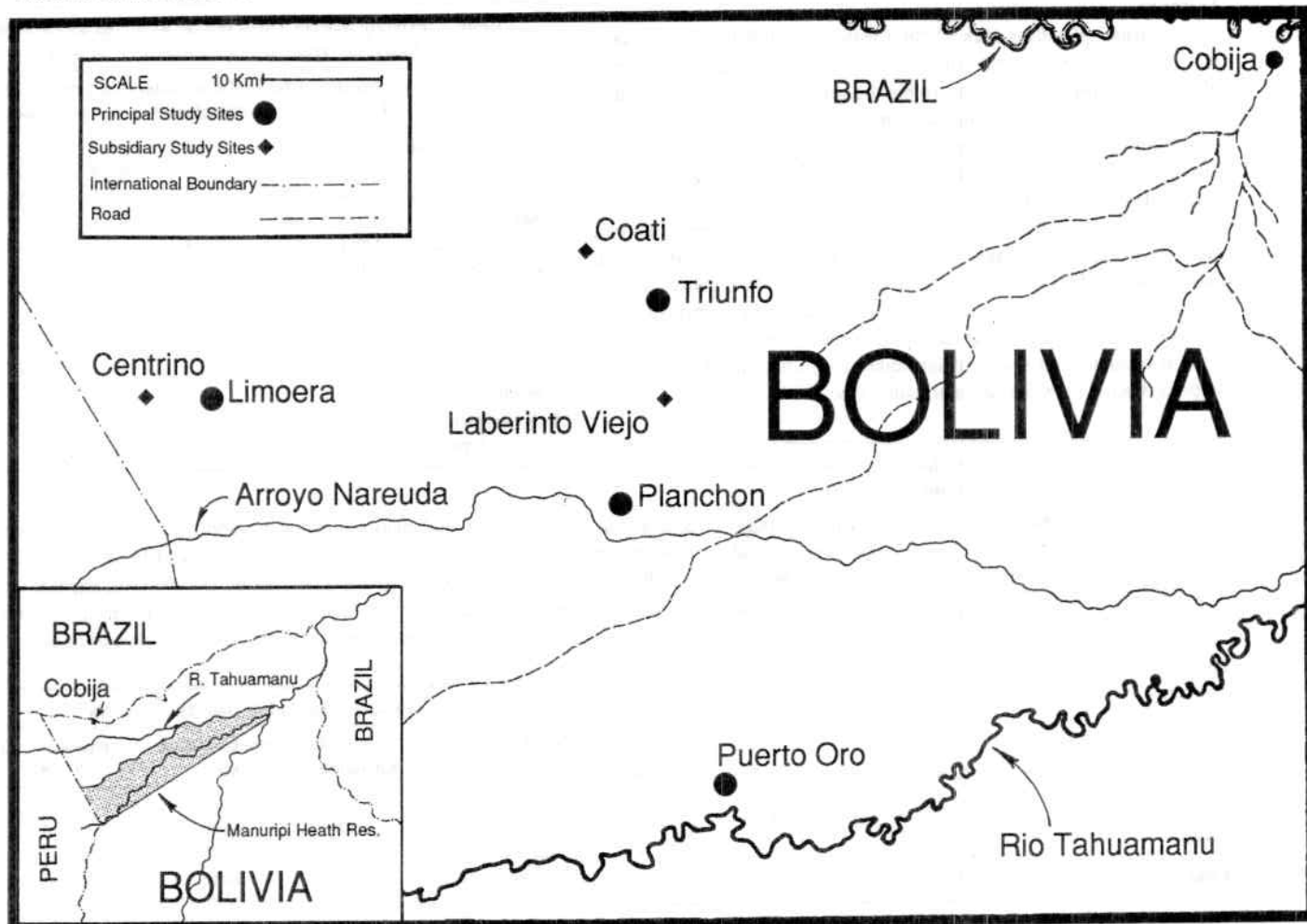


Fig. 1. Map of the study area in northwestern Bolivia (map by S.D. Nash from authors' original).

ment development plans, and resettlement schemes. They also noted that the political importance of the area might reduce the long-term viability of reserve proposals. They suggested that a place less accessible and politically important, and containing higher densities of the larger primates, *Ateles paniscus* and *Alouatta seniculus*, would be more suitable for a reserve. Unfortunately, no such area has been found, and, in view of the threats outlined, the conservation status of *Callimico* in the Pando has been uncertain.

During our survey, we hoped to gain up-to-date information on the abundance and distribution of *Callimico* and other primate species in the area and to investigate current and potential threats in order to evaluate the potential of the area for primate conservation.

Habitat

For convenience, the study area may be defined as the area bordered by longitude 69° W, the Rio Tahuamanu, and the borders of Peru and Brazil (Fig. 1). The altitudinal range of the area is approximately 185–290 m, slightly above the main Amazon Basin. The characteristic terrain is that of undulating hills largely covered by seasonally dry *terra firme* forest. The upper canopy of the forest is at an average height of 25–30 m, with some emergents reaching 35–40 m. In many areas it is fairly broken; consequently, much of the forest has a fairly dense middle canopy 10–20 m above the ground. The undergrowth is relatively thin on the drier hilltops, where it is dominated by saplings and low palms. On lower ground, shrubs provide a thick undergrowth with occasional dense patches of *tapoca* (bamboo). Izawa (1979) designated this type of forest as 'shabby forest' and correlated its presence with the 'peculiar distribution of *Callimico*.'

The human population of the forest is now considerably lower than it was earlier in this century, due to the decline of trade in natural rubber, and the density of households does not appear to have increased significantly since 1979. However, some residents of the forest believe the population is increasing through intrinsic growth and immigration from Brazil. Throughout the forest, clearings containing one to three families occur at regular intervals, a few kilometers apart, and are interspersed with a well-developed network of foot paths. Disturbance of the vegetation is minor and mainly consists of the cutting of narrow trails between scattered rubber trees and the temporary clearing and burning of *chacos*, small areas for subsistence cultivation near each habitation. The effects of this activity on the nonhuman primate populations are unclear. It is possible that it improves the forest for *Callimico*, for example, by increasing the amount of its preferred habitat. If that is the case, a less accessible and less inhabited forest may in fact be less suitable for a *Callimico* reserve.

In 1979, Pook and Pook noted a heavily felled area 10–15 km around Cobija. This area does not appear to have expanded significantly since then, except along the roads to Nareuda and Vera Cruz, where large areas have been cleared for cattle grazing. The extent of the road-building program mentioned by Pook and Pook is unclear. The roads are narrow and rough and usually adequate for small trucks. They appear to have had no effect on the forest, except for some settlement and forest clearance along their borders. A road to link the Pando with La Paz was scheduled to be completed in early 1988, but at the time of our survey the forest had not yet been affected by government development plans and there was no evidence of resettlement schemes in any of the areas we visited.

Methods

Four principal census sites where it was reported that many primates were present were chosen. Since the choices maximized our chances of detecting all species present, we felt the consequent possibility of biasing population density estimates was justified. In this respect, our method of site selection differed from that of Pook and Pook (1979), who followed reports solely concerning the occurrence of *Callimico*.

Periods of six to nine days were spent at each of the principal sites. During the time at the first two sites, Triunfo and Limoero, one pair of observers spent two days censusing at subsidiary sites nearby, Coati and Centrino. This prevented us from having to work paths that had recently been used by other people or disturbed by over-censusing, and was useful in broadening the sample covered by the survey. Censuses were also carried out at a third subsidiary site, Laberinto Viejo, during stops in transit between the main sites (see Table 1).

Table 1. Observation Details for Each Site
(+ = subsidiary site)

Site	No. of Days at Site	Time (h)	Censusing Data Distance (km)	Speed (km/hr)	Non-census Observation (h)
Triunfo + Coati	7	45'05"	60.4	1.34	19'20"
Limoero + Centrino	6	34'	50.3	1.48	16'50"
Planchon	7	52'40"	55.0	1.04	19'45"
Puerto Oro	9	52'40"	65.6	1.24	20'50"
+ Laberinto Viejo	2	11'25"	18.0	1.58	6'
Total	31	195'50"	249.3	1.27	82'45"

The work largely followed Southwick and Cadigan's (1972) transect census technique, adapted for South America by Freese (1975) and used for previous surveys in the study area. When primates were seen, observers recorded the time of the sighting, the animals' distance from the path and height at first sighting, group size, and behavior. Auditory contact alone was not recorded. Censuses were conducted mostly in the early morning and mid- to late afternoon. Pook and Pook (1979, 1981) found no noticeable hourly pattern to the number of primates encountered, but, as a precaution, similar proportions of morning and afternoon censuses were completed at each site.

All censuses were carried out by single pairs of observers moving along established paths (usually three or four in number) radiating from the central clearing at each site. The use of existing paths introduced the possibility of bias due to non-random variation of terrain, vegetation, and disturbance. However, since the paths were infrequently used, narrow, and had no distinct effect on the bordering vegetation, they were considered suitable for use. Heltne *et al.* (1975) and Pook and Pook (1979) also used existing paths, so in this respect the technique has remained standard. In addition, to minimize the possibility of observer bias, pairs were formed by rota and individuals spent similar amounts of time working on each transect.

The swath width (the breadth of forest in which the observers could reliably detect monkeys from the path) and the average group size of each species were taken from estimates made during our censuses and from values used in previous surveys (see Appendix 1). They are very similar to those used by Pook and Pook (1979).

Population Densities

The survey covered 249.3 km of transect in approximately 196 h of censusing. The encounter rates at each site are presented in Table 2 and

Table 2. Primate Species Observed or Reported at Each Site
(+ = heard or reported to be present; - = absent.)

Species	No./Frequency of Encounters (per min x 10 ³)					
	Triunfo	Limoero	Planchon	Puerto Oro	Laberinto	Total
<i>Saguinus fuscicollis</i>	5/1.9	6/2.9	24/7.6	14/4.4	5/7.3	54
<i>Saguinus labiatus</i>	4/1.5	5/2.5	17/5.4	14/4.4	2/2.9	42
<i>Callicebus cupreus</i>	5/1.9	6/2.9	5/1.6	4/1.3	4/5.8	24
<i>Cebus apella</i>	4/1.5	1/0.5	4/1.3	3/1.3	+	12
<i>Pithecia irrorata</i>	1/0.4	2/1.0	12/3.8	+	+	15
<i>Cebus albifrons</i>	1/0.4	+	1/0.3	1/0.3	+	3
<i>Saimiri boliviensis</i>	+	+	+	3/1.0	-	3
<i>Callimico goeldii</i>	4/1.5	+	3/1.0	1/0.3	-	8
<i>Alouatta seniculus</i>	1/0.4	+	2/0.6	+	-	3
<i>Aotus</i> sp.	+	1/0.5	+	+	+	1
<i>Cebuella pygmaea</i>	+	+	-	-	-	0
<i>Ateles paniscus</i>	-	+	+	-	-	0
<i>Saguinus imperator</i>	-	+	-	-	-	0

the population density estimates in Table 3, together with the previous findings of Heltne *et al.* (1975) and Pook and Pook (1979). The latest figures are, on the grounds of a larger sample size, expected to be the most accurate, but the results of the three studies are in general agreement. For all species, the estimates are of comparable order.

Table 3. Population Density Estimates

Species	No. of Encounters*	Area Censused km ²	Groups/km ²			Ind/km ²
			'75	'79	'87	
<i>Saguinus fuscicollis</i>	52	12.5	4.6	5.5	4.2	25.2
<i>Saguinus labiatus</i>	42	15.0	4.6	3.6	2.8	16.8
<i>Callimico goeldii</i>	8	5.0	-	0.3	1.6	9.6
<i>Saimiri boliviensis</i>	3	20.0	0.6	0.7	0.2	5.3
<i>Callicebus cupreus</i>	24	10.0	4.9	2.1	2.4	7.2
<i>Cebus apella</i>	11	20.0	0.7	1.0	0.6	3.3
<i>Cebus albifrons</i>	3	20.0	-	-	0.2	0.9
<i>Pithecia irrorata</i>	14	15.0	1.1	0.3	1.0	2.9
<i>Alouatta seniculus</i>	3	7.5	-	0.3	0.4	1.2
Total	159		16.5	13.8	13.2	71.2

*excludes sightings of animals outside the species' designated swathe width

In 1987, the apparent population densities of the tamarins *Saguinus fuscicollis weddelli* and *S. labiatus* were lower than they had been at the times of the earlier surveys. The estimate for *S. fuscicollis weddelli* rose from 4.6 groups/km² in 1975 to 5.5 groups/km² in 1979, but dropped to 4.2 groups/km² in 1987. That for *S. labiatus* dropped twice, once from 4.6 groups/km² in 1975 to 3.6 groups/km² in 1979, and then again to 2.8 groups/km² in 1987. The changes for both species may be the result of commercial trapping. In 1979, Pook and Pook estimated that at least 1,500 *S. labiatus* were being removed from the area each year and that large-scale export of *S. fuscicollis weddelli* was just beginning. This could account for the consecutive drops in the population of *S. labiatus* and possibly the initial increase in *S. fuscicollis weddelli* on removal of a competitor, followed by the decrease after its export began. However, interviews with people previously employed as commercial trappers laid emphasis on the numbers of *S. labiatus* bought, and we received no indication of there having been a demand for *S. fuscicollis weddelli*.

Although the current governmental ban on the capture and export of all primate species began in May 1984, it is unclear when commercial trapping of *Saguinus labiatus* stopped. In 1981, possibly the most important trader of primates from the Pando was arrested, and our interviews suggested that little hunting has happened in the area since then. If that is the case, trapping continued for only two years after Pook and

Pook's survey. Since then, however, there has been no net recovery of the populations of either tamarin. Consequently, it is our opinion that if trapping is ever to resume and be sustainable, far fewer animals should be taken from the wild each year.

Notably, the current abundance ratio of the two tamarin species is almost exactly the same as that indicated by Pook and Pook. In 1979, the population density of *Saguinus labiatus* was 65.5% that of *S. fuscicollis weddelli*, and in 1987 it was 66.6%.

In contrast with those of the tamarins, the apparent densities of the larger primates (*Callicebus cupreus*, *Cebus* spp., *Pithecia irrorata* and *Alouatta seniculus*) are higher than they were in 1979. All are hunted in some areas, so the increases may result from the 1987 census sites being in more remote, less populated areas than those selected by Pook and Pook.

Except for *Callicebus cupreus*, the larger species and *Saimiri boliviensis* are locally distributed, so their density estimates are more likely to reflect sampling variation according to the selection of transects than are the estimates for the tamarins and *Callicebus cupreus*. For example, although single groups of *Saimiri boliviensis* were present at both Limoero and Puerto Oro, the species was seen to frequent a transect only at the latter site. Estimates of population density at individual sites may, therefore, not be as reliable as originally hoped. However, similar bias is not likely in population density estimates for the whole area because the sample size of transects is much greater. It is probable that the calculated values of population density are good approximations, even for the more locally distributed species.

