

# PRIMATE CONSERVATION

The Newsletter and Journal of  
the IUCN/SSC Primate Specialist Group  
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State University of New York at Stony Brook.





Leontopithecus chrysopygus

**Front Cover:** Male black or golden-rumped lion tamarin (*Leontopithecus chrysopygus*) from the founding captive colony established at Tijuca, Rio de Janeiro, Brazil in 1973 (photo by Ademar F. Coimbra-Filho) (see article on page 19).

# A Word from the Editors

We would like to take this opportunity to thank all of you for your very positive response to our new title, *Primate Conservation*, and to the expanded newsletter/journal format. As soon as *Primate Conservation* appeared under its new title, subscriptions increased dramatically, and we hope that this is both an indication of improved quality of the publication and a growing interest in primate conservation in general.

Since so much of the newsletter/journal now consists of longer articles, we feel that it is necessary to establish an Editorial Board to ensure that a high level of quality is maintained. We are now in the process of establishing this board, and if any of you are interested in participating, please let us know. We would like to keep the board fairly small (10-15 members), but very active, which means that each of the members would be very much involved in reviewing and editing contributions as they are received.

As you can see from the Appendix, the PSG continues to grow, with 10 new members having been added in the last six months. An increase in size brings with it an increased need for coordination and communication, so we also have plans to create a Steering Committee to assist in management of the group. The members of this new Steering Committee will be announced in the next issue, to appear in January, 1986.

As always, we hope that you will continue to send us your contributions. Articles for the journal section should be in the 3-20 double-spaced typed page range, while announcements from the field/captivity section should be 1-3 pages in length. In exceptional cases, we will consider publishing longer articles of great interest to primate conservation. Please try to illustrate your contributions with photographs and maps, since these add a lot to the publication as a whole. Also, we continue to need high quality photographs for our front and back covers, preferably of little-known primate species that have rarely or never been illustrated before. In exceptional cases, we can also publish color illustrations if they add a great deal to the contribution in question, so please let us see what you have available.

Finally, please let us know if there is anything else that you would like to have us include in *Primate Conservation* to improve its value to our field as a whole.

Thank you very much and looking forward to hearing from you.

Russell A. Mittermeier  
Editor, *Primate Conservation*

William R. Konstant  
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# ANNOUNCEMENTS

## WWF-U.S. Launches a Million Dollar Global Primate Conservation Campaign for 1985-1989

WWF-U.S. has started a five-year, one million dollar Global Primate Conservation Campaign to raise funds for endangered primates around the world. The campaign was launched on May 13, 1985 at the National Press Club in Washington, D.C., with presentations by WWF-U.S. President Russell E. Train, Dr. Jane Goodall, who is serving as Honorary Chairperson of the campaign, and PSG Chairman Russ Mittermeier, who will direct the campaign. The campaign will raise funds for a wide variety of primate conservation projects, but special attention will be given to the highly endangered lemur fauna of Madagascar, to great apes, and to the most endangered Neotropical primates (Fig. 1). Contributions for this campaign can be sent to the World Wildlife Fund — U.S. office in Washington, D.C., earmarked for the species or region that concerns you most:

World Wildlife Fund — U.S.  
1255 23rd Street, NW  
Washington, D.C. 20037

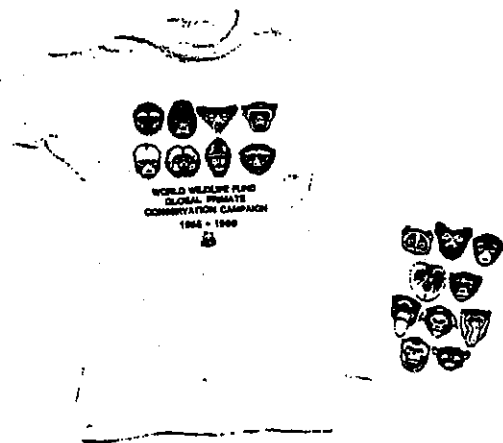


Fig. 1: Global Primate Conservation Campaign t-shirt, depicting many of the endangered primate species on which the campaign will focus (design by Stephen Nash).

## XIth Congress of the International Primatological Society to be Held in Göttingen, West Germany

The XIth Congress of the IPS will be held from July 20-25, 1986 at the Central Lecture Halls (ZHG) of the University of Göttingen, West Germany. Thus far, symposia and plenary sessions are planned on genetics, comparative anatomy, sociobiology, ecology and conservation, and the Program Committee welcomes further suggestions. The Congress will be held in English, and it is being organized by Dr. Hans-Jürg Kuhn. For further information, write to:

XIth Congress of the  
International Primatological Society  
German Primate Centre (DPZ)  
Kellnerweg 4  
D-3400 Göttingen  
West Germany

## Three Conferences to Focus on Conservation Priorities in Madagascar

The island of Madagascar and its unique lemur fauna may well be the highest-major-primate/forest-conservation-priority on earth. Three conferences to be held in Antananarivo in October-November, 1985 will focus on the problems of conservation in Madagascar, and will attempt to develop solutions for them. The first conference will be a scientific seminar on research in Madagascan forest ecosystems, and will take place from October 28-30. It is being organized by Mme. Rakotovo Lala of the Direction d'Appui aux Recherches sur les Sciences de l'Environnement of the Ministère de la Recherche Scientifique et Technologique pour le Développement. As part of this meeting, there will also be an SSC Workshop on Species Conservation Priorities in Madagascar, to begin on the afternoon of October 30 and to continue until the afternoon of October 31. The workshop is being organized by Russ Mittermeier and Alison Richard, and its purpose will be to identify the highest species and protected area conservation priorities and to prepare a list of recommendations and an Action Plan to ensure their survival. The third meeting, to be held from November 4-12, has as its goal the development of a National Conservation Strategy for Madagascar (Conference Internationale sur la Conservation des Ressources Vivantes au Service d'un Développement Durable à Madagascar). IUCN and WWF-International have worked with a number of Madagascan ministries to develop this conference, in which both the President of Madagascar and H. R. H. the Prince Philip, President of WWF-International, will participate. A report on the results of these meetings will be provided in the next issue of *Primate Conservation*.

## Conference on "Primates: The Road to Self-Sustaining Populations" Held in San Diego

A major conference entitled "Primates: The Road to Self-Sustaining Populations" was held in San Diego from June 24-28, 1985 (Fig. 2). Organized by Dr. Kurt Benirschke of the Zoological Society of San Diego, and sponsored by the Zoological Society and the Morris Animal



Fig. 2: "Primates of the World" poster, produced jointly by WWF-US and the Zoological Society of San Diego, was used for fund-raising during the conference and is still available from both institutions (original painting by Stephen Nash.)

Foundation, the conference included sessions on the status of primates in their natural habitats, the genetics of captive breeding, artificial reproduction, virus diseases, veterinary concerns, housing and furniture, behavioral requirements necessary for the creation of self-sustaining populations, primate models for new reproductive technologies, causes of mortality, and strategies for the conservation of the extremely endangered. The final day included a discussion of major direction and a plenary round table on "Who Will Pilot the Ark. Monetary Resources and other Topics".

One of the clearest messages to emerge from the conference was the need for greater interfacing between experts on wild primates and zoo and laboratory researchers trying to save endangered species in captivity. Special attention was paid to the need for zoos to become more involved in the conservation of wild populations of the species they are working with in the captive setting. Such involvement would be sure to result in an international cross-fertilization that would be of benefit to all concerned, and particularly the primate species that everyone wants to save from extinction.

This important meeting is sure to emerge as a landmark in primate conservation, and the PSG would like to take this opportunity to commend the Zoological Society of San Diego (and especially Dr. Benirschke) and the Morris Animal Foundation for having organized the meeting.

The proceedings of the meeting are being published by Springer Verlag and should be available in the latter part of 1986.

Since many PSG members were in attendance, a meeting of our group was held during the course of the conference. John F. Oates and Ardith Eudey, coordinators of the African and Asian sections of the PSG, discussed progress on the Action Plans for their regions and the rating systems used to determine priorities in primate conservation. The meeting also recommended the establishment of a Steering Committee for the PSG, which has grown to almost 150 members, and also an Editorial Board for *Primate Conservation*. Membership on the Steering Committee and the Editorial Board will be announced in the next issue of *Primate Conservation*.

## Brazilian Primatological Society Holds its Second Congress and Issues its First Bulletin

The Brazilian Primatological Society held its Second Congress in Campinas from Jan. 27-Feb. 1, 1985. Some 60 papers were presented by Brazilian and foreign researchers, and new officers for the Society were elected. The new President is PSG member, Dr. Celio Valle of the Universidade Federal de Minas Gerais, the Vice-President is Dr. Alcides Pissinatti of the Rio de Janeiro Primate Center, the General Secretary and Treasurer are Maria Cristina Alves and Ilmar Bastos Santos, both of the Universidade Federal de Minas Gerais, the Vice-Secretary is Cecilia Torres of the Universidade de São Paulo, and the Vice-Treasurer, Carmen Alonzo of the Universidade Federal da Paraíba. The Society also produced its first published bulletin and announced the creation of a new prize for excellence in primate conservation in Brazil. This prize will be named the *Premio Aguirre* in honor of Dr. Alvaro Coutinho Aguirre, whose pioneering work on the conservation status of the marmoset (*Brachyteles arachnoides*) has become a classic of Brazilian primatology.

## Second Brazilian Training Course on Primatology

The Second Brazilian Training Course on Primatology was held from Dec. 10, 1984 to March 8, 1985 in Brazil. The course was organized by the University of Brasilia in cooperation with the Brazilian Society of Primatology, under the coordination of Society President Professor Milton Thiago de Mello. Seven graduate students completed the course, including three veterinarians, two biologists, a psychologist and an

anthropologist.

Classes were held both in Brasilia (University of Brasilia) and in Belém (Museu Paraense Emílio Goeldi, National Primate Center and University of Pará), and included lectures on phylogenetics, systematics and biogeography. Foreign lecturers in the course included David Abbott (Institute of Zoology, Zoological Society of London, U.K.), Neil Chalmers (The Open University, U.K.), B. A. Lapin (Institute of Experimental Pathology and Therapy, Sukhumi, USSR) and James Dietz (Smithsonian Institution/Golden Lion Tamarin Reintroduction Project/IBDF, Rio de Janeiro, Brazil). Brazilian lecturers included Fernando Dias de Ávila Pires (University of Rio Grande do Sul), and Iris Ferrari and Celia Koiffmann (University of São Paulo). Between the two phases of the course, students also had the opportunity to attend the Second Brazilian Primatology Congress held in Campinas from Jan. 27-Feb. 1, 1985.

The Third Specialization Course on Primatology, Conservation and Management, is scheduled for July 29-September 28, 1985. Information on future courses can be obtained by writing:

Dr. Milton Thiago de Mello  
Departamento de Biologia Celular  
Instituto de Ciências Biológicas  
Universidade de Brasília  
70.910 Brasília DF  
Brasil

## Argentine Primate Specialist Group (GADEP) Established

The organization of the Centro Argentina de Primates — CAPRIM — (Argentine Primate Center) in 1973 stimulated primatological research in Argentina (biology, ecology, behavior, pathology). Subsequent work resulted in many valuable contributions to conservation: including an updating of the situation of wild populations of *Cebus apella* in north-west Argentina and of *Aotus azarae* in the provinces of Chaco and Formosa, in addition to implementation of different methods for censusing wild monkeys. CAPRIM also made possible the development of experimental models in monkeys for the study and prevention of the Argentine hemorrhagic fever and Chagas disease, cardiovascular and traumatological surgery, child malnutrition and odontological pathologies. Breeding colonies of *Saimiri boliviensis*, *Callithrix jacchus* and *Cebus apella* were established, and parameters of reproduction, behavior, growth and maturation in these captive populations were developed. Moreover, technical and scientific personnel were trained and a useful infrastructure for research and conservation within the country was created.

In 1985, financial and administrative problems made it impossible to continue these studies, so the working group, developed during the last 12 years, decided to create the Grupo Argentino de Especialistas en Primates (Argentine Primate Specialist Group) with the main objective of following studies in the biology, ecology and conservation of neotropical primates as an advisory committee for the rational use of monkeys in biomedical research. GADEP is presently composed of the following members:

Lic. Alejandro Brown — Ecology  
Dr. Orestes J. Colillas  
— Medicine and Reproduction  
Lic. Silvia Chalukian — Ecology  
Lic. Carlos Galliari — Anthropology  
Dra. Marta M. de Pargament  
— Cytogenetics  
Dr. Julio C. Ruiz — Behavior  
Lic. Damián I. Rumiz — Ecology  
Dr. Bruno L. Travi  
— Infectious Disease  
Lic. Gabriel Zunino — Ecology



GADEP also produces the Boletín Primatológico Argentino, of which two issues have already appeared. Anyone interested in subscribing to this publication should write to the editor at the address below.

Lic. Alejandro Diego Brown  
Editor of the Boletín  
Serrano 661  
1414 Buenos Aires  
Argentina

## Primate Proposals at the CITES Meeting in Buenos Aires, Argentina

In the last issue of *Primate Conservation*, we announced that several primate proposals were up for consideration at the 5th Meeting of the Conferences of the Parties to the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), held in Buenos Aires, Argentina from April 22 to May 3, 1985. The proposals dealt with the mantled howler monkey (*Alouatta palliata* — Appendix I to Appendix II), the slender loris (*Loris tardigradus* — Appendix II to Appendix I), the gray or hanuman langur (*Presbytis entellus* — Appendix I to Appendix II), the dusky langur (*Presbytis phayrei* — Appendix II to Appendix I), and the snub-nosed monkeys (*Pygathrix* spp. or *Rhinopithecus* spp. — Appendix II to Appendix I). The proposal for the snub-nosed monkeys presented by the People's Republic of China was approved, but all the other primate proposals were withdrawn, meaning that all of the species under consideration retain the status that they had prior to the meeting.

## Campaign for the Buff-Headed Tufted Capuchin

*Cebus apella xanthosternos* (Fig. 3) is a distinct and attractive subspecies of the tufted capuchin and has always been restricted in its distribution to the southern tip of the state of Bahia, Brazil, between the Rio Jequitinhonha and the Rio de Contas. Thus it is largely sympatric with the golden-headed lion tamarin (*Leontopithecus chrysomelas*) whose plight is well known. Only recently, Ademar F. Coimbra-Filho and R. A. Mittermeier have drawn attention to the fact that *Cebus apella xanthosternos* is highly endangered as well.

While little data is available concerning the capuchin's numbers, it suffers not only from all the threats affecting the tamarin, but because of its fairly large size it is also hunted for food by the local human population. In late 1983 and 1984, conservationists all over the world were alarmed by the international trade in live *L. chrysomelas*. One could have suspected that other species from the same general area were also taken illegally from Brazil, and indeed in 1984 we received notice of two *C. a. xanthosternos* which were for sale by an animal dealer in Cayenne, French Guiana. The dealer did not know what he had, apart from that it was something very rare. Unfortunately, all efforts to secure the two capuchins failed.

All in all, there can be little doubt that *C. a. xanthosternos* is very much at risk of becoming extinct. Being aware of this, Ademar F. Coimbra-Filho in Rio de Janeiro and Ilmar Bastos Santos in Belo Horizonte have started a captive breeding program for the subspecies. The breeding project is still small scale, but already bore fruit in 1984 when the first *C. a. xanthosternos* was born at the Rio de Janeiro Primate Center.

Building additional breeding enclosures is not very expensive in Brazil but, due to economic difficulties in the country, money for such projects has to come, at least in part, from outside sources. Therefore, the Zoological Society for the Conservation of Species and Populations, Munich, stimulated by Russ Mittermeier, has initiated a fund-raising



Fig. 3: Young male *Cebus apella xanthosternos*, a pet confiscated in southern Bahia and sent to the colony at the Rio Primate Center (photo by R. A. Mittermeier).

campaign in Germany on behalf of the *C. a. xanthosternos* captive breeding project.

In contrast to most other countries in the tropics, Brazil is fortunate in that it already has conservation-oriented breeding programs for endangered primates. Enlargement of the existing projects and new ones for other species and subspecies are planned. Since a moderate amount of money can make an important contribution to any of these projects, we hope that our *C. a. xanthosternos* campaign will stimulate other smaller conservation groups, as well as zoos and universities, to initiate their own fund-raising campaigns for one or more of the many other endangered Brazilian primates.

Zoos, in particular, should become more interested in this sort of international cooperation, since in the long term they can clearly benefit from it. Once the captive population of any primate species in Brazil has stabilized and reached a certain level, the breeding program can be extended to other institutions. Thus, supporting institutions have a good chance of becoming directly involved in an extended breeding project for some of the Brazilian primate species. Apart from the fact that this is the only way that any endangered primate should leave Brazil, this is an important argument for zoos with a city administration, which may not understand why the zoo should invest money outside the zoo grounds.

Roland Wirth  
Franz-Senn-Str. 14  
8000 München 70  
West Germany

## Primate Conservation Campaign at Free University of Berlin

With 50,000 students, the Free University of Berlin is among the largest of German universities. In April 1984, five volunteers from its Section of Human Biology began a Primate Conservation Campaign (Primatenschutz-Aktion) on campus, developing contacts with local radio stations, newspapers and the zoological garden.

From late August to October 1984 the campaign engaged its first fund-raising activities. Following the example of similar campaigns held at universities in the U.S., volunteers sent over 1,000 letters to influential members of the community and to private industries seeking support. Unfortunately, this effort did not result in any major contributions to the campaign and netted perhaps only 20% more than the cost for stationery and postage.

In October, news of the campaign was broadcast by the largest radio station in West Berlin and several of the major newspapers ran articles which informed the public of the critical situation facing primates and their tropical forest habitats. The German Press Agency (DPA) also distributed these messages. In each case, donations were requested in care of WWF-Germany.

The campaign volunteers, who grew in number from five to 25 during its course, manned information stands on weekends in front of the larger department stores, selling balloons and t-shirts with the campaign logo on them. Two lectures held on Oct. 18th featured showings of the film "Cry of the Muriqui" by Andrew Young. Information stands, which were part of local Christmas fairs, brought volunteers out in the freezing temperatures to sell hot spiced wine and German raspberry brandy (Himbeergeist). In all, the campaign collected about \$4,200 in sales and donations, approximately half which must be shared between WWF-International and the Conservation Program of the International Primatological Society.

In addition to the fund-raising activities, we were also able to conduct several public information exhibitions. From May 30-July 18, 1985, the "Primates in the Tropical Rainforest" exhibition from the Primate Breeding and Conservation Conference held at Bielefeld University was displayed at the Free University of Berlin. Coverage of the event appeared in the May issue of *FU-info* and the Berlin Zoo assisted by distributing our press invitation to their membership. For two weeks the exhibition was held at Urania, an adult education institution. It's estimated that perhaps 20,000 people were able to view it there. Following its relocation to one of the major town halls, it was visited by many of the local school classes.

The success of the exhibition was made possible not only through the help given by the volunteers, but also by the press we received in several Berlin newspapers and a 15-minute broadcast by Radio Free Berlin in their Saturday morning scientific magazine. Schering AG (a producer of human hormones and contraceptives) helped us to finance transportation of the exhibit from Munich to Berlin.

Plans are already being made by the Educational Service of Museums to display the "Primates in the Tropical Rainforest" exhibit at the Zoological Gardens of West Berlin. We hope that these activities will continue to be popular, inform people of the precarious situation facing the world's tropical forest species, and help to raise funds which can be applied to the projects and programs necessary to conserve them.

Carsten Niemitz  
Section of Human Biology  
Free University of Berlin  
FB 23, WE1  
Fabeckstrasse 15  
1000 Berlin 33  
West Germany

## Captive Breeding of Roloway Guenons (*Cercopithecus diana roloway*)

While there exist good, internationally coordinated breeding programs for some primate species, guenons have been traditionally neglected in this context. On the other hand, guenons have always been favorable zoo exhibits and many different species and subspecies of this diverse and colorful group of monkeys are still represented in zoo collections around the world. Taking a closer look, one realizes that only few forms are fairly well established in captivity. Some guenons are becoming increasingly rare and endangered in the wild and efforts have to be undertaken to locate the often isolated individuals of a given species or subspecies in captivity and to unite them in breeding groups.

This is a request for information on captive Roloway guenons (*Cercopithecus diana roloway*). This subspecies is endangered in the wild and we know of only a few Roloway guenons in captivity. Wassenaar Zoo, in the Netherlands, had the most successful breeding group of the subspecies, which originated from a single pair. The pair has produced several female and one male offspring. The young male is now breeding with unrelated females in the Parc Zoologique des Minieres, Doue la Fontaine, France, but the Wassenaar group stopped breeding due to the death of the old male. Two additional males have been located so far, one in a small zoo in France and one in private hands in Munich, West Germany. The former has already been transferred to Wassenaar, but has shown no sexual activity. Attempts are being made to secure the Munich specimen for the breeding project.

Apart from the animals mentioned above, we know only of two individuals each at the Leipzig Zoo, German Democratic Republic, the Mulhouse Zoo, France, and the St. Louis Zoo, USA, a trio at the San Diego Zoo and a single female in a private collection in France. Unfortunately, another breeding group in a West German zoo has now been lost due to hybridization with the Diana guenon (*Cercopithecus diana diana*).

We ask all readers who know of any other Roloway guenons in captivity to contact either John Rens, Adjunct Director, Dierenpark Wassenaar, Rijkstraatweg 667, 2245 CB Wassenaar, Netherlands, or the author of this note.

Roland Wirth  
Franz-Senn-Str. 14  
8000 München 70  
West Germany

## Studbook to be Created for the Drill

The Hannover Zoo plans to establish an international studbook for the drill (*Mandrillus leucophaeus*). The drill is listed as an endangered species in the IUCN Red Data Book 1984 and the present level of hunting is almost certainly too high to be sustained without seriously affecting the drill's chances for survival.

In zoological collections around the world, a little more than 60 individuals can be identified, and of these 75% are not part of the breeding population. According to data published in *International Zoo Yearbook*, the situation has not changed positively since 1980. The Hannover Zoo maintains a group with four regularly producing females and is willing to become the international studbook keeper.

Since a large number of animals are being kept in pairs or as solitary individuals, and only a few institutions maintain reproducing family groups, the studbook should be established as soon as possible and should focus on the following:

- international coordination of drill collections
- intensified breeding activities through establishment of family units in zoos that provide adequate facilities
- monitoring and prevention of inbreeding
- collection of scientific data on this species
- suggestion of plans for protection and (if possible) reintroduction to the wild, if a self-sustaining captive population is established

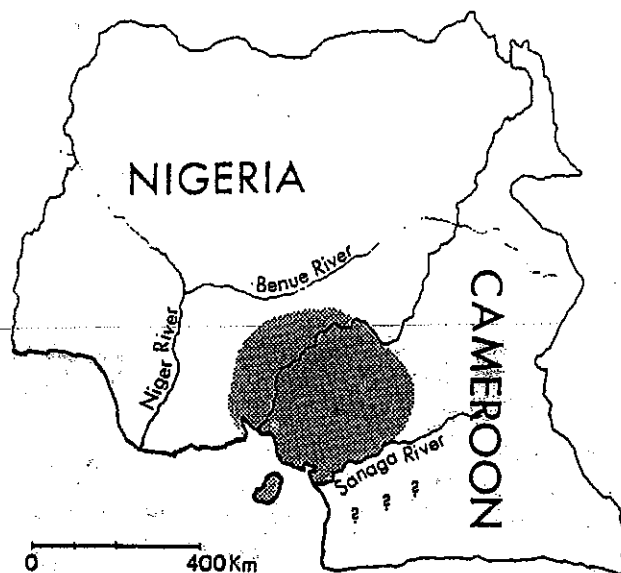


Fig. 4: The range of the drill (*Mandrillus leucophaeus*) in Nigeria and Cameroon, West Africa (map by Stephen Nash).

Russ Mittermeier (IUCN/SSC Primate Specialist Group) and Peter Olney (International Studbook Coordinator, Zoological Society of London) have already announced their support of this project. All field and zoo primatologists interested in this project or having information on the status of the drill in the field (Fig. 4) are invited to contact the Hannover Zoo.

Dr. Michael Böer  
Scientific Assistant  
Zoo Hannover  
Adenauerallee 3  
D-3000 Hannover 1  
Federal Republic of Germany

## Book on the International Primate Trade Published by WWF, TRAFFIC (USA) and the PSG

A new book on the primate trade, entitled *The International Primate Trade, Vol. 1, Legislation, Trade and Captive Breeding*, has been published by WWF-US, TRAFFIC (U.S.A.) and the IUCN/SSC Primate Specialist Group (Fig. 5). Edited by David Mack and Russ Mittermeier (with editorial assistance from Bill Konstant and Stephen Nash), this 185 page book provides the first major comprehensive treatment of the primate trade and includes the following chapters:

1. Introduction, by David Mack and Russell A. Mittermeier
2. A synopsis of legislation and the primate trade in habitat and user countries, by Michael Kavanagh and Elizabeth Bennett
3. A review of the international primate trade, by Michael Kavanagh
4. A review of the U.S. primate trade, by David Mack and Ardith Eudey
5. Use of primates and captive breeding programs outside the United States, by Julian Oliver Caldecott and Michael Kavanagh
6. Use of primates and captive breeding programs in the United States, by Ardith Eudey and David Mack
7. Summary, update and conclusions, by David Mack and Russell A. Mittermeier

# THE INTERNATIONAL PRIMATE TRADE

Volume 1



Edited by David Mack and Russell A. Mittermeier

TRAFFIC(USA) WWF

Fig. 5: Volume 1 of *The International Primate Trade*.

This book is available for \$20.00, and can be obtained by writing to either of the following addresses:

TRAFFIC (U.S.A.)  
1255 23rd Street, NW  
Washington, D.C. 20037  
U.S.A.

Dr. R. A. Mittermeier  
Dept. of Anatomical Sciences  
Health Sciences Center  
State University of New York  
Stony Brook, New York 11794

Please make checks payable to World Wildlife Fund.

A second volume on the status of primates used in research is expected some time in 1986.

## Two New Books by PSG Members

Two new books by PSG members have appeared during the past year. One, entitled *The Lesser Apes: Evolutionary and Behavioural Biology* (Fig. 6), was edited by H. Preuschoft, N. Creel, and PSG members D. J. Chivers and W. Brockelman. It is a massive, 800 page treatment of gibbons, and is sure to be considered a classic. It can be obtained from the Edinburgh University Press for £65.

The second book, entitled *The Ecology of Sumatra* (Fig. 7), was edited by PSG member A. J. Whitten, S. J. Damanik, Jazanul Anwar and Nasaruddin Hisyam. It deals with various aspects of the ecology of this Indonesian island, so important for primates, and includes a color map of the four species and 21 subspecies of leaf monkey found on Sumatra.



Fig. 6: *The Lesser Apes: Evolutionary and Behavioural Biology*, a new text on gibbons.

This book is published by Gadjah Mada University Press, Yogyakarta, Indonesia, and is distributed in North America by Ohio State University Press, Athens, Ohio, in Europe by E. J. Brill in Leiden, the Netherlands, in Japan by Horaka Books, Chiyoda-ku, Tokyo, in Malaysia and Singapore by Select Books (Singapore) and in Australia by Spectrum Books, Croydon, Victoria. The English version costs \$20 and the Indonesian version \$12.50.

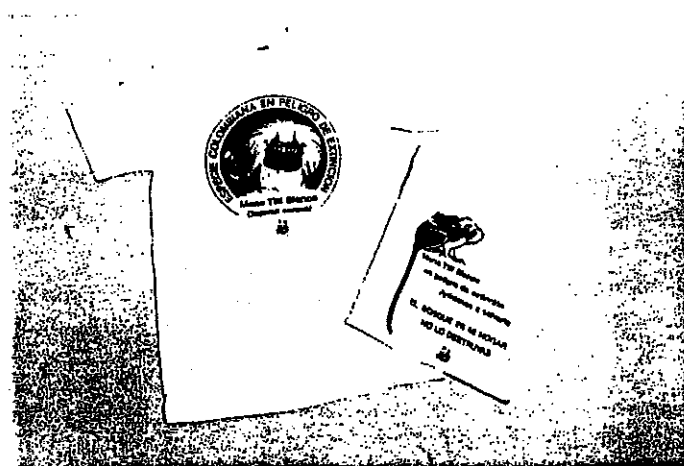


Fig. 8: Cotton-top tamarin t-shirt. Spanish text on the front reads: "Colombian species in danger of extinction. Cotton-top tamarin." Text on the back reads: "Cotton-top tamarin in danger of extinction. Help us save it. The forest is my home. Don't destroy it." (design by Stephen Nash).



Anthony J. Whitten  
Sengul J. Damanik  
Jazanul Anwar  
Nazaruddin Hlsyam

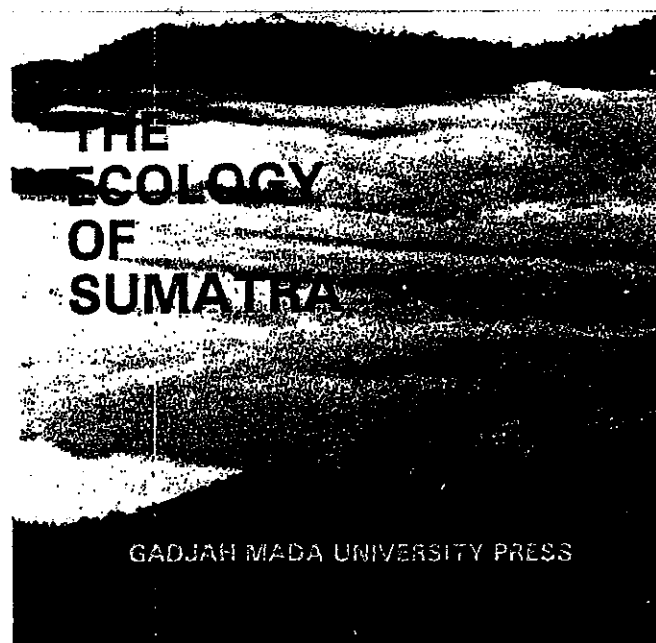


Fig. 7: *The Ecology of Sumatra*, a new book which contains important information on the island's leaf-monkeys (*Presbytis* spp.).

## New Primate T-Shirts and Poster Available from the WWF-U.S. Primate Program

Several new primate educational materials have been produced by the WWF-U.S. Primate Program over the past year, including t-shirts depicting the critically endangered cotton-top tamarin (*Saguinus oedipus*) of Colombia (Fig. 8) and the howler monkeys (*Alouatta* spp.) and spider monkeys (*Ateles geoffroyi*) of Belize (Fig. 9), and a poster depicting representative primates of the world (Fig. 2). Artwork for all the materials was done by Stephen Nash.

The cotton-top tamarin t-shirt will be used along with other educational and public awareness materials to draw attention to this animal's plight - its habitat is being threatened by construction of two hydroelectric projects in northwestern Colombia (see article by Ramirez in News From the Field section). The t-shirt comes only in beige. The "Monkeys of Belize" t-shirt is being used to help establish support for the Belize Zoological Society and its newly proposed zoological park. The zoo will exhibit and breed native wildlife, and has plans for colonies of both howler and spider monkeys. The Belize t-shirt comes in red, light blue and yellow. All t-shirts cost \$10.

The "Primates of the World" poster was reproduced from an original painting done by Stephen Nash, which is exhibited at University College, London. The cost of the poster is \$5.

An order form for all Primate Program t-shirts, posters and note cards can be found on page 87.

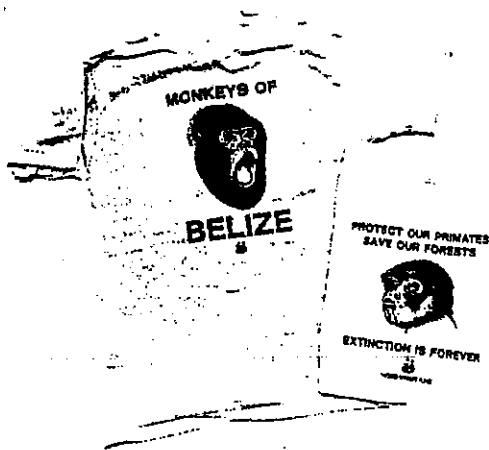


Fig. 9: "Monkeys of Belize" t-shirt, depicting a howler monkey (*Alouatta* spp.) on the front and a spider monkey (*Ateles geoffroyi* spp.) on the back. (design by Stephen Nash).

## Primate Films Produced by WWF-U.S. Primate Program now for Sale

Since 1982, the WWF-U.S. Primate Program has produced three films on Neotropical primates and their habitats, all of them by Andrew Young. The first of these, entitled "Cry of the Muriqui", deals with the muriqui (*Brachyteles arachnoides*), the golden lion tamarin (*Leontopithecus rosalia*), and their endangered Atlantic forest habitat in southeastern Brazil. It is 28 minutes in length and available in English and in Portuguese. The other two films were made in Peru. "Monkey of the Clouds" is on the Peruvian yellow-tailed woolly monkey (*Lagothrix flavicauda*) and its Andean cloud forest habitat, and covers the rediscovery of the species and current conservation efforts on its behalf. It is 18 minutes in length and is available in both English and Spanish. "Amazonia: A Celebration of Life" is on the diversity of the lowland Amazon rain forest in Peru, particularly Manu National Park and the Pacaya-Samiria Nature Reserve. Although it includes a lot of primate footage, it also discusses many other species in the region and is a good general statement on biological diversity. It is 20 minutes in length and is available in English only.

"Cry of the Muriqui" is available for \$400, and the other two can be purchased for \$350 each. For further information, please write to Stephen Nash at the Stony Brook address given below:

Dept. of Anatomical Sciences  
Health Sciences Center  
State University of New York  
Stony Brook, New York 11794  
U.S.A.

## New Primate Stamps

Several new primate stamps have been issued during the past year by the governments of Bhutan, Togo and Zambia. The Bhutan series (Fig. 10) is of a single endangered species, the golden langur (*Presbytis geei*). The single issue from Togo depicts the olive colobus (*Colobus verus*, Fig. 11). Zambia's four new primate stamps (Fig. 12) include the chacma baboon (*Papio ursinus*), blue monkey (*Cercopithecus mitis*), vervet (*C. aethiops*) and Moloney's monkey (*C. albogularis moloneyi*).



Fig. 11: Single stamp from Togo, West Africa, depicting the olive colobus monkey (*Colobus verus*).



Fig. 10: Series of four stamps from Bhutan depicting the golden langur (*Presbytis geei*).



Fig. 12: Series of four new stamps from Zambia depicting the chacma baboon (*Papio ursinus*), vervet (*Cercopithecus aethiops*), blue monkey (*C. mitis*) and Moloney's monkey (*C. albogularis moloneyi*).

## Availability of Volunteer Field Assistants

As in past newsletters, we are continuing to list people interested in participating in primate field projects on a volunteer basis. We hope that PSG members with ongoing field projects will be able to place some of these people, and if any of you have requests for assistants with specific skills, please feel free to advertise here.

### Volunteer field assistants:

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Ms. Lorna Arness  
2 Dundas Road  
Eskbank  
Dalkeith, Midlothian  
Scotland, UK

Ms. Arness is a graduate of Aberdeen University with a background in ecology and behavior. She has some field experience with primates in central Brazil, and has also worked as a volunteer in the Pantanal region of Brazil and Arusha National Park, Tanzania. She can provide at least partial support for her work.

---

Mr. Lawrence H. Bannister  
95 West Squantum Street  
Apartment 918  
North Quincy, Mass. 02171

Mr. Bannister would like to volunteer for a six month field assistantship in East Africa. He speaks some Swahili and already has some experience working with large mammals in Kenya. He has also conducted geological field research for the Massachusetts Institute of Technology. Mr. Bannister can provide living and travelling expenses.

---

Ms. Joanna Greenfield  
Box 527  
Wesleyan University  
Middletown, Conn. 06880

Ms. Greenfield is a physical anthropology major at Wesleyan University. She speaks fluent French and some Spanish and has studied at the Field School of Primatology on Morgan Island, South Carolina. Ms. Greenfield will be available as a field assistant for a period of from five to eight months and is able to provide travel costs.

---

Ms. Lisa Naughton  
5608 Crestwood Place  
Madison, Wisconsin 53705

Ms. Naughton is looking for work as a field assistant in the tropics. She has done independent research on *Saimiri oerstedii* in Costa Rica and field assistant work on oryx in Kenya. She speaks both Spanish and Swahili. Following graduation from the University of Wisconsin in December, 1985 she will be available as a volunteer and is able to provide partial support.

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Ms. Katy Offutt  
Dept. of Zoology  
Birge Hall  
University of Wisconsin  
Madison, Wisconsin 53706

Ms. Offutt wishes to become involved in a primate behavior or ecology study. She recently received her M.S. in Zoology from the University of Wisconsin at Madison, studying the behavior of rhesus macaques and pygmy chimpanzees. She can pay her own transportation and is available for one year after August, 1985.

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Ms. Rosemary D. Power  
P. O. Box 91  
Field, British Columbia  
V0A 1G0  
CANADA

Ms. Power has a B.A. in archaeology, specializing in primatology, from Simon Fraser University. She is presently employed as a naturalist by Parks Canada and has field experience with orangutans in Indonesian Borneo. Ms. Power would prefer to work on a project involving the African apes and will be available between September-May, 1985-86 or 1986-87. She would require some financial assistance.

---

Ms. Beth Pratt  
1841 Ingleside Terrace, N.W.  
Washington, D.C. 20010

Ms. Pratt is an anthropology graduate seeking a field assistantship studying primate social behavior in Central or South America, having a special interest in marmosets. She speaks Spanish and is an experienced backpacker.

---

Mr. Jesse Rodefer  
PO Box 594  
Corrales, New Mexico 87048

Mr. Rodefer is a sophomore in biological anthropology at Harvard University. He wishes to pursue fieldwork in primate ecology and is available for 12 months beginning in June, 1985.

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Mr. David Stewart  
Mareravana  
Edgemore Road  
Hatfield  
Harare  
ZIMBABWE

Mr. Stewart completed his undergraduate zoology degree at Edinburgh University in 1983 and is interested in fieldwork in the southern half of Africa. As a student, he conducted a six month behavioral study on captive primates. He is available for the months of August and September (as well as Christmas and Easter vacations) and is able to fund himself.

---

Ms. Maryann Watson  
1001 E. Seneca Pl.  
Peoria, Illinois 61603

Ms. Watson is seeking to spend a year or more working in Africa as part of a primate research program. She speaks French fluently and has travelled throughout much of eastern and southern Africa, including Kenya, Tanzania, Zambia, Zimbabwe, Botswana and South Africa.

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## Field Assistants Wanted

As another service to PSG members and people interested in primate field research, we list announcements of field positions available, in addition to our list of volunteer field assistants.

### The Primate Sub-project of the Minimum Critical Size for Ecosystems (MCSE) Project of WWF-US/INPA

Graduate students are invited to participate in an ongoing study of primate population biology and ecology as part of the MCSE project based in Manaus, Amazonas, Brazil.

The MCSE project is being conducted to study the characteristic diversity of tropical Central Amazonian rainforest and determine the minimum size of protected areas necessary to preserve it. Biological inventories are taken in variable-sized forest remnants located within the agricultural district of Manaus.

The Primate Sub-project has been in operation since July 1983, data being gathered on the survival of *Saguinus midas*, *Pithecia pithecia*, *Chiropotes satanas*, *Cebus apella*, *Alouatta seniculus*, and *Ateles paniscus*. Population densities in continuous and remnant forest are calculated by repeat transect surveying and direct observation. Behavioral and ecological studies are conducted simultaneously.

Students wishing to participate in this research should have a strong background in ecology and prior field experience. Physical fitness is important.

The project offers return airfare, field expenses, food and accommodation and a small personal allowance. Due to higher airfare costs, students from Europe are generally not considered unless they can contribute to this expense. Participation by non-Brazilian students requires permission from the Brazil National Research Council (CNPq). This usually requires 3-4 months.

Application for participation should be addressed to:

Dr. Thomas E. Lovejoy  
World Wildlife Fund  
1255 23rd St., NW  
Washington, DC 20037  
UNITED STATES

Copies should be sent to Dr. H. O. R. Schubart, Dr. R. O. Bierregard and Dr. A. B. Rylands at the following address:

Instituto Nacional de Pesquisas  
da Amazonia (INPA)  
Caixa Postal 478  
69.000 Manaus  
Amazonas  
BRAZIL

## Position Available for Natural History Illustrator/Graphic Designer

The WWF-U.S. Primate Program is seeking an illustrator to work on a variety of projects carried out by the program at the Stony Brook office.

Activities would include layout, design and preparation of maps, tables and wildlife illustrations (with special emphasis on primates) for various program publications, design of conservation education materials and management of the program's collection of maps, photographs and scientific illustrations.

Preference will be given to individuals with considerable previous experience in drawing primates, and applicants should have the equivalent of an M.A. in Natural History Illustration. Some familiarity with primate taxonomy is absolutely essential since most of the work done involves this order of mammals.

Salary: \$20,000 per year.

Please send resumé and samples of work to:

Dr. R.A. Mittermeier  
WWF-U.S. Primate Program  
Dept. of Anatomical Sciences  
Health Sciences Center  
State University of New York  
Stony Brook, New York 11794



# NEWS FROM THE FIELD

## Central and South America

### Status of the Squirrel Monkey *Saimiri oerstedii* in Costa Rica

*Saimiri oerstedii* is the Central American squirrel monkey, disjunct by 500 km from the nearest South American population. This monkey once ranged through the lowlands of the Pacific coastal provinces of Puntarenas, Costa Rica and Chiriqui, Panama. Two subspecies are recognized, *S. oerstedii citrinellus* north of the Rio Naranjo in Costa Rica and *S. oerstedii oerstedii* (Fig. 13) to the south (Fig. 14). Limited field data exists from Chiriqui (Baldwin and Baldwin, 1976). Other than reports on museum specimens, no observations regarding Costa Rican squirrel monkeys have been published.

With the support of WWF and other agencies, I recently completed an initial evaluation of *S. oerstedii* in Costa Rica. Unfortunately, the animals are much more seriously threatened than was anticipated. During the two field periods (Feb-Sept., 1982 and June, 1983 - Sept., 1984) I studied detailed aspects of the foraging ecology, as well as basic natural history, of selected troops in the vicinity of Estación Sirena, Parque Nacional Corcovado on the Costa Rican Osa Peninsula. During the first three weeks of each month from October 1983 to September 1984, scan focal and group behavioral samples were made of individuals in the main study troop. All the squirrel monkeys were individually recognized by natural markings or permanent cattle dye applied with a squirt gun. During the final week of each month, habitat samples were made in randomly located 5 x 5 m quadrats within the study site to estimate the food resources available to squirrel monkeys. In each quadrat, fruit, flower, leaf flush phenologies and litter depth were measured, and three types of insect samples made. This fieldwork was interspersed with exploratory forays throughout the Osa Peninsula and portions of the Puntarenas lowlands.

The Puntarenas lowlands are characterized by a strongly seasonal rainfall. This seasonality is also reflected by marked changes in fruit and insect abundance. During the wet season, suitable fruit, with the exception of cultivars like bananas and guavas, is scarce and unpredictable, and the monkeys become almost completely insectivorous, although even insect abundance and biomass are very low at this time of year. The monthly troop range is 2 km<sup>2</sup> and troop members forage or travel for > 90% of daylight hours. With the dry season comes renewal of both insect and fruit resources. Depending on the age and sex of the squirrel monkey, the proportion of time spent resting by an individual during day light hours can exceed 40%, and range covered per month decreases to 1 km<sup>2</sup>.

Throughout the year, squirrel monkeys heavily utilize second growth habitats when foraging, often merely passing through mature forest. Squirrel monkey troops have not been located within the few extensive and undisturbed mature forests (eg., between the Rio Pavo, Osa Peninsula and the Llorona plateau) that remain in the area encompassed by their greatest known range. Extremely rugged terrain, as is found in

the southern third of the Osa Peninsula, is not used. Second growth offers a high density of the small thin-skinned fruits and flowers and the dead foliage from which squirrel monkeys glean insects.

Squirrel monkeys have apparently been eradicated from all but a tiny fraction of their former range in Costa Rica. The seasonal requirement for a large contiguous range, in combination with severe deforestation, limits the opportunity for regrowth of the population. Large tracts of what was at one time good forest, interspersed with second growth only 10 years ago on the Pacific wet and moist lowlands, has now been converted to pasture and farmland. Few sites, aside from those described below, appear promising in surveys made from small, low flying planes. Hunting for food has likely never been a major threat. Until 12 to 15 years ago, however, it appears there was a lively export trade in squirrel



Fig. 13: *Saimiri o. oerstedii* from Corcovado National Park, Costa Rica (photo by Sue Boinski).



monkeys, mainly to Brazil and several other South American countries. This certainly contributed to the population decline. Informants stated that the trade was abandoned when the price received by the trappers, \$1 per monkey, ceased to be worth the effort of locating the increasingly sparse troops.

Less than 300 squirrel monkeys are found in and around the immediate vicinity of Parque Nacional Manuel Antonio, adjacent to Quepos. This is the only known surviving population of *S. oerstedi citrinellus*. In P. N. Corcovado fewer than 450 *S. o. oerstedi* survive. Their ranges include large portions of continuous second growth created by human disturbance, both recent and that ascribed to former Indian populations. Troops also exist in the flooded, difficult to explore mouth of the Rio Serpe. Isolated troops are known from several sites draining into the Golfo Dulce. More exploration by foot and car is needed on the western drainage of the Golfo Dulce, the Barica Peninsula and the base of the Fila Cruces. However, reports from informants familiar with these areas are not encouraging.

In summary, the available data indicates that the Costa Rican *Saimiri oerstedi* population is unlikely to exceed 3,000 (perhaps 2,500 *S. o. oerstedi* and 500 (?) *S. o. citrinellus*). Negligible opportunity for gene exchange exists between the small and widely dispersed demes. Recently, a report estimated that between 33,533 and 170,446 Central American

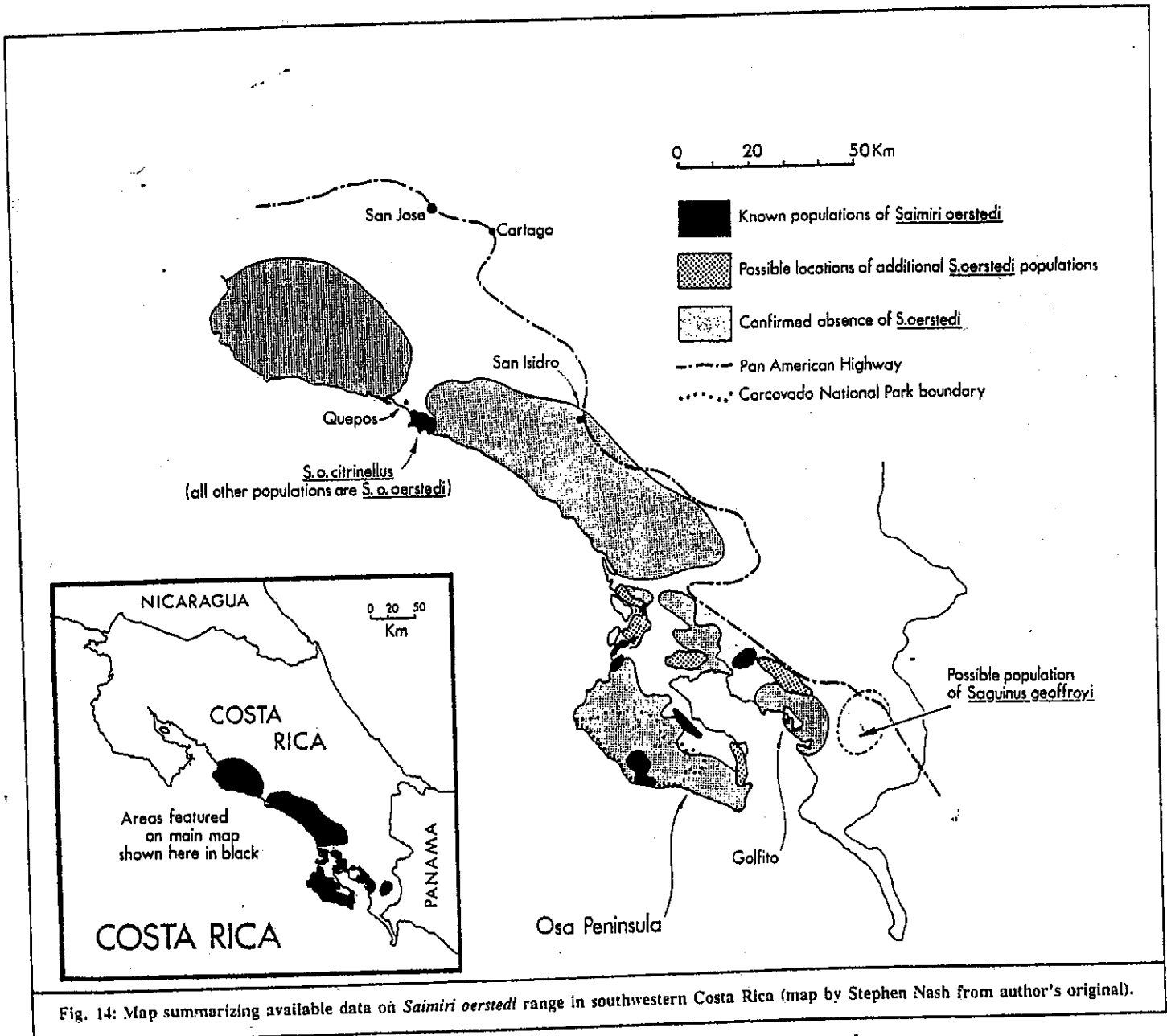
squirrel monkeys survived in the southwest portion of Costa Rica (Vaughn, 1983). To obtain these figures, land area thought to be suitable habitat was multiplied by density figures from study sites in Panama and Peru. I am not able to corroborate these figures. *S. o. citrinellus*, most probably extinct outside of the immediate vicinity of Quepos, should receive immediate attention to ensure its survival. Management decisions must be made only slightly less immediately regarding *S. o. oerstedi*. Without the Costa Rican National Park system and its conservation efforts and dedication, this report would have been even more bleak.

Sue Boinski

Department of Zoology  
University of Texas at Austin  
Austin, Texas 78712

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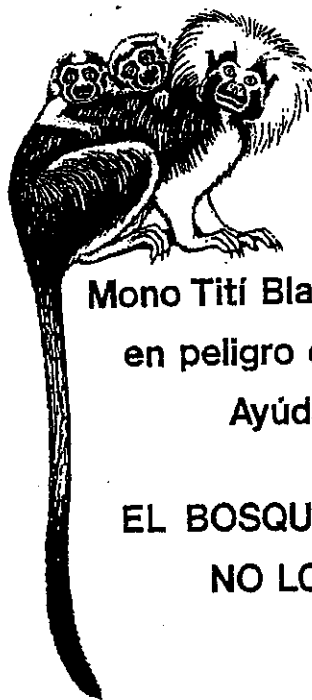


## S.O.S. for the Cotton-Top Tamarin (*Saguinus oedipus*)

The cotton-top tamarin of Colombia is seriously threatened with extinction (Figs. 15-16). It is listed as Endangered in the IUCN Red Data Book and by the Colombian government, on Appendix I of CITES, and on the list of highest priority species of the PSG. The cotton-top tamarin is endemic to Colombia, restricted in its distribution to the northwestern part of the country, including the departments of Atlántico, northwestern Bolívar, Sucre, Córdoba and northwestern Antioquia (Hernandez-Camacho and Cooper, 1976; Neyman, 1978). The actual boundaries of its range are unknown (Fig. 17).

Neyman (1978) estimated that three-quarters of the cotton-top's original range had been cleared for agriculture and pasture, and that the remaining quarter was represented by 1) very small remnants patchily distributed in the northern half of its range, and 2) an important forest tract in southern Córdoba and northern Antioquia, most of which lies within the Parque Nacional Natural de Paramillo (450,000 ha). Most of the remaining wild cotton-top tamarin population is believed to inhabit this park.

In the past, large numbers of *Saguinus oedipus* were trapped and exported to the United States and Europe, to supply both the pet trade and biomedical research. More than 13,000 were imported into the United States during the period 1968-1972 (Green, 1976; Muckenhiirn, 1976) and Hernandez-Camacho and Cooper (1976) estimated that 30,000 to



**Mono Tití Blanco**

**en peligro de extinción**

**Ayúdanos a salvarlo**

**EL BOSQUE ES MI HOGAR  
NO LO DESTRUYAS**



40,000 were exported in the 15 years prior to 1976. Since *Saguinus oedipus* has been declared an endangered species, international trade has been largely curtailed.

A proposed Colombian hydroelectric project now poses a serious threat to the remaining wild tamarins. Proyecto Hidroeléctrico de Urrá, composed of two dams, Urrá I and Urrá II, will harness power from the rivers Sinú and San Jorge and its tributaries (CORELCA, 1983). Urrá I will flood approximately 6,200 ha of unforested land. Its construction is about to commence. Urrá II is a much larger structure and its construction presents a greater danger to the tamarins and their forest habitat. It will be located on the Andean foothills within the boundaries of the Parque de Paramillo and is expected to flood more than 54,000 ha of land now covered by both primary and secondary forests. This area is part of the last major stronghold for *Saguinus oedipus*.

To date, no detailed studies of the vegetation or the wildlife of this area have been conducted. Neither has an environmental impact statement been prepared. It is certain, however, that destruction of approximately one-quarter of the cotton-top tamarin's remaining range will bring this species that much closer to the brink of extinction. Other primate species, including *Ateles belzebuth hybridus*, *Lagothrix lagotricha lugens*, *Aotus lemurinus griseimembra*, *Cebus capucinus*, *Alouatta palliata* and *A. seniculus* will also be affected by the construction of Urrá II.

The area of the upper Sinú River is very important from a zoogeographic standpoint. It represents one of the most important Pleistocene refugias of northwestern South America and is probably a major area of contact between the Central American and South American biotas.

Urrá II has met strong resistance from several Colombian governmental and non-governmental agencies, universities and the general public. Opposition to the project has focused on the certainty of its adverse environmental impact, the extremely high project costs, and its dubious economic benefit to the people of this region.

At this point, it is urgent that detailed field studies be conducted to evaluate the threats that Urrá will pose to the local flora and fauna. Focus should be placed on *Saguinus oedipus*, as it is an endangered species

Figs. 15-16: (Above and upper right) Designs being employed in conservation campaign on behalf of the cotton-top tamarin (*Saguinus oedipus*) in Colombia. The Spanish text above reads "Cotton-top tamarin in danger of extinction. Help us to save it. The forest is my home. Don't destroy it" (designs by Stephen Nash).

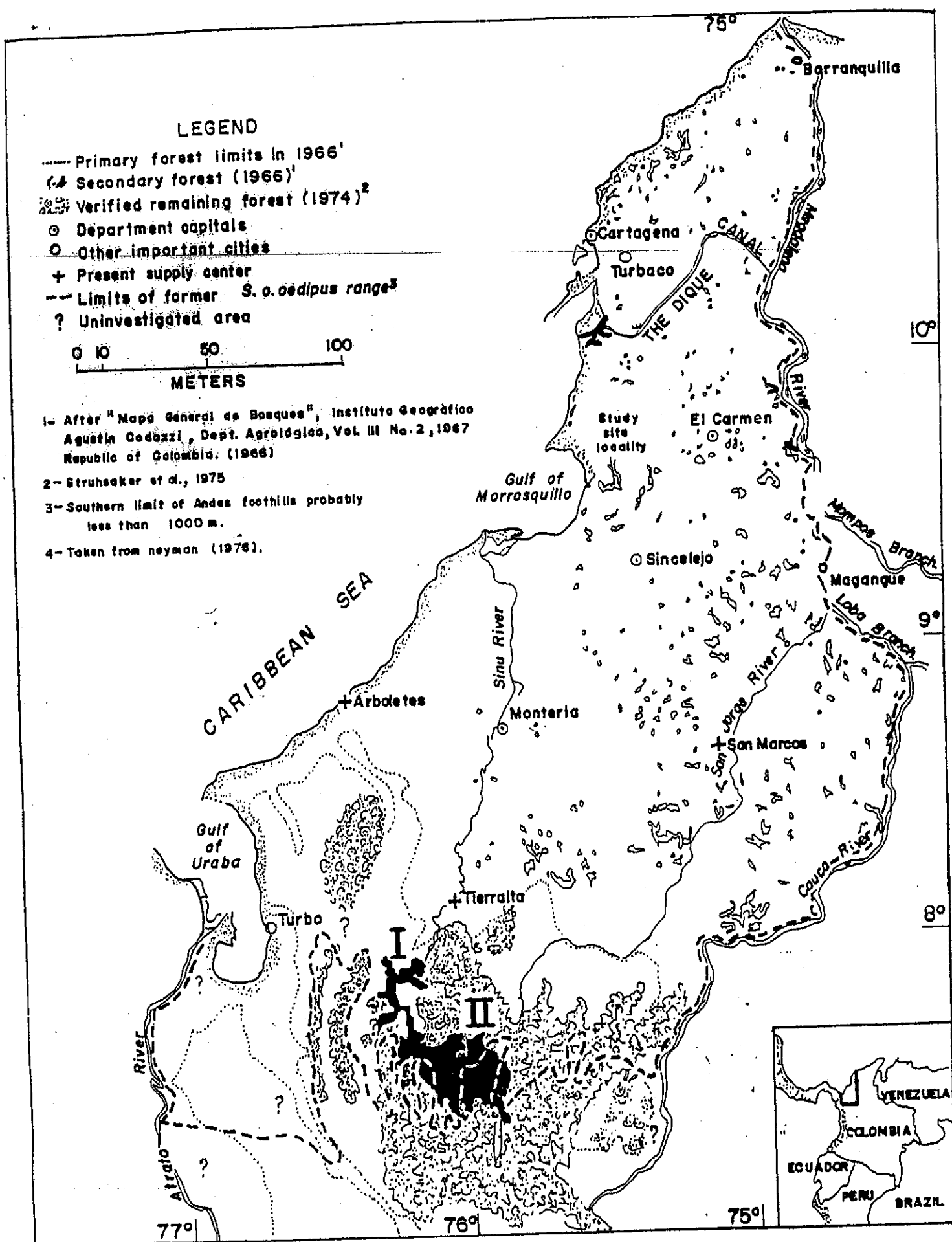


Fig. 17: Map showing presumed range of *Saguinus oedipus* in northwestern Colombia and location of the hydroelectric projects Urra I and Urra II (black areas with corresponding Roman numerals) (map courtesy of the author).

endemic to Colombia. It is important that we obtain a better idea of this species' density, range and overall conservation status. Findings should be used in conjunction with a coordinated conservation education campaign to strengthen existing opposition to the hydroelectric project. The area which will ultimately be affected already lies within the boundaries of a national park. At one point in time someone had the wisdom to protect this land for the benefit of future generations. That action must be defended.

Jairo Ramirez Cerquera  
Instituto Nacional de Salud  
Avenida Eldorado con Carrera 50  
Zona 6  
Apartados Aereos 80080 y 80334  
Bogotá, D. E., Colombia

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- Mittermeier, R. A. and Coimbra-Filho, A. F. 1982. Distribution and conservation of New World primate species used in biomedical research. In: *Reproduction in New World Primates. New Models in Medical Science*. J. Hearn, (ed.) MTP Press Limited. Lancaster, Boston. The Hague. Pp. 1-37.
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- Neyman, P. F. 1978. Aspects of the ecology and social organization of free-ranging cotton-top tamarins (*Saguinus oedipus*) and the conservation status of the species. In: *The Biology and Conservation of the Callitrichidae*. D. Kleiman, (ed.) Smithsonian Press. Washington, D.C. Pp. 39-71.

## Major Program Underway to Save the Black Lion Tamarin in São Paulo, Brazil

The black, or golden-rumped lion tamarin (*Leontopithecus chrysopygus*) is almost certainly the rarest and most endangered of all South American primates (Fig. 18). Always restricted to the interior of the state of São Paulo, Brazil's most developed state, this monkey's range has now been reduced to two widely-separated, isolated forest reserves and perhaps a few tiny privately-owned patches of forest as well. The two protected areas in which it still occurs are the 37,156.68 ha Morro do Diabo State Forest Reserve in the extreme western corner of the state and the 2,178.84 ha Catterus State Reserve in central São Paulo (Fig. 19). Although remaining populations occur in reserves, they do so at such low densities that there has been considerable doubt that this species would survive in the wild, ever since its rediscovery (after a hiatus of some 65 years) in 1970 by Ademar Coimbra-Filho, one of the pioneers of Brazilian primatology. Given the uncertain future of the species in the wild, Coimbra decided in 1973 that it would be important to establish a captive colony for this primate. With the assistance of the Forestry Institute of São Paulo, he was able to capture six individuals, which became the basis for the current colony, presently at 25 individuals.

This colony in the Rio de Janeiro Primate Center (FEEMA-SOMA) is the only captive colony of this species in the world.

A further threat was added in 1978 when it was decided that a hydroelectric plant would be constructed on the Paranapanema River which forms one of the boundaries of the reserve. The flooding would

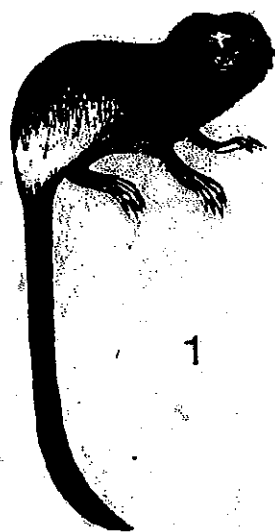
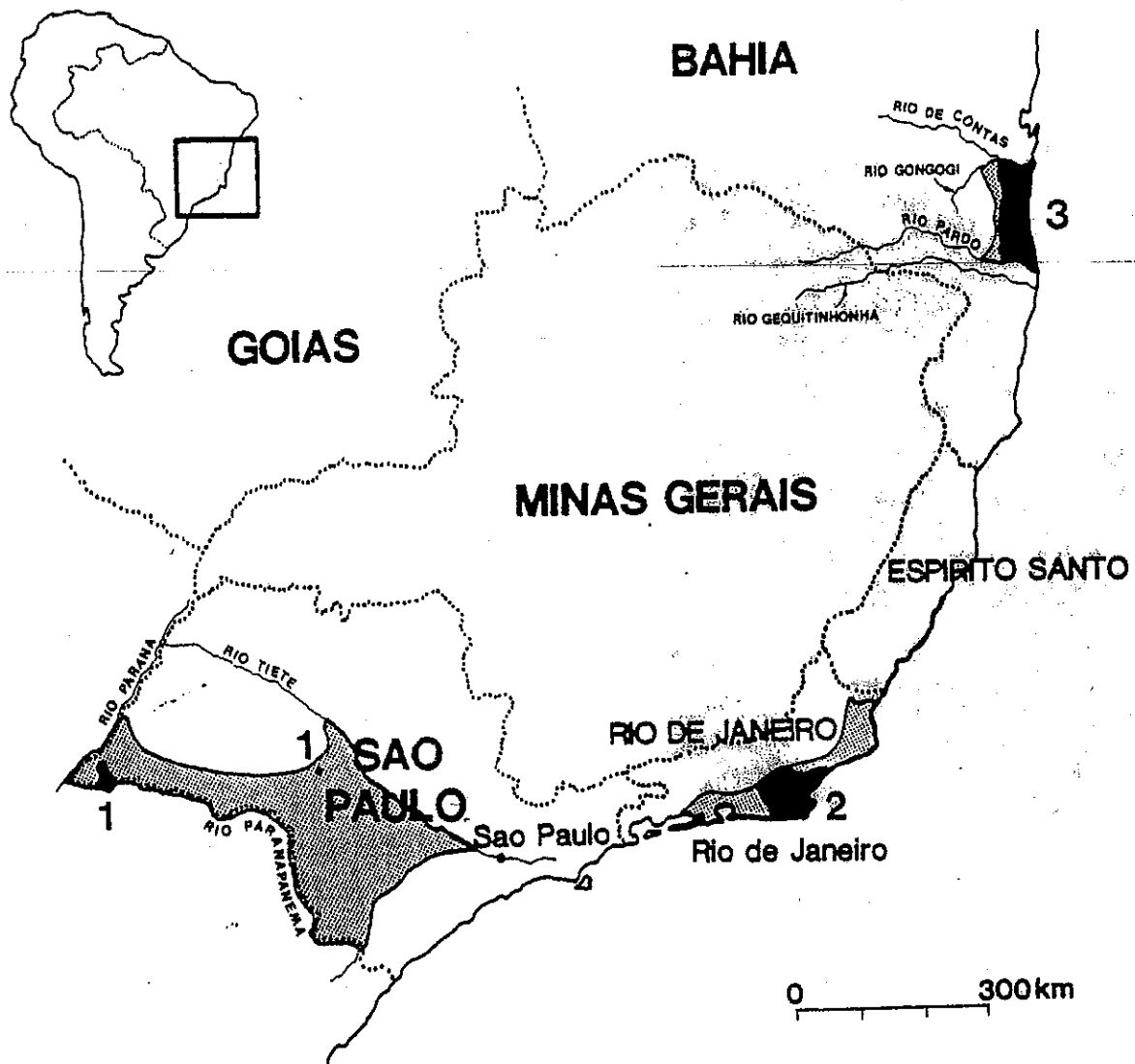


Fig. 18: Infant black lion tamarins born at the Rio de Janeiro Primate Center cling to their parent (photo by A.F. Coimbra-Filho).

result in the destruction of some 4,200 ha of the forest, or about 11% of the reserve. It first appeared that little would be done, except perhaps a post-inundation rescue project of the kind that has followed similar hydroelectric projects in other countries and even within Brazil. Now, however, thanks to the efforts and farsightedness of Brazilian conservationists like Maria Tereza Jorge Padua, Secretary-General of the Brazilian Forestry Development Institute (IBDF) and former Director of the Department of Environment and Natural Resources of the São Paulo Energy Company (CESP), João Regis Guillaumon, Director of the Forestry Institute of São Paulo, and professor Jose Goldemberg, a Brazilian scientist internationally known for his works in the area of physics and presently President of CESP, a major program to save this species has now been initiated that may well serve as a model for similar efforts in the future.

The history of the project goes back to 1983 when Maria Tereza J. Padua, representing CESP, and João R. Guillaumon of the Forestry Institute of São Paulo made an historical agreement by which all money received by the Forestry Institute as reimbursement for the flooding of part of Morro do Diabo would be used to implement the reserve's management plan. This plan includes, among other important provisions, steps to conserve the remaining area and its fauna, with special emphasis being placed upon wild black tamarin populations. This agreement has received the endorsement of the Governor of São Paulo and is responsible for the commitment of \$500,000 to the program, money which has already helped to support much of the research that has taken place at Morro do Diabo to date. World Wildlife Fund - U.S. has provided supplementary funding (\$15,700) for the project and has also designed and produced a poster and a t-shirt that have been used in a very successful educational project in the vicinity of the Morro do Diabo reserve (Fig. 20).

Research on the biology of the species is being coordinated by Claudio Valladares Padua, Assistant Director of the Rio de Janeiro Primate Center (FEEMA-SOMA) and currently a Ph.D. candidate at the University of Florida at Gainesville. He has conducted research on the population genetics of wild *L. chrysopygus*, the species' remaining natural habitat, and also on the demography of the combined wild and captive populations.



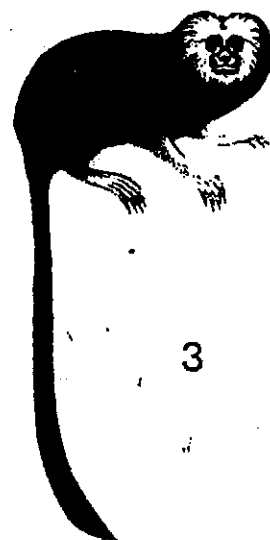
1

*Leontopithecus chrysopygus*



2

*Leontopithecus rosalia*



3

*Leontopithecus chrysomelas*

Fig. 19: Map showing past and present distributions of *L. chrysopygus* in relation to those of the two other lion tamarin species in southeastern Brazil. Solid black areas show present distributions and stippled areas show presumed original distributions (map by Stephen Nash).

Census work on the Morro do Diabo population is under the direction of Celio Valle of the Federal University of Minas Gerais, and his team has already succeeded in locating three groups (about 14 individuals) in the area to be inundated.



### MICO-LEÃO-PRETO

*Leontopithecus chrysopygus*

O mico-leão-preto que se existe no Estado de São Paulo, é um dos macacos mais raros e mais ameaçados do mundo. Correu a destruição das matas em que vive. Esse belo tamariz só sobreviveu nas matas em duas reservas pertencentes ao Governo de São Paulo, localizadas nos Municípios de Gália e de Teodoro Sampaio.

O Instituto Florestal, a Companhia Energética de São Paulo, e a Fundação Brasileira para a Conservação da Natureza, com a cooperação do Fundo Mundial para a Vida Selvagem (WWF-US) e o Centro de Primatologia do Rio de Janeiro (FEEMA-SOMA), realizam um amplo trabalho para salvar o tamariz e toda a fauna e flora dessa nobre reserva.

C-SP



Fig. 20: Poster depicting the black lion tamarin in its native habitat, used as part of a public awareness and conservation education program in the Brazilian state of São Paulo (poster design by Stephen Nash).

A meeting to determine future strategies for the conservation of this species was held on August 16, 1985 in the offices of CESP in São Paulo, and was attended by 14 participants, including Valle and Padua, Luiz Fernando Galli and Antonio Audi of the Dept. of Environment and Natural Resources of CESP, Admiral Ibsen de Gusmão Camara, President of the Brazilian Conservation Foundation (FBCN), Osmar Correa Negreiros, Director of Parks and Reserves of the Forestry Institute, Francisco Correa Sereio, Forestry Institute Coordinator of the project, Cory Carvalho, a researcher from the same institution, and several other representatives, including PSG Chairman Russ Mittermeier. In this meeting, the project was evaluated and three important decisions were arrived at. First, the area to be flooded would be gradually and carefully logged, with efforts being made to locate groups of tamarins in the process. The second decision was that any tamarins captured would be either transferred to the existing colony at the Rio de Janeiro Primate Center (FEEMA-SOMA) or otherwise used to develop a second colony being planned by CESP and the Forestry Institute in the vicinity of Morro do Diabo. This facility would serve as a satellite colony to the Rio Primate Center. The third decision was that a reintroduction program would eventually be developed, should it be possible to return any of the captive animals or their progeny to the wild.

As a result of these efforts, the outlook for this highly endangered primate, which may number only 50-100 individuals in the wild, is

brighter now than at any time in the past decade. Furthermore, this project serves as a model of local, national and international cooperation that hopefully will be followed around the world. The PSG would like to extend thanks for the tremendous support in helping to ensure the survival of this species to Dr. Jose Goldemberg, President of CESP, Dr. Luiz Fernando Galli, Director of the Dept. of Environment and Natural Resources of CESP, Dr. Antonio Audi, Chief of the Section of Fauna and Flora of CESP, and Dr. João Regis Guillaumon, Director General of the São Paulo Forestry Institute.

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## Captive-Born Golden Lion Tamarins Released into the Wild: A Report from the Field

It has been eight months since the release of the zoo-born golden lion tamarins here in the Poço das Antas Reserve (Figs. 21-22). I am happy to report that all concerned in the project are now willing to declare the effort a success.

May 3, 1984, was an important day for all project participants. That morning a family group of eight golden lion tamarins was placed in travelling cages at the Rio de Janeiro Primate Center, where they had spent the past five months in quarantine and in training with the National Zoological Park's primatologist, Dr. Ben Beck and his four assistants (three young Brazilian biologists: Maria Ines Castro, Rosa



Fig. 21: Author, Lou Ann Dietz, with two of the reintroduced golden lion tamarins (*Leontopithecus rosalia*) at the Poço das Antas Biological Reserve (photo by R. A. Mittermeier).

Lemos de Sa, and Vera Luz; and Beate Rettberg of Chicago's Brookfield Zoo). The tamarins made the two-hour trip by car to what was to become their new home, the forests of the Poço das Antas Biological Reserve. These tamarins' ancestors had for centuries lived in the lowland forests of the state of Rio de Janeiro, but none of the group of eight had ever before seen a real forest.

At the reserve, a small crowd of people anxiously awaited the tamarins' arrival. Dr. Adelmar Coimbra-Filho and other officials of the Rio Primate Center, officials of the Brazilian Forestry Institute (IBDF) which administers the reserve, the Mayor and Secretary of Education of Silva Jardim (the municipality in which the reserve is located), representatives of a newly-formed local conservation group, and a bevy of press photographers, cameramen, and reporters, had all followed our field personnel through knee-deep swamp water and mosquitoes to reach the large enclosure (15m x 4.5m x 3m) constructed in the forest. Upon the tamarins' arrival, reserve guards and project field assistants carried them in their travelling cages to the enclosure where Ben Beck and two assistants released them into their new surroundings. As we expected, with all the people around, the tamarins first found their familiar nest box (the two infants on their own) and remained there until the crowd

had left. One adventurous individual, however, found the feeding platform and ate a banana, posing for the press. His photo appeared in every large newspaper and on Brazilian TV news on two national networks that evening!

When the first day's commotion had subsided, the real work began. Ben Beck continued the daily observations and training activities with Group 1 (as the tamarin group came to be called) which he had begun at the Primate Center. These animals, which at one time didn't know how to open a banana, were, within a few days, all catching some of the same insects, lizards, and tree frogs eaten by the wild tamarins. A banana was, happily, no longer a challenge. To Jim Dietz, who had spent the last eight months studying the wild tamarins in the reserve, Group 1 members seemed clumsy and not very alert. The infants, and to a lesser degree the subadults, did better on the complex, flexible, natural vegetation, but the older adults spent most of their time on the wood and wire mesh of the enclosure.

Within a few weeks the project team concluded that they had done all they could to prepare these tamarins for life in the wild. The release was scheduled for May 31.