Although transect selection may affect encounter rate, it is not likely to account for more than a minor part of the marked site-to-site varia-

tion in this quantity. This variation is linked to some extent to local hunting or trapping pressure. *Saguinus fuscicollis* and *S. labiatus*, although trapped for food in some parts of the Pando, were not eaten at any of the study sites. Their distributions probably reflect the relative absence of commercial trapping. The encounter rates of the larger species show no convincing correlation with ranked estimates of hunting pressure at each site. This is complicated by the varied preference of hunters for certain species. Habitat preference may also obscure the effect of hunting. The forest is visibly heterogeneous, and if the effect of hunting is to be quantified rigorously, the relation of a species' distribution to various habitats must be better understood.

Height Preference

For each primate encounter during both census and non-census observations, record was made of the height at which the group was first seen. If a group was spread over a range of heights, only that of the first individual seen was noted. This differs from the recordings of Pook and Pook (1979) which represented the mean height of individuals within the group.

Nevertheless, once again our results (Fig. 2) are substantially in agreement with those found previously. The heights most frequently recorded are the same for six species: *Saguinus fuscicollis*, *S. labiatus*, *Callimico*, *Saimiri boliviensis*, *Pithecia irrorata*, and *Alouatta seniculus*. They are different for *Callicebus cupreus* and *Cebus apella*, though their generalized height preferences are indicated by both studies. The new information has shown both species to use a wider range of levels in the forest than Pook and Pook (1979) recorded. By contrast, the range of heights at which *Saguinus fuscicollis* and *S. labiatus* was recorded

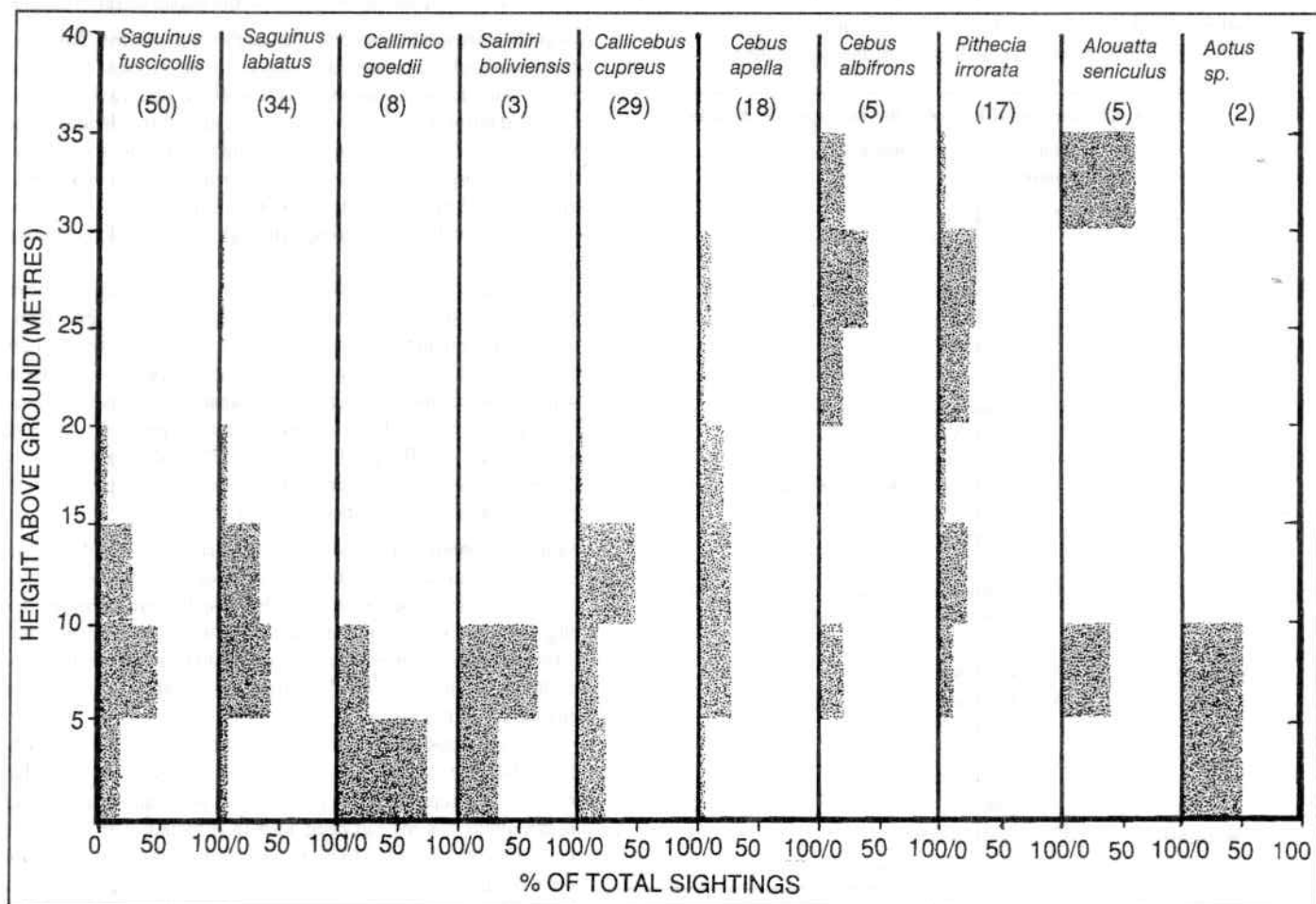


Fig. 2. Graph showing height preferences of each species, as percentages of first sightings (numbers in brackets indicate total observations for each species) (graph provided by authors).

is smaller, though this may be an artifact of the different recording criterion. *Cebus albifrons* was not recorded in either of the previous surveys. In four out of five 1987 sightings, it was first seen above 20 m, which suggests that it prefers to remain higher than *C. apella* does.

Pook and Pook (1979) suggested that *Pithecia irrorata* and *Alouatta seniculus* had a marked preference for remaining above 20 m. We recorded *P. irrorata* in all height groupings from 5-35 m, and in 49% of the encounters it was first sighted less than 20 m from the ground. Thus, such a preference seems unlikely in this species. In two out of five encounters, *Alouatta seniculus* was first seen to be no more than 10 m from the ground. Both sightings were made at roughly the same spot near Planchon, where the species may never have been hunted. Its preference for the upper story of the forest may be less strong in areas where it can descend in relative safety.

Interspecific Associations

Primate species were recorded to be in close proximity to each other on many occasions (Table 4). The data, however, give only circumstantial evidence on the occurrence of interspecific association. Pook and Pook (1979) recorded interspecific association "if there was a visually observable overlap of members of different species or if at least one member of one species was closer to individuals of another species than to the other members of its own group." This definition, however, is likely to include coincidental aggregations, especially when group members are widely scattered or when only single individuals are spotted, and it appears little if any more reliable an indication of interspecific association than is close proximity. For some species the results of each approach are very similar. For example, Pook and Pook (1979) reported that *Saguinus fuscicollis* and *S. labiatus* were associating on 57% of all *S. fuscicollis* encounters and on 72% of all *S. labiatus* encounters. This survey noted the species to be in close proximity to each other on 59% and 72% of all encounters with each species respectively.

Table 4. Circumstantial Evidence for Interspecific Association

Species	Total Encounters	Proximates	No.	% of total
<i>Saguinus fuscicollis</i>	75	<i>S. labiatus</i>	36	48
		<i>S. labiatus</i> + <i>C. cupreus</i>	2	3
		<i>S. labiatus</i> + <i>Callimico</i>	1	1
		<i>S. labiatus</i> + <i>Callimico</i> + <i>C. cupreus</i>	1	1
		<i>S. labiatus</i> + <i>P. irrorata</i>	3	4
		<i>C. cupreus</i>	1	1
		Total	44	59
<i>Saguinus labiatus</i>	61	<i>S. fuscicollis</i>	36	59
		<i>S. fuscicollis</i> + <i>C. cupreus</i>	2	3
		<i>S. fuscicollis</i> + <i>Callimico</i>	1	2
		<i>S. fuscicollis</i> + <i>Callimico</i> + <i>C. cupreus</i>	1	2
		<i>S. fuscicollis</i> + <i>P. irrorata</i>	3	5
		<i>C. cupreus</i>	1	2
<i>Callimico goeldii</i>	8	Total	44	72
		<i>S. fuscicollis</i> + <i>S. labiatus</i>	1	13
		<i>S. fuscicollis</i> + <i>S. labiatus</i> + <i>C. cupreus</i>	1	13
<i>Saimiri boliviensis</i>	4	<i>C. apella</i>	3	75
		Total	2	25
<i>Callicebus cupreus</i>	28	<i>S. labiatus</i>	1	4
		<i>S. fuscicollis</i>	1	4
		<i>S. labiatus</i> + <i>S. fuscicollis</i>	2	7
		<i>S. labiatus</i> + <i>S. fuscicollis</i> + <i>Callimico</i>	1	4
		Total	5	18
<i>Cebus apella</i>	19	<i>Saimiri boliviensis</i>	3	16
<i>Pithecia irrorata</i>	17	<i>S. fuscicollis</i> + <i>S. labiatus</i>	3	6

During our survey, all but five of the encounters involving more than one species included both of the tamarins, and on six occasions they

were seen in close proximity to either *Callicebus cupreus* or *Callimico* or both. On three occasions they were seen together in roughly the same spot in close proximity to what was almost certainly the same group of *Pithecia irrorata*. There was no apparent coordination between the groups of *Saguinus* and *P. irrorata*, but this may have been disrupted before observation because they show different responses to humans. *Pithecia* species are rarely seen in association with other species. *Pithecia monachus* has been seen in close proximity to *Cacajao calvus* in Brazilian Amazonia and, in 1976, was seen following a group of *Lagothrix lagotricha* in Colombian Amazonia by Izawa (Buchanan *et al.*, 1981).

Cebus apella and *Saimiri boliviensis* were seen associating on three occasions. At Limoero and Puerto Oro they were seen feeding and travelling together, and at the latter site they appeared to rest in fairly close proximity at night.

Species Accounts

***Cebuella pygmaea*:** Pygmy marmosets were not encountered during the survey but are reported to be seen occasionally by the residents of Triunfo and Limoero (Table 2). This species is also reported to be present by the Arroyo Nareuda, two-hours' walk upstream from Planchon. The vegetation along this stretch of river is likely to be similar to that near Planchon, which has a low canopy and is finely heterogeneous, with patches of dense scrub and small, inundatable areas with little undergrowth. In addition, *Cebuella* was said to occur near the road from Cobija to Vera Cruz, where the vegetation is likely to be heavily disturbed and mostly secondary. This information is consistent with the hypothesis that *Cebuella* inhabits edge areas of 'shabby' forest (Izawa, 1979).

Cebuella is locally distributed and uncommon, but it is not trapped for food or export and may actually benefit from some habitat disturbance. Thus, it appears to be under no immediate threat in the study area.

***Saguinus fuscicollis weddelli*:** The saddle-back tamarin, having a population density of 4.2 groups/km², appears to be the most common monkey in the study area. It was observed on all but one transect and to all intents and purposes is distributed continuously throughout the forest. The species was observed in numbers ranging from 1-12 animals. Single individuals were almost certainly accompanied by others unseen, and aggregations of more than 10, seen twice out of a total of 65 encounters, may have involved two groups (though no agonistic encounters were noted).

It is likely that *S. fuscicollis weddelli* was commercially trapped for only two or three years before 1981 and not at all since then, yet its estimated population density is currently lower than it was in 1979. We expect, therefore, that it was trapped in numbers far exceeding those which could be sustainable and that its population has not recovered since. If trapping is to resume, a sustainable rate of removal should be determined; Pook and Pook (1979) suggest 750 individuals *per annum* for the whole Pando Department. Since there is no trapping currently, this species appears to be under no threat in the area.

***Saguinus labiatus*:** The red-bellied tamarin has a population density of 2.8 groups/km² and may still be seen frequently. It was the main target of commercial trappers until 1981, but despite there having been no trapping since that year, its population has shown no net recovery since 1979. If trapping is to resume, this species should be removed at a rate similar to that for *S. fuscicollis*. While trapping is banned, this species is not threatened in the Pando.

Pook and Pook (1979) confirmed reports cited by Heltne *et al.* (1975) that *S. labiatus* could be found at least as far south as the Rio Tahuamanu. We received reports that it does not occur south of this river, where *S. fuscicollis* has instead been seen to associate with *S. imperator*. It was, however, reported to be present further south in Manuripi Heath Reserve (Tello, 1986). We recorded *S. labiatus* as far west as Centriño (69°23' W), a site where *S. mystax* is reportedly not present. *S. labiatus* western limit at the latitude of the study area is almost certainly in eastern Peru, where it is thought to be replaced by *S. mystax*.

***Saguinus imperator*:** We did not observe the emperor tamarin in the field, but most of the people we interviewed knew this animal. It has been the subject of some demand for export and, though it may never have been common, commercial trapping has reduced its range in the Pando. Previously, it could be seen south of the Rio Tahuamanu near Puerto Oro, but now one must travel a day's boat ride upriver (west) to see it.

***Saguinus mystax*:** We received one reliable report that the moustached tamarin could be seen in the extreme northwest of the study area. Pook and Pook (1979) heard reports of it occurring west of 69°10' W.

***Callimico goeldii*:** Goeldi's monkey appears to be present throughout the study area. We observed it eight times and at three sites during the census and estimate its population density to be 1.6 groups/km². This figure differs more markedly from Pook and Pook's (1979, 1981) estimate (0.25 groups/km²) than do our density estimates for any other species. A fraction of the difference is accounted for by a reduction of the swath width used in calculating its population density, from 30 m to 20 m, because at all encounters it was first sighted no more than 10 m from the path. Had the same swath been used by Pook and Pook, their estimate would have been 0.38 groups/km². Most of the remaining difference is possibly an artifact of selecting sites in areas where the species is less likely to have been trapped or where the habitat is superior. Whether this is the case or not, the estimate still reflects a real population density in the area censused, and the figure calculated by Pook and Pook is probably an underestimate for the study area as a whole.

Callimico was seen in numbers from one to eight. Single individuals were seen on four occasions, and on each of these it was probable that others were present but not seen. On two occasions groups of three were seen, and there was no evidence to suggest that others were nearby. These may actually have been subgroups as described by Masataka (1981). Only one group of six individuals was sighted; they were feeding and could be observed for some time and counted easily.

Six out of the eight encounters with *Callimico* were within or near patches of bamboo. Also, the species was reported to be common in the northwestern part of the study area, adjacent to Peru, where there is thought to be much bamboo. The other two encounters were on relatively high ground where the undergrowth was dominated by saplings.

Callimico in the area have been little affected by commercial trapping. We received only one report that it had ever been captured locally for trade, nor is it trapped for food. Given that there is no short-term likelihood of large-scale forest conversion, it appears to be under no immediate threat. The potential of the area for conservation of *Callimico* is considered further in the conclusion.

***Aotus* sp:** No special survey was carried out to estimate the population density of this nocturnal monkey. It was, however, known to be present at all the principal census sites and may well be common throughout the Pando. Two groups, of three and five individuals, were seen.

Hershkovitz (1983) suggests that the boundary between the ranges of the species *Aotus nigriceps* and *A. azarae* is the Rio Madre de Dios, some 150 km to the south of the study area. During the survey it was not determined which of these two species was present.