The enclosure hatch was opened at 9:40 am. Within two minutes the

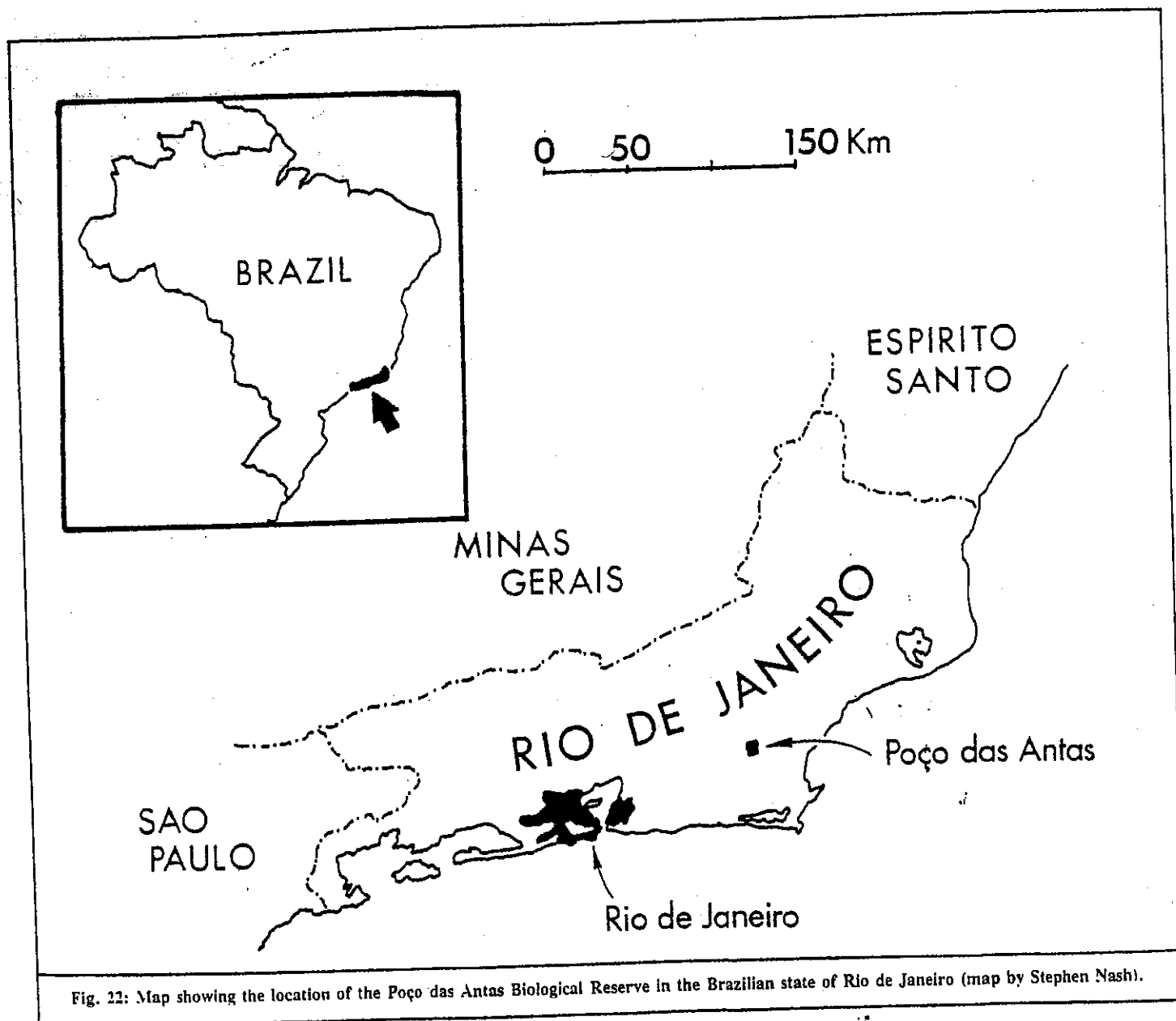


Fig. 22: Map showing the location of the Poço das Antas Biological Reserve in the Brazilian state of Rio de Janeiro (map by Stephen Nash).

adolescent male, known as Number 9, noticed the opening and exited tentatively, followed by his younger brother and sister. Within twenty minutes, the entire group of eight was out and climbing high in the trees. We all somehow feared the worst, but it didn't happen. The group behaved as if they had been doing this sort of thing all their lives. They remained out of the enclosure exploring the immediate vicinity most of the day and spent the night in their familiar nest box, a hollow log we had provided during training. In the days following the release, the project team felt the group regressed slightly — spending too much time on the top of the enclosure where they were ready targets for aerial predators. To prevent this, the enclosure screen was removed by June 2. Daily observations showed a gradual improvement in their locomotion and foraging behavior.

During the following month our field assistants constructed three additional enclosures in the nearby forest, and the three remaining adult pairs chosen for reintroduction were brought to the reserve and eventually released. One of these tamarins was a wild-born male who had been illegally kept in a nearby town. As a result of our education campaign, the local mayor confiscated him and brought him to the reserve. Except for Micueca (the name we gave him), these adults, like the older members of Group 1, did not adapt as quickly as the young members of that family group. The adults spent a dangerous amount of time on the ground and were slower to find natural foods.

Shortly after each of the releases, the groups began to encounter one another. Two adults wandered off during these encounters and were presumed dead when they failed to return to their groups. A third adult was killed on the ground by a hunting dog, and another adult died of exposure after she found her accustomed nest box occupied by another animal and spent the night in the cold rain. We did lose one young animal, a fine female, when she was bitten on the hand by a snake, probably while she was probing for an insect in a crevice.

These deaths and social encounters in July 1984 resulted in the reorganization of the original four groups. At times the researchers felt chaos had broken loose; their field notes for this period read something like a soap opera! But after a short time the tamarins formed two groups which have remained stable to date.

By July, when Ben and his assistant Beate had to return to their jobs in the U.S., one of his Brazilian assistants, Maria Ines, decided to remain with the project and coordinate the field observations of the reintroduced tamarins. She and a group of dedicated high school students from the local community have maintained nine months of continuous daytime observations to monitor the progress of these animals. By November, Jim considered the behavior of all individuals to be very similar to that of wild tamarins. Their color had improved too, becoming a brilliant dark red — probably a result of the Brazilian tropical sun and the natural diet. Since November, they have been finding all their water on their own. Food provisioning was stopped in early March. All animals and observers survived a devastating windstorm in November which blew down trees all around them in the forest and blew the tile roof off the house of our field assistants.

On December 19, we had an early Christmas celebration — in honor of the first birth in the forest to captive-born parents (Fig. 23). The baby tamarin is growing fast and soon will be weaned. All of Group 1 members have helped to raise him, carrying him and sharing their food with him when he gives his sharp rasping food call. We had hoped the baby would be a female so we could call her "Esperanca" which means "hope" in Portuguese. But since he has turned out to be a male, we decided to name him "Natalino", a name derived from "natal" meaning "Christmas" and "native".

February was both a sad and a happy month for all of us here. February marks the climax of summer and is always very hot with sudden heavy rains which regularly make the dirt roads of the region and the reserve impassable. Mosquitoes are especially bad during this season. Our field team has gone through twelve bottles of extra strong insect repellent in about four weeks! It has been a difficult time for tamarins as well as humans. The two dominant males of the large family group died sud-



Fig. 23: The first lion tamarin infant produced by captive-born parents released at Poço das Antas (photo by R. A. Mittermeier).

denly of an unidentified disease, and Marcos, one of the juvenile twins born at the Rio Primate Center last March, apparently came down with the same disease and had to be evacuated to the Rio Primate Center for treatment. Another adult male (#5) was severely wounded in a dispute for dominance with the only other remaining adult male (#9) in the group. His (#5) weakened condition necessitated his removal, leaving the group with only four members. The remaining four continue to do well, however.

Our happy news last month was the birth of twins to the adult pair, Vera and Micueca. We had not been certain Vera was pregnant, because Micueca keeps her relatively distant from observers. But on February 15, the observers noticed a rope-like ring of golden fur around Vera's reddish body. With a closer look, the ring proved to be twins! All of us were ecstatic! Micueca is a good father, and the infants seem to prefer being carried by him except when nursing. Observers think that since Micueca is still more agile than his captive-born mate, he may be giving his offspring a smoother ride!

What is the situation now, and what have we learned from all this? Today there are still two groups of reintroduced tamarins in the forest, four individuals in each group. Three (2 adult females and one adult male) of those were among the original 15 tamarins who arrived in Brazil from U.S. zoos in November 1983. Four are their descendents, and one was a local contribution. The mountains of data collected to document their progress have yet to be completely analyzed, but we have already learned that golden lion tamarins can be reintroduced into the wild. In the future, project researchers will choose larger family groups for reintroduction, since the curiosity and adaptability of the youngsters is often better than that of adults. Project initiator and coordinator Devra Kleiman,



Ben Beck, and Jim are already planning the next reintroduction for later this year. As a result of this experience they hope to perfect the technology for reintroduction in general and to develop techniques for the introduction of individual tamarins into wild family groups.

Like the reintroduction of zoo-born animals, the other aspects of the Golden Lion Tamarin Conservation Project have been developing full steam.

During the past year, Jim has divided his time between the reintroduction studies and field studies of the wild tamarins in the reserve (Fig. 24). He has had two Brazilian graduate students working on ecological problems. Carlos Peres, a young biologist from Belém who now is in a master's program at the State University of Florida, Gainesville, spent April through July here with us, and Laurenz Pinder, who is doing the research for his master's thesis in ecology at the State University of Rio de Janeiro, has been here with us for over a year now. All three are studying various aspects of the habitat used by the wild tamarins. There is almost no virgin forest left in the reserve, so the research has focused on the kinds of secondary forest used by the tamarins.



Fig. 25: James Dietz and Brazilian colleagues tattoo tamarins for future identification (photo by Lou Ann Dietz).

Another focus of the ecological studies during the last year was phenology — a study of the monthly changes in the availability of many of the fruits the golden lion tamarins eat. Jim, the students, and field assistants spent several days each month systematically estimating the percent of flowers, dead and green leaves, buds, and fruits on and around each tree in the transects in the study areas. With this information, they can determine when each species is in fruit and compare that with the tamarin's use of the area. The comparison will tell them which fruit species are important for golden lion tamarin survival.

A group of three Brazilian botanists from the Botanical Garden in Rio have spent a total of six weeks with us here in the field helping to quantify the diversity of the tree species in the study areas and to identify the fruits the tamarins use. Identification of plants here in the tropics is much more difficult than in temperate zones because of sheer numbers. The number of different species of trees in any given area may be 100 times greater than in a temperate forest.

The studies of the tamarins depend to a great extent on radiotelemetry to locate the animals in the forest. To date, project personnel have caught and taken data on 53 wild golden lion tamarins and fitted 21 with radio transmitter collars (Figs. 25-26). We are very pleased that no animals have been visibly harmed as a result of the trapping or handling procedures. The radio transmitters make it possible to quickly locate the tamarins in the forest in order to record information on activity patterns and habitat use. The largest group of tamarins studied has 11 members; the smallest has four. Each wild group is using an average area of 41.7 hectares. Jim has located two tamarin groups daily during a period of 11 months. After patiently following the groups for several weeks, Jim was elated when these wary animals finally ignored his presence and went about their normal activities.

Carlos Peres' four-month study focused on habitat selection and ranging patterns of one wild group of tamarins. He also collected some good information on the number and kinds of dens the group used.

Laurenz's thesis research involves a study of the ecology of the tamarin group we translocated to the reserve from a nearby area being cut in December 1983. He is comparing the ecology of this group with that of a group still in its natural area. The translocated group has stayed in its new area for over a year now, even though a large part was burned in a tragic fire last year. Laurenz has found the behavior of this group to be the same as that of the control group. We know now that translocation can succeed, and we are convinced that it will be an important technique for genetic management of the wild tamarin population. It is relatively inexpensive, and it takes advantage of genetic resources — confiscated or donated animals or those whose territories are destroyed or have become too small to support them — that would otherwise be lost. Translocation of individuals can also be used to decrease inbreeding in the isolated golden lion tamarin populations still existing in the region.

Laurenz also had the opportunity to observe dispersal of two individuals from one of his study groups. In encounters between tamarin groups, both Jim and Laurenz have observed that the conflict seems to be only between the dominant males of each group. Each of these males remains at the "combat" line protecting his mate from any contact with the op-



Fig. 24: Biologist James Dietz captures lion tamarins as part of his ecological study and monitoring of the reintroduced animals (photo by Lou Ann Dietz).

Jim's preliminary results show that the tamarins use forest rich in epiphytes and lianas more often than bare trees, even when the bare trees are larger. Epiphytes are most abundant in older forest, but it appears that the epiphytes are also present on younger trees located at the edge of wetlands. This is good news for us as habitat managers, because it means that we don't have to wait for high forest to regenerate. There are plenty of wet areas in the reserve, and near these a secondary forest can develop conditions for tamarin survival within 10-15 years after having been cut.



Fig. 26: A radio-collared lion tamarin provides information on the daily activities of this species in its natural habitat (photo by R. A. Mittermeier).

posing group. The other "single" adult group members seem to use the encounter to investigate the prospective mates present in the other group. It may be that if a "single" adult finds a willing partner it breaks off from the main group, perhaps accompanied by other "single" adult brothers or sisters. This would explain a group division which Jim witnessed after an encounter. The juveniles may use the encounters to get to know their peers in neighboring groups. On several occasions Laurenz and Jim have observed juveniles in opposing groups playing together during an encounter while their parents are involved in a ritualized battle.

The dispersal Laurenz observed was of individuals which left alone, supposedly in search of a mate. One, a young adult female from the translocated group, left her area and crossed incredible barriers (a swamp with no trees, a railroad track, and a road) in pursuit of single male tamarin we were temporarily holding in a cage at our field headquarters. Those of us present that day heard the two calling and watched in amazement as she approached the house and jumped into the open window of our car parked beside the male's cage. She sat on the steering wheel conversing with the male who obviously wanted to be with her. The romantics among us wanted to let the lovers be together, but scientific minds prevailed. The female was returned to her area, from which she later disappeared. Micueca, the male donated to the reserve, was released with one of the zoo-born tamarins as previously planned. Project personnel have seen unknown lone tamarins on several occasions in the reserve, twice in the reintroduced animals' area. We hypothesize these individuals travel through the territories of other groups until they find mates and can establish their own territories.

It could take years to be sure what really happens with the social dynamics of the golden lion tamarins in the wild. Biologists can only learn by observing incidents such as I have described above. Jim and Laurenz both emphasize that it is essential for them to be in the field

as much as possible because they never know when an important event will happen. Jim, who is also field administrator for the entire project, says that "after dealing with the impassable roads and the resulting broken cars the last few months, it is always refreshing to return to the woods — and the mosquitoes!"

Jim's plans for the immediate future include analysis of the large amounts of ecological and behavioral data on the wild and reintroduced tamarin groups. In March, he will be initiating intensive trapping of wild tamarins in the reserve both for censusing and to collect blood samples to determine the amount of inbreeding present. He suspects that inbreeding may be a serious problem in the wild population because of the small numbers and isolated populations. (He now estimates a total golden lion tamarin population of 331, of which 115 are in the reserve.) This trapping will also enable him to refine his census of tamarins in the reserve and to identify new groups for intensive study. At the same time, he will identify new areas and construct enclosures for the second wave of reintroduction scheduled for June 1985. Laurenz is now analyzing his data. He plans to defend his thesis by October.

The ecological studies should yield some interesting comparisons. The data collected, both systematically and opportunistically will contribute to habitat management, population management, and public education. There is much yet to be learned, but we already have information which is permitting informed decision-making in aspects of each of these areas — all combining to achieve the conservation of the golden lion tamarin in the wild.

One phase of habitat improvement is nearing completion now. Twenty percent of the reserve's 5,018 hectares had been cleared for agriculture before the reserve was created in 1974. In these degraded areas the soil pH measured 5.0 and less — too acidic for natural regeneration of forest to replace the grass of former cattle pasture. To correct the situation local laborers were hired under the supervision of the reserve director, Dionizio Pessamilli, for the backbreaking task of distributing by hand about 1.5 metric tons of lime per hectare in 500 hectares of degraded areas. These areas were selected for their accessibility and because they link isolated forests of the reserve. Dionizio and Jim have also initiated research to test which available methods (mowing of grass, plowing, and spreading of lime) are most efficient in promoting regeneration of the forest in degraded areas. They will have results from this research in three or four years.

A serious problem retarding the natural regrowth of forest in the reserve are fires set by motorists on the bordering highway, hunters, and neighboring ranchers. In 1984, over 20% of the reserve was burned at least once, some areas twice. Our project has financed the installation of fire-breaks and access roads to help protect these areas, and we have requested the federal highway department to install signs along the highway to request motorists to be more careful with cigarettes. The education program is also working to inform the public, especially the land-owners adjacent to the reserve, about the problems caused by fire. Without fire disturbance, the degraded lowland areas will regenerate forest suitable for golden lion tamarins in approximately 15 years.



Fig. 27: A selection of conservation education materials being used by the Smithsonian's Golden Lion Tamarin Project in the state of Rio de Janeiro, including a t-shirt, stickers, pins, brochures and booklets.

The battle to increase available protected golden lion tamarin habitat has resulted in progress on another front. The letters sent to Brasília by hundreds of concerned local and international organizations and individuals have had an effect. A huge agricultural cooperative, which had been at the point of moving onto government land adjacent to the reserve to begin intensive vegetable farming, certainly with insecticides which would be deadly to the insectivorous golden lion tamarin, has given up the idea. As a result of our campaign it is now possible that the land will be used to nearly double the size of the reserve. We sincerely thank all those who participated in this effort.

We continue to be convinced that the public education program is our best bet for the long-term conservation of the golden lion tamarin (Fig. 27). In the education program, we are using the tamarin as a symbol for saving its habitat, and thus to save many other species of plants and animals as well. Because the golden lion tamarin exists only in the municipalities where we are working and because it is such an attractive and interesting animal, we are finding that it already is becoming a symbol for the conservation of the forest here.

Before beginning our education efforts last year we had to know specific reasons why the golden lion tamarin is disappearing and which of those were directly related to actions of the local community. The project ecological studies were soon able to furnish the information which helped us to set our priorities for action: 1) reduce deforestation in the lowland areas surrounding the reserve, 2) assure permanent conservation of privately-owned forests, 3) reduce forest and grassland fires near the reserve, and 4) reduce illegal hunting in the reserve.

We also needed to better understand the local people. With the help of local volunteers we conducted 519 interviews with a representative sample of the population to discover their knowledge, attitudes, and behavior regarding the golden lion tamarin and conservation in general. Besides helping us to plan our education activities, the information we collected will serve as a basis for comparison with a later survey to evaluate our education efforts and thus contribute to the development of education as a tool for conservation. The questionnaire gave us some interesting information. We found we were dealing with a generally low education level. Forty-one percent of the people five years and older have no schooling. Those who have been to school generally have only completed the fourth grade. Many of the large landowners, however, have a college education. We found that 92% of the people interviewed listen to radio and 76% watch television. Where there is no electricity many of the rural homes have televisions run by car batteries. The mass media became an obvious tool for our efforts. Half the people interviewed could recognize a golden lion tamarin from a photo, but they knew little of its habits and had no idea that it or other local species were endangered with extinction. Most didn't know if the golden lion tamarin had any benefit for man or not. We were encouraged to discover that the people had no prejudices against wildlife, and they were concerned about the high rate of deforestation in the area. Three-quarters of the landowners interviewed wanted to protect or not bother the wildlife on their property. It became apparent that our challenge was to inform the public of the problems of local forest destruction and wildlife extinction and to increase their awareness of the long-term global consequences of their actions. We also needed to teach them about the interdependency of man, habitat, and wildlife.

Because the changing of attitudes and behaviors is a slow process, planning for the continuation of the project has been paramount. Since March of last year, an enthusiastic young Brazilian university graduate biologist, Elizabeth Nagagata, has been working with me here on the education program. She has accepted the challenge of carrying on the coordination of the education work here after I leave. Together we have worked hard to involve representatives of the local people in the planning and development of our program. We have found that given the proper information and support they can develop activities that are appropriate for them. Because of their involvement in the planning, they are also more dedicated to carrying out the activities.

We have gained the support of the local officials as well as other community leaders. Conservation clubs we have organized for young people in two counties have been functioning for over a year now. The members have been of considerable help here in the reserve and have carried out many educational activities in the community.

We have also counted on the participation of various professional and student interns (six, so far, from various parts of Brazil) who have spent



Fig. 28: A municipal parade in Silva Jardim which had as its theme, "Our Natural Resources" and which featured a golden lion tamarin float (photo by Lou Ann Dietz).

periods of a week to over a month with us in the reserve learning from our experiences in developing a community conservation education program. Three of these former interns are now developing their own conservation education programs.

Beth and I have become literal "jacks-of-all-trades" developing a myriad of materials and activities as the interest and needs arose in the local communities. We have organized press events in the reserve on two occasions during the past year, taking advantage of the general interest in the reintroduced animals' progress to furnish the press with more general conservation information and through them appeal to the public for help. We continue to use taped copies of the television and radio coverage in our direct contact here in the region. We obtained the collaboration of IBDF and of a local foundation to produce public service messages for radio and television. National television network time with a commercial value of U.S.\$ 61,000 was donated, and our messages were broadcast during prime time locally and in the important population centers of Rio de Janeiro, São Paulo, and Brasília. We have produced pamphlets of up-to-date information on the golden lion tamarin and the reserve for teachers, students, the press, and other interested persons; school notebooks with a story on the cover concerning the golden lion tamarin and its conservation, for distribution to school children; educational posters which have been distributed to schools and public gathering places; slide-tape programs for various uses; pamphlets for landowners which explain how to save on property tax by establishing private forest refuges; and various other materials such as stickers, buttons, decals, and t-shirts with the new reserve logo, for prizes, for recognition of contributions to local conservation, and for sale by conservation club members to finance their activities (Fig. 27).

We and other project participants have given lectures to local officials, conservationists, farmers' groups, university students, and presentations at four Brazilian scientific congresses. Beth and I have given short training sessions for 214 local teachers, and our group of eleven trained local volunteers have given 154 presentations in 96 schools (all the schools in two of the three target municipalities) reaching approximately 8,000 students. Approximately 4,700 people have passed through our traveling exhibit, which has been displayed in seven locations. We have received more invitations to display the exhibit than we are able to accept. We organized a group of local students to present a full-length children's play about the golden lion tamarin six times in three municipalities. Parts of the play will soon appear on TV in Japan to educate the Japanese people about the problems caused by the illegal importation of lion tamarins into that country. Six schools, with a total of 260 students, have organized field trips to the reserve. Here they follow a nature trail we developed to stimulate observation of forest elements.



Fig. 29: Two local children dressed as "giant" golden lion tamarins bring a conservation message on behalf of this species to the residents of Silva Jardim (photo by Lou Ann Dietz).

All visitors have had an opportunity to see golden lion tamarins — since the reintroduced animals are accustomed to people. During one visit, one daring young tamarin came down from a tree, found a tree frog, and ate it about two feet from a group of 25 ecstatic high school students! Seeing their faces and those of the thousands of other children and adults as they participate in our programs makes all the hard work well worth it. Enthusiasm is growing.

Local teachers last May chose the theme "Our Natural Resources" for a parade they organized in honor of the 143rd anniversary of their municipality (Fig. 28). They asked us for lists of plant and animals species which occur locally; consequently, every bird, mammal, insect, reptile, amphibian, and tree so far identified in the reserve appeared in some form in the parade. The local samba school asked us last September for information they could research to develop their theme for Carnaval 1985 "Samba in Defense of Ecology". They were a little confused about the meaning of "ecology", but their intentions were obvious. Last month during the unrestrained enthusiasm of the pre-Lenten Brazilian Carnaval, the samba school with their typical glitter, feathers, and contagious drum beat, danced and sang their original music about conservation, through the crowded streets of Silva Jardim. Behind them was a golden float, an ark filled with dancing people dressed as local animals. At the helm of the ark was a human-size golden lion tamarin (Fig. 29). In Brazil, when a message reaches the level of samba and Carnaval, you know it has reached the people! Our challenge now is to keep this public enthusiasm alive, so that conservation will come to be regarded not just as something in vogue today, but as an issue of continuing importance.

Our plans for the education program in the next few months involve presentations in the schools of the third target municipality, an essay contest for all the students of the other two municipalities, visits to local landowners, and the production of more instructional materials for the schools.

As you may have sensed by now, coordination of transportation and accommodations for the personnel and activities involved in all the different aspects of the Golden Lion Tamarin Conservation Project is often a rather harrying task. But fortunately, sometimes even amazingly, all the separate talented musicians of our project orchestra are playing beautifully, both solo and in harmony. Conservation of the golden lion tamarin is not as distant a possibility as it once appeared.

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Education Specialist  
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#### Acknowledgement

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## Primates and Forest Exploitation at Tefé, Brazilian Amazonia

The region between the Juruá and Purus rivers, in western Brazilian Amazonia, contains some of the most species-rich primate communities in the world. A total of 15 species occur between the lower reaches of these two rivers and as many as 13 may occur at one site.

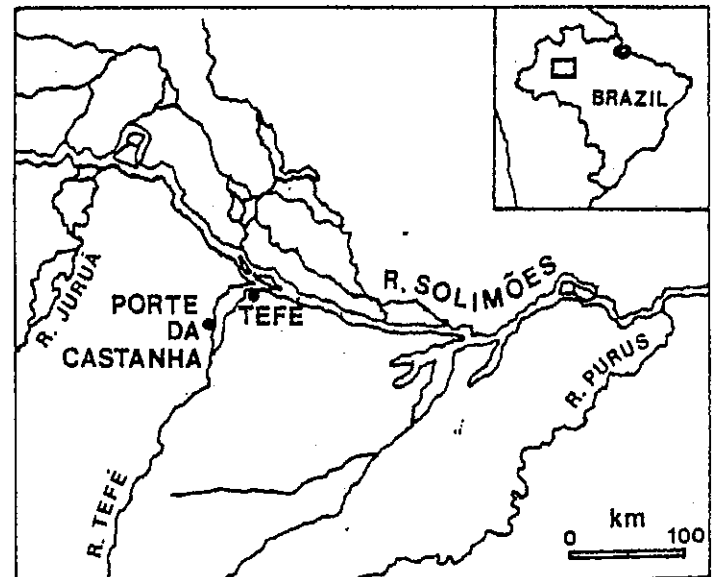


Fig. 30: Map of the Tefé region, east of the Juruá River in the state of Amazonas, Brazil (map courtesy of the author).

Table 1: Abundance of Diurnal Primates in Primary and Disturbed Forests at Porte da Castanha, Tefé (Preliminary Results)

Species	# Encounters/ 10 km Surveyed		Primary forest	Selectively logged forest	Forest island (40 ha)	Agricultural mosaic
	Mean	band size				
<i>Saguinus m. mystax</i> <sup>1</sup>	6.9	2.0	1.96	2.14	0.25	1.27
<i>Saguinus fuscicollis avilapirisi</i>	2.0	0	0	0	0	0.03
<i>Cebus apella apella</i>	7.6	0.83	0.83	1.58	2.22	0.15
<i>Cebus albifrons</i>	10.9	0.40	0.40	0.37	0	0
<i>Saimiri s. sciureus</i> <sup>2</sup>	60	0.58	0.58	1.11	1.24	0.47
<i>Callicebus moloch cupreus</i>	2.3	0	0	0	1.24	0.44
<i>Callicebus t. torquatus</i>	3.4	0.28	0.28	0.56	present	0.15
<i>Pithecia albicans</i>	4.3	0.83	0.83	0.65	0.12	0.18
<i>Alouatta seniculus</i>	2.9	0.15	0.15	0.09	0.74	0
<i>Lagothrix lagotricha</i> <sup>3</sup>	17.4	0.15	0.15	0.09	0	0
<i>Ateles paniscus chamek</i>	7.6	0.18	0.18	0.19	0	0
Total distance walked (km)			397	108	81	338

<sup>1</sup> The range of *S. m. pileatus* is subsequently restricted to east of the Tefé River (contra Hershkovitz, 1977).

<sup>2</sup> The distinctive *Saimiri* on the west bank of the Tefé River, originally referred to as '*Chrysotrux nigritiuta*' by J. A. Wagner, has been included within *S. s. sciureus* by Hershkovitz (1984), but may merit reexamination. A second species, *S. boliviensis*, occurs sympatrically with the above south of Tefé Lake.

<sup>3</sup> Two forms of *Lagothrix* occur sympatrically, one being the typical *L. l. cana*, the other being considerably smaller but with a pelage conforming to *L. l. praepiui*. The extent of hybridization, if any, is unknown at present. They are included together in the table.

Note: *Aotus ? nigriceps* is also common throughout the study area. *Cebuella pygmaea* is reported by local residents but has yet to be observed.

This region of Amazonia has been relatively little studied in the past. As recently as June 1985, PSG member José Márcio Ayres reported the discovery of a new species of squirrel monkey (*Saimiri vanzolinii*) in seasonally flooded várzea forest east of the mouth of the Jurua river (Ayres, 1985).

Since December 1984, a study has been underway to determine the extent and effects of human disturbance in the region, particularly to investigate the latent impact of commercial logging operations. This forms part of a larger project encompassing other regions of Brazilian Amazonia, funded by WWF-U.S. and operating since February 1984. Work has so far concentrated around Tefé, 130 km east of the lower Jurua river (Fig. 30). Tefé is the type locality of three little-known primates, *Pithecia albicans*, *Saguinus mystax pileatus*, and *Saguinus fuscicollis avilapirisi*.

In 1980, a French-controlled logging company began work in terra firme forest behind the small community of Porte da Castanha, on the west bank of Tefé lake. This area was already locally affected by shifting manioc cultivation, having been settled for around 40 years. Logging of 12 commercial species was carried out with the aid of heavy machinery, and damage levels are provisionally estimated at a loss of 45% of the trees. The company ceased operations in 1981, however, and only four to five km<sup>2</sup> of forest were affected.

Synecological studies carried out at this site have shown that there are considerable differences between primates in their use of primary and logged forest, and in their ability to persist in isolated forest islands and cultivated areas (encompassing fields, regenerating scrub and isolated forest corridors). Differences may be indicated by frequencies of encounters in the various vegetation types (Table 1), although more subtle ecological and behavioral differences are also evident.

All species except *Cebus albifrons*, *Ateles paniscus* and *Lagothrix lagotricha* have been observed in the cultivated section along the edge of Tefé lake (which includes a 40 hectare forest island and corridors extending outwards from it into planted sections). Two primates, *Callicebus moloch* and *S. f. avilapirisi*, have been observed only here. The logged forest is visited by most species but is heavily used only

by five, all of them of small body weight and all of which spend a high proportion of foraging time searching for arthropod prey. It is possible that there is a higher density of suitable prey in the regeneration vegetation. To some extent the scarcity of the larger species in logged forest may be due to past hunting, but hunters have probably entered the unlogged forest too. Surveys carried out 60 km south of Porte da Castanha, in an unpopulated region of the Tefé river, have indicated far larger population densities of the target species *Alouatta seniculus*, *L. lagotricha* and *A. paniscus*. Although logged forest affords easier access to hunters, it continues to be exploited by target species, food supplies for the larger primates apparently still being present. Regeneration forest may contain fewer large food sources, provided by trees of such genera as *Hevea* and *Virola*, but others, such as those of the genus *Inga*, are common in logged forest and are exploited by many primates.

Since all transport in this region of Amazonia is by river, there are few settlements inland. Most human activities, including manioc and Brazil-nut tree cultivation, timber logging, and casual and commercial hunting for food species, are restricted to the fringes of the lakes and rivers; enormous areas of completely undisturbed forest remain. However, this will not always be the case. In view of the rising value of timber, the depletion of current source areas, and continual exploration of the commercial properties of Brazilian species, large-scale logging may be expected to begin in terra firme forests throughout Amazonia within a few years.

Porte da Castanha represents an interesting example of interacting human interests, including both agriculture and commercial logging, and wildlife populations. There is no evidence to suggest that all primates could persist solely in disturbed habitat, but it is apparent that all can be found around forest patches or within recently (five year old) logged forest, although they may include primary forest within their home ranges. Possibilities for integration of land use and wildlife conservation may well exist. Despite long-standing settlement, and a profusion of shotguns, *P. albicans* may be seen in regeneration scrub on the edge of Tefé lake, and both *L. lagotricha* and *A. paniscus* are common within a three hour trip from Tefé's international airport.

The study area at Porte da Castanha is due to be vacated at the end of 1985. In view of its ease of access and the extent of local goodwill (including cessation of hunting within the environs of the study area) the area would be suitable for further long- or short-term research, either ecological studies or conservation-oriented projects. Further details of the area may be obtained from the author or PSG chairman.

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## Primate Survey in the Iquê-Juruena Ecological Station, Mato Grosso, Brasil (Secretaria Especial do Meio Ambiente - SEMA)

The Iquê-Juruena Ecological Station, formerly known as Iquê-Aripuanã (Brasil, 1977), is located in the state of Mato Grosso, Brazil, north of the Iquê and west of the Juruena Rivers (lat. 11° 30' to 12° 21' S, long. 58° 42' to 59° 53' W) (Fig. 31).

The Ecological Stations Program of SEMA (Secretaria Especial do Meio Ambiente) has the objective of preserving representative samples from the main Brazilian ecosystems for development of comparative studies between these systems and those of neighbouring areas occupied by man (Perfil, s.d.). According to Brazilian law, an *Ecological Station* is an extension of a preserved national area, of ecological value, destined for research and limited experiments.

The Iquê-Juruena station holdings are estimated at 200,000 hectares. The soil in the station region is notably sandy and of very poor quality, supporting for the most part large areas of vegetation type known as "cerradão" (low xerophyll forest, after Eiten, 1979). In riparian areas, however, where conditions are more lush, tall tropical forest with emergents (Eiten, 1979) occurs, consisting of various large stems, primarily of Amazonian affinities. One of the more common larger trees in more open areas is *Chorisia* sp. (Bombacaceae), which was conspicuous during the time of our study because of its leafless condition and the presence of many large dried fruits on the bare branches.

The station facilities are concentrated in a single cleared area some 300 m from the Vilhena-Juina road (highway BR-174). There is also an airstrip directly adjacent to this clearing. This station is ideal for educational purposes as it has a well equipped dormitory consisting of four large rooms with baths, each capable of holding at least four students comfortably. A fully equipped kitchen and a dining room adjoin the dormitory section. A separate building houses laboratory facilities.

During the dry seasons of 1982 (E.S.) and 1983 (E.S. & K.M.), we spent one week walking through portions of the station and immediately adjacent areas to determine which primate species occur there. To census primates, several trails in and adjoining the station were covered,

some repeatedly. Whenever primates were encountered, the time was noted, the distance from the station buildings was estimated and an attempt was made to count the animals. In all, six species were seen and reliable reports from a farmer who has resided near the station for 10 years suggest that there may be an additional three or four species living in the station holdings (Table 1). Three primate species were seen directly adjacent to the station clearing. A stream about four meters wide runs through the forest some 400 m from the station buildings. In this riparian area both *Callicebus moloch* and *Cebus apella* were encountered on more than one occasion (see Table 1), in both 1982 and 1983. Two *Pithecia monachus* were also seen in this area in 1983 and a station employee stated that he had seen two *Pithecia* there on various other occasions. In 1982, E.S. saw a fourth species, *Aotus cf. nigriceps*, in another section of this forest bordering the same stream.

In lower forest several kilometers from the station clearing, both *Cebus apella* and *Saimiri sciureus* were seen — *Cebus* on three occasions and *Saimiri* on two. Once, a group of *Cebus* and a group of *Saimiri* were in direct proximity, suggesting a mixed foraging association. Some ten kilometers from the station clearing in an area of tall riparian forest, one troop of *Lagothrix lagotricha* was encountered. *Saimiri* was also observed in low forest in 1982, a few meters from the airstrip (Table 1).

A local resident states that spider monkeys (*Ateles*) and howler monkeys (*Alouatta*) also occur in the station in areas of forest adjacent to large rivers. Several residents mentioned a very small monkey, probably a callithrichid, and one resident reported a dark monkey with a patch "like a heart" on the forehead we suspect to be *Chiropotes*.

From species distribution maps, *Callicebus moloch* should be subspecies *donacophilus* (see Kinzey, 1982) and *Lagothrix lagotricha*, should be represented by *cana* (see Fooden, 1963). The night-monkey indicated for the region is *Aotus nigriceps* (see Hershkovitz, 1983) and the spider monkey is *Ateles paniscus chamek* (see Kellogg & Goldman, 1944). More

Table 1 — Primates Observed In and Directly Adjacent to the Iquê-Juruena Ecological Station, Mato Grosso, Brazil

Date (July 1983)	Time and Distance from Station Facilities	Species
10	0700: 100 m	<i>Cebus apella</i> (4-5 individuals including female with small carried infant)
	1630: 1 km	<i>Cebus apella</i> (6 ind.)
	1700: 3 km	<i>Callicebus moloch</i> (3 adults + 1 small carried infant)
11	0800: 4 km	<i>Saimiri sciureus</i> (no estimate of number)
	0930: 5 km	<i>Cebus apella</i> (10 ind.)
12	0830: 300 m	<i>Callicebus moloch</i> (2 adults and a large juvenile)
	0847: 300 m	<i>Pithecia monachus</i> (2 adults)
13	0624: 300 m	Same <i>Callicebus</i> group as 12 July
14	0650: 200 m	Same <i>Callicebus</i> group as 12, 13, July
	0825: 8 km	<i>Cebus apella</i> (2 ind.) and in direct proximity to <i>Saimiri sciureus</i> (5 ind.)
	1030: 10 km	<i>Lagothrix lagotricha</i> <sup>a</sup> (10 ind.)
17	0555: 200 m	<i>Callicebus moloch</i> (same group as 12, 13, 14 July)
	1545: 200 m	<i>Cebus apella</i> (same group as 10 July)

NOTE: Primates reported to be in the station but not seen include *Ateles paniscus*<sup>a</sup>, *Alouatta* sp., at least one callithrichid (*Callithrix argentata* or *C. humeralifer*<sup>b</sup>) and *Chiropotes cf. albinasus*<sup>b</sup>. *Aotus cf. nigriceps* was seen by E.S. in August 1982 some 350 m from the station clearing.