***Saimiri boliviensis*:** Only two groups of *boliviensis* squirrel monkeys were observed and only one of these during a census. However, the low density of groups of *S. boliviensis* (approximately 0.15/km²) is offset by the large group size characteristic of the genus. In terms of individuals, its 5.3/km² population density is higher than that of all of the other cebids except *Callicebus cupreus*. We received no reports that it was hunted for food or export in the Pando, and it appeared tolerant of some human disturbance.

***Callicebus cupreus*:** This titi was formerly considered a subspecies of *C. moloch* (Hershkovitz, 1963), but it has recently been elevated to full

species status (Hershkovitz, 1988) and represents the nominate subspecies *C. cupreus cupreus*. This species appears to be common throughout the study area. The population density estimate of 2.4 groups/km² is similar to Pook and Pook's (1979) but is much lower than that made by Heltne *et al.* (1975). Pook and Pook suggested that their estimate was artificially low due to hunting of the species at their sites, and that the figure from the earlier survey was more accurate. *C. cupreus* was not hunted at any of the 1987 census sites, so our data are unlikely to be biased in that manner.

Group size for *C. cupreus* varied from one to four individuals and was most commonly recorded at two. Some of the single individuals may actually have been with others unseen, so a group size of three was used in the population density estimate. Mean group sizes elsewhere have been similar to this: for example, 3.1 and 3.4 in consecutive years (Mason, 1966), 2.67 (Janson, 1975), 2.3-2.5 over three years at one site and 3.9 at another (Robinson, 1977), and 2.75 (Kinzey, 1981).

C. cupreus was frequently seen near inhabited clearings and in disturbed or secondary vegetation. It is hunted for food by only a small proportion of the families living in the forest and can be expected to remain common in the study area.

***Cebus apella*:** The black-capped capuchin was observed at all the principal census sites in groups of 2-10 individuals. It is possible that some of the group estimates are inaccurate because *Cebus* are generally difficult to count. Nevertheless, similar figures were indicated by the previous surveys. Others (*e.g.* Hernandez-Camacho and Cooper, 1976; and Thorington, 1967) have reported small groups in areas where group sizes have probably been reduced by capture or hunting (Freese and Oppenheimer, 1981), and Izawa (1976) suggested that subgroups of one to five individuals are formed when one larger group splits.

Our survey indicated a population density of 0.55 groups/km², which is of the same order as the previous estimates. *Cebus apella* is only eaten by some of the people in the forest and presently appears to be under no threat in the Pando.

***Cebus albifrons*:** The white-faced capuchin was not recorded in a census during either of the previous surveys. It was seen only three times during the 1987 survey and appears to occur at a density of only 0.15 groups/km². That it was still reported to be seen near all the principal sites suggests that there are a relatively small number of groups, each ranging over a large area.

Reports from various regions of Amazonia indicate that *C. albifrons* is generally less abundant than *C. apella* (Freese and Oppenheimer, 1981). It is not hunted any more avidly than other species and has probably always been uncommon in the study area.

***Pithecia irrorata irrorata*:** Heltne *et al.* (1975) and Pook and Pook (1979) identified the *Pithecia* in the area as being of the species *P. monachus*. The *Pithecia* we saw fit Hershkovitz's 1987 description of *P. irrorata irrorata*. This species was not recognized in Hershkovitz's earlier (1979) revision of the genus' taxonomy. We conclude that the recordings made by the previous surveys do, in fact, refer to *P.i. irrorata*.

We calculated a density of 2.9 groups/km², which is high compared to values calculated by Pook and Pook. It is possible that this increase is an artifact of the selection of census sites in less heavily hunted areas. However, though the species was under no hunting pressure at three of the principal sites, 12 out of 15 of our encounters with it occurred at Planchon. Contrary to the suggestion of Pook and Pook, hunting may play a minor part in determining the local population density of the species.

***Alouatta seniculus*:** The red howler monkey is present at a low population density, 0.4 groups/km², but was observed at three of the sites and heard in most areas visited. Therefore, it appeared to occur throughout most of the area. Local people prefer its meat to that of the other resident primates, and in many areas it is the only species hunted. However,

we were told by those who hunt it (as were Pook and Pook) that it was shot only once or twice a year by each household. The species may have reached a stable population under the given hunting pressure, and, unless hunting increases, its population level is unlikely to decline significantly.

***Ateles paniscus*:** The black spider monkey was reported to be a vagrant at Limoero, probably at intervals of some years, and a wet-season visitor near Planchon. There are probably no resident breeding groups of this species in the study area.

***Lagothrix lagotricha*:** Heltne *et al.* (1975) reported that people in the area recognized pictures of the woolly monkey, but we found no evidence that this species had occurred in the area at any time.

Conclusion

Our results indicate that *Callimico* is more common than previously supposed, having a population density around 1.6 groups/km² rather than 0.25 groups/km². Even at that lower level, the area was regarded by Freese and Pook and Pook as the only area known to hold sufficient numbers of *Callimico* for scientific study. Also, 10 other primate species occur throughout, or at least at a number of localities in the area. A viable reserve would, therefore, protect an important population of *Callimico* and what is "one of the broadest spectra of primate species in the New World" (Pook and Pook, 1981).

The density estimate for *Callimico* is still low compared to those for *Saguinus labiatus* and *S. fuscicollis*, and systematic commercial trapping could remove *Callimico* from relatively large areas. During our survey, the species was protected by a total ban on the capture and export of primates. Following the ban's expiry in 1989, *Callimico* should receive specific legislative protection against removal from the wild.

Were the study area to receive reserve status, it would benefit a wide range of animals other than primates. During the survey, members saw or recorded evidence of five other IUCN (1982a,b) *Red Data Book* species: jaguarundi (*Felis yagouaroundi*), which is listed as 'indeterminate'; jaguar (*Panthera onca*), ocelot (*Felis pardalis*), and giant otter (*Pteronura brasiliensis*), which are listed as 'vulnerable'; and black caiman (*Melanosuchus niger*), which is listed as 'endangered.' A full list of mammals recorded is presented in Appendix 2.

Reserve status would also directly benefit the human residents of the forest. Many of the people do not have any livestock and most cannot afford to buy animal protein, so they rely on forest fauna as their protein source. Also, the increased population density estimates for the larger primates and the frequency with which other game species are seen suggest that current hunting pressure is sustainable. Therefore, the establishment of a faunal reserve could be made compatible with patterns of current use.

The forest habitats, in fact, essential to the main livelihood of the area — latex collection — because of the local susceptibility of pure stands of rubber trees (*Hevea brasiliensis*) to epidemics. The *seringueiros* (rubber tappers) belong to trade unions which, in the light of potential forest clearance, have collectively expressed interest in the maintenance of their working environment and way of life. The increased importance of the rubber tappers' trade unions has been recognized by the United Nations, which awarded the Brazilian Chico Mendes a gold medal for his contributions to conservation.

Considering the stance of the *seringueiros*, the existence of a human population in the area may actually favor the viability of proposals for a reserve there. Also, as mentioned earlier, the scattered small-scale cultivation which occurs may actually enhance the environment for particular species (including *Callimico*) and increase the diversity of the primate fauna. However, the presence of human activity does inevitably make the long-term future uncertain. Plans for road building, development, and resettlement schemes have not damaged the forest significantly since it was visited by Pook and Pook in 1979, yet they may still do so. The viability of a reserve depends on the continuation of the demand for rubber latex from the area. Should this cease, plans for legal protection of the forest may lose the support that is available now.

No less-inhabited sites suitable for a *Callimico* reserve have been located outside the study area. The species was reported by Jose Tello (1986) to be present in the Manuripi Heath Reserve, which also contains *Ateles paniscus* and a range of other high priority species. Its northern border is, however, delineated by the Rio Manuripi and the Rio Orton which are thought by Izawa (1979) to be the southern limit of the distribution of *Callimico*, so greater protection of that reserve would only marginally benefit the species. The area immediately to the north may contain good numbers of *Callimico* but has not yet been censused.

The Pando has been noted by ecologists to have outstanding potential for rational exploitation. We recommend assigning it a reserve status similar to that of the 'special management areas' in Suriname (see Baal *et al.*, 1988). Under such protection, the sustainable practices of latex collection, *chaco* cultivation, and subsistence hunting would continue in the forest. Large-scale clearance to provide grazing for cattle, for example, would be limited to its current extent. The commercial trapping of primates and other animals would be regulated. *Saguinus fuscicollis* and *S. labiatus* should not be removed at a rate greater than that already suggested. However, the removal limits of most species must, to a certain extent, be set in accordance with the primate resources of Bolivia as a whole. There is little information on primate populations in other parts of Bolivia, and surveys are urgently needed to determine sustainable trapping levels before export is resumed.

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Epilogue

A major objective of the expedition, not discussed in this report, was that it should be of educational value to the team members from Oxford and La Paz. The experience that it provided has enhanced the ability of the participants to contribute to conservation and has increased their eagerness to do so. On these grounds, we consider it a success.

It is hoped that the fruitful link between Oxford University and the Universidad Mayor de San Andrés continues, and that interest in conservation of the Pando's wildlife is sustained and advertised by both. This has been ensured for the near future by a botanical expedition, the first to compile an organized collection of plant specimens from the area.

Appendix 1. Data Used in Estimating Population Densities (groups/km²)

	Swathe Width	Group Size
<i>Saguinus fuscicollis</i>	50	6
<i>Saguinus labiatus</i>	60	6
<i>Callimico goeldii</i>	20	6
<i>Saimiri boliviensis</i>	80	35
<i>Callicebus cupreus</i>	40	3
<i>Cebus apella</i>	80	6
<i>Cebus albifrons</i>	80	6
<i>Pithecia irrorata</i>	60	3
<i>Alouatta seniculus</i>	30	5

Estimates were made as follows:

$$\text{Population density} = \frac{\text{number of encounters}}{\text{distance of transect walked} \times \text{swathe width}}$$

Appendix 2. Mammals Recorded During the Survey

Species	Common Name	Evidence
<i>Cebuella pygmaea</i>	pygmy marmoset	reports
<i>Saguinus fuscicollis</i>	saddle-back tamarin	observed
<i>Saguinus labiatus</i>	red-bellied tamarin	observed
<i>Saguinus imperator</i>	emperor tamarin	reports
<i>Saguinus mystax</i>	moustached tamarin	reports
<i>Callimico goeldii</i>	Goeldi's monkey	observed
<i>Aotus sp.</i>	night monkey	observed
<i>Saimiri boliviensis</i>	squirrel monkey	observed
<i>Callicebus cupreus</i>	dusky titi	observed
<i>Cebus apella</i>	black-capped capuchin	observed
<i>Cebus albifrons</i>	white-faced capuchin	observed
<i>Pithecia irrorata</i>	monk saki	observed
<i>Alouatta seniculus</i>	red howler monkey	observed
<i>Ateles paniscus</i>	black spider monkey	reports
<i>Didelphis marsupialis</i>	common opossum	skin
<i>Bradypus variegatus</i>	brown-throated three-toed sloth	observed
<i>Choloepus hoffmanni</i>	Hoffmann's two toed sloth	observed
<i>Dasypus novemcinctus</i>	9-banded armadillo	observed
<i>Myrmecophaga tridactyla</i>	giant anteater	reports
<i>Tamandua tetradactyla</i>	southern tamandua	reports
<i>Cyclopes didactylus</i>	silky anteater	reports
<i>Nasua nasua</i>	ring-tailed coati	observed
<i>Potos flavus</i>	kinkajou	observed
<i>Eira barbara</i>	tayra	observed
<i>Pteronura brasiliensis</i>	giant otter	observed
<i>Felis concolor</i>	puma	skin
<i>Felis pardalis</i>	ocelot	skin
<i>Felis yagouaroundi</i>	jaguarundi	observed
<i>Panthera onca</i>	jaguar	skull, faeces
<i>Tapirus terrestris</i>	Brazilian tapir	skull
<i>Tayassu tajacu</i>	collared peccary	skin
<i>Tayassu pecari</i>	white-lipped peccary	reports
<i>Mazama americana</i>	red brocket	observed
<i>Mazama gouazoubira</i>	brown brocket	observed
<i>Sylvilagus brasiliensis</i>	forest rabbit	observed
<i>Sciurus aestuans</i>		observed
<i>Sciurus spadiceus</i>		observed
<i>Hydrochoeris hydrochaeris</i>	capybara	observed
<i>Dasyprocta punctata</i>	agouti	observed
<i>Agouti paca</i>	paca	observed

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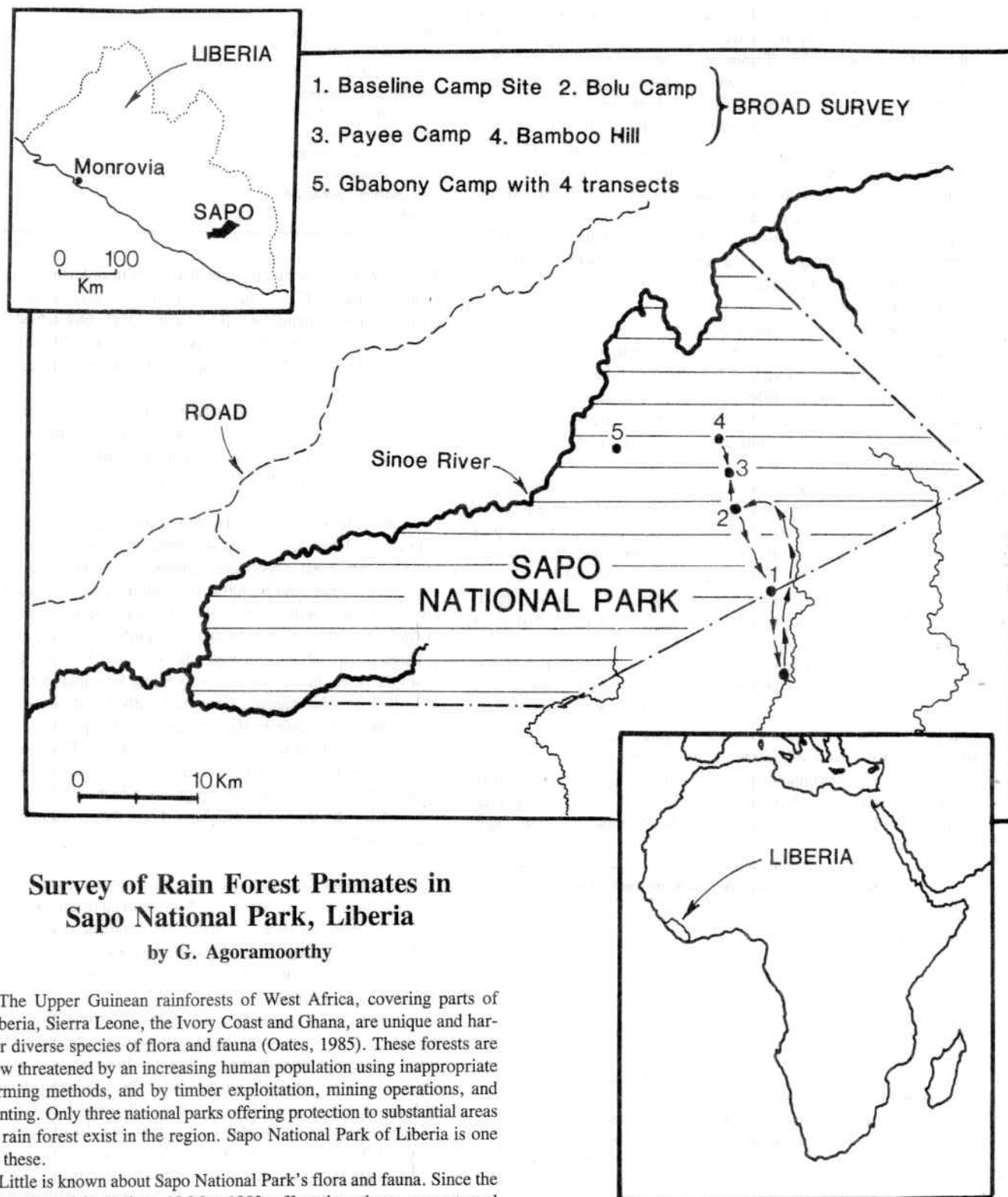
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Africa



Survey of Rain Forest Primates in Sapo National Park, Liberia

by G. Agoramoorthy

The Upper Guinean rainforests of West Africa, covering parts of Liberia, Sierra Leone, the Ivory Coast and Ghana, are unique and harbor diverse species of flora and fauna (Oates, 1985). These forests are now threatened by an increasing human population using inappropriate farming methods, and by timber exploitation, mining operations, and hunting. Only three national parks offering protection to substantial areas of rain forest exist in the region. Sapo National Park of Liberia is one of these.

Little is known about Sapo National Park's flora and fauna. Since the formation of the park on 19 May 1983, efforts have been concentrated on establishing park boundaries, employing staff, organizing educational programs and promoting tourism. To date, only two primate research projects have taken place inside the park (Anderson *et al.*, 1982, on chimpanzees, and this study). This study was initiated in an effort to identify the primate species present and to investigate the present population status, distribution, and relative density of these rainforest primates.

Fig. 1. Map showing the location of the Sapo National Park study area in Liberia, West Africa (map by S. Nash after original provided by author).

Sapo National Park (5°15'–5°40' N, 8°10'–8°50' W) is situated in Sinoe County, about 634 km away from the nation's capital, Monrovia (Fig. 1). The park has an area of 130,747 ha, approximately 1% of the total land area of Liberia (IUCN, 1986).

The climate is composed of distinct wet and dry seasons. The rainy season lasts from May to October and the dry season from November to April. Approximately two-thirds of the rainfall occurs at night in Liberia (Gnielinski, 1972). Temperatures are lower at the start of the dry season due to the harmattan winds, which originate in the Sahara Desert and bring cooler temperatures, less humidity, and dust. As the dry season progresses, the winds become hot and continue to bring dust. Temperatures in the park vary between 22–28° C, with a maximum temperature occurring between 1400–1500 h (Anderson *et al.*, 1982). Relative humidity within the forest can be as low as 80% but averages 91%. Annual rainfall data collected from 1982–87 at Basintown, where the park headquarters are situated, averages 2,596 mm (Carter, 1987). In general, May and August are the wettest months, while January and December are the driest. The dry season is the best time to do field work in Sapo National Park.

Most of Sapo National Park is intact tropical rainforest. The heavy rainfall classifies the forest as wet evergreen (Hall and Swaine, 1976), dominated by plant species such as *Tertraberlina tubmaniana*, *Herrietia* sp., *Brachystegia leonensis*, *Gilbertiodendron splendidum*, etc. Anderson *et al.* (1983) describe Sapo as 63% primary and mature secondary forest, 13% swamp, 13% seasonally inundated forest, and 11% young secondary forest.

Field work for this survey was conducted from December 1988 to March 1989. Surveys were conducted along forest trails, foot paths, roadsides, boundary lines, and riverbanks in the southeastern part of the park. On the northern side of the park, south of the Sinoe River, four transects, each 3 km long, were randomly placed in an area of 30 km². The total area covered during this survey was estimated to be 35 km² (Fig. 1). In all, 80 km were covered on foot during 14 days of censusing. On the northern side of Sapo National Park, each transect was censused four times per month. On average, each transect was composed of 60% primary/secondary forest, 25% hilly terrain, and 15% swampy area. Censuses were conducted in the morning (0700–1100 h) and in the evening (1500–1800 h). I have calculated primate densities according to Struhsaker (1981) and Whitesides *et al.* (1988).

Eleven species of primates, including nine diurnal and two nocturnal species, occur in Sapo National Park (Table 1). Of the 47 primate sightings, 98% were group sightings; only *P. potto* was seen singly.

Table 1. Primates in Sapo National Park, Liberia

Family Lorissidae
Subfamily Lorissinae
<i>Perodicticus potto</i> Potto
<i>Galago demidovii</i> Dwarf galago
Family Cercopithecidae
Subfamily Cercopithecinae
<i>Cercocebus a. atys</i> Sooty mangabey
<i>Cercopithecus petaurista buettikoferi</i> Lesser spot-nosed guenon
<i>Cercopithecus d. diana</i> Diana monkey
<i>Cercopithecus c. campbelli</i> Campbell's monkey
<i>Cercopithecus nictitans stampflii</i> Greater spot-nosed monkey (or putty-nosed quonon)
Subfamily Colobinae
<i>Colobus p. polykomos</i> Western black-and-white colobus monkey
<i>Procolobus b. badius</i> Western red colobus monkey
<i>Procolobus verus</i> Olive colobus monkey
Family Pongidae
<i>Pan troglodytes verus</i> Chimpanzee

Table 2. Relative Abundance and Estimated Density of Primates in Sapo National Park

Species	Total No.	Average Group Size	Relative Density (%)
<i>Procolobus b. badius</i>	317	24.4	47.5
<i>Cercopithecus d. diana</i>	192	12.8	28.7
<i>Cercocebus a. atys</i>	69	11.5	10.3
<i>Pan troglodytes verus</i>	31	7.8	4.6
<i>Colobus p. polykomos</i>	26	6.5	3.9
<i>Cercopithecus nictitans</i>	15	7.5	2.2
<i>Procolobus verus</i>	7	7	1.0
<i>Cercopithecus campbelli</i>	4	2	0.6
<i>Galago demidovii</i>	3	3	0.5
<i>Cercopithecus petaurista</i>	3	3	0.5
<i>Perodicticus potto</i>	1	1	0.2

The three most commonly sighted species in order of frequency were Diana monkeys (*C. d. diana*), western red colobus monkeys (*P. b. badius*) and sooty mangabeys (*C. a. atys*). Of the 668 individuals sighted, 47.5% were western red colobus monkeys, and 28.7% were Diana monkeys (Table 2). These two species frequently formed large mixed groups. The western red colobus was seen 13 times with an average group size of 24.4 individuals near Old Town, Payee, and the northern transect line 3. The average troop size of Diana monkeys was 12.8 individuals, observed 15 times. The densities estimated from the transects were 0.85 groups/km² for Diana monkeys, and only 0.52 groups/km² for red colobus monkeys.

Occasionally, species associated to create large mixed groups of 35–45 individuals. These groups consisted either of western red colobus, Diana monkeys, and greater spot-nosed guenons, or Diana monkeys and sooty mangabeys. These interspecific associations may be accounted for by random events (Whitesides, 1989), but more studies need to be done to find out if there is any biological significance for this behavior.

Three groups of chimpanzees with 4, 5, and 12 members were seen near Old Town, behind the Gbany Camp Site, and along transect line 1. Calls from chimpanzees were frequently heard and 25 chimp nests were found on Bamboo Hill. Whenever chimp groups appeared, it became difficult for me to find monkeys like the Diana or the red and black-and-white colobus. Once I saw a group of seven Diana monkeys 'hiding' 50 m away from a chimp group, which may indirectly indicate the predation by chimps on monkeys. From the direction of chimpanzee vocalizations, the existence of wild chimpanzees outside Sapo National Park was confirmed.

Sapo National Park, the only established national park in Liberia, contains populations of all the Upper West Guinea primates (Oates, 1985), even *Cercopithecus nictitans* which was regarded as an exception prior to this study. Among the 12 primate species present in Liberia (Oates, 1985), the green monkey (*Cercopithecus aethiops*) was the only species not seen in this census.

According to the Action Plan for African Primate Conservation, Diana monkey, olive colobus and chimpanzee are on the very high or high priority list, and western red colobus and black-and-white colobus are regarded as vulnerable African primates. The occurrence of large groups of Diana monkey, a species restricted to the high forests of the Upper Guinea region (Oates, 1986), further indicates the importance of Sapo National Park for the protection of this vulnerable species.

Essentially, all primates are threatened in Liberia due to serious hunting and habitat destruction outside protected areas. Presently, the forest within the park is not exploited by agriculturalists or by the lumber industry. However, portions of the park are composed of old rice and cassava farms as well as cash-crop farms such as coffee and cocoa. Timber operation has been prohibited inside the park but selective felling is in progress along the park boundary. Although there is now a ban on hunting wild animals, all forms of wildlife are still exploited by

poachers. Jeffrey (1977) estimates that over 70% of human protein requirements in Liberia are supplied from bushmeat. Illegal hunting within the park is promoted by logging roads on the boundary of the park. The existing wild chimpanzee troop outside the park indicates that conservation work is timely and education programs are desperately needed. I strongly urge the Liberian Government and the Forestry Development Authority to consider establishing more national parks and to continue ensuring the protection of this one.

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Nigeria's Gorillas: A Survey and Recommendations

by A.H. Harcourt, K.J. Stewart and I.M. Inahoro

Nigeria's Gorillas Rediscovered

As of 1987, no report of a sighting of gorillas in Nigeria had appeared in the conservation literature for thirty years. The last was in 1957 by E.W. March, then the Chief Conservator of Forests in Nigeria. The long silence led some conservationists to think that Nigeria's gorillas were now extinct. Others simply expressed ignorance about their status (Oates, 1986). Then, in early 1987, rumors began of their continued presence in southeast Nigeria. These were confirmed in the middle of the year by the Nigerian Conservation Foundation, a non-governmental organization. [It later transpired that a party of expatriate conservationists had found evidence of gorillas in the region in December, 1986 (Harris *et al.*, 1987), but the information had not reached the Nigerian Conservation Foundation, or other conservation authorities in the country.] Realizing the importance of its find for conservation and development in Nigeria, the Foundation requested a fuller survey, with the backing of the British Council.

Two months' work, in December 1987 and January 1988, enabled us to establish the limits of distribution of gorillas in Nigeria, and to obtain some idea of their numbers. The population is large enough to be conserved, and we suggest here how this might be done.

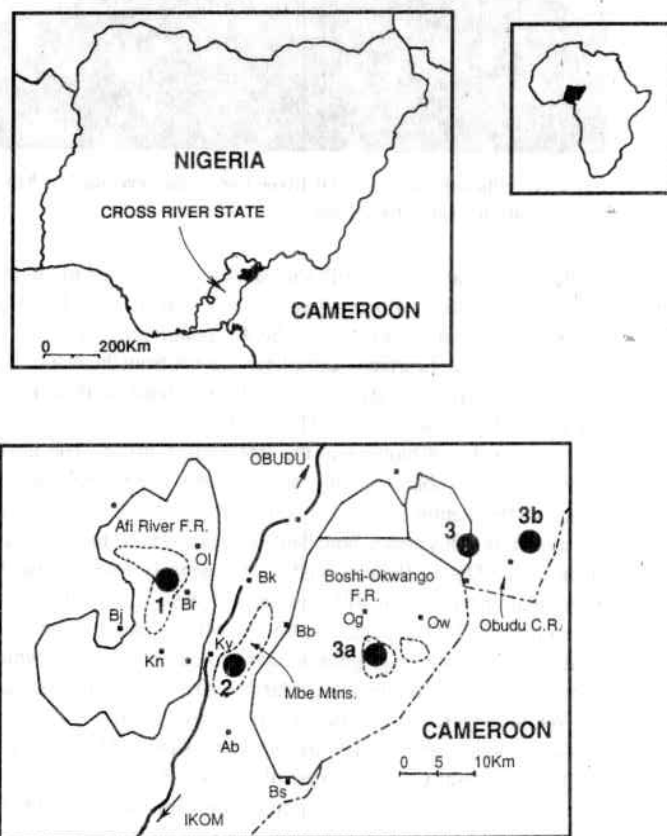


Fig. 1. Maps showing (a) the Sonkwa Mountains (black shading) in Cross River State, Nigeria; (b) the distribution of Nigeria's gorilla population. Large circles show where recent signs of gorillas were found. Also shown are the two Forest Reserves, the Cattle Ranch, the community-owned Mbe Mountains and the various community centers (indicated by two-letter codes) mentioned in the text. Dotted lines indicate surveyed mountainous ground (map provided by authors).

Distribution and Numbers

In the extreme southeast of the country in the forests of the Sonkwala Mountains in Cross River State (Fig. 1), Nigeria's gorillas are surviving. They are concentrated in three to five subpopulations, in a total of 120 km² over an area of about 750 km², or less than 0.1% of Nigeria's surface area.

In two areas, the Afi River Forest Reserve and the Mbe Mountains, our survey was extensive enough to allow an estimate of numbers. In these two regions we walked an estimated total of 100 km of transects. The ten sleeping sites and one group of gorillas that we saw enabled us to calculate a density of 1-1.5 gorillas per km². With 120 km² available to them, Nigeria's gorillas might number about 150, or say somewhere between 100 and 300, given all the potential inaccuracies in the estimates. From the size of the dung found, we know that the population is reproducing. We calculated a maximum rate of 10 births per year in a population of 150 animals, assuming a composition and reproductive rate similar to other known populations (Harcourt *et al.*, 1981).

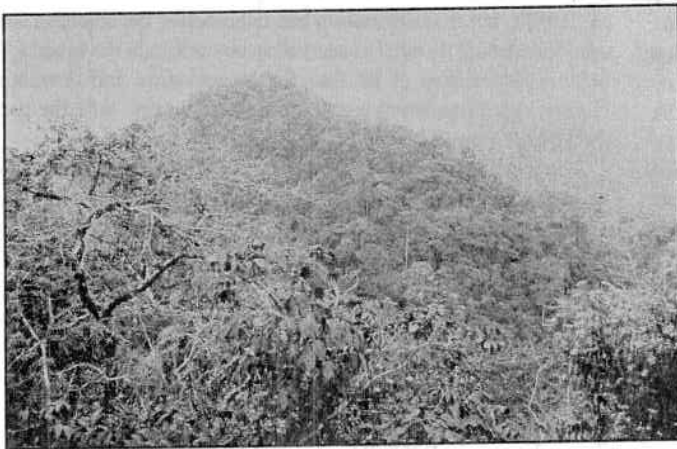


Fig. 2. Gorilla habitat of the Afi River Forest Reserve and the Mbe Mountains (photo provided by authors).