<sup>a</sup> species not currently listed in the IUCN Red Data Book but which should be (after Mittermeier & Coimbra-Filho, 1977)

<sup>b</sup> amber sheet, vulnerable species in the IUCN Red Data Book (after Mittermeier & Coimbra-Filho, 1977)

# ECOLOGICAL STATION OF IQUÊ — JURUENA - (MT)

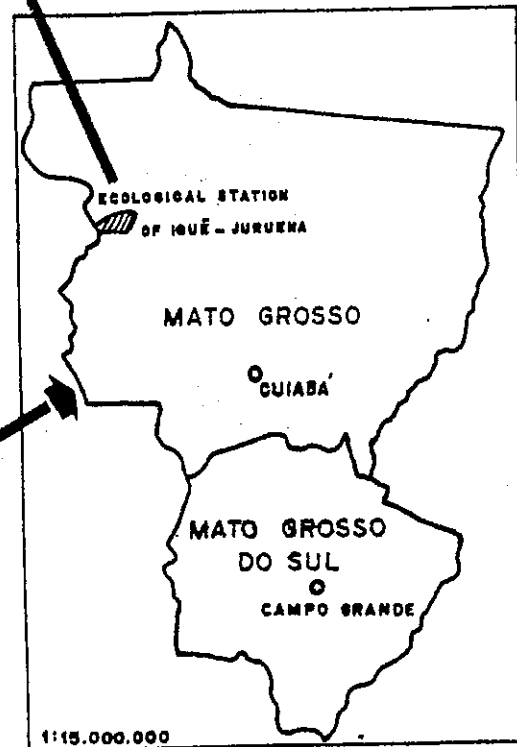
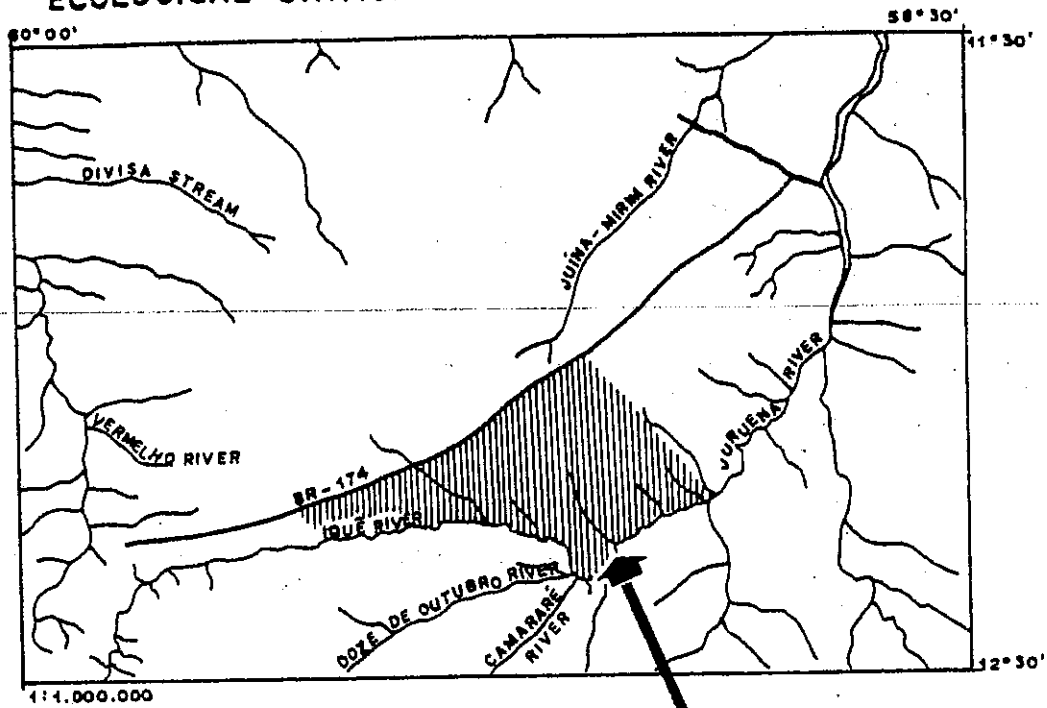


Fig. 31: Maps showing the location of the Iquê-Juruena Ecological Station in the state of Mato Grosso, Brazil (maps courtesy of the authors).



than one species of howler is known for western Mato Grosso: *Alouatta seniculus* was observed in the Guapore Valley (southwest and west of the station, Setz, 1983) and *A. caraya* near the Juina River (south of the station, Setz, 1983). *A. belzebul* is also potentially present. The callithrichid could be either *Callithrix humeralifer* or *C. argentata* (see Hershkovitz, 1977). The description given for the suspected *Chiropotes* appears to fit *C. albinasus*, a species collected by Miller in 1914, near the Comemoração River (about 100 km west of the station), and described by Allen (1916) as *Cacajao roosevelti* (Fontaine, 1981; Ayres, 1981). Miranda-Ribeiro (1914) also collected *Chiropotes albinasus* in riparian forests by the Piroculuina River and reports collecting *C. satanas* at the same locality, although this latter record is undocumented and is not mentioned in recent distribution maps (Ayres, 1981).

In addition to its primate fauna, the Iquê-Juruena Ecological Station also supports a wide variety of other animal species including puma, ocelot and peccary as well as at least four Psittacidae, including the blue and gold macaw (*Ara ararauna*), two species of *Amazona* and a smaller blue-headed parrot.

A program is currently underway to cut a series of trails both through the taller forest areas and some of the extensive areas of cerrado. Once this project is completed the reserve should prove ideal for a wide range of ecological studies: the rich concentration of animal and insect life directly adjacent to the station facilities currently permit the implementation of a number of projects on the flora and fauna of this interesting region.

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## Mandrill Ecology and the Status of Gabon's Rainforests

The behavior and ecology of the mandrill, *Mandrillus sphinx*, (Fig. 32), are scarcely known. Short-term studies of the mandrill by Jouvenin (1975) and Sabater Pi (1972) provided the only information about this elusive species until the recent publication by Hoshino *et al.* (1984) of an extended study of mandrill ecology in Cameroon. Despite these commendable efforts, the socio-ecology of mandrills is still not known in detail due to their timidity, wide-ranging habits, and densely vegetated habitat.



Fig. 32: Young adult male mandrill (*Mandrillus sphinx*) from the colony at the San Diego Wild Animal Park, California (photo by R. A. Mittermeier).

I conducted a self-financed ecological study of the mandrill in northeastern and central Gabon from November 1982 to October 1983, based at the Institut de Recherche en Écologie Tropicale near Makokou. Data were gathered by direct observation, by collecting evidence left along fresh trails, and by fecal and stomach content analyses. Surveys were conducted in several localities in Gabon, while actual fieldwork was done in the vicinity of the Institut, as well as at the Réserve de Lopé-Okanda in central Gabon, approximately 250 km southwest of Makokou (Fig. 33). The study yielded data on mandrill diet and habitat preference, with additional information regarding group size, composition, defense and predation.

The mandrill is one of the largest of the Cercopithecinae. Adult males attain weights of 30–40 kg, while females are nearly half the size of the males. The mandrill is most readily distinguishable from the baboons by the vivid facial coloration and longitudinal muzzle ridges of both sexes and the bright colors on the male's rump.

Like the baboons, mandrills exhibit a highly eclectic feeding behavior through the selection of a diverse array of dietary items from a wide range of species. Sixty-three species of plants and fruits in 27 families were identified as mandrill foods. Of the fruiting species, 72% were trees and 9% were lianas, while 11% were undetermined. Herbaceous plants, which account for 8% of plant foods consumed, produce small amounts of fruit, but may be utilized more for the nutritional components of young shoots.

In addition, I received many reports from the local people of mandrills consuming plantation crops including *Elaeis guineensis* (palm nut)

and *Manihot utilisima* (manioc). Other cultivated plants mentioned were bananas, mangos, pineapples, papayas and avocados. The major dry season (June through August), when forest foods are least available, was cited as the time of most frequent mandrill incursions into cultivated areas.

Animal foods appear to be taken infrequently on an opportunistic basis and probably account for only a small fraction of the total food intake of mandrills (found in 7% of fecal samples and stomach contents). Sizes of vertebrate prey ranged from the African brush-tailed porcupine (*Atherurus africanus*) to small undetermined species of tortoise and frog. Invertebrates (51 determined species) may be important supplements, with beetles (Scarabaeidae, 6 species), ants (Formicidae, 15 species) and spiders (Araneida, 5 species) being the most frequently consumed items. Frequencies for insect remains ranged from 90–100%. Leaves, shoots, stems and bark are also consumed in small quantities.

Overall, analyses revealed fruits to be the numerically most important dietary item (88%), supplemented by various plant parts (5%) and numerous insect species (5%), with fungi and earth particles each comprising 2% of relative intake of foods. In my study locations, the majority of mandrill sightings and identified foods were attributed to primary forest (71%), but foraging also occurs in secondary (14%), riparian and inundated forests (14%). Mandrills feed primarily on the forest floor, but also climb trees to obtain food, probably on a more frequent basis than do the *Papio* species.

Mandrills were observed in one-male and multi-male aggregations ranging from 15–150 individuals, and also as solitary males. Thus, sizable populations exist in northeastern and central Gabon, and hopefully in other areas of Gabon where mandrills occur. Although the mandrill is officially listed as an endangered species, and is subjected to heavy hunting pressure in Equatorial Guinea (Rio Muni) and southern Cameroon (Wolfheim, 1984), this situation does not appear to prevail in Gabon. It is hunted for meat, but its elusive nature and wide-ranging habits, combined with the dense vegetation, make this practice difficult. Infant mandrills are also taken as pets when adult females are shot.

Gabon is composed of 85% rainforest and 15% savanna, with many inaccessible and uninhabited regions. Economic development and the human population density remain at low levels (approximately 1 million people in an area of 267,667 km<sup>2</sup>), so Gabon has retained much of its primary rainforest and, thus, its diverse plant and animal communities.

Although the Gabonese government has created several reserves, a severe lack of knowledgeable personnel has prevented the proper administration of these areas. The Département des Eaux et Forêts has expressed the intention of designating two reserves as national parks in the future. Dr. Caroline Tutin's presence at the Réserve de Lopé-Okanda in central Gabon, where she commenced an ecological study of sympatric gorillas (*Gorilla g. gorilla*) and chimpanzees (*Pan t. troglodytes*) in the autumn of 1983, will hopefully accelerate the development of this 5000 km<sup>2</sup> reserve into a national park. An additional reserve (1000 km<sup>2</sup>) in southwestern Gabon is also under consideration.

Selective logging practices have thus far prevented the destruction of Gabon's rainforests. The average lifespan of a logging operation is seven years, after which time the area is usually vacated. Despite the disturbance caused by heavy machinery and the creation of access roads and new human communities, the area surrounding a logging camp is certainly not devoid of wildlife. It appears that animal communities may sufficiently recover within several years after the abandonment of a logging camp. Pre- and post-logging surveys of exploited rainforest would be highly beneficial to the establishment of conservation policies in Gabon and will be recommended.

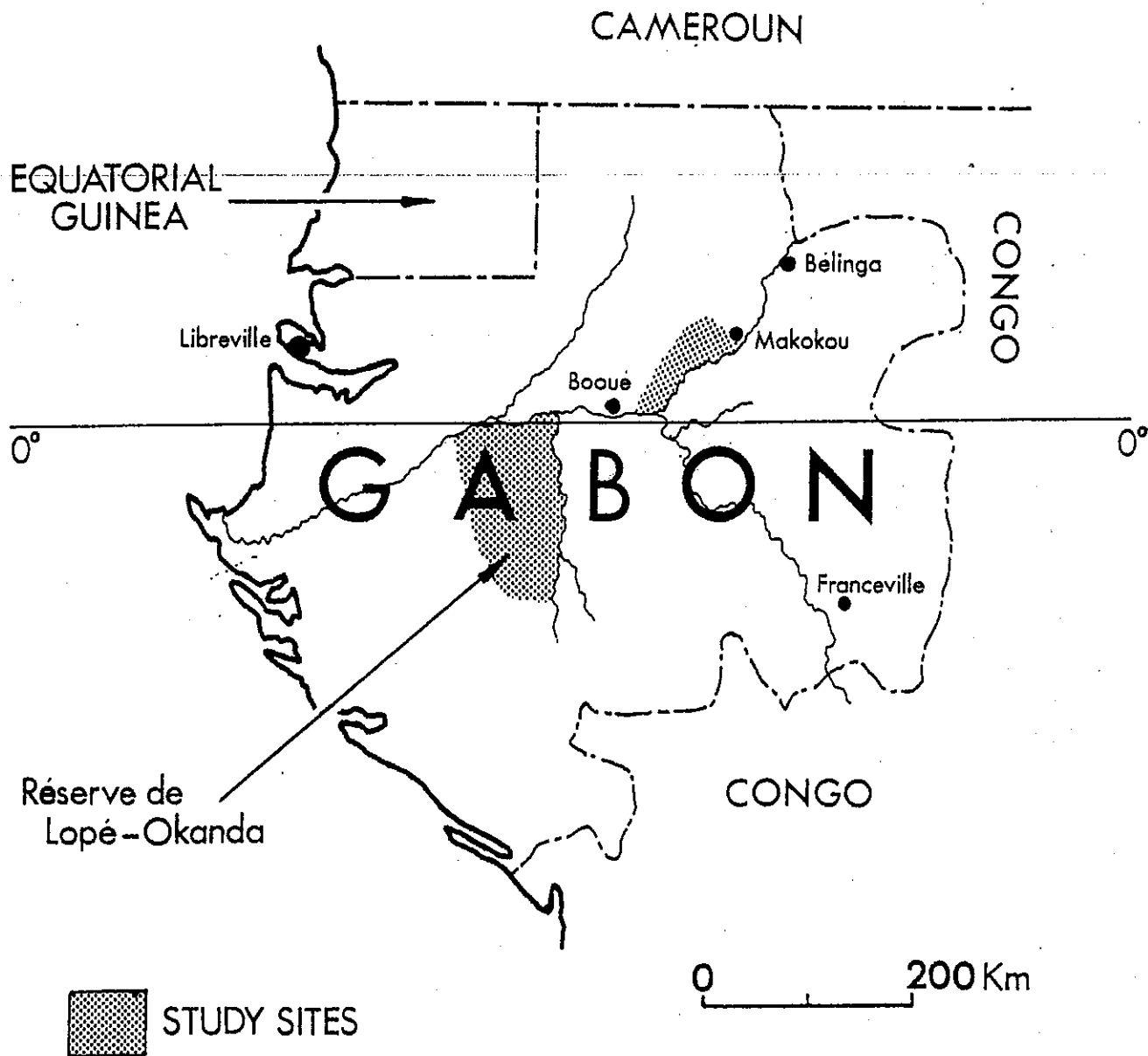


Fig. 33: Locations of study sites in Gabon visited by the author (map by Stephen Nash).

Probably the greatest threat to the existence of Gabon's rainforests is the construction of the Transgabonais railroad. When I left Gabon in October, 1983, the railroad extended nearly 300 km from Libreville, the capital on the coast, to Booué in the central region. Construction was already underway towards Franceville in the southeast. Future plans call for a railline between Booué and Makokou in the northeast. This area is largely unexploited due to its rough terrain, yet the railroad would facilitate the extraction of both timber and minerals. The abandoned iron mining community of Béliinga in the extreme northeast would flourish once again. A survey of the impact of the railroad's progression on the surrounding environment and local ethnic cultures will also be recommended to appropriate government officials in Gabon.

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## Current Conservation Status of the Mwanihana Rain Forest, Uzungwa Mountains, Sanje, Tanzania

The eastern scarp of the Uzungwa Mountains is located in the central area of the chain of isolated block mountains running from southern Malawi to northeast Tanzania. The Uzungwas, an area of about 10,000 km<sup>2</sup>, is the only area in East Africa where there is continuous forest cover from lowland forests of 300 m through intermediate Parinari rain forest to montane *Podocarpus* forest at 2600 m. The Uzungwas have five species of forest antelope: red, blue and Abbott's duikers, suni and bushbuck, making it the richest area in Tanzania for this group. Elephant, buffalo, bushpig, squirrels, hyrax, anomalures, leopards, and otters are among the forest mammals in the Uzungwas. But perhaps of greatest conservation interest in the Uzungwas are the six species of primates found there: the endemic Iringa red colobus (*Colobus badius gordonorum*), the black and white colobus (*C. angolensis palliatus*), the endemic crested mangabey (*Cercocebus galeritus sanjei*), the blue monkey (*Cercopithecus mitis monoides*), and two common lowland species at the forest edge, the yellow baboon (*Papio cynocephalus*), and the vervet monkey (*Cercopithecus aethiops*) (Rodgers and Homewood, 1982). Like many other East African montane forests, the Uzungwas have a number of endemic plant groups as well. In fact, the phytogeographical uniqueness of the Mwanihana appears to have resulted in substantial dietary and associated behavioral differences among the two Mwanihana colobines as compared to those of the same or closely related colobines in other forests throughout East and West Africa.

Because of the conservation value of the Uzungwas, substantial efforts have been made to gazette part of the area, the Mwanihana Rain Forest, as a national park. Original plans were to make the Mwanihana a separate park, but creating a new national park involves tremendous bureaucratic complications, requiring parliamentary decision. Fortunately, the eastern edge of the Mwanihana is only 10 miles NNE of Mikumi National Park. This creates the potential of extending the border of Mikumi National Park to include Mwanihana. We have since pursued this idea, and I am happy to say that our efforts seem to be paying off. The Director of Tanzanian National Parks has already approved the extension, as have the regional district directors of Morogoro and Iringa, and the Director of Forestry in Tanzania who currently controls the area. All that remains is final approval by the Ministry of Natural Resources of the map designating the boundaries of the new conservation area. This, we hope, will happen soon.

A large number of researchers have been working in the Mwanihana characterizing its community ecology for scientific purposes, as well providing the Tanzanian government with a biological profile of the area. Ongoing work in the Mwanihana include floral studies by J. Lovett, D. Bridson, and D. Thomas; studies of invertebrates by N. Schraff, T. Congdon, and M. Stolze; K. Howell is investigating the herpetological and small mammalian fauna of the area; S. Stuart, and F. Jensen are investigating the avifauna, and S. Wasser and A. Starling are studying the forest primates. The work of all of these scientists, along with some additional work by other scientists working in the Eastern Arc Forest Mountains of Tanzania are presently being compiled in an edited volume by J. Lovett and S.K. Wasser.

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## Utilization of Eucalyptus and Pine Plantations by Brown Lemurs in the Eastern Rainforest of Madagascar

From August-October 1984, I studied the feeding behavior of the brown lemur (*Lemur f. fulvus*) in an eastern Malagasy rainforest near Perinet (Fig. 34). This study was funded by the Deutsche Forschungsgemeinschaft. I found that during the day the lemurs ranged mostly through secondary forest. However, many of their sleeping trees were located in eucalyptus and mixed eucalyptus-pine plantations (Fig. 35). The most important tree species in these plantations were: *Eucalyptus cideroxylon*, *E. maculata*, *E. robusta*, *Pinus patula*, and *P. pinmaritima*. Before entering and after leaving their sleeping sites the animals spent two to three hours in these plantations. During this time, as well as during nocturnal activity periods, they fed extensively on the flowers of both eucalyptus and pine species.



Fig. 34: Secondary rainforest habitat of the brown lemur (*Lemur fulvus*) near Perinet in eastern Madagascar (photo courtesy of the author).

To understand the relative nutritional importance of these items in the diet of the brown lemur, I studied fecal samples. In August, when most of the eucalyptus trees flowered, 26.6% of the dried lemur feces consisted of eucalyptus flowers. Pine flowers contributed another 10.5% to the dry weight of the feces (Table 1). After the main flowering period the percentage of these two items of the total dry weight of the feces dropped to some 4.8% and the lemurs ate more leaves and fruits of trees growing in the secondary forest.

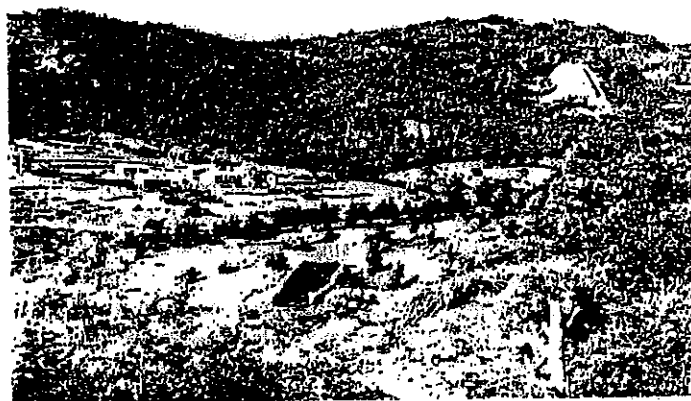


Fig. 35: View of mixed eucalyptus-pine plantation which is utilized by brown lemurs (photo courtesy of the author).

Table 1: Feces composition of *Lemur f. fulvus* in the eastern Malagasy rainforest in August and September 1984 (percentages of dry weight).

		August	September
<i>Eucalyptus</i> spp.	stamina	26.6%	2.7%
<i>Pinus</i> spp.	flower	10.5%	2.1%
<i>Pinus</i> spp.	leave	0	0.1%
<i>Canthium</i> spp.	fruit	10.3%	5.4%
<i>Symphonia</i> sp.	fruit	7.9%	1.2%
<i>Symphonia</i> sp.	fruit	0	2.1%
<i>Ravensara</i> sp.	fruit	6.6%	21.0%
<i>Gambeya</i> sp.	fruit	4.7%	3.0%
<i>Chrysulidocarpus</i> sp.	fruit	0	0.3%
other <i>Palmae</i>	fruit	0.4%	0.1%
<i>Mymecylon</i> sp.	fruit	0	0.1%
unidentified items		33.0%	61.8%

*Lemur f. fulvus* was the only one of the ten sympatric prosimian species occurring in the area to be seen feeding on the flowers of eucalyptus trees, though some of the other species may use the plantations for traveling and resting (see also Pollock, 1975). This ability of the brown lemurs to use new and unfamiliar food resources may contribute to the wide distribution of this species in Madagascar.

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### Notes On The Recently Rediscovered Sclater's Lemur (*Lemur macaco flavifrons*)

*Lemur macaco flavifrons* is a diurnal and gregarious subspecies with a marked sexual dimorphism, the fur of the male being completely black and that of the female being red-orange and white (Fig. 36). This subspecies was described from a single female specimen as *Prosimia flavifrons* by Gray in 1867. Sclater described the male in 1880 as *Lemur nigerrimus*. Its classification in the *macaco-fulvus* taxon has been changed many times since, despite the fact that very few museum specimens exist and none have been captured or sighted in the wild since 1932. For more details on its classification the reader is referred to Koenders *et al.* (1985).

In 1983 we found *L. m. flavifrons* in different forests in the Maromandia region of northwest Madagascar. The first group (at least four in-

dividuals) was seen 20 km west of the main road between Befotaka and Maromandia along a small track to Analalava. It seems likely that *L. m. flavifrons* occurs throughout the peninsula east of Befotaka. About 15 km south of Maromandia we saw at least 10 different groups. Although exact group sizes could not be ascertained, we estimated that they contained between six and 10 individuals, an average size similar to *L. m. macaco* or *L. fulvus* spp.

The northern limit of the *flavifrons* range is the Andranomalaza, an important river flowing through Maromandia. We found several individuals of *L. m. macaco* (two males and two females, all separately) in two different forests 5 km north of the river. In the area surrounding Befotaka there is no forest left and we believe that *L. m. flavifrons* does not occur south of this area. The eastern limit to its range remains unknown due to logistic difficulties in exploring that region. *L. m. fulvus* occurs around Antsohihy and we saw it in forests along the main road to Bealanana, an area which is likely to be near the northern limit of this subspecies' range.

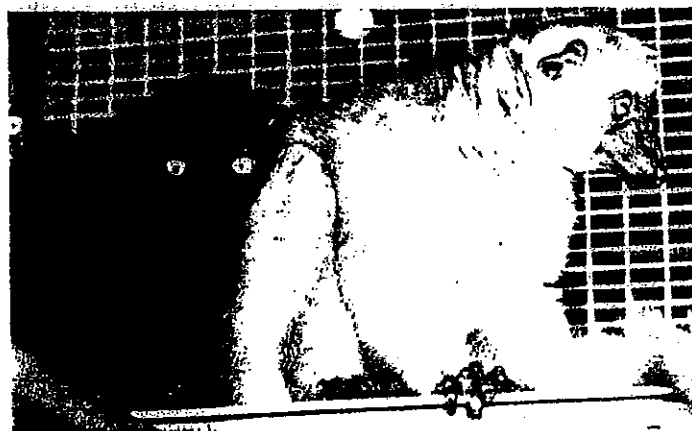


Fig. 36: A pair of Sclater's lemurs, showing their pronounced sexual dimorphism in coloration. The all-black male is on the left and the red-orange and white female on the right (photo courtesy of the author).

*L. m. flavifrons* is one of the nine parapatric subspecies of the taxon *macaco-fulvus*. It is, however, the only subspecies that does not occur in a protected park or reserve and it is threatened by hunting, trapping and especially forest destruction within its range. If no protective measures are taken soon, Sclater's lemur could become extinct.

In order to breed the animals in captivity we captured several individuals in July 1984. Two males and one female are being maintained at the Parc de Tsimbazaza in Tananarive and two pairs are presently at the primate facility at the Faculté de Médecine in Strasbourg, France. It is hoped that reproduction by these animals will help ensure the survival of this subspecies in captivity.

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## Summary of Primate Conservation Problems in the Mentawai Islands, Indonesia

The Mentawai Islands, 85-135 km off the west coast of Sumatra, Indonesia, are home to the following four endemic species and subspecies of primates: Kloss's gibbon (*Hylobates klossii*, Fig. 37), the pig-tailed langur or simakobu (*Nasalis [Simias] concolor*, Fig. 38), the Mentawai langur (*Presbytis potenziani*), and the Mentawai pig-tailed macaque (*Macaca nemestrina pagensis*).

From northwest to southeast, the four islands in the Mentawai chain are Siberut, Sipora, North Pagai, and South Pagai (Fig. 39). All four species of Mentawai primates occur on each island. The total area of these islands is 7,000 km<sup>2</sup>, distributed as follows: Siberut 4,480 km<sup>2</sup>, Sipora 845 km<sup>2</sup>, North & South Pagai 1,675 km<sup>2</sup>.

Biologically, Siberut is the best known of the Mentawais. It has the sparsest human population, 4 persons per km<sup>2</sup>, compared to 9/km<sup>2</sup> in

Sipora and the Pagais. It probably also has the largest primate populations. There is little suitable primate habitat left in Sipora (Tenaza, pers. obs.), and the Pagais have not been adequately surveyed. Consequently, the present report deals mainly with Siberut. The primate populations of Siberut have been estimated at 36,000 Kloss's gibbons, 46,000 Mentawai langurs, 19,000 pig-tailed langurs, and 39,000 Mentawai macaques (World Wildlife Fund, 1980).

The most recent account of conservation conditions in the Mentawais is in a World Wildlife Fund report by Mitchell (1982). This report updates WWF's 1980 report "Saving Siberut." To our knowledge, no WWF representatives or foreign researchers have worked in Mentawai since Mitchell left.



Fig. 37: Juvenile Kloss's gibbon (*Hylobates klossii*) from the island of Siberut (photo by R. Tenaza).



Fig. 38: Immature pig-tailed langur or simakobu (*Nasalis [Simias] concolor*) from North Pagai Island (photo by R. Tenaza).

Siberut is still undisturbed forest. The balance is disturbed to varying degrees by gardens, settlements, commercial logging, and commercial harvesting of rattan (Mitchell, 1982). Commercial logging expanded in Siberut in the early 1970's, then declined to a halt in the early 1980's. The decline was, reportedly, due to lack of profits and difficulties imposed by rainfall, terrain, and soil conditions. Timber exported from Siberut declined from 64,000 m<sup>3</sup> in 1977 to 62,000 m<sup>3</sup> in 1978, 60,000 m<sup>3</sup> in 1979, 24,000 m<sup>3</sup> in 1980, and none in 1981 (Mitchell, 1982). Thus, unless conditions have changed since 1982, commercial logging currently is not a threat to Siberut's wildlife.

Two types of rattan, manau and rotan, are harvested by Siberut islanders for sale to concessionaires, who export it to Sumatra. Manau is cut into 3 meter lengths to be sold, and the thinner rotan is coiled and sold by weight. Between 1977 and 1982, 9.3 million meters of manau and 780 metric tons of rotan were exported from Siberut (Mitchell, 1982). Because rattan fruits are important in the diets of gibbons, macaques and perhaps the other primates in Mentawai, continued large-scale harvest of rattan could be detrimental to primates.

The men of Siberut hunt all four species of primates for food with bows and poisoned arrows (Figs. 40-41), and probably have done so since they first populated Siberut at least three millennia ago (Tenaza & Tilson, 1985). The ability of the primates to withstand this traditional hunting will deteriorate rapidly with growth of the population of hunters in Siberut, or with introduction of modern weapons.

As part of its transmigration program, to help relieve overcrowding

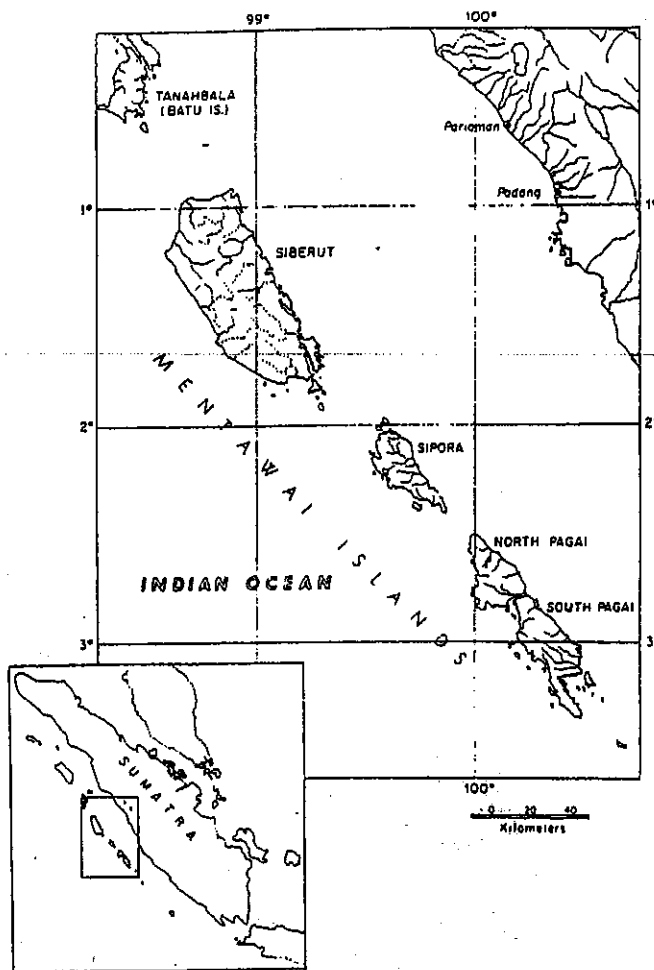


Fig. 39: Map showing the location of the islands in the Mentawai chain off the western coast of Sumatra (map courtesy of the author).

in Java, Indonesia plans to move people from Java to Mentawai. This would involve clearing forests for farming, and constructing roads and airstrips in the islands. The plan as it stood in 1982 was first to move 1,000 "heads of families" to Sipora, then later, in a second phase to move some to Siberut. If this plan were implemented, the clearing of forests to make farmlands would pose a serious threat to wildlife.

In October 1976, a 6,500 ha game sanctuary, Teitei Batti, was established in central Siberut by the Indonesian Ministry of Agriculture. WWF proposed in 1979 that this be expanded to a 50,000 ha strictly



Fig. 40: Three hunters in southeast Siberut return from the forest with a pig-tailed langur (hunter in front) and a Kloss's gibbon (hunter at the rear) (photo by R. Tenaza).



Fig. 41: Hunters butchering a female Kloss's gibbon shot in southeastern Siberut (photo by R. Tenaza).

protected core area with extensions totalling another 100,000 ha in which traditional uses would be allowed. Although the WWF proposal was not followed precisely, in December 1979 the Ministry of Agriculture did extend the original 6,500 ha game sanctuary by an additional 50,000 ha. In lands designated in Indonesia as game sanctuaries (suaka margesatwa), the flora, fauna, and habitat may be strictly protected, or traditional uses and commercial uses may both be allowed (Mitchell, 1982).

Primate populations in the Pagai Islands have not been surveyed. It is possible that they may be as dense or denser than primate populations in Siberut (Tenaza, pers. obs.) because the human population in Pagai is concentrated in villages along the coast, with little utilization of inland areas (in Siberut, by contrast, the population is more evenly distributed over the whole island), and because the men of Pagai hunt less than those in Siberut, protein being more readily available from other sources in Pagai than in Siberut.

To determine requirements for effective conservation of primates in the Mentawai Islands, on-site evaluation of the following is required:

1. Status of primate populations and habitat in the Pagai Islands.
2. Status and nature of any plans to transmigrate people to Mentawai from other areas.
3. Impact of the commercial rattan harvest on primates.
4. Status of management plan implementation on Siberut.
5. Status of the regional development plan for the Mentawai Islands, as proposed by the West Sumatra provincial government in cooperation with the government of West Germany.

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# NEWS FROM CAPTIVITY

## Status of the Cotton-top Tamarin (*Saguinus oedipus*) in Captivity

The conservation of the endangered cotton-top (*Saguinus oedipus*, Fig. 42) presents unique problems and opportunities due to the combined interests of conservation biologists, zoos and biomedical researchers in this species.

No reliable estimates of the wild population exist but there is no question that the species is critically endangered. *S. oedipus* was placed on the Colombian endangered species list in 1972, Appendix I of CITES in 1973, and the U.S. endangered species list in 1976 (Mittermeier and Coimbra-Filho, 1983). *S. oedipus* has a geographic range limited to a small area of northwestern Colombia and the wild population has been placed in a precarious state by deforestation within its range and extensive exportations. Neyman (1978) estimated that up to 70% of the forest in the species' range had been replaced with pasture and farmland by 1966 and much of the remaining habitat consisted of patches too small to maintain a tamarin population. In addition, it is estimated that 30,000 - 40,000 *S. oedipus* were exported from Colombia, primarily for research use, in the 1960's and early 1970's (Hernandez-Camacho and Cooper, 1976).

Cotton-top tamarins have been and continue to be a popular species for zoo exhibition, however, the majority of *S. oedipus* in captivity are in research colonies. Initially, use of *S. oedipus* in biomedical research was related to its easy availability and low costs (Gengozian, 1969; Mittermeier and Coimbra-Filho, 1983). General use of the species in areas of research in which callitrichids are commonly used (viral oncology, immunology, infectious disease, reproductive physiology) was curtailed in 1976. However, two areas of research have been identified in which *S. oedipus* provides a unique model, the study of Epstein-Barr virus-induced lymphoproliferative diseases (Hanto, *et al.*, 1985) and spontaneously occurring colon cancer (Lushbaugh, *et al.*, 1978; Chalifoux and Bronson, 1981).

With a combined interest in the biomedical use of this species and its conservation, Oak Ridge Associated Universities (ORAU) has initiated efforts to assess the status of the *S. oedipus* captive population. As the first step in this process, we have begun compiling an *S. oedipus* studbook and have petitioned the American Association of Zoological Parks and Aquariums for recognition of the studbook. In addition, formation of a species survival plan, involving both zoo and research colonies is being pursued.

The published information available at present and preliminary studbook reports suggest that *S. oedipus* could be sustained in captivity indefinitely as a genetically diverse population if properly managed. The population is large, estimated to be between 1,000 - 1,300 animals. Approximately 30% of these animals are in zoos and 70% in research colonies; approximately 55% are in North America and 40% in Europe and Britain. The studbook information indicates that transfers and loans between research colonies and zoos in Europe are not uncommon. ORAU maintains the largest colony of *S. oedipus*, approximately 260 animals. Within the ORAU colony, 20.4% of the animals are wild-caught (imported between 1970-1976) and the colony-born population represents approximately 45 different founder lines. The information on the rest of the *S. oedipus* population has not yet been analyzed to determine whether the entire population is equally as diverse.

Particularly promising for the future is the fact that captive reproductive performance has improved consistently over the last ten years. The



Fig. 42: A captive female cotton-top tamarin (*Saguinus oedipus*) with one of her infants at the Marmoset Research Center, Oak Ridge Associated Universities (photo courtesy of the author).