We estimate about 50 gorillas in the densely forested mountains (Fig. 2) of the Afi River Forest Reserve and also in the Mbe Mountains (Populations 1 and 2, Fig. 1b). The Afi population, the most westerly in Africa, is almost certainly completely cut off from the rest of Nigeria's, and therefore Africa's, gorillas by the heavily used, tarmac Ikom-Obudu highway. We suspect that the Mbe population is cut off from the others by the intensity of hunting in the intervening forest. The next largest population is probably in the north of the Boshi-Okwangwo Forest Reserve (Population 3, Fig. 1b), although we did not have time to survey the area fully. This area is bounded on its east side by the 1,000 m escarpment of the Obudu Plateau, and is also densely forested and hilly, as is Population 3a's range, although the hills here reach only 650 m, compared to the 1,000 m peaks of Afi and Mbe. Finally, Population 3b is in the middle of a huge government-run cattle ranch, in which small forest patches survive in valleys largely surrounded by grassland (Fig. 3). Within Nigeria, Population 3 is probably cut off from 3a by cultivation and hunting, and from 3b by unsuitable habitat. However, it is possible that the Boshi-Okwangwo gorillas (3 and 3a) independently connect with the Obudu Cattle Ranch population (3b) through Cameroon.

Threats

The local people, the Boki, are primarily farmers, but many hunt also. Game meat is favored over domestic meat and fetches higher prices, the main market being local restaurants. Thus, hunting is a lucrative occupation, enabling the younger, fitter men to earn more from it than they would from manual labor. A reasonable monthly wage in the capital, Lagos, is 150 naira per month; a duiker, one or two of which could

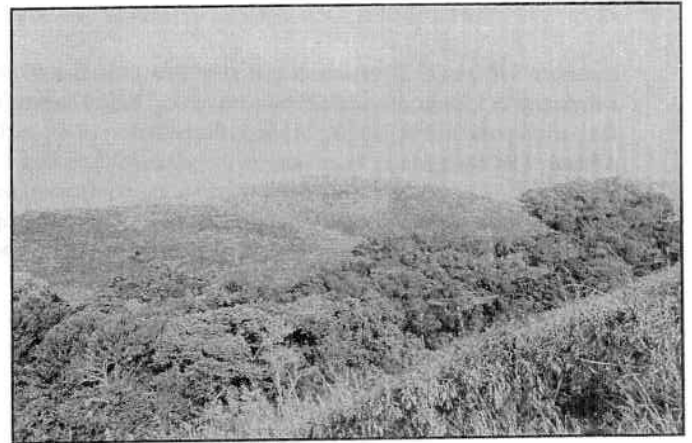


Fig. 3. Valley forest in the Obudu Cattle Ranch (photo provided by authors).

be shot in a night's hunting, can be sold for half that, and a gorilla carcass will fetch at least 300 naira. A number of the villages have poor communications, some being unreachable by road, especially in the rainy season (Fig. 4). The farther from the road a community is, the more efficient it is for the inhabitants to transport game meat rather than farm produce to market.

The Boki hunt intensively throughout the Sonkwala Mountains. All mammal species are targets, and it is not too much of an exaggeration to say that the ground is littered with shotgun cartridges. Except in the government-run cattle ranch, we found the gorillas only in the most inaccessible parts of the mountains. In the cattle ranch, the forest patches are so small that there is nowhere for the gorillas to retreat to.



Fig. 4. A remote village with no access by road (photo provided by authors).

Without doubt, the gorillas are under threat. In fact, we calculate that perhaps twice as many are killed each year as are born. About 15 communities hunt in the gorilla's range in Nigeria. In 1986 one community alone killed eight gorillas; in 1987 another killed six. Others kill one or two every year or so, and these figures count only those gorillas butchered. Based on the number of times we were told of gorillas shot at close range but not killed outright by the twelve-bore guns used, a large number of animals must be lethally wounded and left to die in the forest. Taking an average of only one gorilla killed per year per village, a minimum we think, we estimate that one and a half times as many gorillas are killed as are born.

The Nigerian peoples' rate of population increase is the sixth highest in Africa (World Resources, 1987). The resultant increase in the human population will only intensify hunting. Forest is now being cleared



Fig. 5. A banana and palm plantation cut out of the natural forest (photo provided by authors).

for agriculture around all the villages (Fig. 5) and will be destroyed at an increasing rate (Anadu, 1987). Slopes are steep in the region, the soil is thin, the rains are heavy. Extensive forest clearance will threaten not just the gorillas, but the people too.

Solutions

Any conservation plan for the region needs to take into account both the financial value of hunting to the Boki and their need for economic development and better communications. Conservation measures are required that will not only protect the gorillas and the forest on which they and the people depend, but will bring development to the region as well (Anadu, 1987). We propose the following:

(1) Current laws banning the killing, capture or trade of endangered species must be advertised and enforced.

(2) The core of each gorilla sub-population's range should be gazetted and maintained as a sanctuary in which no hunting of any species is allowed. Surrounding these sanctuaries should be hunting zones like the current Forest Reserves, where non-endangered species may be hunted, but forest clearance is banned. These moves would have the benefit of protecting the gorillas, the game populations, and the forest on which the local people depend for the integrity of the region's watersheds.

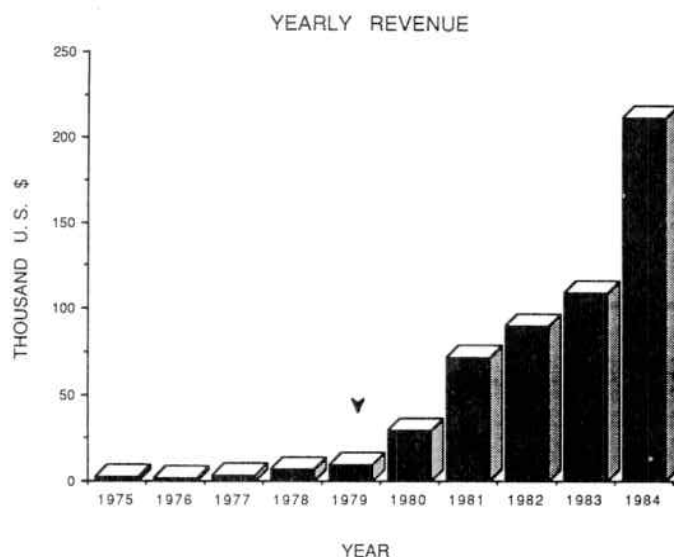


Fig. 6. Revenue received by Rwanda's Volcano National Park before and after the start (arrow) of a major tourism program (graph provided by authors).

(3) Since the Boki people are primarily agriculturalists and their population's increase is so recent, no traditions exist that might limit overexploitation of the forest. Conservation awareness programs should be initiated in order to provide the people with the knowledge that they require for informed decisions about their own and the forest's future (Aveling, 1987; Harcourt, 1986; Harcourt *et al.*, 1986; Weber, 1987).

(4) In Rwanda and Zaire, tourism based on gorilla viewing has markedly improved the economy of the parks (Fig. 6) and also the region, by bringing jobs and a market for local skills and produce (Harcourt, 1986; Weber, 1987). Tourism based on gorillas is possible in the Boki region, especially in the Obudu Cattle Ranch, and a tourism program should be implemented.

(5) The size of the gorilla populations in the Boshi-Okwangwo Forest Reserve and the Obudu Cattle Ranch needs to be determined, as does that of the contiguous gorilla population in Cameroon, part of which is in the Takamanda Reserve.

(6) Information should be exchanged with the Cameroon authorities so that compatibility of conservation measures is assured.

Accounts of the "rediscovery" of Nigeria's gorillas have appeared in the international press in Africa, Europe and North America. Gorillas are intrinsically no more important than are other organisms. Indeed on biological and conservation grounds, our confirmation of the presence of the far rarer and more endangered drill (*Papio leucophaeus*) should have received wider coverage. However, gorillas are attractive animals, as demonstrated by the success of the Mountain Gorilla Project in Rwanda, and the similar projects now being run in Zaire and Uganda. Conservation organizations in Nigeria and elsewhere should use this international interest to begin immediate conservation and development programs in the area.

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Note: Harris *et al.* (1987) reported that according to local villagers, both chimpanzees and gorillas occurred in the Obudu Cattle Ranch forests. We were told that only gorillas lived there, and indeed we found no sign of chimpanzees. The Virunga Volcanoes region of Rwanda, Uganda, and Zaire is the only other area that we know of where gorillas occur without chimpanzees.

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Madagascar

Distribution and Conservation of Sclater's Lemur: Implications of a Morphological Cline

by David M. Meyers, Clement Rabarivola and Yves Rumpler

Since the rediscovery of Sclater's lemur, *Lemur macaco flavifrons* (Gray, 1867), in 1983 (Koenders *et al.*, 1985), there has been little conservation activity directed towards this endangered subspecies. The lack of direct action towards protecting this Malagasy lemur can be seen as a result of its uncertain taxonomic status and a general scarcity of information on its geographic distribution (Richard and Sussman, 1987).

Koenders *et al.* (1985) suggest that the Andranomalaza River is the geographical barrier between the two subspecies of *Lemur macaco* (Sclater's lemur, *L. m. flavifrons*, and the black lemur, *L. m. macaco*; see Fig. 1). Since 1985, several expeditions to this region by a team of researchers from the Duke University Primate Center, the University of Antananarivo, and the University of Strasbourg were conducted to examine further the geographical distribution, taxonomy, and conservation status of Sclater's lemur. In this report, we present new distributional information pertinent to the lemur's conservation status. Furthermore, we present the conservation implications of a recently located geographical cline in morphological characteristics within *Lemur macaco*.

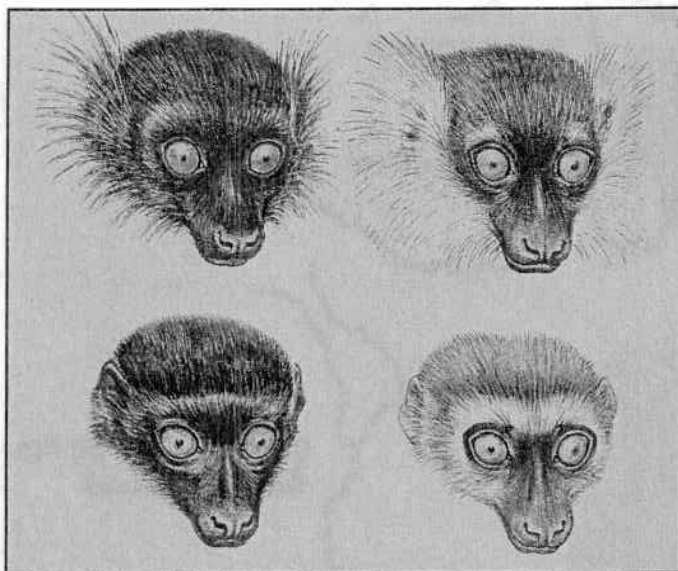


Fig. 1. Male and female *L. m. macaco* (above) and *L. m. flavifrons* (below) (drawings by S. D. Nash).

Methods

Two broad surveys were performed in 1985 and 1986 by D. Meyers in the region of Maromandia in northeastern Madagascar (Fig. 3). In each survey, the suggested geographic barrier was examined by first interviewing local residents, who helped locate potentially valuable forests, and then verifying the presence of the animals through observation and photography. General habitat descriptions were compiled to complement available maps of the region. Locations of the interviews and censuses and descriptions of the habitats are given in Figure 4.

From August to November 1988, the aforementioned multinational research team continued surveying in the region of Maromandia and Ambodivoahangy and extended the area of study to Beraty (Fig. 3). Methods

during this third phase of survey included live capture of subjects. Each subject was measured, weighed, bled, and photographed, after which, dermatoglyphic prints were taken. During photographic and quantitative documentation, special attention was given to the morphological characteristics that distinguish the two different subspecies. A total of 35 subjects were captured, examined, and released.

Geographic Distribution

Populations of Sclater's lemur occupy the southernmost portion of the geographic range of *Lemur macaco* (Fig. 3). The range of Sclater's lemur extends south from the Andranomalaza River to, but not past, the Sandrakota River. North of the Andranomalaza, a morphological cline was found in which the groups seen near the headwaters of the Andranomalaza River were more similar to Sclater's lemur and those which were further north and away from the headwaters more closely resembled the black lemur.

The *Lemur macaco* populations located in the region of Ambodivoahangy (Fig. 4) were generally similar to *L. m. flavifrons* except for several subspecific characteristics. Similarities include the lack of ear tufts and light extremities (Fig. 5). Short ear tufts were noticeable only in two groups of ten described during both visits to the area. Characteristics which diverged from *L. m. flavifrons* were female coat color and eye color: female coat color varied among individuals and tended to include more rufus than *L. m. flavifrons*; eye color (blue to grey in *L. m. flavifrons* and brown to red in *L. m. macaco*) was generally light brown in this population.

Different hybrid forms (Fig. 6), morphologically intermediate between *L. m. flavifrons* and *L. m. macaco*, were located and captured east of the village of Beraty, which lies 12 km northwest of Ambodivoahangy. As can be seen in Figure 4, there are no geographical barriers between Ambodivoahangy and Beraty. In fact, the dense, humid forest that lies between these two points is completely intact, so far totally unaltered by human activities.



Fig. 2. Female *L. m. macaco* (photo by R.A. Mittermeier)

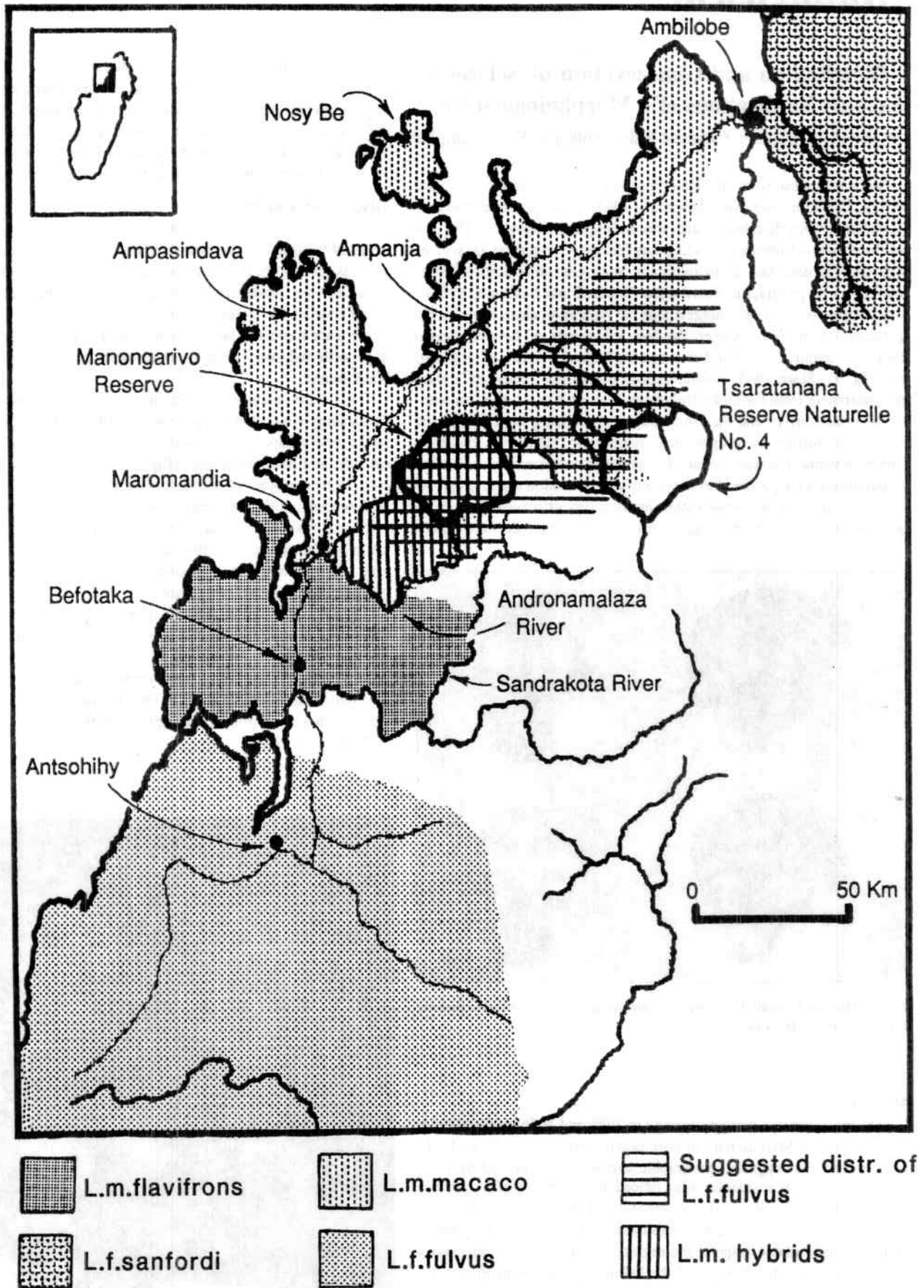


Fig. 3. Map showing distribution of *Lemur macacoo* and *Lemur fulvus* in northwestern Madagascar (map by S.D. Nash based on authors' original).

Habitat Description

Habitat types occupied by different populations of *L. macaco* varied from arid scrub brush to moist evergreen forest. Although habitat variation was not discrete, for a discussion of conservation concerns we have divided habitat types into categories.

Sclater's lemur was found south of the Andranomalaza River in gallery forests surrounded by heavily degraded secondary forests, in dry forests typical of western Madagascar, and in coffee plantations interspersed with small stands of native (dry) forest (Fig. 4). Populations of what we consider pure *L. m. flavifrons* were small and patchy throughout the subspecies' entire range.

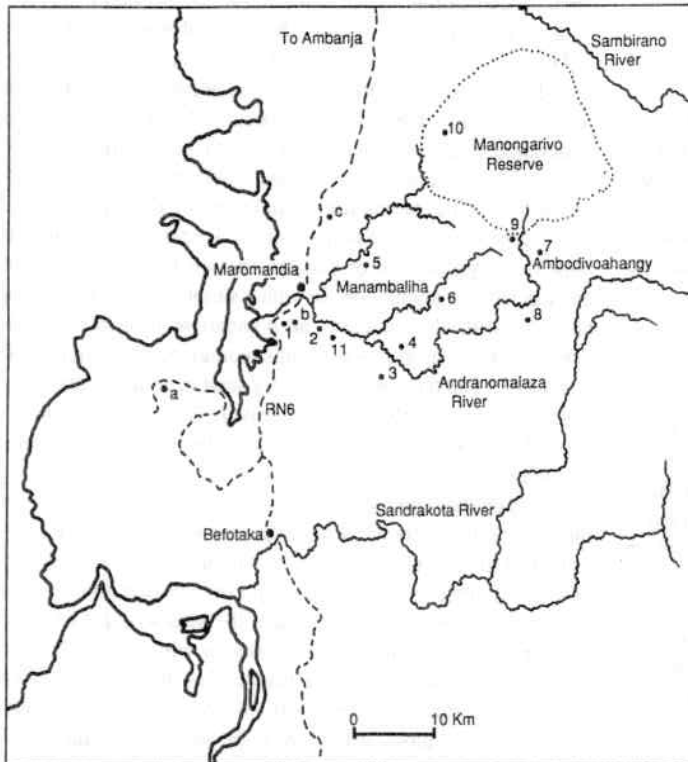


Fig. 4. Map showing survey localities in Andranomalaza region (map by S. D. Nash based on authors' original).

(a, b, c: sites from Koenders *et al.* (1985); Nos. 1-8: 1985 and 1986 surveys, D.M.M.; Nos. 9-11: locations during Phase 2, 1988; (1): mango dominated forest patches; (2) and (11): coffee plantations with small, adjacent natural forests; (3): gallery forests with degraded secondary forest; (4): primary semi-evergreen forest interspersed with tavy; (5) and (8): secondary forest; (6): primary semi-evergreen forest; (7), (9) and (10): *sambirano* with tavy.)

Hybrid populations were found in habitat similar to that occupied by most other populations of *L. m. macaco*. The entire region of the Manongarivo Mountains (and Reserve) consists of evergreen rainforest known as *sambirano* (Petter *et al.*, 1977; Tattersall, 1982). This forest type is considered the western-most aspect of Madagascar's eastern humid forests. With its climate heavily influenced by altitude and proximity to the largest mountain range in Madagascar, Tsaratanana, the *sambirano* forests have stronger seasonal variation in rainfall than the eastern rainforests.

The Andranomalaza River marks the southern limit of the *sambirano* region. Thus, *L. m. flavifrons* resides south of the *sambirano* region, whereas the hybrid populations and *L. m. macaco* are found almost entirely within this region. Although these habitat differences coincide well with the distribution of the different subspecies, two lines of evidence suggest that the association of subspecies with habitat type is historical and not due to subspecific habitat preferences. First, other populations of *L. m. macaco* have been located in habitats which are altitudinally



Fig. 5. Hybrid female from Ambodivoahangy (photo by D. Meyers).

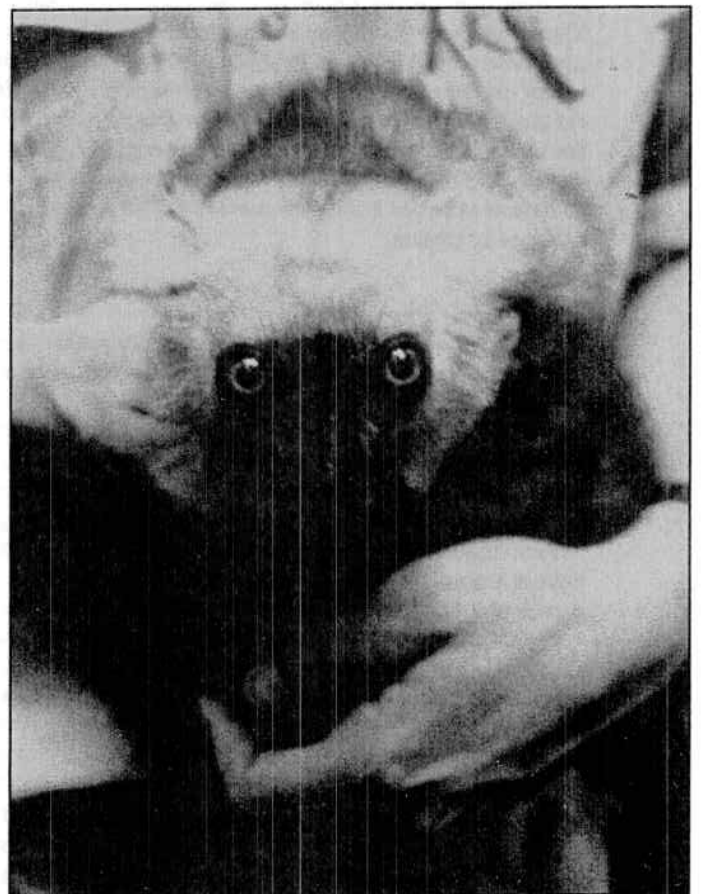


Fig. 6. Hybrid female from Beraty (photo by D. Meyers).

low and structurally similar to the dry native forests occupied by *L. m. flavifrons*. Secondly, the hybrids found near Ambodivoahangy are morphologically similar to *L. m. flavifrons*, yet occur in the *sambirano* forest region.

The two different habitat types are vulnerable in different ways. The *sambirano* region, including the Manongarivo Mountains, is either altitudinally high or at least near mountains that trap passing moisture. South of the Andranomalaza River, however, the altitude rarely exceeds 300 m. This area is drier year-round, more vulnerable to fires, less resilient after deforestation, and, therefore, also particularly vulnerable to human disturbance.

Hunting and trapping occasionally occur, but were not obviously restricting lemur population sizes at the time of our surveys.

Lemur fulvus

Lemur fulvus, once considered conspecific with *Lemur macaco* (see Petter *et al.*, 1977), has been found to occur sympatrically with *Lemur macaco* only in a small area northeast of Ambanja (Tattersall, 1976). The location of a population of *Lemur fulvus fulvus* at both Ambodivoahangy and Beraty suggests that the range of sympatry of these two species includes most of the geographic range of *Lemur macaco* (Fig. 3).

Taxonomy

The use of the subspecific name *Lemur macaco flavifrons* to represent the *Lemur macaco* populations south of the Andranomalaza River is presently justified by the consistency with which the observed animals fit the descriptions by Gray (1867) and Sclater (1880) of the type specimen living at the London Zoo. In comparison with the highly variable population at Ambodivoahangy, the populations of pure *L. m. flavifrons*, which exist in a specific geographic area, are more homogenous and clearly different from the description of *L. m. macaco* (Linnaeus, 1776:44). These characteristics support the continued use of *L. m. flavifrons* as a taxonomic unit (see Mayr, 1942). Presently, the only simple discriminating characteristic between these pure forms (*L. m. flavifrons*) and extremely similar forms near Ambodivoahangy is eye color. Other discriminating factors may be uncovered during the genetic and dermatoglyphic analyses being performed on the data collected from the 35 subjects examined in this project and from captive subjects with known locations of capture.

A Geographic Cline

At present, we suggest that a zone of intergradation between the black lemur (*L. m. macaco*) and Sclater's lemur (*L. m. flavifrons*) occurs over the entire Manongarivo Mountain range and foothills (Fig. 3). Although the dermatoglyphic and genetic data have not been analyzed, we suggest that the present distribution of morphological variation is not a result of human habitat alteration but has been in existence for a long, so far undetermined, period of time. The lack of any obvious geographical barrier and the suitability (and integrity) of the forests between the populations at Ambodivoahangy and Beraty present strong support for the existence of a fairly smooth geographical cline in subspecific traits.

Further analysis and studies focused on determining the time frame for the intergradation and the underlying genetic variation are underway. Two competing hypotheses will be examined concerning the origination of the variation. Hypothesis A states: After allopatric differentiation, the subspecies rejoined to form a recent and presently changing zone of secondary intergradation. Hypothesis B states: The variation is clinal, resulting from a restriction of gene flow due to distance only and either selected or stochastic morphological variation. A third possibility, intermediate between these two hypotheses, states: Once allopatric differentiation occurred, selective pressure maintained hybrid forms in some areas. To examine these hypotheses, we will compare

the morphological, genetic, and dermatoglyphic variations of *Lemur macaco* found throughout the region of the Manongarivo and the Andranomalaza River.

Conservation Concerns

Conserving Sclater's lemur and *Lemur macaco* in general would accomplish three main goals. The first and most commonly cited is the preservation of diversity within the species. The second is the preservation of the potential for continued evolution of this species, an especially valuable goal considering the geographic variation which we have been documenting. The third is the conservation of the region's ecosystem, necessary for both human and non-human inhabitants.

The preservation of biological diversity within *Lemur macaco* can obviously be enhanced by the preservation of natural populations of Sclater's lemur. Not only does this lemur occupy the most southern edge of the geographic range of *Lemur macaco*, but it also represents the most morphologically divergent populations within the species. This is the case regardless of the taxonomic distinctness of this variety.

At present, no single population of Sclater's lemur has been located which is large enough or isolated enough from human disturbance to be targeted as a population for which simple conservation measures will be successful. Concurrently, all populations located to date are threatened by habitat destruction. In this bioregion, deforestation permanently alters the habitat: the extended dry season, common to most of western Madagascar, constrains forest regrowth, and, coupled with the high demand for agricultural land, eliminates the likelihood of natural forest regeneration.

Although this situation may not be unique, it is a prime example of the need to integrate rural development with conservation. If land-use pressures are not alleviated, there will be no hope for the conservation of Sclater's lemur. Furthermore, once the remaining forests of the region are converted into agricultural land, the microclimate will be destroyed and widespread desiccation and erosion will ensue. This process has already started and is placing pressure on the southern border of the Manongarivo Reserve where most villages have *tavy* (slash-and-burn hill rice production) plots. Within the three years that members of this project have been investigating the region, deforestation of the southern foothills of the Manongarivo Mountains has been rapidly increasing (Meyers, pers. obs.).

We suggest that a socioeconomic study of the Andranomalaza region, with emphasis on the threatened area south of the Andranomalaza River, be conducted as soon as possible. Once this is completed, plans should be developed with the involvement of the local governments to reduce or eliminate conversion of the remaining natural forests. Furthermore, conservation education would be useful in redirecting local opinion towards the positive aspects of living sympatrically with the lemurs and away from the local view of lemurs as agricultural pests.

The second conservation goal, preserving the potential for evolution within the species, can be accomplished through the adequate protection of the Manongarivo Reserve in coordination with the protection of forest corridors leading from the headwaters of the Andranomalaza River south to the forests between the Andranomalaza River and the Sandrakota River (Fig. 3). The protection of the Manongarivo Reserve, which is inadequate at present, will only be possible if boundaries are clearly marked (or at least known by the local governments), and if at least one reserve guard is appointed. These are basic necessities for any protected area.

If the protection of the reserve is to be managed on a long-term basis, slash-and-burn agriculture in the region must be modified to become sustainable. This is one of the most pressing problems occurring throughout forested regions of Madagascar. Information generated from the proposed rural development projects in the eastern forests, such as those at Ranomafana, Masoala, and Mananara, may be appropriate for

the Manongarivo region as well. However, lack of adjustment for different climatic, social, and economic factors could lead to the inappropriate use of technology from these projects. The most effective procedure will always involve the local governments and local farmers in decision making.

The achievement of the third conservation goal, the preservation of ecosystem function, naturally accompanies the accomplishment of the first two. In addition, planting trees in deforested areas and controlling fires, by maintaining fire breaks, for example, would enhance the economic and ecological value of degraded areas.

The suggestions we have presented above are necessary for the ecological and economic stability of the region. The threatened status of Sclater's lemur is a strong indicator of the threatened status of the ecosystems in which it is found. If the ecosystems become unproductive, both lemurs and humans will lose.

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Distribution and Conservation of Two Endangered Sifakas in Northern Madagascar

by David M. Meyers and Joelina Ratsirarson

The purpose of this report is to present new distributional information gathered in 1988 during field censuses in northern Madagascar on two of the most endangered Malagasy primates: Perrier's sifaka (*Propithecus diadema perrieri* Lavauden, 1931 Fig. 2) and a recently described new species, the golden crowned sifaka (*Propithecus tattersalli*, Simons, 1988 Fig. 3). Prior to the surveys presented here, estimates of population numbers for Perrier's sifaka suggested there could be as few as 100 animals of this subspecies remaining (Richard and Sussman, 1987). As with most lemurs, the extent of their geographic range was not certain. Information on the range of the golden crowned sifaka, or Tattersall's sifaka, has been even more limited. The only information that has been available for *Propithecus tattersalli*, generated by the Duke University Primate Center breeding program capture missions, suggested an extremely small geographic range for this species located near Daraina in the region of Vohemar (Simons, 1988; see Fig. 1). Given the lack of information on these large folivores, no sound conservation strategy could be formulated.