Table 1: Survival of *S. oedipus* Born in ORAU Colony

Year	% Survival to One Year of Age:	
	of Total Births	of Live-Births
1976	23.4	-
1977	24.2	-
1978	36.4	-
1979	36.0	51.0
1980	47.0	55.0
1981	45.0	60.0
1982	47.0	61.0
1983	54.0	67.0
1984	48.0	79.0
1985	52.0	73.0



figures presented in Table 1 on reproduction in the ORAU colony reflect this trend, and reports on other large callitrichid colonies also indicate improved reproductive performance. In reports on captive reproductive performance prior to 1978, infant survival to one year was frequently less than 35% of live births (Gengozian, *et al.*, 1978; Hampton *et al.*, 1978). However, more recent reports (Brand, 1981; Kirkwood, *et al.*, 1983; Snowdon, *et al.*, in press; Tardif, *et al.*, 1984a) indicate that 55-70% of live-born infants survive to weaning. For 1985, 73% of the live-born young in the ORAU colony survived to weaning (see Table 1). More importantly, successful reproduction by captive-born animals is reported from a number of research colonies and zoos (Kirkwood, *et al.*, 1983; Snowdon, *et al.*, in press; Tardif, *et al.*, 1984a,b). Table 2 contrasts the reproductive performance of wild-caught and captive-born pairs at ORAU. Our successful captive-born breeding population includes three second-generation females and two second-generation males (animals with at least one captive-born parent). The improvement in breeding of captive-born *S. oedipus* is generally believed to be due to increased understanding of the importance of social experience in tamarins, particularly early experience with infants.

**Table 2: Comparison of Reproductive Performance of Wild-Caught and Captive-Born Matings.**

Year	% Survival to One Year of Age for Live-Born Offspring of:	
	Wild-Caught Pairs	Captive-Born Pairs
1980-81	60.1 (47/78)	0.0 (0/7)
1982-83	83.3 (20/24)	43.5 (10/23)
1984-85	72.7 (8/11)	60.0 (12/20)

Problems do remain. While survival of live-born infants has improved dramatically, high abortion and stillbirth rates (10-30%) continue to be a problem in many colonies. Some zoos have expressed difficulties in finding new mates, especially females. It is likely that certain founder lines will be heavily represented. The impact of over-representation of certain lines is difficult to assess at present, with a large percentage of the breeding population still composed of wild-caught animals. However, with a large, relatively diverse population, this over-representation should not be a limiting factor. No difficulties are evident which cannot be overcome if all concerned work together to maintain a genetically diverse population.

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## The Brazilian National Primate Center

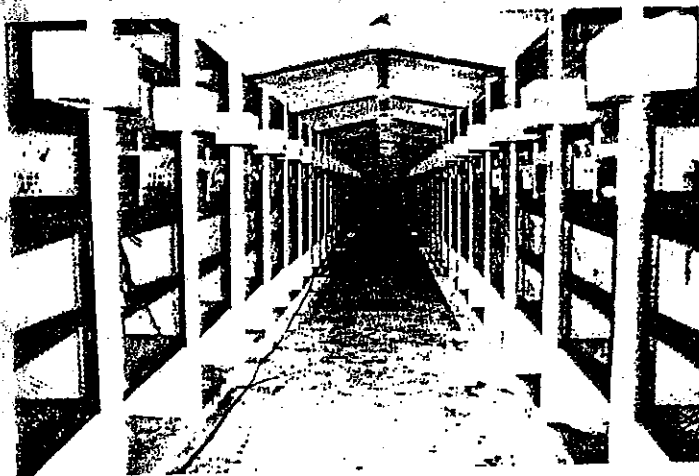
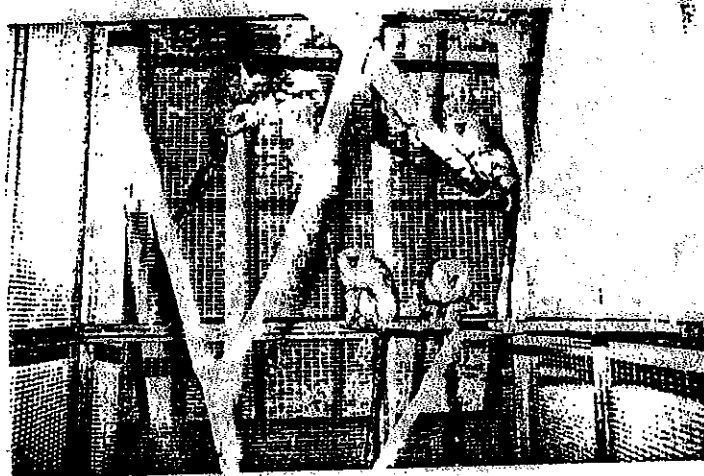
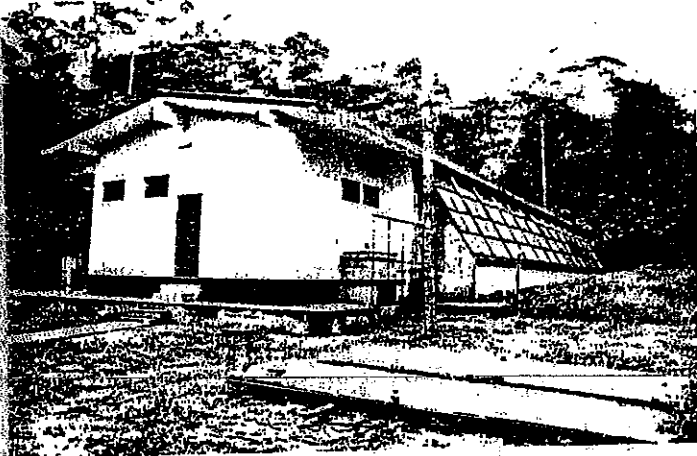
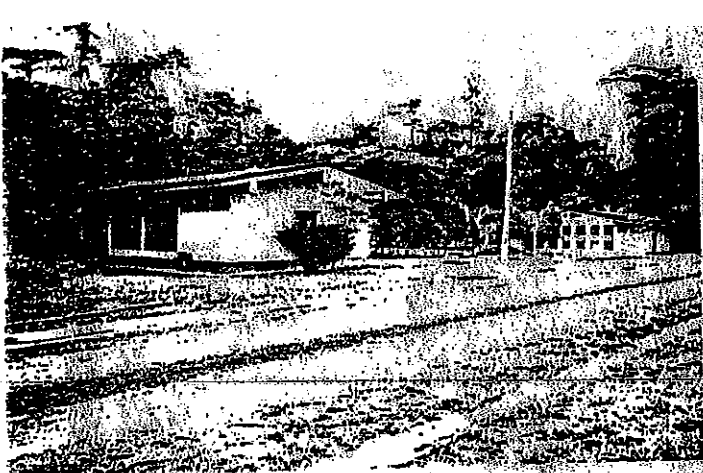
World wide concern over the threat of tropical forest destruction to non-human primate populations resulted in a series of meetings between the Pan American Health Organization and the appropriate government departments of Peru, Colombia and Brazil. The aim of these meetings was to develop captive breeding centers and other conservation measures to ensure the continued availability of primate species important to biomedical research. By directive of the Brazilian Health Minister, Dr. Paulo de Almeida Machado, the Centro Nacional de Primatas was created on March 20, 1978. Responsibility for its development was assigned to the Fundação Serviços de Saude Publica (FSESP), a department of the Health Ministry.

The primary objective of the center is the controlled breeding of all non-human primate species required for national bio-medical research projects. Secondary objectives include the breeding of species which have not yet been screened as models for research and those which are endangered. Agreements exist with national universities and other Brazilian institutions for cooperation in general primatological research. Funds for the development of the center are provided by the Health Ministry, channelled through the Fundação SESP.

The center is located approximately 15 km from the city of Belém, the capital of the state of Pará in northern Brazil, south of the Amazon river. The site encompasses 25 hectares and is approached by a private road off BR-316. Plans provide for 12 breeding rooms, 3 quarantine rooms, a site workshop, an administrative office block, and an animal clinic with surgical facilities (Figs. 43-46). To date the following buildings are completed and operational:

One quarantine room, 14 x 8 m, housing 50 individual suspended wire cages. The sides and one end of the building are of wooden framed panels





Figs. 43-46: (upper left) Quarantine and callitrichid breeding facilities at the National Primate Center, Belém. (upper right) Cebid breeding facility. (lower left) *Callipectus moloch* ssp. colony. (lower right) Interior of a callitrichid breeding facility, containing 50 enclosures (photos courtesy of the author).

of nylon fly screen netting above a 1 m high brick wall. The other end is all brick, enclosing a ceramic-tiled food preparation area with stainless steel sink units, a staff bathroom and food store including a large refrigerator.

Three breeding rooms, each 45 x 14 m, with a food preparation area, food store, office, small laboratory/clinic and staff bathroom. The sides of the animal quarter are of fly screen above a 1 m brick wall and are inclined 30° from the vertical. This, plus the north-south orientation of the buildings, ensures that all cages have at least a few hours of daily exposure to direct sunlight. This was considered desirable because of the high levels of vitamin D<sub>3</sub> required for the health of Neotropical primates. Two of the rooms, designed for group breeding of cebids, provide 12 breeding pens (5 x 4 x 2.5 m) which have brick sides and welded mesh wire fronts, backs and tops. Each of these is divided centrally by wire mesh with a door through which the animals can pass, so that each half can be used separately, thus doubling the number of cages available. The pens are furnished with a galvanized mesh platform 3 x 0.5 m wide set 2 m high on the dividing walls and a securely fixed series of 5 to 10 cm diameter natural wood perches at various heights. The third room is designed to accommodate callitrichids and pair bonded species such as *Aotus* and *Callipectus*. It provides 48 cages (1 x 3 x 2.5 m) and two double size cages for family groups. The dividing walls are brick and the front, back, top and floor are of welded mesh wire. The floors are suspended 60 cm above the concrete floor of the building. A small wooden nest box is provided in each cage, the wood being treated with marine varnish, making it impervious to fluids. The perches are of natural debarked tree branches.

The basic diet for all species is whole grain rice mixed with recon-

stituted whole milk powder, a little sugar, and a locally available pelleted dog diet (27% animal protein). This diet is fed to all animals for the first meal of the day. In the afternoon, they receive a selection of fruits and vegetables including banana, papaya, carrot and pumpkin. In addition to this, *Alouatta* are given a selection of natural tree foliage. Three times weekly all species receive a portion of hard boiled egg and on alternate days the callitrichids are given newborn mice. Complete vitamin supplements are given twice weekly in the drinking water. This diet appears to be satisfactory for all species — we have very few health problems and most species have bred. The cost for each animal per month does not exceed \$3.00 U.S.

All newly trapped animals are quarantined individually for a minimum of three weeks. During this period fecal samples are taken and examined for parasites. All infected animals, the vast majority, are dosed with an oral suspension of Mebendazole and Tiabendazole (Helmidrax — Quimica Haller Ltda) at 10 day intervals. At the behest of the associated Evandro Chagas Institute and the Wellcome Parasitology Unit, blood samples and skin biopsies are also taken, the latter to detect *Leishmania* infection. Xeno diagnosis, using live *Rhodnius* bugs, is also performed on many animals to detect infection with *Trypanosoma cruzi* (Chagas Disease). Diagnosed disease conditions are given appropriate veterinary treatment, but blanket dosing with antibiotics is not conducted. When the animals are considered fit, they are lightly anaesthetised with Ketalar, weighed and fitted with a light chain collar carrying either a light numbered disc or a system of colored plastic beads coded to indicate both sex and number of the animal. They are then transferred to the breeding rooms and incorporated into a breeding group. A register is kept of all animals received and individual cards prepared for each animal.

providing data of origin, health and veterinary treatment, breeding and location in the Center. In addition, all personnel are provided with forms to record events affecting the animals. The presence of small laboratories in each building prevents the necessity of removing any animal from that building for treatment with concomitant risk of disease transfer. All deaths are subject to necropsy. Museum type skins and skulls are routinely prepared of all casualties, except for cases where postmortem autolysis or necropsy procedures make this impracticable.

At the time of writing the center houses some 350 animals, including 19 species of which all but one, *Cercopithecus aethiops*, are found in Brazil. Between March, 1980 to September, 1984, breeding stock was trapped by our own personnel under license from the Instituto Brasileiro de Desenvolvimento Florestal (IBDF), the Brazilian government department responsible for faunal conservation. Currently, we are receiving relatively large numbers of primates rescued from the area flooded by damming the Tocantins river at Tucuruí, a large scale hydroelectric project. The bulk of the stock is made up of *Cebus apella*, *Alouatta belzebul* (Fig. 47), *Saimiri sciureus*, *Callithrix humeralifer* (Fig. 48) and *Callithrix argentata*. Smaller numbers of *Alouatta seniculus*, *Chiropotes satanas*, *Cebus albifrons*, *Lagothrix lagotricha*, *Ateles* sp., *Alouatta* sp., *Callicebus moloch*, *Callithrix jacchus*, *Callithrix penicillata*, *Saguinus midas midas*, *S. midas niger*, *Cebuella pygmaea* and *Cercopithecus aethiops* are also maintained. In the list of species currently maintained in the center, it will be noticed that precise taxonomic identification of some species has been omitted. With the exception of the Callitrichidae for which we have a copy of Dr. Philip Hershkovitz's monograph, we lack adequate descriptive literature for positive identification in some cases even to the species level and in others to subspecies. In view of this uncertainty, it was considered desirable to list only the genera or nominate specific nomenclature. The bulk of the 150 births recorded to date are callitrichids, particularly *C. humeralifer* (67) with lesser numbers of *C. argentata* (20), *S. midas* (18), *Cebus apella* (17) and *Cercopithecus aethiops* (9). It should be noted that this number does include still births and neonatal deaths, but that the great majority have survived and second generation *C. humeralifer* are being successfully reared. A number of other species are already multiparous. All species of which we have sufficient numbers are maintained in normal social groupings and all young are parent reared, except in cases where the mother has died. Young callitrichids are left with their parents past the birth of siblings and until these reach a minimum age of three months.

The center operates under the local direction of Dr. Jose Augusto P. C. Muniz, DVM, who is assisted by a second veterinarian, Dr. Marcos Aurelio F. Malacco. The remainder of the staff consists of a laboratory technician, artificer, secretary and nine animal technicians. Technical advice to the center has been provided intermittently by W.R. Kingston, contracted under arrangements with the Pan American Health Organization.

Future plans call for a fourth breeding room, designed to accommodate 112 suspended cages for callitrichids.

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Fig. 47: *Alouatta b. belzebul* at the Belém Primate Center. This individual is one of a number rescued following the flooding caused by the Tucuruí hydroelectric project (photo by R. A. Mittermeier).



Fig. 48: The National Primate Center at Belém maintains a breeding colony of *Callithrix h. humeralifer*, the only one known at present (photo by R. A. Mittermeier).

# ARTICLES

## Central and South America

### Some Aspects of the Conservation of Non-human Primates in Colombia

Colombia is situated in the intertropical zone in northwestern South America and covers 1,141,704 km<sup>2</sup> (excluding the archipelago of San Andres and Providencia and the Island of Malpelo). The Cordillera of the Andes in Colombia is divided into three ranges: the Eastern Cordillera, the Central Cordillera and the Western Cordillera. On the Caribbean coast is found the isolated Massif of the Sierra Nevada de Santa Marta where the highest elevations in the country are attained (Chundúa or Cristobal Colón Peak, 5780 m). Parallel to the Pacific coast to the north of the Baudó River is the Serranía de Baudó and to the north of this range the Serranía of Darién forms the border with Panama. To the east of the Cordillera of the Andes lies the Serranía de La Macarena, which reaches more than 2500 m. In the eastern part of the country there are numerous mesas and hills related to the Guyana tepuis formations. These are located principally between the Guaviare (to the north) and Caquetá Rivers (to the south). The watershed of the Orinoco River (Orinóquia) is located east of the continental divide (*divortium aquarum* of the Eastern Cordillera of the Andes). South of this is the watershed of the Amazon River (Amazonia) and to the west of these watersheds are the watersheds of the Catatumbo, Ranchería or Calancala, Magdalena-Cauca, Sinú and Atrato Rivers, all of which drain into the Caribbean Sea. Finally, numerous rivers drain into the Pacific Ocean such as the Baudó, San Juan, Dagua, Cajambre, Yurumanguí, Naya, Micay, Patía, Mira, etc. (Fig. 1). Many different climates are associated with this diverse geography so that the average annual isotherm is 27°-28°C on the Caribbean coast and 26°-27°C in the interior of the country. The altitudinal thermogradient varies locally (ca. 0.54-0.66° C/100m) and the limit of perpetual snows is found on the average at about 4800 m. The average annual rainfall varies from 150 mm (San José de Bahía Honda, Guajira) to 11,600 mm in the lowlands of the valley of the San Juan River, Chocó. The total area occupied by each district altitudinal level is shown in Table 1.

The non-human primates in Colombia have a notable amplitude with respect to their altitudinal distribution, since two species, *Alouatta seniculus* and *Aotus lemurinus* are found from sea level to 3200 m in cloud forest. Table 2 shows altitudinal limits of Colombian species and the corresponding annual isotherms; these were calculated based on meteorological data for weather stations situated within the species' range or from areas which were indicative of the regional thermogradient. Altitudinal limits in some cases indicate maximal elevations locally reached within the country, which do not take into account data for other countries. One may suppose that the upper altitudinal limits may be higher for some species. For eight species found only to the base of the Eastern Cordillera of the Andes, the limit has been considered 500 m (the average elevation at which the steep slopes of the Andes begin) and it is not improbable that this limit could be found up to 1000 m or perhaps higher in the case of those species whose area of distribution reaches the Andean slopes or in the Sierra of La Macarena.

The thermic tolerance was calculated as the difference between the annual isotherms for the altitudinal limits of distribution; and, although future research could increase or otherwise modify the obtained values, it is evident that the species can be classified on the basis of this criterion into two groups:

- (1) *Stenothermal species*: with a thermic tolerance less than 10°C. This group includes all the species of the Callithricidae as well as *Callimico*, *Saimiri*, *Aotus* (2 species), *Callicebus*, *Pithecia*, and *Cacajao*.
- (2) *Eurythermal Species*: with a thermic tolerance above 10°C. This group includes one species of *Aotus*, and *Alouatta*, *Cebus*, *Lagothrix*, and *Ateles*. Judging by the ecological information available with respect to *Alouatta palliata* in Central America, this species belongs to the second group. It should be noted that all of the species of the two groups have distributions in the lowlands.

The difference between these groups is related to body weight. In effect, with the exception of *Aotus lemurinus*, all of the eurythermal species have weights on the order of 3 kg or more: species of greater size clearly possess a greater altitudinal tolerance and can be found above 1500 m (body weights correspond to specimens in the collection of INDERENA). Based on the data presented in Table 2 we found that the

Table 1. Altitudinal Thermic Levels in Colombia (Excluding the Archipelago of San Andres and Providencia).

Thermic Level	Annual Isotherms	Area (km <sup>2</sup> )	Synonym
Hot	24°C	923,866.23 (80.92%)	"tierra caliente" tropical zone (auct. pluri)
Temperate	18-24°C	110,431.33 (9.67%)	"tierra templada" subtropical zone (auct. pluri) premontane zone (Holdridge)
Cold	12-18°C	77,746.75 (6.81%)	"tierra fría" temperate zone (auct.) lower montane zone (Holdridge)
Subparamo	6-12°C	27,559.09 (2.41%)	subalpine zone (auct.) montane zone (Holdridge)
Paramo	1.5-6°C	2,027.15 (0.177%)	alpine zone (auct.) subalpine and alpine zones (Holdridge)
Perpetual Snow	1.5°C	74.00 (0.006%)	

Table 2: Estimated Thermic Tolerances and Body Weight of Colombian Primates (see text).

Species	Calculated Altitudinal Limits	Thermic Limits (annual isotherms)	Thermic tolerance	Male Body Weight (gr)	Female Body Weight (gr)	Average Weight (both sexes)
<i>Cebuella pygmaea</i>	ca. 80-500 m	23.9 - 26.4°C	2.5°C	90 (N=1)	(83.3, 120; N=2)	101.1
<i>Saguinus nigricollis</i>	ca. 80-500 m	23.9 - 26.4°C	2.5°C	(425, 500; N=2)	470 (N=1)	465.0
<i>Saguinus fuscicollis</i>	ca. 80-500 m	23.9 - 26.4°C	2.5°C	(385-562; N=4)	(333-534; N=4)	461.7
<i>Saguinus inustus</i>	ca. 100-300 m	24 - 26.4°C	2.4°C	670 (N=1)	803 (N=1)	736.5
<i>Saguinus leucopus</i>	ca. 25-1500 m	20.4 - 28.5°C	8.1°C	(456-532; N=2)	(435-525; N=2)	487.0
<i>Saguinus oedipus</i>	ca. 0-1500 m	21.6 - 28°C	6.4°C	(458-490; N=2)	(466-579; N=3)	489.8
<i>Callimico goeldii</i>	ca. 100-500 m	23.8 - 26.2°C	2.4°C	630 (N=1)		630.0
<i>Saimiri sciureus</i>	ca. 80-1500 m	21.0 - 26.4°C	5.4°C	(835-1380; N=9)	(595-1148; N=5)	970.4
<i>Aotus lemurinus</i>	0-3200 m	9.5 - 28.5°C	19.0°C	(608-1150; N=7)	(578-1050; N=6)	889.8
<i>Aotus brumbacki</i>	400-1543 m	19.4 - 26.0°C	6.6°C	1 sex not noted - 875	455 (N=1)	665
<i>Aotus vociferans</i>	ca. 80-500 m	23.9 - 26.4°C	2.5°C	(568-800; N=4)		697.5
<i>Callicebus moloch</i>	280-500 m	25.5 - 26.8°C	1.3°C			
<i>Callicebus torquatus</i>	80-500 m	23.9 - 26.4°C	2.5°C	(1232-1722; N=5)	(1030-1360; N=9)	1377.9
<i>Pithecia hirsuta</i>	80-500 m	23.9 - 26.4°C	2.5°C	(2106-3000; N=4)	2101 (N=1)	2281.25
<i>Cacajao melanocephalus</i>	ca. 100-300 m	ca. 24 - 25°C	ca. 1.0°C			
<i>Alouatta palliata</i>	ca. 0-1400 m	18.2 - 27.6°C	9.4°C	(6000-8000; N=5)		6600.0
<i>Alouatta seniculus</i>	0-3200 m	9.5 - 28.5°C	19.0°C	(5000-12500; N=8)	(4000-10000; N=9)	6918.95
<i>Cebus albifrons</i>	0-2000 m	16 - 28.5°C	12.5°C	(2650-5055; N=8)	(1750-5008; N=3)	3077.9
<i>Cebus capucinus</i>	0-2100 m	15.7 - 28.0°C	12.3°C	(3550-3708.9; N=3)	2500 (N=2)	3077.9
<i>Cebus apella</i>	80-2800 m	12.5 - 27.9°C	15.4°C	(2870-4215; N=9)	(2040-3000; N=5)	3032.25
<i>Lagothrix lagotricha</i>	80-3000 m	11.3 - 26.4°C	15.1°C	(7868-11500; N=2)		9684.0
<i>Ateles paniscus</i>	0-2500 m	13.3 - 28.5°C	15.2°C	(7875-8625; N=2)	(7500-10500; N=7)	8700.35

best empirical description of the relation between thermic tolerance and the cube root of body weight is obtained by means of a biolagarithmic equation:

$$\log_{10} t = -0.632685 + 1.35933 (\log_{10} P)$$

where  $t$  = thermic tolerance

$p$  = cube root of body weight

The above equation is supported by a good correlation ( $r = 0.668$ ,  $P < 0.01$ ), which suggests that this relation should be investigated in greater detail. It is worthwhile to note that, in all probability, the group of species that has occupied the Andean slopes and other mountains had their origin in low zones with humid, isomegathemic climates. Such a relationship probably represents an ecophysiological adaptive syndrome, and it should be noted that in the tropandean region under isothermic conditions the thermic equability becomes elevated following altitudinal thermogradients, and the mountainous areas occupied by non-human primates are influenced by the frequency of clouds. Thus, the greatest thermic equability coincides approximately with the 14°C isotherm. In Colombia this isotherm is situated around 2300-2600 m. Above these elevations the thermic equability begins to decrease. Related to this, there has not been a critical study of the geographical altitudinal variability of the Ceboidea of Colombia such as, for example, variation in texture, length and density of pelage in *Alouatta*, *Aotus*, *Cebus* and *Lagothrix*.

Table 3 shows the distribution of the Colombian species according

to the provinces of humidity (according to the Holdridge system), which is defined by the quotient  $PEV/P$  ( $PEV$  = annual evapotranspiration potential;  $P$  = mean annual precipitation). In Colombia the distribution of Ceboidea is found from the semiarid province to the superhumid province. All of the species are represented in the humid province ( $PEV/P = 0.50-1.00$ ) and perhumid province ( $PEV/P = 0.25-0.50$ ), ten species are also found in the superhumid province ( $PEV/P = 0.125-0.25$ ), eleven species extend into the subhumid province ( $PEV/P = 1.00-2.00$ ), while only three are found in the semiarid province ( $PEV/P = 2.00-4.00$ ).

The total areas of the humidity provinces in Colombia are included in Table 4. The absence of primate species in the perarid and arid provinces is easily explained given the corresponding vegetation types. The semiarid province, occupied by *Alouatta seniculus*, *Cebus albifrons* and *Cebus capucinus*, also has favorable habitats for these species in freatophytic forests or woody places with deficient drainage; and this also includes halohelophytic forests (mangroves) in the case of *Alouatta seniculus* (Isla de Salamanca National Park and the region of the Cienaga Grande de Santa Marta, Magdalena).

The subhumid province is found principally in the tropical thermic zone but also is found as an enclave in the temperate and cold thermic zones. The enclaves of the cold zone correspond to low frutescent forests which may be mixed with short grass or with succulents like *Opuntia*, *Agave* sp., or *Fourcraea* sp., and frequently they correspond to chasmocherophytic successions over clay pan soils which do not pro-

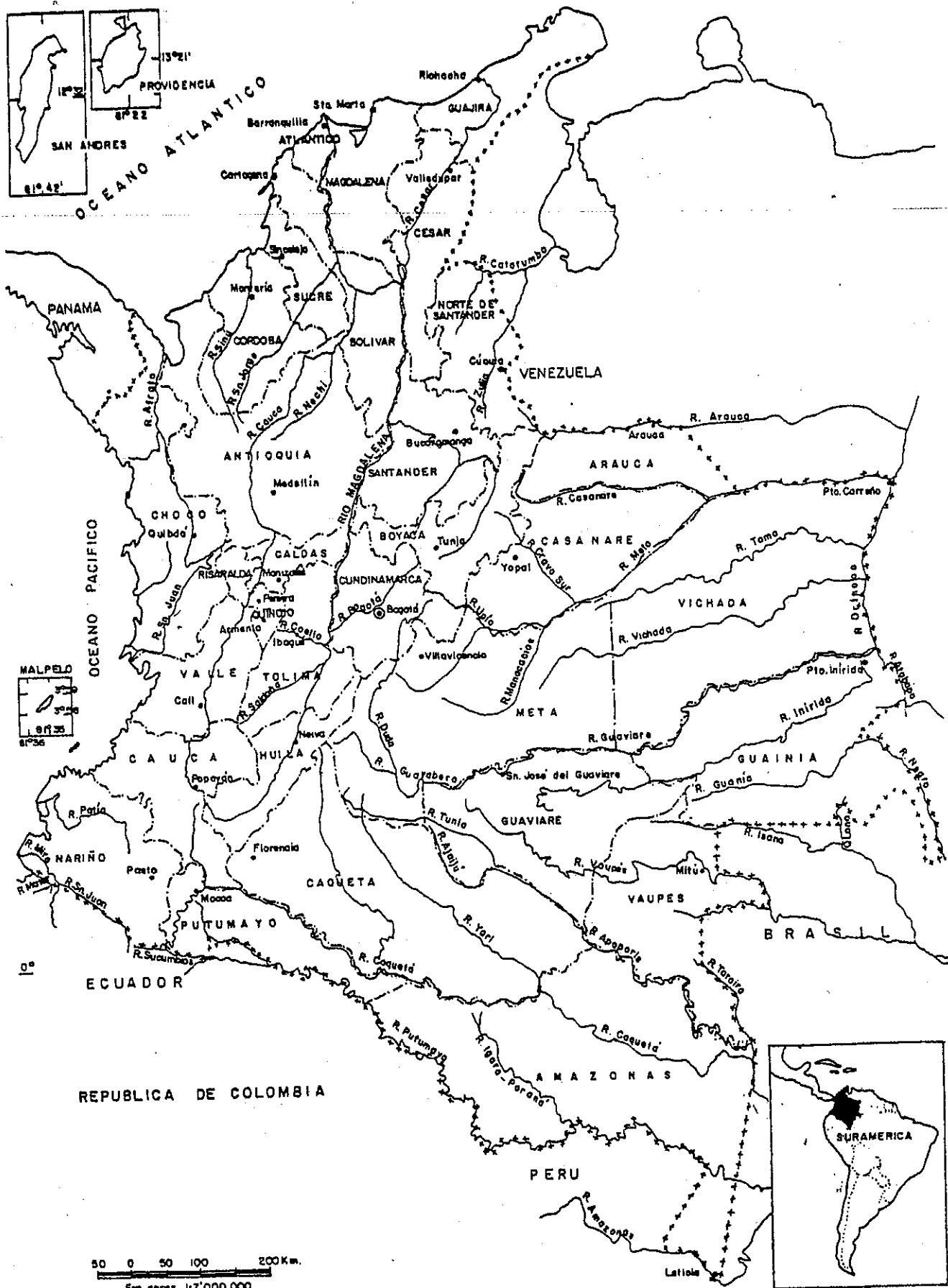


Table 3: Distribution of Known Species of Ceboidea in Colombia, According to the Humidity Provinces of Holdridge.

Species	Perarid	Arid	Semiarid	Subhumid	Humid	Perhumid	Superhumid	Total
<i>Cebuella pygmaea</i>	—	—	—	—	X	X	—	2
<i>Saguinus nigricollis</i>	—	—	—	—	X	X	—	2
<i>Saguinus fuscicollis</i>	—	—	—	—	X	X	—	2
<i>Saguinus inustus</i>	—	—	—	—	X	X	—	2
<i>Saguinus leucopus</i>	—	—	—	X	X	X	X	4
<i>Saguinus oedipus</i>	—	—	—	X	X	X	X	4
<i>Callimico goeldii</i>	—	—	—	—	X	X	—	2
<i>Saimiri sciureus</i>	—	—	—	X	X	X	—	3
<i>Aotus lemurinus</i>	—	—	—	X	X	X	X	4
<i>Aotus brumbacki</i>	—	—	—	—	X	X	X	3
<i>Aotus vociferans</i>	—	—	—	—	X	X	?	2
<i>Callicebus moloch</i>	—	—	—	—	X	X	—	2
<i>Callicebus torquatus</i>	—	—	—	X	X	X	—	3
<i>Pithecia hirsuta</i>	—	—	—	—	X	X	—	2
<i>Cacajao melanocephalus</i>	—	—	—	—	X	X	—	2
<i>Alouatta palliata</i>	—	—	—	X	X	X	X	4
<i>Alouatta seniculus</i>	—	—	X	X	X	X	X	5
<i>Cebus albifrons</i>	—	—	X	X	X	X	—	4
<i>Cebus capucinus</i>	—	—	X	X	X	X	X	5
<i>Cebus apella</i>	—	—	—	X	X	X	X	4
<i>Ligotrix lagotricha</i>	—	—	—	—	X	X	X	3
<i>Ateles paniscus</i>	—	—	—	X	X	X	X	4

Table 4. Humidity Provinces in Colombia, According to Holdridge.

Humidity Province	Climactic Climax	Thermic Zone	Area (km <sup>2</sup> )	% of Continental Area in Country
Perarid and Arid	Hyperxerophytic-Xerophytic	Hot	9985.5	0.87
Semiarid	Subxerophytic-Hygrotropophytic	Hot and temperate	6380.58	0.56
Subhumid	Hygrotropophytic-Subhygrophytic	Hot, temperate, and cold	138,547.85	12.12
Humid	Subhygrophytic	Hot, temperate, cold and subparamo	347,243.62	30.41
Perhumid	Hygrophytic	Hot, temperate, cold, subparamo and paramo	537,849.68	47.11
Superhumid	Hygrophytic	id.	101,725.37	8.91
Zone of Perpetual Snow and Ice	Chionophytic	Snow and Ice	74.0	0.006

vide appropriate habitats for the Ceboidea. There are also natural savannas and open woods (vgr. of *Curatella americana* and *Byrsomyia crassifolia*) which appear where conditioned by pronounced dry periods and edaphic factors (including alternohygic regimes with cyclic floods in vast regions). In general, these savannas correspond to the subxerophytic, although they may extend into vast sectors of the humid province; and, because of the frequency of spontaneous or induced fires, they might be considered as a pyrric climax. Freatic forests ("riparian" or "gallery" forests) occur in places with high freatic levels and in Orinoquia conassociations of "moriche" palm (*Mauritia flexuosa*) constitute a favorable habitat for species of Ceboidea in such forests.

The humid and perhumid provinces occupy 77.42% of the area of the country and, except for locally restrictive conditions, they support forests which are fundamentally perennifolious. Since this vegetation extends to altitudes of 3,000-3,800 m (with notable local variations) where the upper limit of the forest is found, the temperature and elevation figure among the principle restrictive factors in the vertical distribution of primate species.

The greatest concentration (22 species or 100%) of species is found in the humid selva (hygrophytic) of the hot thermic zone, followed by the hygrophytic selva (or transition between hygrophytic-subhygrophytic) of the same zone (18 species or 81.82%) and in hygrotropophytic selvas

(11 species or 50%). As noted before, the number of species decreases with altitude (see Table 5). Figure 2 shows a map of the density of primate species throughout the country.

Of the 22 living species of Ceboidea known for Colombia to date, seven are monotypic (*Cebuella pygmaea*, *Saguinus inustus*, *S. leucopus*, *Callimico goeldii*, *Aotus brumbacki*, *A. vociferans*, *Pithecia hirsuta*) and of these species, two are endemic (*Saguinus leucopus*<sup>1</sup> and *Aotus brumbacki*). None of the 15 polytypic species is endemic and, of these, *Cebus*

Table 5. Number of Species of Ceboidea in Colombia per Thermic Zone and Humidity Province, According to Holdridge.

Thermic Zone	Humidity Province						
	Perarid	Arid	Semiarid	Subarid	Humid	Perhumid	Superhumid
Hot	—	—	3	11	22	18	4
Temperate	—	—	—	—	7	7	7
Cold	—	—	—	—	—	4	3
Subparamo	—	—	—	—	—	—	2
Paramo	—	—	—	—	—	—	—
Perpetual Snow and Ice	—	—	—	—	—	—	—

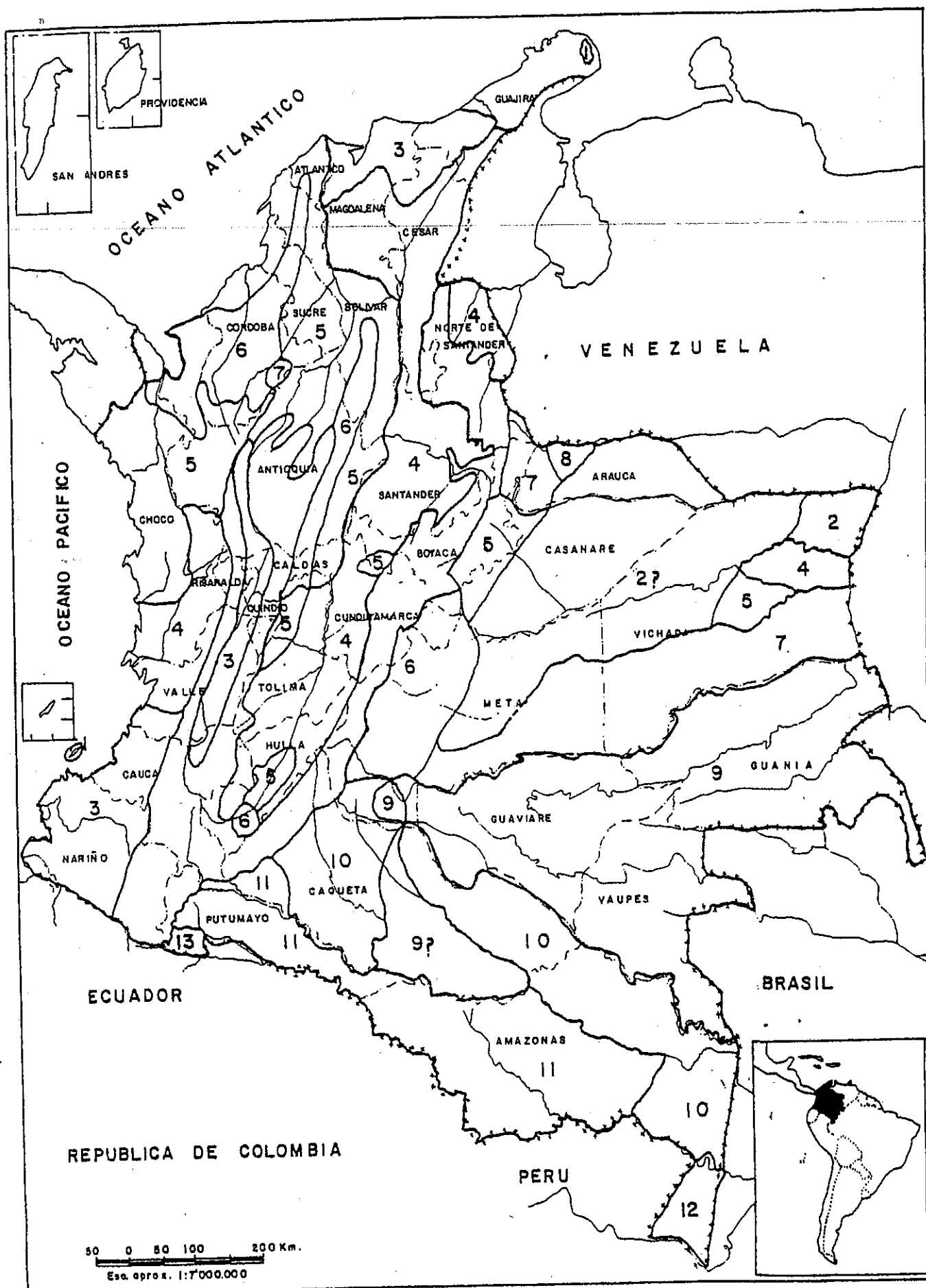


Fig. 2: Map showing regional densities of primate species in Colombia — numbers indicate species within area outlined (map provided by authors).

*albifrons* has six subspecies (two of them endemic to Colombia, cf. Hernandez & Cooper, 1976). *Ateles paniscus* has four subspecies (one of them endemic<sup>2</sup>). *Callicebus torquatus* and *Saguinus nigricollis* each have three subspecies (each an endemic subspecies). *Saimiri sciureus* has two subspecies (one endemic). *Cebus capucinus* has one endemic subspecies. *Lagothrix lagotricha*<sup>3</sup> has two subspecies (one endemic). *Callicebus moloch* has three subspecies (one endemic). *Aotus lemurinus*<sup>4</sup> has two or three subspecies (one endemic), and *Saguinus fuscicollis* and *Saguinus oedipus* each have two subspecies (vide antea). The rest of the existing polytypic species in Colombia (*Cacajao melanocephalus*, cf. Hernandez & Cooper, 1976. *Cebus apella*, *Alouatta palliata* and *Alouatta seniculus*) are each represented by one nonendemic subspecies.

The distribution of the endemic taxa of the *Cebioidea* in Colombia seems to fit eight patterns or models.

*Cebus capucinus curtus* Bangs. This is the only insular endemic and is found only on Gorgona Island in the Pacific. The validity of this subspecies needs to be verified. The origin of the population could be explained by passive migration (accidental cross-oceanic) or rafting from the littoral region of the continent, which is only 32 km away; or the distribution might be due to a lowering of the sea level during a Pleistocene glacial period, which would have diminished the sea barrier to about 2-3 km. However, it is also possible that this species was introduced to the island in the 16th or 17th centuries.

*Ateles paniscus brunneus* J. E. Gray and *Saguinus leucopus* Gunther. The distribution of these taxa is essentially coincident, although there are no data showing the presence of *Ateles* on the fluvial Island of Mompós, perhaps due to recent extinction. The area of distribution of these taxa suggests a possible origin in the humid Pleistocene refugium Nechí, which has been postulated by Haffer (1969) and has also been called the "Magdalena River Refugium" by Prance (1982). The former existence of this refugium is supported by various criteria of Brown (1982). *Saguinus leucopus* along with *S. oedipus* (*sensu lato*) are the only known transandean Callitrichidae and they are closely related (Hershkovitz, 1977). Hershkovitz (1977) suggests a probable origin for *Saguinus* in extreme southwestern Amazonas and from there an ancestor would have migrated west of the Andes to northern Colombia, from which was derived *S. leucopus* and *S. oedipus*. *Ateles paniscus brunneus* is very similar to *A. p. hybridus*, found on the eastern bank of the middle and lower Magdalena River, the watershed of the northern Catatumbo of Venezuela and east of the Andes in Arauca and Casanare. Both subspecies are isolated from each other by the Magdalena River and the differentiation between them probably dates from the Upper Pleistocene.

*Saguinus oedipus oedipus*<sup>1</sup> (Linnaeus). The distribution of this species extends from the left margin of the lower Cauca River and the lower Magdalena River, westward to the right bank of the Atrato River and the watershed of the Rio Sucio. West of the Rio Atrato it is replaced by *S. o. geoffroyi*, which occupies a great part of the Department of Chocó and extends through Panama to the south of Costa Rica. The pattern of distribution of *S. o. oedipus* suggests that this subspecies became differentiated in a Pleistocene refuge in the upper valley of the Sinú and San Jorge Rivers. It seems probable that the area of origin is situated in the region of Urabá or more towards the southwest (less probable), since this zone has been a zone of secondary contact in various cases for subspecies or semispecies of Chocoan origin (humid refugium of the Chocó; Haffer, 1969; Prance, 1982) with corresponding taxa of a more eastern origin (refuges of the upper Sinú-San Jorge or the Nechí)(see Haffer, 1969). An origin in the Nechí refuge is not probable, since that refuge seems to have been the center of origin for *Saguinus leucopus*, and the two species are presently allopatric, separated by the lower Rio Cauca.

The lower Rio Cauca remains a very important barrier for geographic dispersal. Its course approximates the geologic fault of Romeral and to the east it defines the floodable plain which is like an internal delta situated to the south of the geologic fault of Chicagua. Both form arms of the

Cauca, corresponding to an area which had intense processes of subsidence and sedimentation during the Quaternary (Martinez, 1981). Also, the region of the upper valley of the Sinú and San Jorge are centers of endemism for certain groups of animals. All of the above seems to indicate that this region corresponds to a humid Pleistocene refuge, separated by the Rio Cauca from the Nechí refugium.

*Cebus albifrons multosus* Elliot. This subspecies is confined to the northern and western slopes of the massif of the Sierra Nevada de Santa Marta. Although Haffer (1969) does not indicate a Pleistocene refuge for this region, Prance (1982) recognizes it as the Santa Marta refuge and Brown (1982) has presented some evidence in favor of the same. Thus, *Cebus a. multosus* could be considered an endemic which had its origin in this refuge.

*Aotus brumbacki* Hershkovitz (1983) and *Callicebus moloch ornatus* J. E. Gray. The limits of distribution for *A. brumbacki* are insufficiently known, but they overlap in the hot zone with *C. m. ornatus*, which is found in the hot thermic zone of the Orinocan piedmont and in nearby gallery forests from the Upiá River to the north to the Ariari and Güejar Rivers and the *selva* at the base of the Serranía de La Macarena to the right bank (locally) of the Guayabero River. This subspecies is geographically completely isolated from the other subspecies of *C. moloch*.

*Aotus brumbacki*, like the rest of the Colombian species of the genus, belongs to the group of taxa known as the "gray-necked" *Aotus* ("... entire side of neck including area behind and below ear, grayish agouti or brownish agouti like flank or outer side of arm; throat from entirely grayish or brownish agouti to entirely orange or buff"); and Hershkovitz (1983) considers it to be the most primitive of the genus. The karyotype of this taxon is structurally similar to that of *Aotus vociferans*, which is found more to the south in the Colombian, Ecuadorian and Brazilian Amazon, to the north of the Amazon River and west of the Rio Negro.

*Callicebus moloch ornatus* is closest to *C. m. discolor* in the Colombian Amazon (south bank of the Guamues River, Putumayo and the region of Leticia, Amazonas (Hernandez & Cooper, 1976) and the Ecuadorian and Peruvian Amazonian region. Vanzolini (1973) recognizes a humid Pleistocene refuge for the immediate region of Villavicencio and Brown (1982) presents some evidence in favor of the Villavicencio refuge. *Callicebus m. ornatus* probably originated there (Kinzey and Gentry, 1979; Kinzey, 1982), as well as *Aotus brumbacki*.

*Saimiri sciureus caquetensis* J. A. Allen. This subspecies lives in the eastern piedmont of the Eastern Cordillera of the Andes and also is found in a wide adjacent belt of habitat. The limits of this taxon to the north and to the south are not clearly established. Its center of origin probably was a humid Pleistocene refuge in the above cited piedmont, possibly the Villavicencio refuge or a refuge in the region of Florencia (Caquetá).

*Callicebus torquatus medemi* Hershkovitz. This taxon is known in the region defined between the Caquetá and Putumayo Rivers from the piedmont to the region of La Chorrera, Igará-Paraná River, Amazonas. Kinzey (1982) supposes the origin to be a humid Pleistocene refuge of Putumayo, already recognized by Brown (1976) and supported with some evidence by Brown (1982). The refuge was located in the Amazonian piedmont of the Eastern Cordillera in the Intendencia (i.e. "state") of Putumayo.

*Lagothrix lagotricha lugens* Elliot. With its present pattern of distribution, it is difficult to postulate an area of origin for this taxon. It is possible that it might have been the humid Pleistocene refuge of the Magdalena (upper Magdalena) recognized by Brown (1976, 1982). Table 6 presents a known list of Colombian primates and their status in the country. Figure 3 shows locations of protected areas in the country.

The information found in Table 6 makes it obvious that there are many situations which require immediate action in order to guarantee effective consideration for some of the species. For example, within Colombia there are six species whose present areas of distribution do not include a park or reserve and two of these are endemic. Also, there are other species of primates found within the limits of some parks and



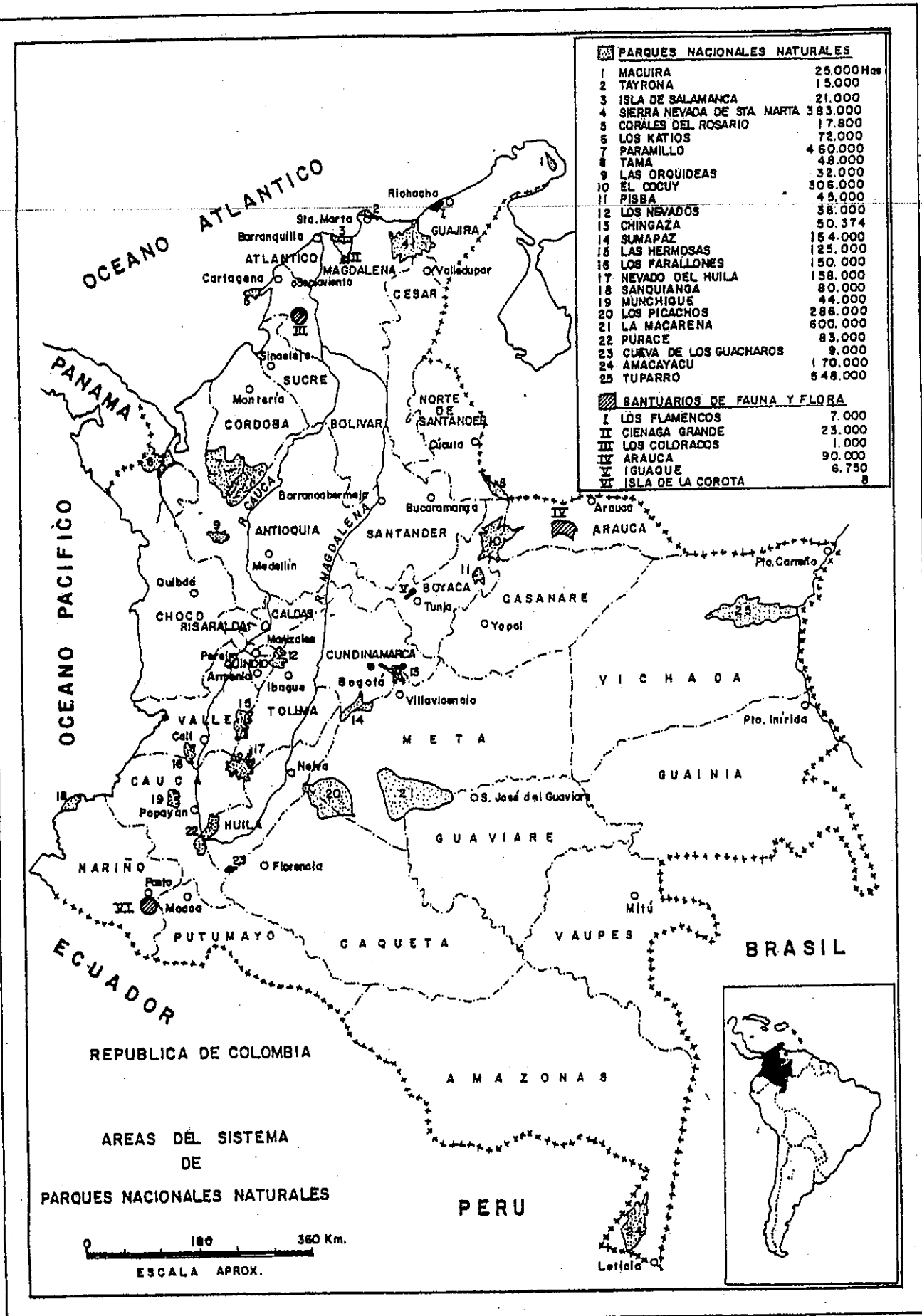


Fig. 3: Map showing national parks and other protected areas in Colombia (map provided by authors).

Table 6. List of Colombian Species and Their Status in the Country

Species	Status	Type of Protection in Colombia
<i>Callimico goeldii</i>	Uncertain: scarce, very localized and threatened	Not protected in any reserve: may be found in Amacayacu National Park
<i>Cebuella pygmaea</i>	Common in certain areas and capable of existing in isolated patches of forest near human settlements	Protected, found in Amacayacu National Park
<i>Saguinus inustus</i>	Unknown and uncertain: but can exist close to human habitations	Not protected in a reserve
<i>Saguinus fuscicollis</i>	Rather common in Amazonia	Protected in Amacayacu National Park
<i>Saguinus nigricollis</i>	Not well known	Of three subspecies only <i>S. n. nigricollis</i> is protected in Amacayacu National Park
<i>Saguinus leucopus</i>	Endemic to Colombia, its habitat is disappearing reserve due to deforestation: a determination of its status is urgently needed	Not protected in any reserve
<i>Saguinus oedipus</i>	Endemic to Colombia and threatened because of rapid deforestation	Probably protected in Paramillo National Park and the Los Colorados Sanctuary
<i>Saguinus geoffroyi</i>	Not threatened at this time	Protected in Los Katios National Park
<i>Saimiri sciureus</i>	Rather common and able to survive in degraded habitat	Protected in Amacayacu and La Macarena National Parks
<i>Aotus</i> spp.	Some threatened populations (e.g., <i>A. lemurinus griseimembra</i> ). The status of other populations is unknown due to a lack of data	<i>A. vociferans</i> is protected in Amacayacu National Park; <i>A. brumbacki</i> is endemic to Colombia and has no protection; <i>A. lemurinus</i> is protected in various reserves
<i>Callicebus moloch</i>	<i>C. m. ornatus</i> is threatened by deforestation, but can survive in forest patches	<i>C. m. ornatus</i> is found in La Macarena National Park; <i>C. m. discolor</i> is not protected in a reserve
<i>Callicebus torquatus</i>	<i>C. t. lugens</i> is common in all of Amazonia and in some parts of the Orinoquia; the status of <i>C. t. medemi</i> is unknown (possibly scarce and very localized)	<i>C. t. lugens</i> is protected in Tuparro and Amacayacu National Parks, but <i>C. t. medemi</i> has no protection
<i>Pithecia hirsuta</i>	Poorly known but with a wide distribution throughout Amazonia	Possibly found in Amacayacu National Park
<i>Pithecia monachus</i>	It is expected that this species occurs between the the Caquetá and Putumayo rivers	If it exists in Colombia it has no protection
<i>Cuacajao melanocephalus</i>	Abundant in certain regions, but it is very easy to hunt, making it very vulnerable	This species has no protection in Colombia
<i>Alouatta palliata</i>	In part unknown: probably has disappeared or is endangered throughout much of its range	Found in Los Katios National Park and Las Orquideas and Farallones National Parks
<i>Alouatta seniculus</i>	Has been exterminated in many areas due to hunting and deforestation	Found in Salamanca, Tayrona, Sierra Nevada de Santa Marta, Tama, Pisba, Cocuy, Tuparro, Amacayacu, Cueva de las Guacharos, Purace, Orquideas, Los Katios, Paramillo, La Macarena, Los Colorados, and Cienaga Grande de Santa Marta National Parks
<i>Cebus albifrons</i>	Probably threatened in parts of its range on the Atlantic coast, but in general not too bad	Protected in El Tuparro, Amacayacu, Tayrona, and Sierra Nevada de Santa Marta National Parks
<i>Cebus capucinus</i>	In some parts of the Caribbean coast it is threatened due to deforestation	Protected in Paramillo, Los Katios, Orquideas, Farallones, Munchique and Sanquianga National Parks, and on Gorgona Island, which is likely to become a National Park
<i>Cebus apella</i>	Apparently plentiful throughout much of its range	Protected in Purace, Cueva de los Guacharos, Picachos, Tuparro, Amacayacu and La Macarena National Parks
<i>Lagothrix lagotricha</i>	One of the species most threatened by hunting for meat; <i>L. l. lugens</i> is endangered due to deforestation on the Andean slopes	Protected in Nevado de Huila, Purace, Cueva de los Guacharos, Picachos, Chingaza (?), Pisba (?), Tama, Cocuy, Amacayacu, and La Macarena National Parks
<i>Ateles paniscus</i>	One of the most endangered Colombian species due to hunting and its need for virgin tropical forest	Protected in Los Katios, Paramillo, La Macarena, Cocuy, Los Picachos and Los Farallones National Parks

reserves, but special actions of INDERENA are needed for their conservation, since their situation is vulnerable. *Saguinus o. oedipus*, a primate in danger of extinction, is in this category, and unfortunately there is no concrete information confirming its existence in Paramillo National Park or in the Sanctuary of Los Colorados. It is urgent to do exhaustive studies in order to determine the precise status of this taxon in the above zones and in the rest of its former area of distribution.

Deforestation is one of the most serious threats to primate species in Colombia. Fundamentally, the country's economy is based on agricultural activities. Population growth has fueled the demand for basic foodstuffs, erosion, repeated burning, and harmful grazing and agricultural prac-

tices. All these factors have contributed to the steady advancement of the so-called agricultural frontier. It should be noted that, according to estimates of the Geographic Institute Augustin Codazzi (IGAC), only 18% of the surface of Colombia has soils suitable for agriculture, and only about 5% can support extensively mechanized farming. Also, the scarcity of alternative energy sources for the inhabitants of isolated areas creates an unending demand for fuelwood and charcoal for domestic uses. This results in the gradual annual destruction of many relic forest.

Another important cause of deforestation is the exploitation of wood for lumber, resulting in cut over areas which are not replanted. Such

affairs do not often permit advanced stages of secondary vegetation. Lumbering also contributes indirectly to colonization by providing access to remote areas. The opening of new roads always encourages the establishment of settlements. Consequently, vast areas that should be protected or managed on a sustainable yield basis are destroyed in a short time.

At this time, the northern part of the country on the Caribbean coast and the valleys of the Cauca and Magdalena rivers (center of the country) are the zones most altered by deforestation and human impact. In the north there are only three blocks of virgin forest left: the upper valley of the San Jorge river (Cordoba), the Serranía de San Lucas (southeast of Bolívar) and the massif of the Sierra Nevada de Santa Marta; although there also exists extensive forest west of the Atrato river along the Panamanian border (Chocó).

Since the middle of the 1960's a great part of the original *selva* in the piedmont of the Departments of Caquetá and Putumayo has been cut following colonization. Almost nothing of the piedmont of the llanos of Meta, Boyacá, Casanare and Arauca survives, and this zone once had a rich primate fauna. In the Chocó the original forest is still largely intact, but future projections suggest that lumbering and mining will increase in this area. Of an estimated 678,000 km<sup>2</sup> of original virgin forest in the country, approximately only 364,000 km<sup>2</sup> remains. Almost half of the country's forest has already been destroyed (NRC, 1980), the extant forest being located in two principle regions, the Pacific coast (especially Chocó) and Amazonas.

Colonization has also been responsible for forest destruction within reserves and the national park system. The situation of the National Park of La Macarena has gained worldwide fame for the richness of its flora and fauna. Equally impressive, however, is the destruction of more than half of the park's territory by colonists.

Although there are problems in maintaining the system of parks and reserves as it presently exists, it is necessary to establish new reserves in other parts of the country. In all of the Colombian Amazon there is only one national park, Amacayacu, and this in the region which contains the most extensive *selva* of the country. Immediate needs are, for example, a reserve in the southwest part of the Intendencia of Putumayo on the upper Guamues river, an area which contains the highest diversity of primate species in the country (Fig. 2) and which probably forms part of a Pleistocene refugium in that area (Brown, 1982). On the upper Apaporis river (the border between the Department of Caquetá and the Intendencia of Guaviare) there is a complex of mesas and inselbergs (especially the Sierra de Chiribiquete) which are important for endemic forms of plants. Since this region is very poorly known, it is thought that there may be endemic forms of fauna as well. A national park in this region would be appropriate. On the lower Apaporis river there is a transitional zone between the Amazon valley and the Guyana shield that probably contains some endemic species. This region is also home to at least nine species of primates. These are only three examples of zones which are important enough to be declared national parks and which are in fact being studied for that eventuality. Without such areas the efforts of the Colombian government and of INDERENA cannot effectively conserve the country's primate species, nor its other flora and fauna.

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#### Notes

1. *Saguinus Geoffroyi* has been considered by Hershkovitz (1966, 1977) as a subspecies of *S. oedipus*. Both taxa are allopatric and very similar, but they could be considered as species of the same superspecies. Allowing the above, *S. oedipus* could be a monotypic, endemic species. *S. Geoffroyi* would be a monotypic species and the total Colombian primate species would number 23.

2. *Ateles paniscus* includes as subspecies, following Hershkovitz (1972) the following taxa recognized by Kellogg & Goldman (1944): *Ateles belzebuth belzebuth*, *A. b. hybridus* and *A. fusciceps rufiventris* (syn: *A. robustus*). To these is added *A. paniscus brunneus* = *Ateles*

*brunneus* J. E. Gray, 1872, type locality: "Medellin", Antioquia, Colombia (not recognized by Kellogg & Goldman, 1944 nor Hershkovitz, 1949), which corresponds to the populations of the SE part of the Department of Bolívar, E. of Antioquia and E. of Caldas, situated between the left bank of the Magdalena river and the right bank of the lower Cauca river. It is characterized by a chromatic design more contrasting than in *A. p. hybridus*, with the reddish pelage of the head, tail (dorsally) and dark areas of the limbs notably more saturated. 3. *Leontideus leontideus lugens* probably exists in the Andean piedmont of the extreme western parts of the state of Apure, Venezuela and may extend to the south on the eastern slope of the Cordillera in the north of Ecuador. 4. *Aotus lemurinus* (sensu Hershkovitz, 1983) has two subspecies: *A. l. lemurinus* endemic to Colombia and *A. l. griseiventris*. Eventually it may be possible to separate *A. l. zonulis* from the nominotypic subspecies (cf. Hernandez-C. & Cooper, 1976).

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# Distribution and Status of Primates in Paraguay

## Introduction

Little is known of the present status of Paraguayan primates (IUCN/SSC/PSGN, 1981). Few published reports are detailed, and most are anecdotal and scattered. In this paper, I review the pertinent literature and present the results of recent field work in Paraguay (particularly in the chaco boreal) to add to the scanty knowledge on the five primate species that occur there, and on the habitats they occupy.

Another important objective of this paper is to evaluate the prospect of survival for each primate species. This depends largely on the amount of suitable habitat available in protected and unprotected areas, and requires the knowledge of the deforestation rate in both the chaco and eastern regions of Paraguay. There are less data available regarding the amount of forested habitat remaining in the chaco than for the eastern region. Approximately 15% of eastern Paraguay remains in climax dense forest. Protected areas represent less than 3% of the total area of the country and primates occur in each refuge.

I analyzed the potential that the country's protected areas have to conserve the primate species that occur in them. Deforestation surrounding protected forest areas does not allow primates to migrate to other refuges. This in turn curtails the exchange of genetic material between populations inside and outside of the refuges. This insularization of the primate fauna is a major threat to the survival of the species because it increases the amount of inbreeding. Using density data and the basic ecological characteristics of the primate species, I estimated the minimum area required for populations to retain sufficient amounts of genetic variability.

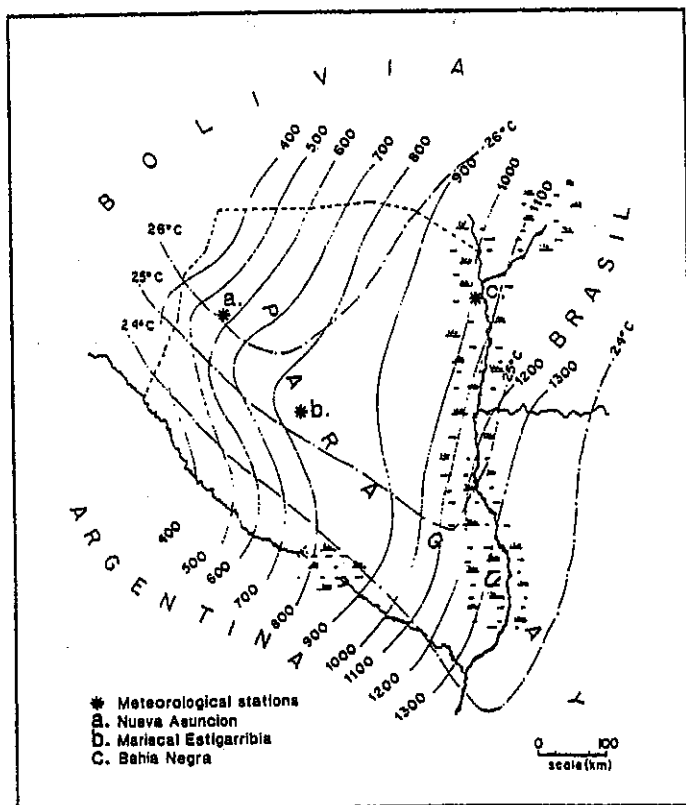


Fig. 1: Map showing progressively increasing levels of annual precipitation (mm) from west to east across the chacoan plain (map provided by author).

## Habitat

**Chaco.** The chaco boreal extends westward from the Rio Paraguay and consists of eroded Andean parent material with most elevations below 500 m. In general there is a gradual increase in elevation from the Rio Paraguay west to the Bolivian border (Short, 1975).

The climate of the chaco is classified as tropical semiarid or subhumid (Thornthwaite, 1933). Annual precipitation increases progressively from west to east across the chacoan plain, from 400-1300 mm (Fig. 1). This variation in precipitation has a marked effect on the vegetation. Consequently, preliminary data suggest that as one travels eastward in the chaco, there is an increase in vegetation height and diversity, as well as annual precipitation.

The majority of the chaco is xeric, with extended periods of water deficit, especially in June, July, and August (Fig. 2). The pronounced dry season affects the phenology of the vegetation. Much of the chacoan vegetation is deciduous.

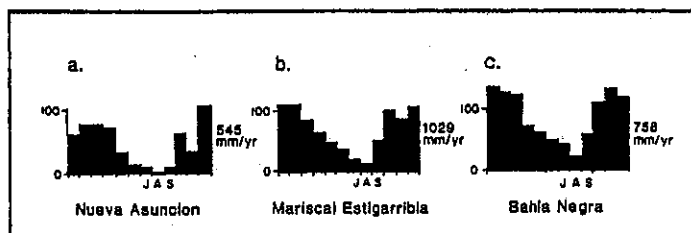


Fig. 2: Bar graph depicting the seasonality of rainfall in the chaco region (data from three meteorological stations), showing clearly the dry season (graph provided by author).

The vegetation of the chaco can be characterized by continuous xeric forest in the northern half of the plain, swampland and gallery forest along rivers, and palm savanna mixed with forest patches in the southern areas.

The xeric forest grows on soils of varying permeability. The poorly drained soils support a low forest that has little undergrowth. These forests remain flooded for extended periods after the wet season rains begin. *Ruprechtia triflora*, *Caesalpinia paraguayensis*, and *Capparis* spp. are the principal tree and shrub species. The better drained soils support a taller forest composed of these same species and others. The taller trees, e.g., *Aspidosperma guebracho*, *Bulnesia sarmientii*, and *Chorisia insignis*, usually occur in these forests. The undergrowth is extremely dense and thorny.

Natural causeways or *cauces* of the ephemeral streams cross the northern chaco from the western Andean foothills to the Rio Paraguay. After prolonged wet season rainstorms, these waterways are full and fast moving and deposit transported soils along the edges of the *cauce*. The areas bordering these waterways probably have the richest, moistest and best drained soils in the region. The forest that occurs along the *cauces* is tall and diverse, with a very dense undergrowth. The forest supports many of the previously mentioned tree species, as well as others that do not occur away from the *cauce*. Especially noteworthy for primates are several leguminous tree species (e.g., *Piptadenia* spp., *Phasedus* spp.).

**Eastern Paraguay.** The eastern region differs from the chaco in that there are several rivers, the topography is undulating and the soils are of different parent material.

Thornthwaite (1933) classified the climate of eastern Paraguay as tropical subhumid and mesothermal humid to subhumid. Annual precipitation increases from the west to the east and approaches 1700 mm in the southeast (Sanchez, 1973). The eastern region has a less variable climate than the chaco. The winter season produces less precipitation than the summer. Tree species tend to be more semideciduous and semi-evergreen than chacoan species (Pincus, 1968).

The OAS (1971) natural vegetation map shows three basic vegetation zones for eastern Paraguay. Nearly the entire eastern half of this region supports a dense humid semideciduous formation, much of which has been intensely timbered and turned into grasslands for agriculture and livestock production. The northwestern quarter of eastern Paraguay supports savanna with thorn scrub forest. This variable formation is semixerophytic to subhumid. The drier areas support trees 5-10 m in height.

while some trees in the more humid areas can reach 20 m. The southwestern quarter of eastern Paraguay is covered by extensive grasslands and savannas intermixed with low trees and shrubs. Higher gallery forest occurs along waterways and on well drained soils.

#### Primate Species

Paraguay, located near the southernmost range of primates in South America, has five primate species (Stallings and Mittermeier, 1983). These are the dusky titi monkey, or in the guarani language, *cai ygau* (*Callicebus moloch*), the night monkey or *cai pyhare* or *mbirikina* (*Aotus azarae*), the tufted capuchin or *cai comun* (*Cebus apella*), the black howler or *caraya* (*Alouatta caraya*) and the black-tailed silvery marmoset or *cai poshy* (*Callithrix argentata*).

While little detailed information has been published regarding Paraguayan primates, several anecdotes have appeared regarding natural-

istic observations and indigenous uses or taboos. Perhaps the earliest account of primates in Paraguay was in 1770 when Labrador mentioned that *Alouatta* occurred in Paraguay and noted the guaycuru name as *aychega*. He also commented on the sexual dichromatism and vocal performances of the species. Azara (1801) first mentioned that *Cebus* occurred in Paraguay, but the species was not described until almost 30 years later by Fischer (1829) and Rengger (1830). Rengger (1830) also described *Alouatta* from Paraguay. *Callicebus* was first collected in Paraguay by J. Bohls in 1893, and Thomas (1908) provided the first description of the chacoan form. Azara (1801) and Rengger (1830) stated that *Aotus* did not occur in Paraguay, but were probably referring to eastern Paraguay. Later, Bertoni (1914) and Allen (1916) reported *Aotus* to occur in the Paraguayan chaco. More recently, Hershkovitz (1983) has revised the genus *Aotus* and classified the night monkey in Paraguay.

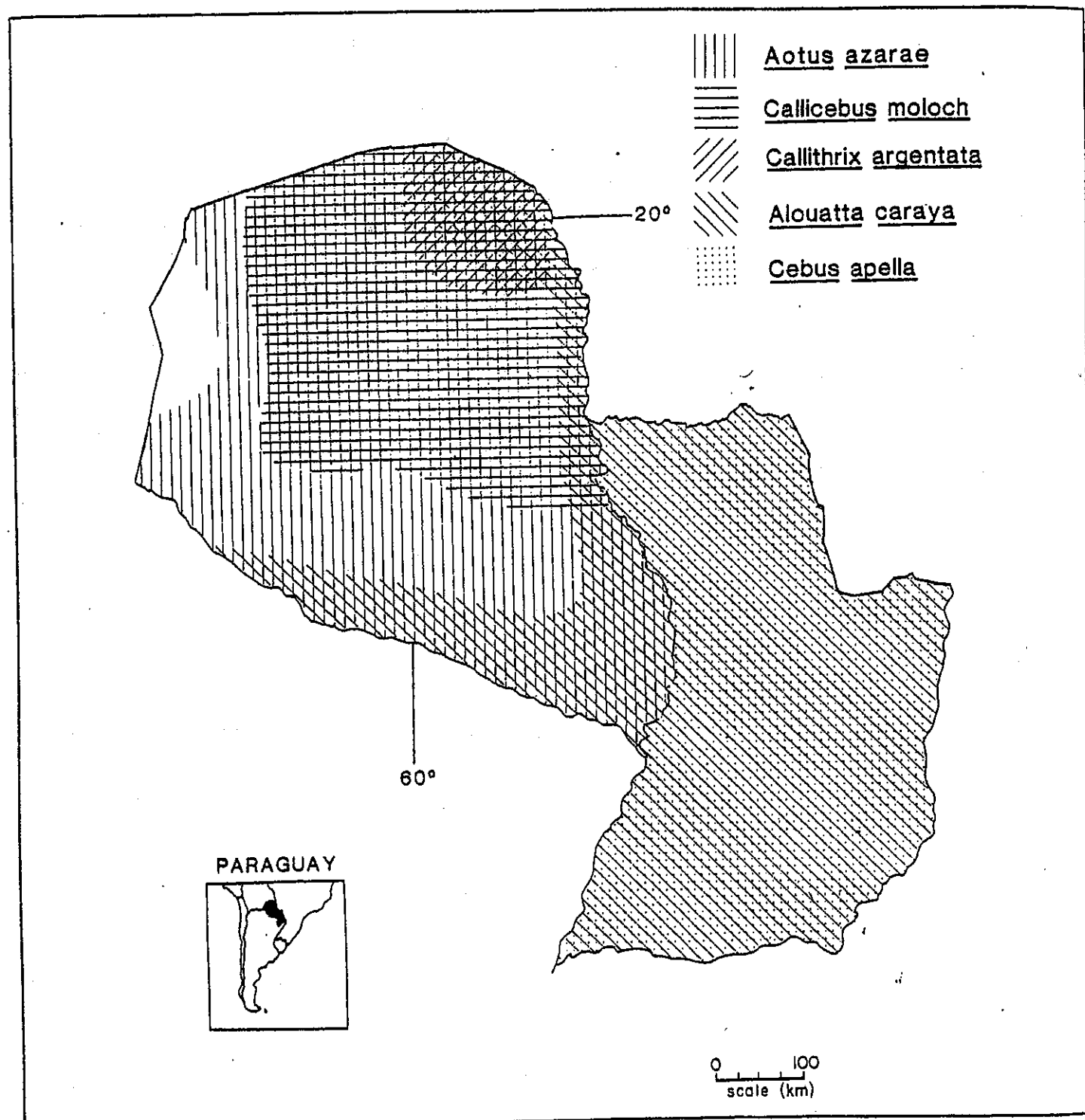


Fig. 3: General distribution of all the Paraguayan primate species (map provided by the author).

us *A. azarae*. Prior to 1983, *Callithrix* was not known to occur in Paraguay. However, Stallings and Mittermeier (1983) offer data on localities, habitat, and geographical distributions of this species in the Paraguayan chaco.

Several authors either have reviewed existing literature (e.g., Elliot, 1912; Cabrera and Yepes, 1940; Napier and Napier, 1967; Freese and Oppenheimer, 1981; Hill, 1960, 1962) or have provided collecting localities and general geographical ranges for Paraguayan primates (e.g., Wetzel and Lovett, 1974; Kinzey, 1981, 1982; Pusch, 1941; Kreig, 1930; Hershkovitz, 1963; Cabrera, 1961; Allen, 1916; Bertoni, 1914, 1939).

#### Distributions

Figure 3 shows the general distributions of the primates in Paraguay. More specific accounts follow.

**Aotus:** This nocturnal primate occurs only in the chaco boreal of western Paraguay. Although reports from indigenous groups in the eastern region suggest that a rare *mbirikina* inhabits the forest, *Aotus* has never been collected. Earlier reports support this view (e.g., Azara, 1801; Rengger, 1930; Bertoni, 1914; Allen, 1916; Grubb, 1911; Kerr, 1950; Kreig, 1930). *Aotus* is widespread in the chaco, ranging north of the Rio Pilcomayo to the northern Paraguayan border with Bolivia, and west of the Rio Paraguay to approximately 62°W, where the habitat begins to change to rolling hills with more open short scrub. If *Aotus*, or any other species of primate occurs in this latter region, it most certainly is restricted to small isolated patches of adequate forest habitat.