This report contains information valuable for the development of a conservation plan for both endangered sifakas as well as for other lemurs in northern Madagascar.

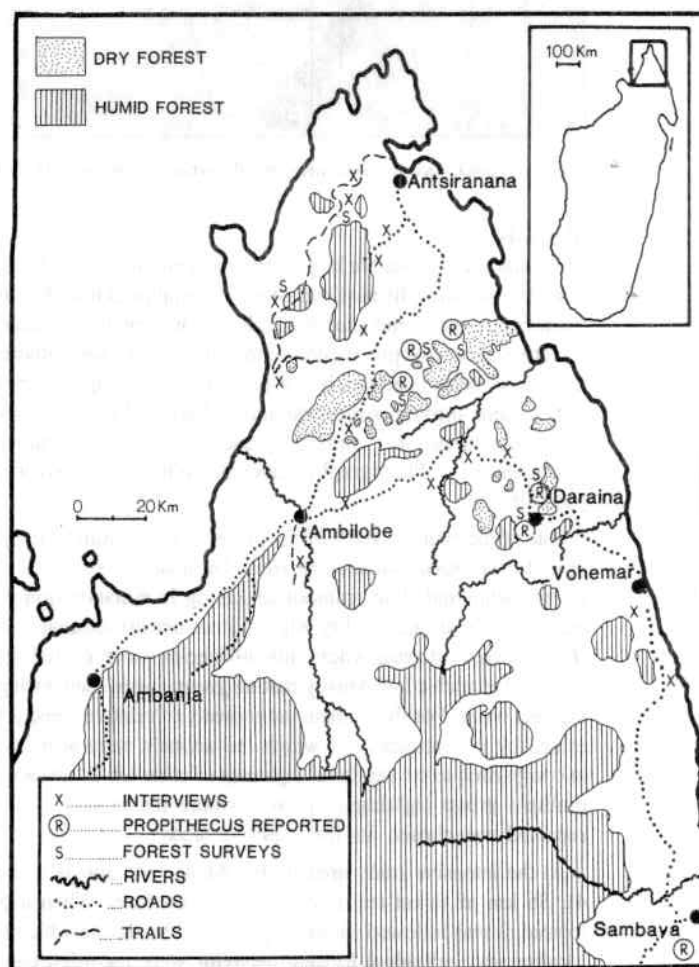


Fig. 1. Forest cover and locations of interviews in northern Madagascar (map by S.D. Nash from authors' original).



Fig. 2. *Propithecus diadema perrieri* (drawing by Stephen D. Nash).



Fig. 3. *Propithecus tattersalli* (drawing by Stephen D. Nash).

Methods

Propithecus species are large lemurs and are familiar to Malagasy even in areas somewhat distant from where these animals live. For this reason, the broad survey conducted throughout northern Madagascar was very effective. Accurate presence/absence information was gathered through interviews with residents living near forests throughout the region of Antsiranana through Ambilobe and Vohemar (Fig. 1). Short censuses were conducted to confirm presence and to document pelage characteristics. Photographic documentation was performed when possible.

One of the primary goals of the project was to estimate the population size of *Propithecus diadema perrieri*. The analysis combined widespread interviewing and short transect censusing in collaboration with an intensive study at one locality where direct density estimates were taken (Fig. 4). In most areas where this subspecies was reported, the animals occurred at such a low density that no groups were seen during the short transect work. For these areas, an estimate of relative density was determined by the frequency at which the animals were seen by residents in comparison to the residents' sightings of other lemur species. To assure multiple group sightings, the area where the highest densities were reported was chosen for the intensive study.

At the intensive study area, in the Analamera Special Reserve (Fig. 4), 56 km of forest trails were covered on foot. When a group was located, it was followed for as long as possible, during which time group location and individual feeding behavior were recorded continuously. For a calculation of population density, an area of detection was estimated to be 15 m to each side of the trail. Thus, a total of 168 ha of forest

was censused. A complementary method of density analysis was conducted through a home range estimate for the group with the greatest number of hours of observation.

Perrier's Sifaka, *Propithecus diadema perrieri*

Perrier's sifaka was found to have an extremely limited distribution. Although individual animals have been seen as far west as the Ankarana (J. Ganzhorn, pers. comm.), the only substantial populations were found in the forests of Analamera and the Andrafiarana mountain chain (Fig. 4). Fortunately, most of these populations are located within the Analamera Special Reserve.

The forests of Analamera are dry from May through November and have a different floral composition and structure than the moist forests of the Montagne d'Ambre. The distribution of these two forest types, as represented on topographic maps of the region, are shown in Figure 4.

From interviews around the forests of the Montagne d'Ambre (Ambohitra), it was found that *P.d. perrieri* did not occur at all within this entire region. The region of Andavakoera contained moist forest, and although it was directly adjacent to Andrafiarana, contained few or no *Propithecus*. An apparent conclusion derived from this distributional association of *P.d. perrieri* with the drier forests of the region is that this subspecies depends on some floristic qualities of this forest type. However, another possibility is that the unsuitability of the drier parts of the Analamera forest for *Lemur fulvus sanfordi* and *Lemur coronatus* (which occurred at uncharacteristically low densities in areas with strong *P.d. perrieri* populations) reduced dry season competition pressure for resources (fruit), which in other areas are consumed by these *Lemur* species.

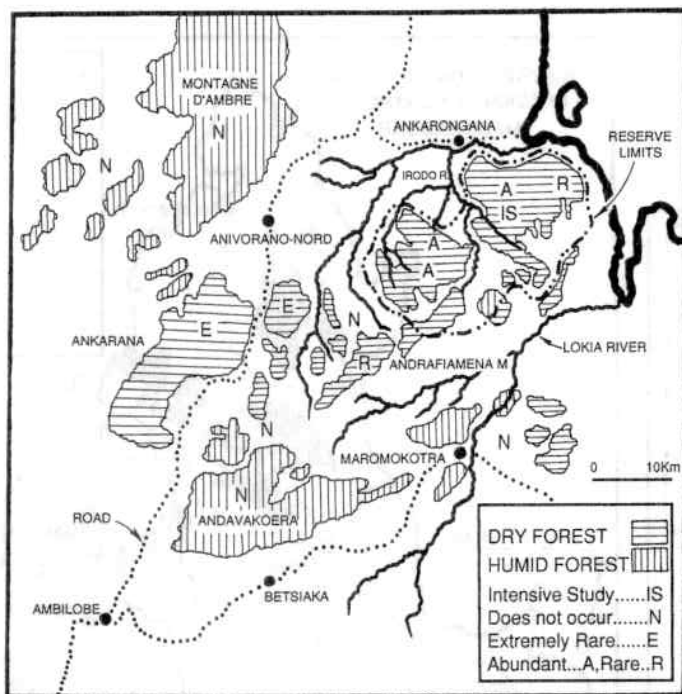


Fig. 4. Forest type and relative density of *Propithecus diadema perrieri* near Analamena Special Reserve (map by S.D. Nash from authors' original).

The diet of *P.d. perrieri* during the month of August, a very dry month, consisted mostly of mature leaves (33%) and unripe fruit (30%), and included petioles, young leaves, stems, and flowers (in decreasing importance). Table 1 contains more specific information on the food types eaten by this subspecies.

Table 1. Twelve Plants Eaten by *Propithecus diadema perrieri* During August in Bobakindro River Study Site

Family	Latin Name	Malagasy Name	Type	Part Eaten
Acanthaceae	<i>Ruellia</i> sp.	Malemy	tree	flowers
Acanthaceae	unknown	—	herb	mat. leaves
Asclepiadaceae	<i>Secamone</i> sp.	Vahiabaniakondro*	vine	mat. leaves
Ebenaceae	<i>Diospyros</i> sp.	Omylahiala	tree	unripe fruit
Guttiferae	<i>Garcinia</i> sp.	—	tree	leaf petioles
Leguminosae	<i>Xanthocercis</i> sp.	Voankazomeloka	tree	unripe fruit
Loganiaceae	<i>Strychnos</i> mad.	—	tree	yng. leaves
Oleaceae	<i>Olax</i> sp.	Kimbimba	tree	leaves, stems
Rubiaceae	<i>Canthium</i> sp.	Piro	tree	yng. leaves
Rubiaceae	<i>Canthium</i> sp.	Hitry	tree	mat. leaves
Sapotaceae	<i>Sideroxylon</i> sp.	Nanto	tree	unripe fruit
Sapotaceae	unknown	—	tree	leaf petioles

*name from Ranomafana where it is eaten by *P.d. edwardsi*

At the intensive study area, the two density estimates produced similar results. Over the 168 ha covered, 36 adult or subadult animals were sighted. This gave a density estimate of 21.4 ind/km². The *P.d. perrieri* at the study site were not habituated to the presence of observers. The longest continuous observation period was only three hours. As a result of this limitation, the area through which the animals ranged represented only a percentage of their total home range. Thus, the calculated density may overestimate the actual density. The calculation for the most frequently observed group (5 inds + 1 infant) produced a minimum home range of 28 ha and a density (excluding the infant) of 18 ind/km².

It is important to note that most transects were conducted near the Bobakindro River. The vegetation near the river, a year-round water source, was more lush than in other parts of the forest. *P.d. perrieri* may have spent relatively more time in this microhabitat during the dry months, thus inflating the density estimates produced by this dry season study. Therefore, the use of the mean of the two estimates (20 ind/km²) should be considered as a maximum density for the study site, which in turn held one of the largest populations of *P.d. perrieri*.

Considering the maximum density estimates and the relative density information, we suggest there could be nearly 2,000 remaining individuals of *P.d. perrieri*. Discounting subadults and non-breeding males and females, the effective population size may be far below the total population number.

The nearest population of *Propithecus diadema* has a totally different coat color (*P.d. perrieri* are entirely black; the silky sifaka, *P.d. candidus*, are almost entirely white). Although this could be a simple genetic system, the populations have been separate long enough that the black coat color was shared by all individuals known from the *P.d. perrieri* population. The low population number coupled with genetic isolation threatens the continued existence of Perrier's sifaka. Maximum efforts to maintain viable wild populations, in coordination with studies aimed at establishing a captive breeding program to insure against extinction through epidemic disease, habitat degradation, and natural disasters, will be necessary to protect this subspecies.

Sympatric with *P.d. perrieri* in the forests of Analamena were *Lemur fulvus sanfordi*, *Lemur coronatus*, *Lepilemur septentrionalis*, *Phaner furcifer*, *Daubentonia madagascariensis* and *Microcebus rufus*. A *Cheirogaleus* species was reported, but its presence was never confirmed. At the Bobakindro River study site, only *P.d. perrieri* and *Lepilemur septentrionalis* were abundant. *L. fulvus sanfordi* and *Lemur coronatus* were less abundant than *P.d. perrieri* and were only sighted along the gallery forests. Recent traces of *Daubentonia* were found but there were no actual sightings.

Possible predators include the Madagascar Harrier-Hawk (*Polyboroides radiatus*) and the fossa (*Cryptoprocta ferox*). Reactions of *P.d. perrieri* to circling Harrier-Hawks suggested that this raptor posed a threat to *P.d. perrieri*; infants and young individuals would be the most vulnerable.

Golden-Crowned Sifaka, *Propithecus tattersalli*

The golden-crowned sifaka has recently been described by Simons (1988). The existence of the population which contained the type specimens was first noted by Tattersall (1982), who suggested that this sifaka was a variant of *Propithecus diadema candidus*. Support for a separate classification as a species is based on morphology, cytology, and vocalizations (Simons, 1988). Furthermore, *Propithecus tattersalli* is geographically isolated from other types of *Propithecus*. This, along with their morphological divergences from the other congeners, justifies classifying them as a discrete taxonomic unit. If we accept the past separation of *Propithecus* into two species, *P. diadema* and *P. verreauxi*, then it seems appropriate to consider the golden-crowned sifaka as a new species (see Simons, 1988).

Only preliminary studies of the density of the golden-crowned sifaka were conducted. High densities (26 inds along approximately 4 km of trails) were found in gallery forests along dry stream beds in otherwise deforested valleys. On hills above the gallery forests, there were mainly deciduous forests. In these forests, outside of what could be considered gallery forests, only two groups were counted (a total of 8 inds). Since most of the leaves had fallen in these dry forests, it was possible to scan large areas to locate groups. The authors suggest that the high relative densities in the gallery forests indicate that *Propithecus tattersalli* prefers this microhabitat in the dry season.

The average group sizes for both *Propithecus* varieties were similar to each other and close to the mean group size for *P.d. edwardsi*. For

P.d. perrieri and *P. tattersalli*, group size ranged from three to six ($\bar{X}=4.5$, $n=10$; and $\bar{X}=4.1$, $n=8$, respectively). The stable group size range for *P.d. edwardsi* was 4-8 (P. Wright, pers. comm.).

The distributions of *P.d. perrieri* and *P. tattersalli* are presented in Figure 5.

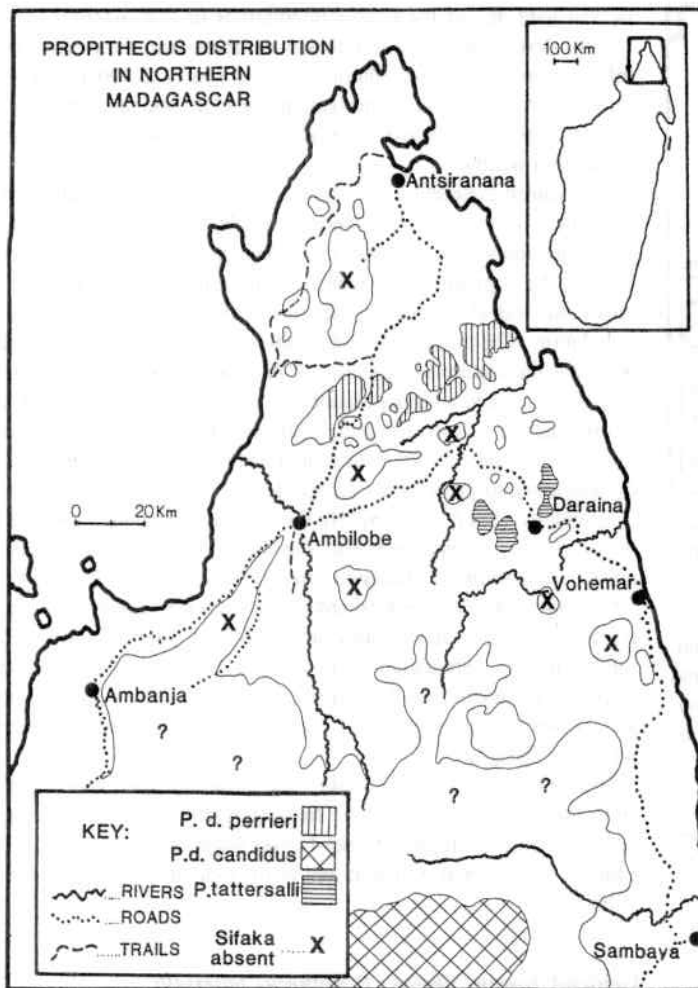


Fig. 5. *Propithecus* distribution in northern Madagascar (map by S.D. Nash from authors' original).