**Callicebus:** The titi monkey is restricted also to the chaco in Paraguay. This species occurs from the northern border with Bolivia south to approximately 23°S and from the Rio Paraguay west to approximately 61°30' W. *Callicebus* is found in the continuous xeric forest of the northern and central chaco boreal. Except for possible remnant populations along gallery forest edges, it is probably excluded from the vast *Caperania alba* palm/savanna formations of the southern chaco. The division between the palm/savanna and continuous xeric formations of the lower chaco near 23°S is the southernmost limit of this species in the Neotropics.

**Callithrix:** Recently, *Callithrix* was discovered in the chaco boreal of Paraguay. This extended the range about 200 km past its southernmost limit (Stallings and Mittermeier, 1983). Its distribution in Paraguay is restricted to the northeastern chaco. This area has a high annual precipitation and supports a diverse habitat. *Callithrix* occurs in the tall forest habitat along the ephemeral waterways or *cauces* of this region. However, this marmoset has not been reported to occur along the northern section of the Rio Paraguay where the forest is inundated almost continuously. **Alouatta:** This species is found in the eastern forests (Azara, 1801; Bertoni, 1939; Cabrera, 1961; Clark, 1983; Hill and Hawkes, 1983; Kulhorn, 1954; Labrador, 1770; and Rengger, 1830), as well as in certain areas in the chaco (Allen, 1916; Kerr, 1950; Kreig, 1930; Grubb, 1911; Page, 1859; Stallings and Mittermeier, 1983). In the chaco, the black howler generally occupies gallery forest along the Rio Paraguay and Rio Pilcomayo, as well as the numerous small rivers that drain the chacoan plain. *Alouatta* also can be found sporadically at low densities throughout the more xeric areas of the contiguous forested habitat (Stallings, 1984).

**Cebus:** The capuchin monkey occurs commonly throughout the eastern forests of Paraguay (e.g., Azara, 1801; Bertoni, 1939; Cabrera and Yepes, 1940; Clark, 1983; Fischer, 1829; Hill and Hawkes, 1983; Kulhorn, 1939; Pusch, 1941; Rengger, 1830). However, there is some question as to whether or not this species crosses into the chaco region.

Pusch (1941) collected the only known specimen from the Paraguayan chaco, which he called *Cebus chacoensis*. Kreig (1930) states that *Cebus* does not exist in the Paraguayan chaco, although it does occur in the Bolivian chaco (Eisentraut, 1933). Cabrera (1961) notes that the tufted capuchin "could occur in the chaco (Paraguay), but probably is restricted to the north branch of the Rio Paraguay near Asuncion where Azara resided." Other authors (e.g., Freese and Oppenheimer, 1981; Rathbun and Gache, 1980) list this species occurring in the chaco. I have never

observed a wild or free ranging *Cebus* in the chaco. However, captive specimens are occasionally kept as pets in the Mennonite community of Filadelfia. These mascots are obtained from the forests of eastern Paraguay. Pusch (1941) provided no collection locality data for his sole specimen except "Chaco Paraguayo", and it is possible that he collected an escaped pet. I believe that *Cebus* is absent from the xeric contiguous forest of the northern, western and central chaco. *Cebus* requires permanent water (J. Robinson, pers. comm.), and because of the pronounced dry season, there is little permanent water. However, there is little reason why this species should not occur in the gallery forests along the southern portions of the Rio Paraguay where there is permanent water and the differences between the climate and habitat on the immediate sides of the river are not great (Myers, 1982). Indeed, the Lengua-Mascoc Sur Indians mention that *Cebus* does occur in the southern wet chaco near the Rio Paraguay (Stallings, 1984).

#### Group Sizes and Densities

Recent field work (mainly in the chaco) has resulted in diurnal site specific group sizes and densities for Paraguayan primates (Stallings *et al.*, in prep.). These data suggest that the primate species are found at relatively low densities throughout the area (Fig. 4). Since micro-habitats vary within major vegetation zones, it is clear that individual species will not occur uniformly throughout this non-homogeneous habitat. Therefore, these estimates (Table 1) represent ecological densities corrected for habitat differences rather than crude densities (Eisenberg, 1980).

Table 1. Mean Group Counts and Ecological Densities of Paraguayan Primates.

Species	Groups Observed	Area Cen.(km <sup>2</sup> )	Groups/ km <sup>2</sup> Gr. Size	Mean km <sup>2</sup>	Ind./ km <sup>2</sup>
<i>Aotus</i>					
Tnte. Enciso	2	0.60	3.33	2.66	8.85
Agua Dulce	3	0.645	4.65	3.09	14.36
<i>Callicebus</i>					
Agua Dulce	4	0.645	6.20	2.77	17.17
<i>Callithrix</i>					
Agua Dulce	2	1.245	1.60	4.60	7.36
Chovoreca	3	0.85	3.52	7.80	27.45
<i>Cebus</i>					
Ybycui	4	1.00	4.00	7.00	28.00

*Aotus* group sizes and densities are available from two chacoan sites, National Park (P.N.) Teniente Enciso and outstation Agua Dulce, P.N. Defensores del Chaco. A positive correlation can be observed by comparing precipitation and *Aotus* group sizes and densities. *Aotus* densities and group sizes are lower in P.N. Teniente Enciso where annual precipitation averages 500 mm. and higher in Agua Dulce where annual precipitation reaches 850 mm. Vegetational or habitat differences in these two sites positively reflect the difference in precipitation. In P.N. Teniente Enciso vegetation types are basically uniform with low scrub and occasional emergents, whereas in outstation Agua Dulce, low scrub, intermediate and tall forest, and tall *cauce* vegetation types occur.

Two site specific densities and group sizes are available for *Callithrix* in the chaco, from outstation Agua Dulce and 54 km further east of Agua Dulce. Stallings and Mittermeier (1983) reported that *Callithrix* was more common and occurred in larger groups further to the east of Agua Dulce. Present data support that trend (Fig. 4), and a positive correlation can be seen by comparing precipitation and vegetation to primate densities and group sizes. This trend probably continues eastward another 100 km until the vegetation height begins to decrease because of the frequent flooding of the Rio Paraguay.

*Callicebus* group sizes and densities are available from only one site, outstation Agua Dulce. This ecological density was estimated from the tall forest on well drained soils. Soil deposition and micro habitat differences in moisture perhaps support a higher and more diverse forest type (Table 2) than the lower xeric scrub forest of the area. *Callicebus* generally occurs in the tall forest on these soils and in the tall forests

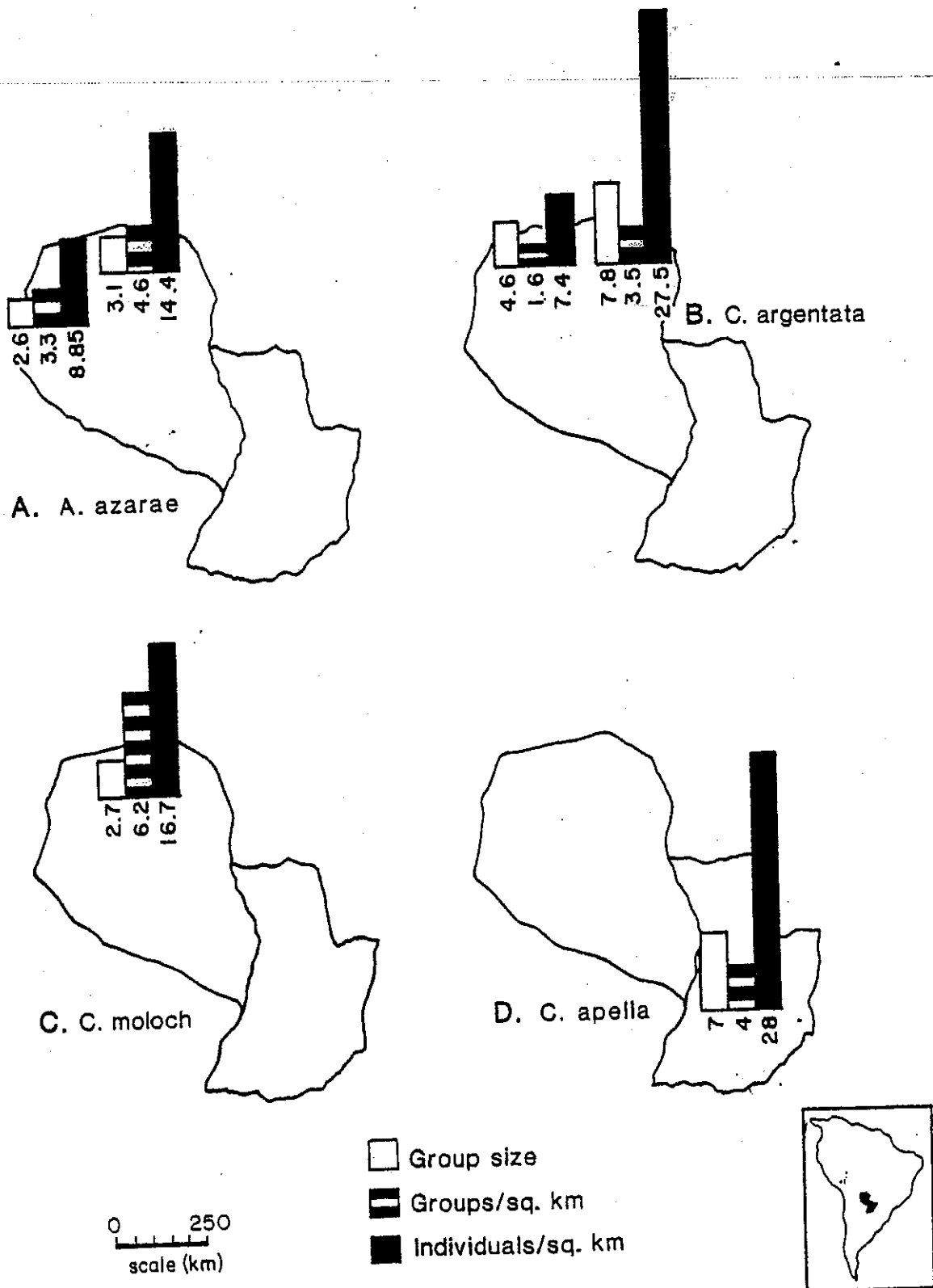


Fig. 4: Diagram showing group sizes and densities for four primate species in Paraguay (diagram provided by author).

along the *cauces* with more frequency and in higher densities than in the lower forest (Stallings, 1984).

Density and group size of *Cebus* are available from P.N. Ybycui in eastern Paraguay (Clark, 1983; Stallings, 1984). Group counts of *Alouatta* have been recorded in two areas, La Golondrina Estancia in the southern chaco and in P.N. Ybycui in eastern Paraguay (P. Wright, pers. comm.; Clark, 1983).

#### Protected Areas

There are nine protected wild areas in Paraguay that total 11,205 km<sup>2</sup> or 2.75% of the total area of the country (SFN, 1983). The chacoan protected areas comprise 4.45% of the western portion of the country, while eastern areas represent only .13%. The largest and most established conservation units in the country are shown in Figure 5.

The three areas occurring in the west are all national parks (P.N. Defensores del Chaco, P.N. Teniente Enciso, and P.N. Tinfunque), while the remaining six eastern areas are divided into three national parks (P.N.

Ybycui, P.N. Cerro Cora, and P.N. Caaguazu), two protected forests (Bosque Protector (B.P.) Yakui and B.P. Nacunday), and one national reserve (Reserva Nacional (R.N.) Kuri y). As demonstrated in Table 3, primates are protected in each area, with P.N. Defensores del Chaco having the highest species richness, while P.N. Teniente Enciso and P.N. Cerro Cora each have only one primate species.

P.N. Teniente Enciso is located in the northwestern section of the chaco where annual precipitation only reaches 500 mm. Only *Aotus* has been observed in this national park and it is estimated to occur at relatively low ecological densities (Table 1). As the species occurs at such low densities in this park, the total population in the park is low. Apparently, ecological conditions are suitable only for this species.

Located in the northern chaco, P.N. Defensores del Chaco is the largest and most impressive park in the country. Annual precipitation ranges from 500 mm on the western border to approximately 850 mm on the east. Vegetation height and diversity appear also to increase from west to east. In the southcentral zone of the park, Cerro Leon, a large sand-

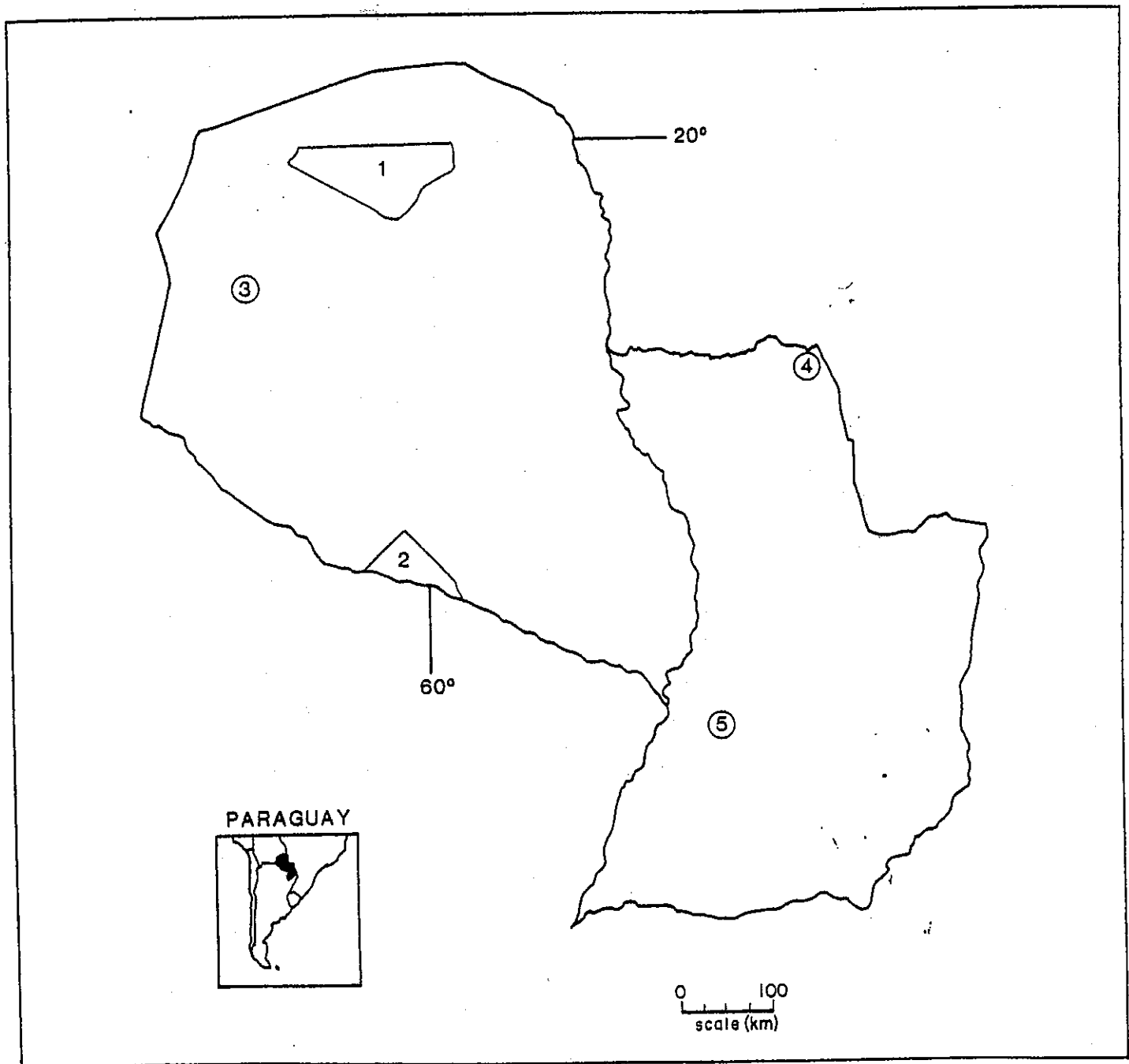


Fig. 5: Localities of five national parks in Paraguay: 1) Defensores del Chaco, 2) Tinfunque, 3) Teniente Enciso, 4) Cerro Cora, and 5) Ybycui (map provided by author).



stone outcrop, adds relief and diversity to a flat topography. In addition, the diverse forest that occurs along the numerous dry drainage channels of the Rio Timane system provide more food resources and resting sites than the short xeric vegetation. Four species of primates are known to occur within the limits of the park. These are *Alouatta*, *Callithrix*, *Aotus*, and *Callicebus* (Table 3). There are no density estimates available for *Alouatta* in the park, but estimates are available for the other primate species (Table 1).

Table 2. Relative Tree Height (DBH  $\geq$  10 cm.) and Species Diversity in Two Habitat Types in Agua Dulce, P.N. Defensores del Chaco.

Sites/Habitat Type	No. Trees $\geq$ 8 m.	Total Species	Nt	Shannon Index H'	Evenness J'
Agua Dulce/High Forest	29	31	450	2.90	84.36%
Agua Dulce/Low Forest	9	14	456	1.72	65.35%

P.N. Tinfunque is a large park located in the lower southern chaco along the Rio Pilcomayo. *Aotus* and *Alouatta* are protected in this refuge. Census transects have not been conducted in this park because of logistical restraints. On the national level, P.N. Tinfunque is probably the most important sanctuary for the protection of the black howler because the large reserve supports suitable habitat and is relatively undisturbed.

P.N. Ybycui is a small park located in southcentral Paraguay and supports perhaps the best forested habitat in the region. *Cebus* and *Alouatta* occur within its limits (SFN, 1982; Clark, 1983). Available data suggest that *Alouatta* does not occur in high densities (Clark, 1983). *Cebus* occurs in relatively high densities (Stallings, 1984) and is common in all park regions (Clark, 1983).

Located in northeastern Paraguay, P.N. Cerro Cora currently protects only one species, *Cebus* (Stallings, 1984). Nevertheless, this species is not frequently observed. *Alouatta* has not been observed in the park for at least 10 years and it is very probable that this species has been extirpated from the region.

There is less information available for the primate species that occur in the remaining eastern protected areas. *Cebus* and *Alouatta* are reported to occur in P.N. Caaguazu. The other areas have not yet been intensively explored or inventoried and there are no data to confirm the occurrence or ascertain the status of any primate species.

Table 3. Primate Species Occurring in Protected Areas in Paraguay.

Region	Area	Classification	Size (km <sup>2</sup> )	Species
Chaco	Defensores del Chaco	National Park	7800	Au, Cm, Ca, Ac
	Teniente Enciso	National Park	400	Au
	Tinfunque	National Park	2800	Au, Ac
	Ybycui	National Park	50	Cap, Ac
Eastern	Cerro Cora	National Park	55	Cap
	Caaguazu	National Park	60	Cap, Ac
	Kuri y	National Reserve	20	Cap, Ac
	Yukui	Protected Forest	10	Cap, Ac
	Nacunday	Protected Forest	10	Cap, Ac
Total			11,205	

Au = *Aotus*, Cm = *Callicebus*, Ca = *Callithrix*, Ac = *Alouatta*, Cap = *Cebus*

## Factors Affecting the Conservation of the Primates

**Hunting.** Although the hunting of primates is a major threat to the survival of some Amazonian species (e.g., Mittermeier and Coimbra-Filho, 1977; Neville, 1974) only small-scale hunting occurs in Paraguay. Most primate hunting is carried out by indigenous groups, but there are also reports of settlers of European descent using primates (i.e., *Cebus*) as a food resource (S. Gonzalez, pers. comm.; Hill and Hawkes, 1983).

Hill and Hawkes (1983) report that both *Cebus* and *Alouatta* are hunted by the Ache Indians of eastern Paraguay. Although no harvest figures are listed for the black howler, the authors do list the capuchin as a commonly obtained food resource with 221 individuals killed within a period of 53 days of active hunting in five consecutive months. Although no measure of the catchment area was calculated, the impact of this high take of *Cebus* on the local populations is probably quite considerable and Hill and Hawkes (1983) suggest that game populations in their study area have diminished in less than two years.

In the chaco, most primate species are small and the price of ammunition high, so it is usually too expensive for settlers to hunt primates for food. Additionally, larger terrestrial game are more readily available and obtainable (Stallings and Mittermeier, 1983). Northern chacoan Indian groups (e.g., Ayoreo and Chamacoco) generally do not use primate meat, either because of taboos or because other food resources are abundant (D. Latton, pers. comm.; F. Valbuena, pers. comm.).

In the southern chaco, the Lengua-Mascoy Sur Indians hunted *Callicebus* (= *Yamkyilineat*) and *Alouatta* (= *Yitsenei Kyelyowai*) in past generations, but never *Aotus* (= *Kyilineat*) (J. Beechy, pers. comm.). At the present time, because of the high cost of ammunition and the loss of the use of traditional weapons, these Indians do not hunt primates.

Conversely, the Manjuy Indians, located in the western and less faunistically diverse chaco, do use primate meat (S. Jackson, pers. comm.). These Indians actively hunt *Aotus* (= *Laynakir*) and *Callicebus* (= *Luvite*), but only the young and/or the very old eat the meat because of taboo. However, these primate species do not occur at high densities in this region and are occasionally taken by the Indians from *cauces* (when they approach the camps by means of *cauces*).

In general, indigenous groups are the principal primate hunters in Paraguay. However, the density of these Indians is low (Bertoni and Gorham, 1973), so their hunting is not the major threat to any species. Perhaps local populations of *Cebus* in eastern Paraguay and of *Callicebus* and *Aotus* in the western chaco are regionally threatened.

**Pet Trade.** Paraguay legally abolished the trade of endangered species, and consequently the primate trade, with the signing of the Convention on International Trade in Endangered Species of Wild Fauna and Flora Treaty (CITES) in 1975 (Verschuren, 1980). Today, the trade in these species continues, but on a much smaller scale and out of the public view. This is a vast improvement from the late 1970's when numerous skin and live animal shops flourished (Stallings, 1984).

Within Paraguay, primates are frequently peddled. Infant primates (*Callicebus* and *Aotus*) are often procured by chacoan Indians and either sold or kept as pets. In eastern Paraguay, *Cebus* is the common primate pet and is usually purchased from Indians or opportunistic Paraguayans. In frontier border towns near Brazil, and in the capital city of Asuncion, exotic species such as *Callithrix jacchus* are occasionally offered for sale.

Biomedical research on *Cebus* is being conducted in Paraguay in order to study chagas disease (Azorero, 1979). The Institute for the Study of Human Reproduction, situated in Asuncion, maintains facilities at the present time for 92 caged individuals. Wild or free ranging capuchins are obtained for this facility from the field by local hunters in the northern part of eastern Paraguay (Dept. San Pedro) for the U.S. equivalent of \$25-40 each (Stallings, 1984).

The pet trade in Paraguay is a potential major threat to the survival of the primates. However, it is extremely difficult to document the quantity of primates that are being exploited. Several Latin American primatologists have observed that Paraguay was a major exporter of native and exotic primate species for biomedical purposes during the last decade. I trust that if these allegations are true, then these trends have been reversed with the new environmental steps taken by the government since 1980. If not, then indeed this trade could seriously threaten the survival of some biomedically important species such as *Cebus*.

**Habitat Destruction.** The destruction of forest habitat in Paraguay is by far the greatest threat to the survival of its primate species. Deforestation data from the past thirty years demonstrate that the destruction of

forested habitat has been progressing at a rapid rate (FAO/UNEP, 1981). Especially critical is the deforestation of eastern Paraguay (Hartshorn, 1977; FAO/UNEP, 1981).

Forested eastern Paraguay dwindled from 68,360 km<sup>2</sup> to 41,774 km<sup>2</sup> between 1945 and 1975. Deforestation of this climax dense forest progressed at a rate of 1,550 km<sup>2</sup> per year from 1976-1980. By the beginning of 1981, only 34,024 km<sup>2</sup> of dense forested habitat remained in eastern Paraguay. Projections for the next five years show no decline, but indicate that the rate will increase to 1,800 km<sup>2</sup> deforested per year (FAO/UNEP, 1981). These data predict that by 1985, 80% of the original forest cover will have been destroyed and only 15.5% of eastern Paraguay will remain in dense climax forests (Stallings, 1984).

Less detailed data are available for the deforestation of the chacoan forests. This is due primarily to the importance of eastern forests with respect to the timber industry. The humid vegetation zone abutting the Rio Paraguay environs in the chaco produces the most desirable hardwood chacoan species (Lopez, 1979). As of 1980, FAO/UNEP (1981) estimated that roughly a quarter of a million km<sup>2</sup> of wooded vegetation remained in the chaco. From 1976-1980, deforestation progressed at a mean rate of 200 km<sup>2</sup> per year in the chaco and was projected to increase to 300 km<sup>2</sup> per year from 1981-1985. Stallings (1984) considered these deforestation figures for the chaco to be on the low side.

#### Conservation of Paraguayan Primates

It is widely recognized that virtually all protected natural habitats will become islands in a sea of development and agricultural lands (Wilcox, 1980). This recognition has led to the application of the theory of island biogeography (MacArthur and Wilson, 1967) to conservation biology (Soulé, 1980; Wilcox, 1980).

If the present rate of deforestation and development continues in Paraguay, then recolonization of habitat islands will no longer be possible, and biotic diversity of these areas will depend on speciation and extinction rates. For some species, colonization may still be possible, but for others a habitat barrier of a few kilometers could be restrictive.

Using the criteria established by Robinson and Ramirez (1982), I report minimum area requirements and viable population sizes of Paraguay's primate species (Table 4). The minimum area required to maintain a viable population can be calculated from the density of breeding adults and the effective population size. Since little is known of the forces involved in the maintenance of viable populations, these estimates are not a question of precision, and should only be viewed as initial approximations.

Table 4. Minimum Area Requirements and Viable Population Sizes for Paraguay's Primate Species.

Species	Min. Pop. Estimate	Area Required(km <sup>2</sup> )
<i>Aotus</i>		
Tnte. Enciso	1000	150
Agua Dulce	1000	107
<i>Callicebus</i>		
Agua Dulce	1000	81
<i>Callithrix</i>		
Agua Dulce	1000	312
Chovoreca	1000	143
<i>Cebus</i>		
Ybycui	1135	81

These calculations are compared to protected areas which possibly could become insular sanctuaries. Although I did not calculate the amount of suitable habitat for each species in each protected area, I present a general overview of the protected habitats in censused parks.

According to my calculations, *Aotus*, in P.N. Teniente Enciso, needs approximately 150 km<sup>2</sup> of suitable habitat to maintain a population of 1,000 breeding adults. This represents 37.5% of the park's total area. I would not consider the total area of the park as suitable habitat for viable populations, but probably this amount occurs in this park as a whole.

P.N. Defensores del Chaco supports more habitat diversity and primate species than P.N. Teniente Enciso. *Callicebus* and *Aotus* require from 80 to 107 km<sup>2</sup> of suitable habitat, respectively, to retain the ability to respond genetically to environmental changes. This represents approximately 1% of the total area of the park and from my frequent observations of both species there, I contend that ample suitable habitat is present. *Callithrix* would require about 312 km<sup>2</sup> of adequate habitat or 4% of the total area of the park. This habitat would need to be high forest vegetation, which occurs only in the northeastern section of the park and along ephemeral waterways. From my observations, probably 4% of the park is composed of this habitat type. But, this species has only been observed in the northeastern section of the park in high vegetation. Thus, it is probable that other factors besides habitat height alone limit its occurrence to the northeastern section. Perhaps precipitation and/or certain tree species associations are equally important limiting factors. I would conclude that the park does not support enough suitable habitat to maintain a minimum viable population of this species.

In eastern Paraguay, the only density estimate for *Cebus* is from P.N. Ybycui. Approximately 80 km<sup>2</sup> of suitable habitat are necessary to support a minimum viable population of 1,135 breeding adults. Obviously, this park is too small to support such a population, and colonization is doubtful since the closest national park, P.N. Caaguazu, is approximately 100 km away.

From a genetic viewpoint, *Callicebus*, *Aotus* and possibly *Alouatta*, have sufficient protected suitable habitat to respond genetically to environmental oscillations for long term survival. *Callithrix* and *Cebus* lack such suitable protected habitat, and at present can only be considered to be genetically protected from the short term effects of inbreeding depression.

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## Chimpanzee Survey in Mali, West Africa

Chimpanzees occupying dry habitats are particularly interesting because of the insights they provide on early hominid adaptations to a woodland/savanna way of life. Though certainly not "surrogate australopithecines," chimpanzees are undoubtedly closer to our ancestors in terms of morphology, physiology and intelligence than are other contemporary primates living in open woodland environments. By comparing chimpanzees living in hot, dry, "marginal" habitats with those living in more forested areas, we can hope to increase our understanding of the environmental pressures experienced during a move from the trees to the plains, and thus refine models of how our ancestors might have responded to these pressures (see Suzuki, 1969; Tutin *et al.*, 1983). In addition to conserving the species by protecting optimal forested habitat capable of supporting high chimpanzee densities, there is thus a compelling reason to protect smaller chimpanzee populations at the very limits of their acceptable ranges.

Kortlandt (1983) recently called attention to southwest Mali as possibly being the hottest and driest place in which western chimpanzees (*Pan*

*troglodytes verus*) exist. With funding from the L. S. B. Leakey Foundation and WWF-US, M. Mamadou Diakite (Eaux et Forêts, Mali) and I made a three-week survey of southwest Mali during December, 1984. The survey covered about 650 km by road and about 100 km on foot. In addition to the primary focus on chimpanzee distribution, we conducted a preliminary survey of a proposed national park site along the Bafing River between the towns of Bafing Makana and Manantali, where a large hydroelectric dam is under construction (Figs. 1-2).

Most of the survey zone lies between the 1100 mm and ca 1300 mm isohyets (PIRT, 1983). This zone has been termed "soudanien" or "soudano-guinéen" by various authors (see Kortlandt, 1983) and is characterized by low rainfall (restricted to July through November) and high daytime temperatures. Much of the land is rocky with frequent lateritic plateaus (Fig. 3); some of which are surrounded by high cliffs broken by ravines that contain evergreen *Ficus*, etc. Many of these plateaus are covered with short grass during the rains, but are barren, rocky plains by January. Vegetation off the plateaus is diverse, and depends on the local history of human use as well as on soil depth and moisture. It is likely that all of the fertile soil in the region has been cultivated at one time or another, and the practice of annually burning off the grasses has probably affected the entire region.

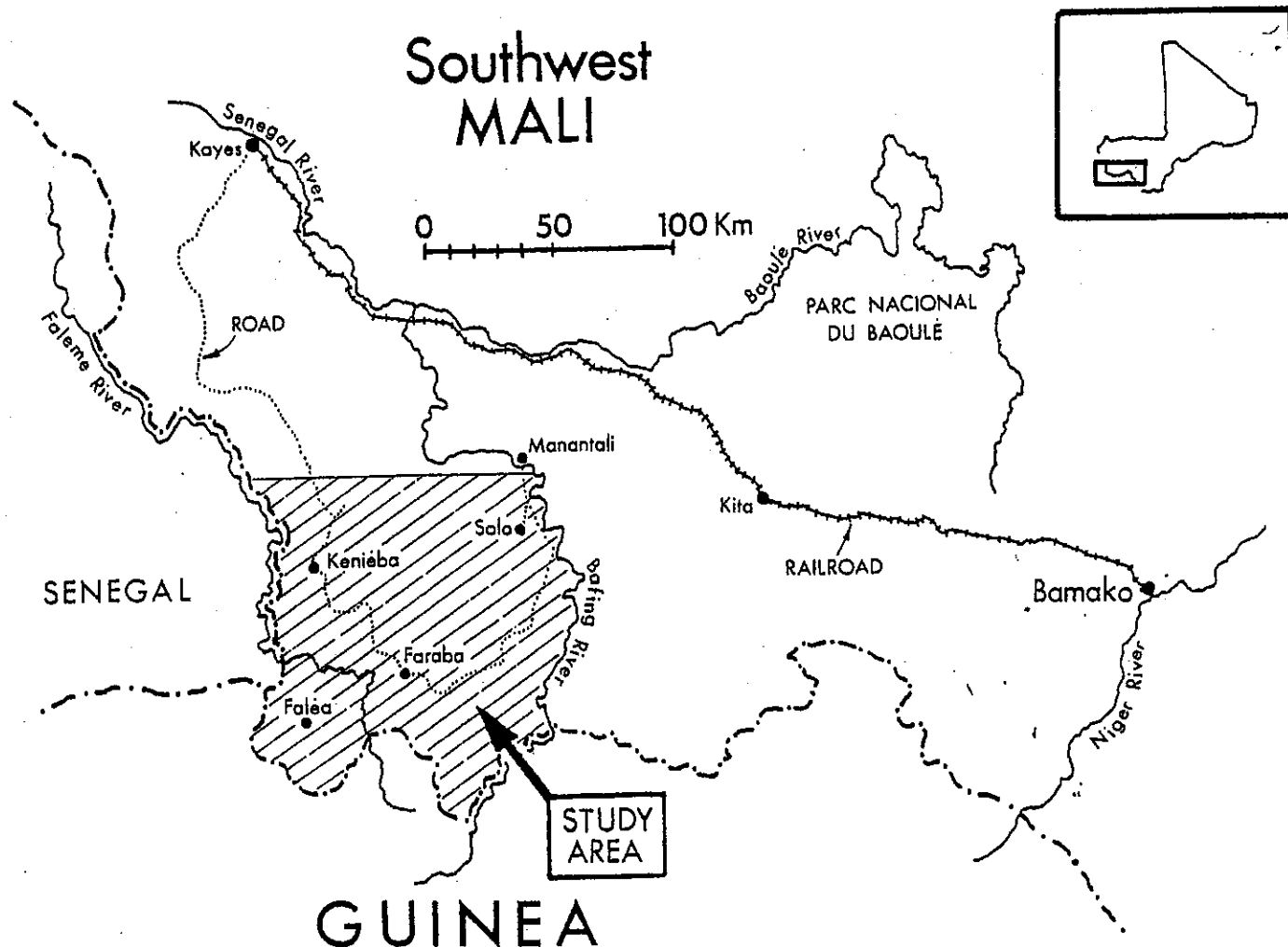


Fig. 1: Map showing the location of the study area in southwestern Mali (map by Stephen Nash from author's original).

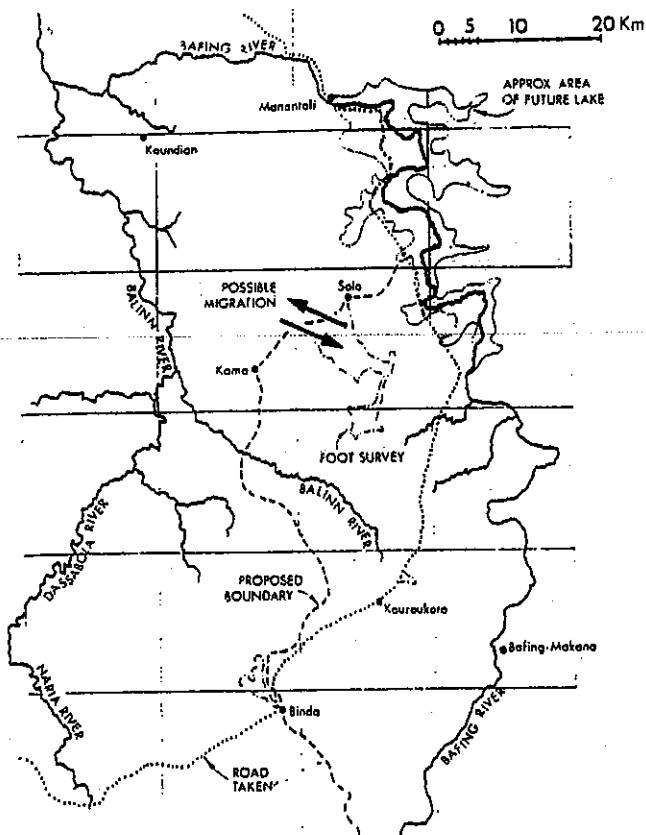


Fig. 2: Map showing portion of study area surveyed for proposed national park and region threatened by flooding from hydroelectric project (map by Stephen Nash from author's original).

The dominant woody plants in the zone include *Combretum* spp., *Pterocarpus erinaceus*, *Bombax costatum*, *Lankea* spp., *Parkia biglobosa*, *Terminalia* spp., *Daniellia oliveri*, *Detarium microcarpum*, *Vitellaria paradoxa*, and others. *Adansonia digitata* (baobab) are patchily distributed and many of the chimp nests we observed were near fruiting baobabs. Large mammals are scarce due to ubiquitous small-scale hunting; signs of buffalo, roan, hartebeest and warthog were encountered regularly near the Bafing River and we were told that eland, lion, leopard, and wild dog also occur at very low densities (see Sayer, 1977 for a summary of large mammal status in Mali). Human population density in the area is low ( $5/\text{km}^2$ ; PIRT, 1983), but small hamlets are widespread and few if any areas are protected from hunting by simple absence of people.



Fig. 3: Cliffside forest at Dabia. Chimps utilize isolated forest patches on the steep slopes (photo by J. Moore).