Binara

It is important to note that a forest was located in the region of Daraina which was markedly different from most forests in the region (Fig. 6). Many of the remaining forests near Daraina are primarily deciduous. The forest of Binara, located southwest of Daraina, resembles the evergreen humid forests of the Sambirano region of northwestern Madagascar. Binara, situated on a mountain that rises to over 1,100 m from surrounding lowlands at 100 m altitude, appears to trap moisture moving westward from the Indian Ocean. The forest is an island of year-round moisture, supporting the only dry season rice cultivation in the area, and most certainly containing an endemic floral and faunal assemblage.

Although the healthiest population of *Propithecus* in the area was located near the dry forests north of Daraina, preservation of Binara in association with these dry forests will insure protection of more diverse habitats. In this way, greater biological diversity and a potential refuge for *P. tattersalli* during climatic change will be accommodated. At present, the forest is protected only by its remote location. With the projected completion of the roadway, R.N.5a, Binara will be rapidly logged and destroyed unless protective measures are taken immediately.

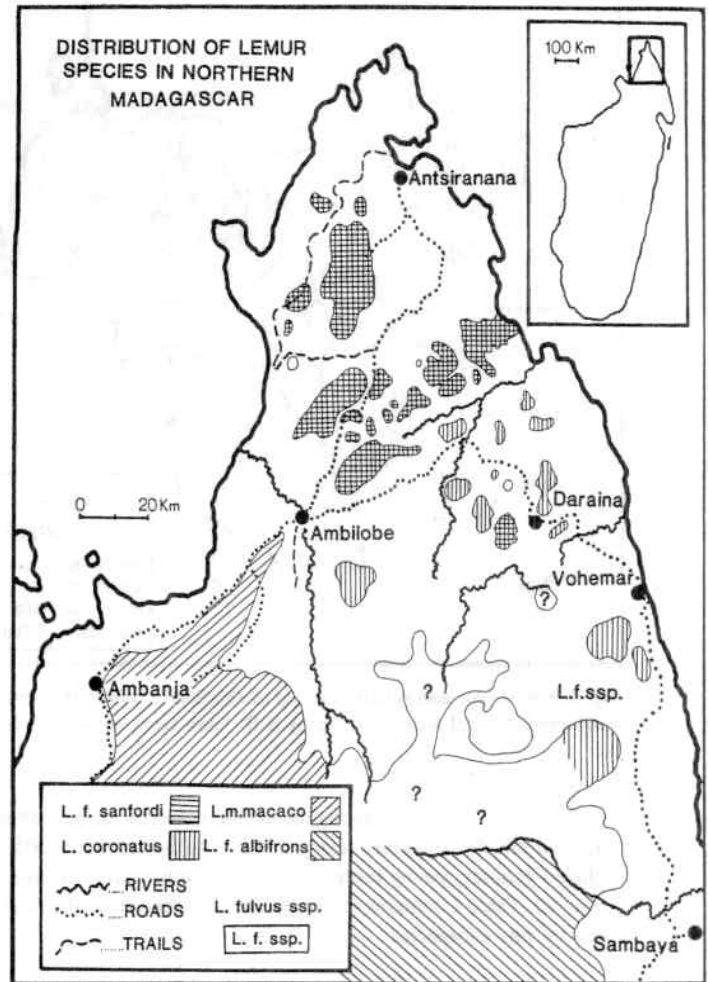


Fig. 6. Distribution of *Lemur* species in northern Madagascar (map by S.D. Nash from authors' original).

Species in the genus *Lemur*

Information was gathered on other lemur species throughout the region, and results are presented in Figure 6. Both *L. fulvus sanfordi* and *L. coronatus* are wide-spread and abundant in most of the forests throughout northern Madagascar. Conservation measures protecting watersheds and general biological diversity would also protect these species. At present, special attention is not required.

Lepilemur septentrionalis (Rumpler and Albignac, 1975) has been suggested to be the most endangered species in its genus (St. Catherine's Island Conference: Lemur Conservation). Observations made during this study and in 1987 by D.M.M. suggested that this species has a patchy distribution throughout the region. They may reach high densities (up to 60/km² at the Bobakindro study area) in the drier forests including Analamera and Analamahinty, southeast of Anivorano-Nord. Petter *et al.* (1977) have shown high variation in chromosome numbers within this species, which may be due in part to the patchy distribution of *L. septentrionalis*.

Conservation Concerns

There are several ways in which human activities threaten the survival of the geographically-limited populations of *Propithecus* in northern Madagascar. Obvious threats are hunting, brush fires, and competition for land.

Most people in the regions in which these animals are located consider the eating of sifaka *fady* (taboo). Unfortunately, the immigration of people without these beliefs has been increasing the potential for a rapid decrease in the populations of one or both types of sifaka.

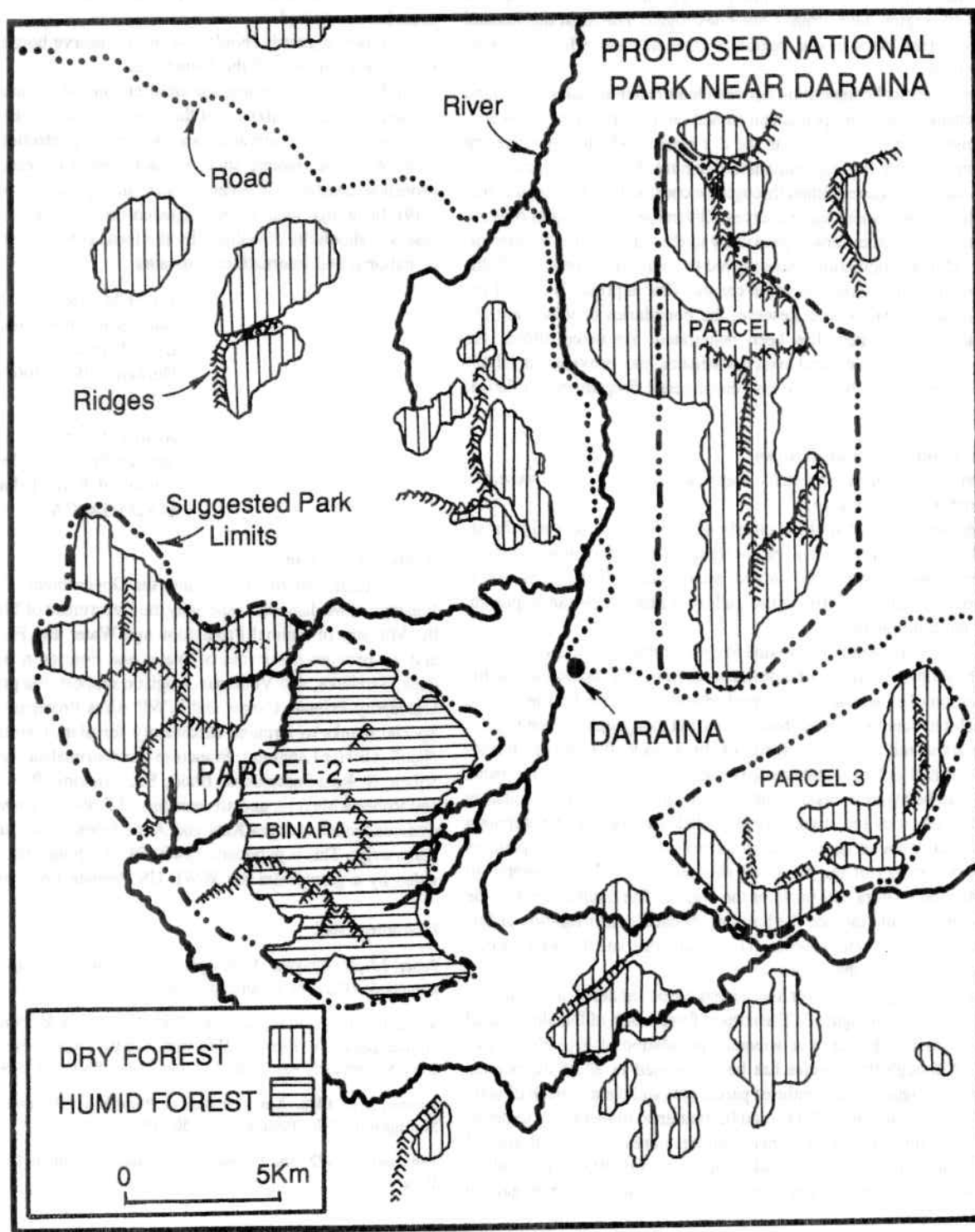


Fig. 7. A proposed national park near Daraina (map by S.D. Nash from authors' original).

In the region of Analamera, a guide explained that lemurs have been hunted and sold to people who came from other regions, but now live in Antsiranana. Although it was *fady* to eat lemurs, hunting them was not always considered wrong. The *fady* against eating lemurs has practically disappeared in the western part of the range of *P.d. perrieri*. In this area, hunting may have resulted in the low population numbers of *P.d. perrieri*. Within the Analamera Special Reserve, the use of guns has been limited to hunting birds and wild hogs.

At Daraina, the situation was slightly different. As in Analamera, the consumption of lemurs was *fady*. However, gold exploitation and the location of Daraina on the only east/west road in the region has resulted

in the presence of many outsiders with different beliefs. Hunting by people from Ambilobe has apparently eliminated the northwestern populations of the golden-crowned sifaka in the region of Maromakotra (Fig. 4). The gold exploiters have limited their hunting to the smaller lemurs, but with the increasing influx of new miners, this self-restraint could diminish. Completion of the improvements planned for the road between Ambilobe and Vohemar (RN 5a) will amplify these present dangers.

Annual human-ignited brush fires maintain deforested areas throughout northern Madagascar. Apparently, the high ground in the southeastern part of Analamera was recently destroyed by fire. During the survey, an area of forest in the reserve contained signs of recent fire, yet re-

maintained fairly intact. It is likely that the drier and thus more vulnerable parts of the region have already been destroyed. The most detrimental aspect of brush fires in this region is their adverse effect on forest regeneration.

The most critical competition between lemurs and humans is for land near permanent and semi-permanent streams and rivers. These areas contain moisture for plant growth in the dry season, which may represent a limiting resource for both humans and lemurs. Furthermore, rice production has been accomplished through the construction and use of small canals fed by permanent water sources. Given the large amount of work necessary to construct canals, proximity to the water source is very important. Human populations have moved to areas where new rice fields could be planted without extensive canals. This is probably one of the reasons that the Analamera Reserve, the boundaries of which are not well-known or marked, has been penetrated. As noted above, the microhabitats near rivers and even dry streams may provide crucial dry season resources for both rare and endangered *Propithecus* varieties.

Conservation Recommendations

Recommended management for these two sifakas will be presented in the order of importance.

The golden-crowned sifaka is clearly one of the most severely threatened Malagasy primates. They are not represented in any protected forest and they have an extremely limited geographical distribution. Their preferred dry-season microhabitat, gallery forest, is also an important human agricultural resource.

A national park should be created to protect this species from extinction. The multiple benefits of a protected area in this region include the preservation of an endangered watershed and protection for the diverse microhabitats scattered throughout the varied topography of the region.

The park should include the forest of Binara as well as the dry forests with associated gallery forests directly north of Daraina (Fig. 7). Special care should be taken to insure that enough gallery forest is included in the park boundaries and effectively protected. Appropriate development of ecologically-sound agricultural practices and other land-use patterns in the environment of the proposed national park will be essential to the protection of flora and fauna of the region. The management of the park borders should include the building of canals for irrigation at farther distances from water sources. This would alleviate the need for cutting the forests near the rivers.

Preliminary suggestions for the forests to be included in a national park are presented in Figure 7. The strip of forest north of Daraina (Parcel #1) is too small to preserve an adequate population of *Propithecus tattersalli*. Although this species has been reported in all of the parcels presented on Figure 5, the southeast parcel (#3) and the mountain directly west of Daraina (in Parcel #2) should be examined immediately to determine the abundance of *P. tattersalli* in these areas. The total area of the suggested national park is small (approximately 20,000 ha) and includes substantial areas of grassland surrounding the important gallery forests.

Additional surveys are necessary to assess the conservation value of other surrounding forests.

The similarities between *P. tattersalli* and *P.d. perrieri* in terms of their environment and the extent of knowledge on their conservation biology allow us to suggest several general recommendations for conservation-oriented projects:

- (1) Intensive floral and faunal inventories should be conducted to investigate the biological diversity within each reserve or park.
- (2) For both *Propithecus* varieties, blood should be collected for the examination of genetic variation in the reserve populations.
- (3) Studies should be conducted addressing the feasibility of captive breeding programs.
- (4) An ecological study of at least one year is needed for each variety to examine further the resource needs of these animals.

(5) Reserve boundaries should be clearly marked with fire breaks and must be maintained.

(6) Reserve guards should live at the reserve border to insure continuous surveillance of the boundaries.

(7) Education programs for children and adults must be developed to increase local awareness of the economic and environmental importance of nature conservation and watershed protection.

(8) A socioeconomic study of each region is needed to insure appropriate assistance is given to surrounding human populations.

(9) Integrated land-use management in the regions surrounding the reserves should be developed by the local governments, with the help of national and international advisors.

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APPENDIX

The IUCN/SSC Primate Specialist Group New Members

This member has been added to the group since the appearance of the last issue of *Primate Conservation*.

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Struhsaker, T.T. 1972. Rain-forest conservation in Africa. *Primates* 13:103-9.

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Goodall, A.G. and C.P. Groves. 1977. The conservation of eastern gorillas. In: *Primate Conservation*, Prince Rainier of Monaco and G.H. Bourne, eds. Academic Press, New York, pp. 599-637.

Example book:

Hershkovitz, P. 1977. *Living New World Monkeys (Platyrrhini)*. Vol. 1. Univ. of Chicago Press, Chicago.

Example dissertation:

Homewood, K.M. 1976. Ecology and behavior of the Tana Mangabey (*Cercocebus galeritus galeritus*). Unpubl. Ph.D. thesis, Univ. of London, London.

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Announcements should be a page or less in length, articles for the 'News from the Field/Captivity' section should be 2-5 pages in length, and articles for the journal section may range from 5-20 pages. In exceptional cases, we will consider publishing longer articles of great interest to primate conservation.

Maps

Please refer to maps in this issue as a guide to style. Maps should always be made as concise as possible and should include an inset showing the location of the area discussed in relation to its home country or continent. If you want us to produce the map for your article, please provide adequate reference material (*i.e.*, rough sketches and photocopies of published maps).

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Back cover. Male Japanese macaque from Yakushima Island (*Macaca fuscata yakui*) in southern Japan. This subspecies is restricted to Yakushima, and there is some indication that it may be a distinct species (photo by Russell A. Mittermeier).