After our survey along the route from Kayes-Faraba-Manantali, the distribution of chimpanzees was estimated by scoring  $18 \times 18 \text{ km}$  quadrats on a 1:200 000 map as: (1) confirmed presence (nests seen); (2) suspected (habitat contiguous with neighboring confirmed presence areas); and (3) probable (maps and recent LANDSAT images show similarity to confirmed habitat and low human density) (Fig. 4). We were greatly aided in this by the use of 1:500 000 LANDSAT imagery and vegetation maps compiled by the *Projet Inventaire des Ressources Terrestres*. The project's final report (PIRT, 1983) contains detailed information on vegetation, soils, hydrology, human demography etc. in southern Mali, and represents a valuable resource for anyone interested in West African ecology.

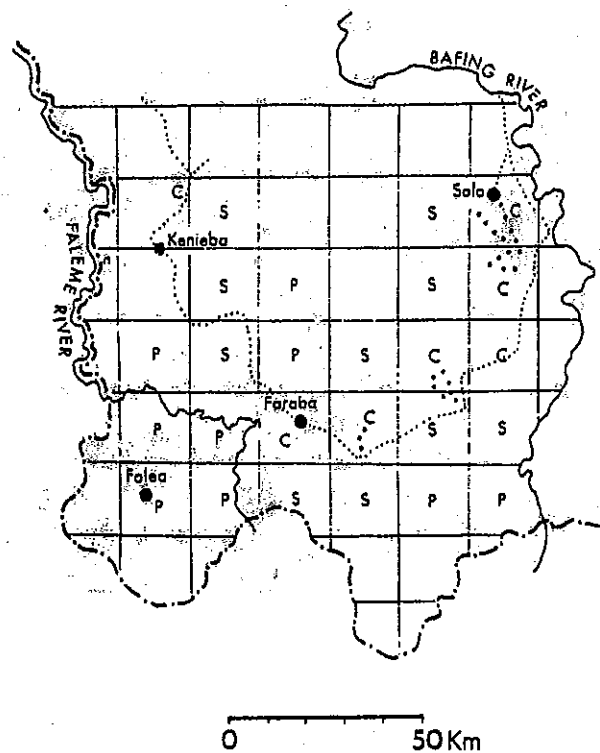


Fig. 4: Quadrat map used to estimate chimpanzee densities within the study area (C = confirmed presence (nests seen), S = suspected presence (habitat contiguous with confirmed presence areas), P = probable presence (habitat similar to confirmed presence areas and with low human population density)) (map by Stephen Nash from author's original).

We found chimp nests (Fig. 5) at all survey sites south of Kassama (about  $13^\circ 30' \text{N}$ ; close to the 1100 mm isohyet on the Bafing), and saw two groups of chimpanzees near Binda: one of 2 adult females, 2 adult males, 1 subadult male and 1 juvenile, and a second group of 1 adult female and adult male, who interacted briefly with the 6-member group. Nests were observed as much as 20 km from the nearest permanent river but most seemed to be within about 10 km of available water and several local informants commented on range shifts as water holes dried up seasonally. This overall distribution agrees well with that found by Sayer (1977), except that our survey indicates that chimpanzees are spread widely through the *soudanien* woodland and are not restricted to riverine forest.

Recent fires throughout the survey area had singed many of the nests, making it difficult to estimate their ages and preventing us from quantitatively estimating chimpanzee populations based on nest counts alone (see Tutin & Fernandez, 1984). An alternative method is to assume a density equal to the lowest reported for chimpanzees, 0.08 individuals per  $\text{km}^2$  (Baldwin *et al.*, 1982), and calculate the population based on this figure. This would yield an estimate of about 190 chimps for the quadrats in which we confirmed chimp presence; including suspected



Fig. 5: Author measuring chimpanzee nesting tree (photo by Mana Diakité).

and probable quadrats as well suggests that maximum population density is greater east of the Bafing, but there are reported to be several small (isolated?) populations of chimps between the Bafing and Bamako; this might add 50-100 for a total of about 700 chimps in Mali. However, the assumption that population density in Mali is no lower than at Mt. Assirik or Ugalla (Tanzania) needs to be tested. If the density in Mali is lower, the population there is of even greater interest regarding hominoid adaptation to a harsh environment.

We obtained only indirect evidence concerning home range size. During the survey of the proposed Bafing Makana park area we found a number of rotten nests, but few recent ones. We were told that chimps migrate into the hills away from the Bafing River during the dry season, which is consistent with the ages of the nests we found. The minimum length of such a migration would be about 25 km, suggesting a home range of *at least* 300 km<sup>2</sup>, the range estimated for chimps at Mt. Assirik, Senegal (Baldwin *et al.*, 1982).

Because of the difficulties estimating nest ages, estimates of party size based on associated nests are very crude. Nevertheless it is interesting to note that the largest number of identifiably same-age nests in a cluster was only five; at Mt. Assirik 37% of nest groups had more than 5 nests and almost 20% of groups had more than 10 nests/group (Baldwin *et al.*, 1981). This does suggest that average party size may be smaller in Mali. Whether this indicates a lower population density or not cannot be determined from our data.

Estimated densities for other primates were calculated based on sightings from the vehicle and on foot surveys, using average and maximum perpendicular distance to the path *and* average and maximum sighting distances. Sample sizes are small (5-10 sightings/species) and

no accurate counts were obtained, so the results are only approximate:

Species	Troops/km <sup>2</sup>	Approximate Density (#/km <sup>2</sup> )
Baboon ( <i>Papio papio/anubis</i> )	0.1 - 0.2	15 at 100/troop
Vervet ( <i>Cercopithecus aethiops</i> )	0.17 - 0.35	5 " 20/ "
Patas ( <i>Erythrocebus patas</i> )	0.15 - 0.28	4 " 20/ "

NOTE: The *P. papio* - *P. anubis* transition lies very near the survey area and our field sightings were not definitive. There may be a hybrid zone.

No other primates were seen, though we were told galago are common and in Faraba (the southernmost town visited) hunters said that black colobus can sometimes be found near the Naria River, nearer the Guinea border. It is worth noting that patas were reasonably common in the scrubby *Combretum* woodland; population densities for several open woodland sites are in the neighborhood of 2-8 individuals/km<sup>2</sup> (Mt. Assirik, C. Henry, unpublished; Laikipia, Kenya, J. Chism, pers. com.; Group II at Murchison Falls, Hall, 1965). Patas are often considered a savanna species, based largely on Hall's account of the overall habitat at Murchison Falls, where patas density may have been as low as 0.04/km<sup>2</sup>. However, their primary habitat may be better characterized as scrub woodland than as "savanna" and conservation planners should probably consider 5 individuals/km<sup>2</sup> a better "norm" than 0.04/km<sup>2</sup>.

Hamlets are scattered throughout the southwest and most men carry shotguns with them (Fig. 6). No species of mammal, bird or reptile seems exempt from hunting (Figs. 7-9); those not eaten as food are used for magic charms and/or traditional medicine. Skins used for medicine are sold by the piece, and *ca* .01 m<sup>2</sup> of chimp skin is worth the equivalent



Fig. 6: Farmers always carry shotguns. Incidental poaching is a serious problem (photo by J. Moore).



Fig. 7: A vendor purchases a patas monkey (*Erythrocebus patas*) head from local people to sell in a Bamako market (photo by J. Moore).



Figs. 8-9: (top) Lion skull, armadillo head and monkey paws among other wildlife artifacts for sale in a Bamako market. (bottom) Various skins for sale in the same market. Arrow indicates a chimpanzee skin (photos by J. Moore).

of several days wages. Elephant, serval, colobus, eagles, python; literally everything from armadillo to zebra was available in Bamako (scraps of zebra skin may have come from a pair that had been at the zoo). It is hard to estimate market turnover and hence impact on species. Over a one-month period, most of two adult chimp skins, half a serval skin, and at least three patas heads were sold at one market. For the more prolific or common species this is probably a negligible rate of use, but for larger carnivores and chimps it could be serious. Two chimps/month would be more than 3% of the estimated Malian chimp population per year.

At this time chimpanzees in Mali are protected only by their resemblance to humans. Most people we spoke with did not approve of eating them, even medicinally (through obviously they are used to some extent). I was told that an isolated group of chimps remains in a small reserve south of Bamako, but according to Eaux et Forêts staff this is not a viable population. Arid-country chimpanzees are primarily interesting for their behavioral adaptation to their habitat. Their ecosystem is unique, and at present there is no area in Mali in which savanna chimps and their habitat are protected. The Parc National du Niokolo-Koba in Senegal contains chimps in similar habitat, but apparently only a single community (Tutin *et al.*, 1983).

There is a large dam being constructed on the Bafing River at Manantali, which is expected to flood some 500 km<sup>2</sup> by about 1990 (D. Schreiber, personal communication). The Government of Mali is considering the establishment of a new national park just south of the dam, partly to compensate for the lost habitat and partly, as I understand it, in recognition of the low wildlife population surviving in the existing Parc National du Baoulé.

Establishment of the Bafing park would in principle protect the habitat of the northernmost chimpanzees in Mali. There is every reason to believe that the park zone contains part of the most marginal habitat in which a reproducing chimpanzee community exists. During our survey, we were struck by the increase in signs of larger mammals — droppings, hoofprints, etc. — encountered when we entered the proposed area, and it is one of the apparently few areas in Mali where giant eland are known to occur. In addition, the dam will probably create extensive shallows as the lake floods the nearly flat land near the river. This may make the area suitable for waterfowl, which are currently seriously affected by the recurring failures of the annual rains and consequent shrinking of the Niger delta near Mopti. Finally, access to the dam site is excellent, creating the potential for wildlife tourism if animal populations are protected.

Although favoring the creation of the park, the Malian government's resources are being seriously strained by the Sahelian drought. The Bafing park has great potential for research on chimpanzee adaptation to the savanna and, more generally, into the *soudanien* ecosystem itself. International interest and support for the Government of Mali's plans, possibly in cooperation with the existing international Manantali dam project, will play a vital role in realizing this potential.

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## Range Extensions for Four *Cercopithecus* Species in the Central African Republic

In 1983-1984, during the course of a WWF-sponsored elephant conservation project in Manovo-Gounda-St. Floris National Park, Central African Republic (Fig. 1), I carried out an intensive floristic survey of gallery forests which occur in the southern portion of the park (Fig. 2).

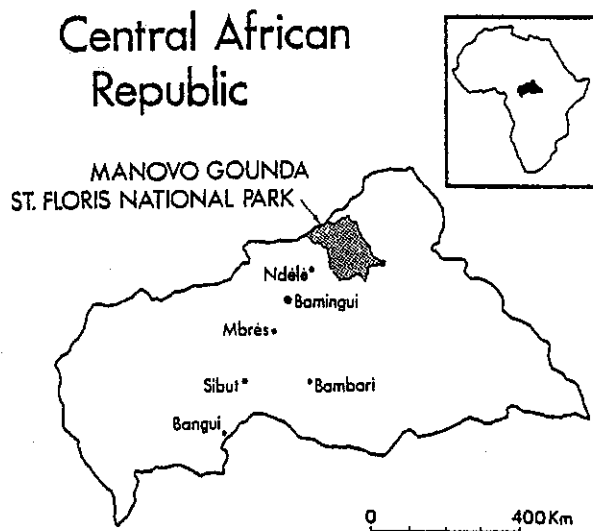


Fig. 1: The location of Manovo-Gounda-St. Floris National Park in the Central African Republic (map by Stephen Nash from author's original).

These gallery forests (Fig. 3) are extremely important as they represent the northernmost limit of this vegetation type in all of greater Central Africa. They also occur in the Chadian basin, not in the Congo basin, which is interesting from a biogeographical point of view. Until just one year ago, access to this area was extremely limited and it is still necessary to walk 20 km to reach the richest of these forests. As a result

the fauna is relatively undisturbed. The elevation in this area varies around 650 m and the annual precipitation is around 1250 mm. Severe drought is rare.

We were interested in this area not only because it contains a flora which is typical of areas much further to the south but also because of the existence of a population of elephants which have many of the morphological features of the forest elephant (*Loxodonta africana cyclotis*). The current, known distribution for this elephant lies far to the south of our study area (Meester and Setzer, 1971). Only since the gallery forests have become more accessible has the importance of this elephant in the park been realized.

During our survey we found four *Cercopithecus* species which had never previously been recorded this far to the north (Hill, 1966; Wolfheim, 1983). Populations of the following four *Cercopithecus* species were seen: greater white-nosed monkey (*Cercopithecus nictitans*), black-cheeked white-nosed monkey (*C. ascanius*), mona monkey (*C. superspecies mona*), and De Brazza's monkey (*C. neglectus*). All four species were observed on numerous occasions, and identifications were confirmed.

The Manovo-Gounda-St. Floris Park covers 1,700,000 ha, of which approximately 16,990 ha is virgin gallery forest (Peyre de Fabregues, 1981; Fig. 2). It is thought that most of this habitat is suitable for the four *Cercopithecus* monkeys observed. Only a very small portion of the forests were intensively surveyed, however, so the total ranges of the monkeys within the park are unknown.

The vegetation of the forests can be broken into three basic zones: dry forest, moist forest, and swamp forest. The dry forest occurs on elevated sites with sandy soils which are well drained throughout the year. The dry forest zone is usually contiguous with the moist forest along the major watercourses. It is also found on the hill crests between watercourses with ferric oxisols and sandy soils. The dry forest zones along watercourses account for the greater proportion of the area classified as gallery forest in the Peyre de Fabregues (1981) report (Table 1).

The swamp forest consists of permanently flooded or waterlogged parts of the gallery forests in the depressions. Swamp forest sometimes covers areas hundreds of hectares in extent. These areas very often contain dense stands of *Raphia* palms and are important elephant habitat (Table 1).



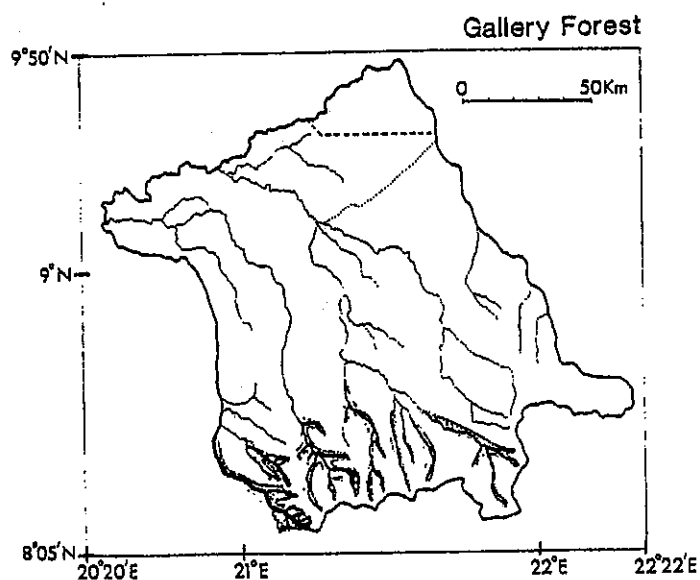
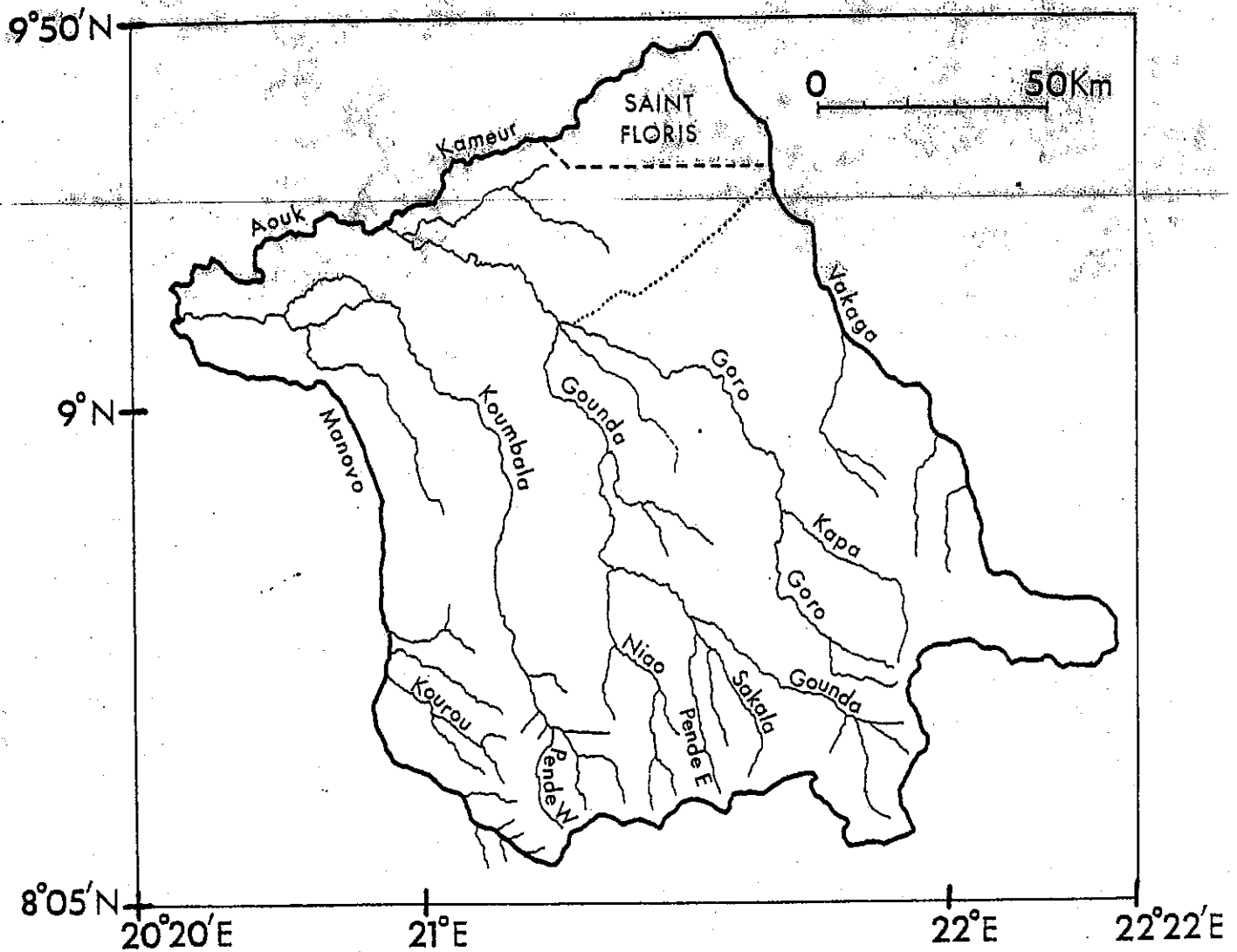


Fig. 2: Gallery forests in the southern portion of the national park (map by Stephen Nash from author's original).

The most extensive and richest gallery forests in the park are situated at the southeastern limit of the reserve on the Manovo River (Fig. 3). This is also where one finds the greatest mammal diversity. All four *Cercopithecus* species are found in this forest (see Figs. 4-8). This is the only known location for the mona monkey within the park, and it is quite common here. As one proceeds farther to the east, the climate of the park becomes somewhat drier and the galleries become much less important. Further investigations will have to be made in these areas to determine if the monkeys range past the Niao River (Fig. 2).

The following is a synopsis of what is known at present about the ranges and abundance of the *Cercopithecus* monkeys in the park (excluding *C. aethiops*).

**Greater white-nosed monkey:** This is the most abundant of the *Cercopithecus* monkeys found in the gallery forests (Fig. 4). They occur in rather large bands from 10-20+ individuals and are often seen in mixed bands with *C. ascanius* and *C. mona* where they occur and also with *Colobus guereza* throughout its range. They spend most of their time in the upper strata of the moist forest but have been observed quite often in the lower strata and in both the dry forest and swamp forest, and sometimes on the ground. Their location in the forest depends to a great deal on their food sources. On one occasion a band of about 20 individuals was seen outside of the gallery forest, but very close to it, feeding on *Tamarindus indica* fruits. They probably don't venture very far from



Fig. 3: Koumbala River gallery forest (photo by M. Fay).

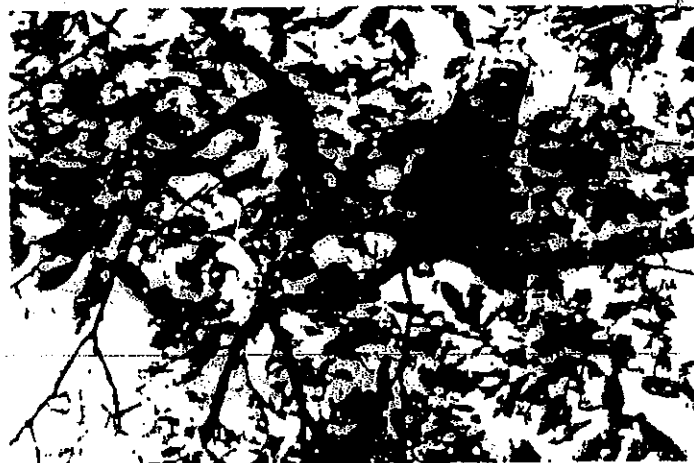


Fig. 4: The greater white-nosed monkey (*Cercopithecus nictitans*) is the most abundant of the *Cercopithecus* monkeys found in the gallery forests (photo by M. Fay)

the gallery forest and have not been recorded in the non-contiguous dry forest.

The known range of this species in the park extends from 8° 14' N - 8° 25' N to 21° 05' E - 21° 22' E on the Manovo and Koumbala Rivers (Fig. 5). The population is not known, but judging from the number of records and the band sizes one could conservatively estimate the population at several hundred in the park. This species has previously been reported from just south of Ndele in the Chadian basin (Fig. 1) (Malbrant, 1952).

**Black-cheeked white-nosed monkey:** This species is almost invariably seen with *C. nictitans*. Group sizes range about the same as those of *C. nictitans*. However, it is not as common as the latter species nor does it range as far north (Fig. 6). It is most frequently encountered on the Manovo River in dry forest and moist forest. On the Koumbala, it has

been seen more frequently on the west branch in moist forest and on the east branch in dry forest. This species has been observed on the ground in the dry forest vegetation but never outside of the gallery forest. It spends most of its time in the upper strata. Like *C. nictitans*, its location in the forest depends to a great extent on its present food source.

The total population is not known but there are certainly hundreds of individuals just along the two rivers mentioned above. It probably ranges into the Niao River drainage and possibly farther east, but this remains to be determined. Wolfheim (1983) shows *C. ascanius* ranging to approximately 250 km south of where it has been observed in the park. It is possible that its range is continuous from this southern sighting to the park as there are galleries on the Kotto drainage which come close to reaching the park forests.

Table 1: Plant Species of Swamp, Moist and Dry Forest in the Southern Region of Manovo-Gounda-St. Floris National Park, Central African Republic.

Swamp Forest	Moist Forest	Dry Forest
<i>Mitragyna stipulosa</i>	<i>Syzygium guineense</i> var <i>guineense</i>	<i>Anogeissus leiocarpus</i>
<i>Ficus lepreuri</i>	<i>Canarium schweinfurthii</i>	<i>Erythrophleum suaveolens</i>
<i>Ficus congensis</i>	<i>Klainedoxa gabonensis</i>	<i>Khaya senegalensis</i>
<i>Ficus mucosa</i>	<i>Khaya grandifoliola</i>	<i>Tetrapleura tetraptera</i>
<i>Syzygium guineense</i>	<i>Uapaca togoensis</i>	<i>Albizia ferruginea</i>
(var <i>guineense</i> )	<i>Myrianthus arboreus</i>	<i>Chorophora excelsa</i>
<i>Uapaca togoensis</i>	<i>Pycnanthus angolensis</i>	<i>Detarium senegalense</i>
<i>Mallotus oppositifolius</i>	<i>Xylopia aethiopica</i>	<i>Fagara macrophylla</i>
<i>Macaranga schweinfurthii</i>	<i>Beilschmiedia</i> sp.	<i>Cola gigantea</i>
<i>Alchornea cordifolia</i>	<i>Combretum</i> spp.	<i>Cassipourea</i> cf <i>ruwenzorensis</i>
<i>Xylopia aethiopica</i>	<i>Ficus</i> spp.	<i>Caloncoba crepiniana</i>
<i>Xylopia</i> sp.	<i>Rauvolfia caffra</i>	<i>Cassia sieberiana</i>
<i>Treculia africana</i>	<i>Rauvolfia vomitoria</i>	<i>Agelea obliqua</i>
<i>Canthium henriquesianum</i>	<i>Saba comorensis</i>	<i>Mossua hirsuta</i>
<i>Antidesma lacinatum</i>	<i>Ouretea flava</i>	<i>Leptaulus daphnoides</i>
<i>Psychotria</i> spp.	<i>Gaertnera paniculata</i>	<i>Belonophora hypoglauca</i>
<i>Piper umbellatum</i>	<i>Coffea</i> sp.	<i>Ouretea affinis</i>
<i>Piper guineense</i>	<i>Canthium mannii</i>	<i>Ochna schweinfurthiana</i>
<i>Impatiens irvingii</i>	<i>Phoenix reclinata</i>	<i>Diospyros mespiliformis</i>
<i>Pteris burtoni</i>	<i>Elaeis guineensis</i>	<i>Streptogyna crinita</i>
<i>Microlepis speluncae</i>	<i>Commelina capitata</i>	
<i>Raphia vinifera</i>		
<i>Aframomum longiscapum</i>		
<i>Calamus deerratus</i>		
<i>Laccosperma secundiflora</i>		
<i>Scleria racemosa</i>		
<i>Bulcasia</i> cf <i>falcifolia</i>		
<i>Entolasia olivacea</i>		

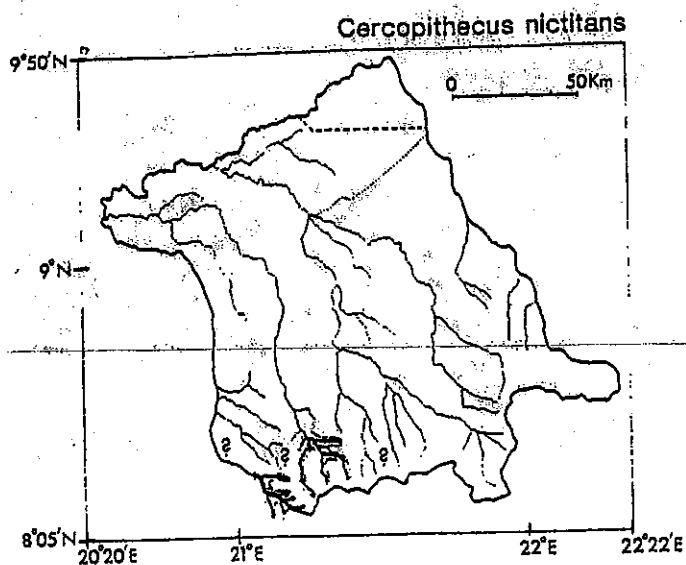


Fig. 5: Known range of *C. nictitans* in Manova-Gounda-St. Floris National Park (map by Stephen Nash from author's original).

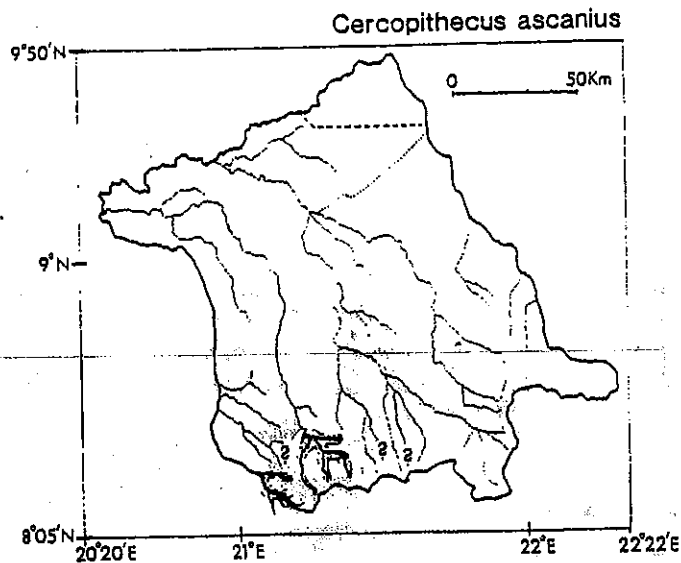


Fig. 6: Known range of *C. ascanius* in Manova-Gounda-St. Floris National Park (map by Stephen Nash from author's original).

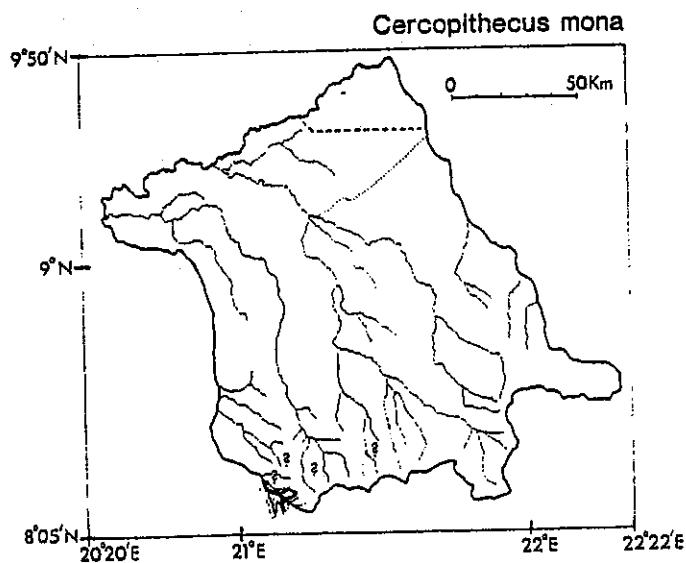


Fig. 7: Known range of *C. mona* in Manova-Gounda-St. Floris National Park (map by Stephen Nash from author's original).

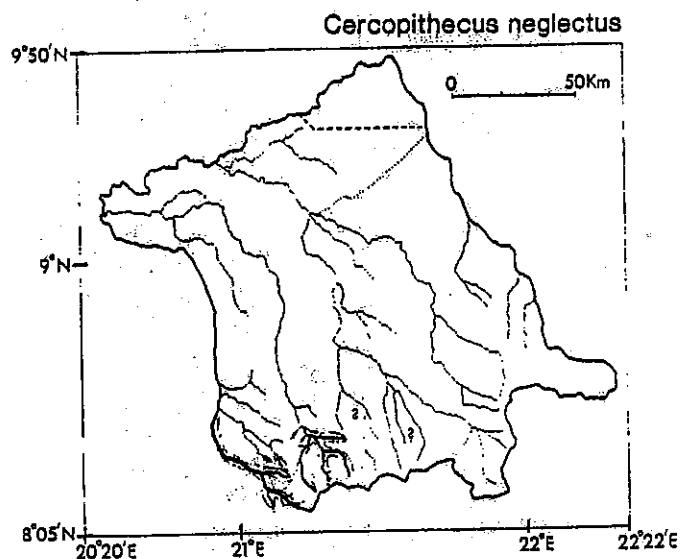


Fig. 8: Known range of *C. neglectus* in Manova-Gounda-St. Floris national Park (map by Stephen Nash from author's original).

**Mona monkey:** The mona monkey thus far has only been recorded on the Manovo River (Fig. 7). It is frequently sighted in mixed bands with *C. ascanius* and *C. nictitans* and is sometimes seen by itself. If this species does occur on the Koumbala River, it is not common. While *C. ascanius*, *C. nictitans* and *C. neglectus* have all been seen on at least ten different occasions, *C. mona* has never been spotted on the Koumbala River.

This species is common on the Manovo River and certainly numbers 100 individuals and probably many more. *C. mona* has previously been recorded as far north as M'Bres, which is approximately 200 km south of where it was recorded in the park (Fig. 1).

As the taxonomy of this superspecies (incl. *pogonias*) is still rather uncertain and inter-specific variation great, we have purposely not attempted to be specific in our determination. The mona which occurs in this forest is rather plain, its back being golden-orange with the underparts a much lighter yellow. It has a dark frontal crest, a conspicuous dark mask and a white chevron. The mona that was recorded for M'Bres was Dent's guenon (Hill, 1966).

**De Brazza's monkey:** Although this species is frequently seen on the Koumbala River, band sizes are very small and many pairs and single animals are recorded. It occurs most frequently in moist forest and swamp

forest but is sometimes seen in dry forest habitat. It seems to range farther out of the main body of the gallery forest (into forest islands) than do the other *Cercopithecus* species. It has been seen on a few occasions at 8° 29'N on the Manovo River and at 8° 29'N on a small tributary of the Koumbala River (Fig. 8). It is also, seemingly, the most widespread of the four species, ranging from these northern limits to the very southern limit of the gallery forest on both the Manovo and Koumbala Rivers. Because of the relatively solitary nature of this species, it is difficult to estimate a population figure, though more than 100 individuals certainly occur in the park. This species has been recorded on the Bamingui River 100 km to the south of the range extension in the park (Fig. 1) (Froment, pers. comm., 1983). I have also observed dead specimens for sale on the side of the road between Bangui-Mbres and Sibut-Bambari, and also in Bangui.

Whether or not these northern *Cercopithecus* populations are truly isolated from more southern populations remains unclear. The gallery forests that lie directly south of the park, which are in the Congo basin, have never been surveyed. There is no reason to doubt that these forests contain *Cercopithecus* monkeys as the habitat is quite similar to that found in the park galleries. If one assumes that they do, then the park popula-

tions are separated by little more than 1 km from the Congo basin populations in some places.

One other species of primate which deserves mention, both because of its abundance and far reaching northern range in the park, is the Abyssinian black-and-white colobus monkey (*Colobus guereza occidentalis*; Figs. 9-11). This species is common throughout the gallery forest system in the south of the park and also ranges far to the north where there are isolated patches of dry forest along the major rivers (for a list of plant species see Table 2).



Fig. 9: Male Abyssinian black-and-white colobus monkey (*Colobus guereza occidentalis*). This species numbers in the thousands in the Manovo-Gounda-St. Floris National Park (photo by M. Fay).

Table 2: Plant Species of Dry Forest in the Northern Region of Manovo-Gounda-St. Floris National Park, Central African Republic.

*Anogeissus leiocarpus*  
*Diospyros mespiliformis*  
*Khaya senegalensis*  
*Tamarindus indica*  
*Pterocarpus lucens*  
*Cassia sieberiana*  
*Kigella africana*  
*Lonchocarpus eriocalyx*  
*Feretia apodanthera*  
*Clausena anisata*  
*Allophylus africanus*  
*Hexalobus monopetalus*  
*Teclea nobilis*  
*Monanthonaxis buechananii*  
*Gutiera senegalensis*  
*Erythroxylum emarginatum*  
*Mimusops kummel*  
*Cratogeomys religiosa*  
*Boscia senegalensis*



Fig. 10: Four Abyssinian black-and-white colobus monkeys peer down at the author. Poaching pressure on this species is minimal in the park, in sharp contrast to the situation in the southern portion of Central African Republic (photo by M. Fay).

In the gallery forests in the south this species is found in large troops of up to 30-40 individuals. They are even quite abundant in the upland, non-contiguous dry forest vegetation where one does not find the forest species of *Cercopithecus*. In the north, this species occurs up to 9° 40' N. At this location the annual precipitation is only around 700 mm. As one proceeds farther to the north the troop sizes diminish considerably. Along the lower Gounda River, the average troop size is only 5-10 individuals. A 1979 population estimate for St. Floris park (including Gounda River to Goro confluence) of 20-50 (Barber, 1981) seems low for this area.

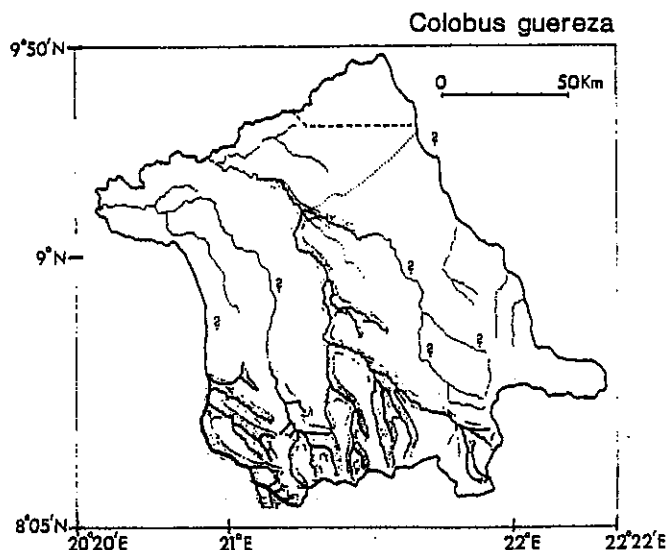


Fig. 11: Known range of *Colobus guereza* in Manovo-Gounda-St. Floris National Park (map by Stephen Nash from author's original).

This species is frequently seen on the ground crossing from one forest zone to another. The farthest they have been seen from a forest, however, is less than 200 m. There is probably a critical size for permanent use of a forest. One isolated dry forest at 8° 40' N of 2 ha in extent contained a semipermanent troop of *Colobus*.

The colobus population in the park numbers in the thousands. On the Koumbala River drainage alone there are probably over 1,000 individuals.

Hunting pressure has reduced the numbers of this species to almost nil in the southern portion of the country. Their pelts are prized by certain tribes for use in headdresses, belts, cloaks, etc. It is probably only a matter of time before the park poachers find a market for the skins of this species. At present, however, poaching pressure seems to be at

a minimum and the park population is stable, although skins have been found in poacher camps.

Other primate species found in the park include the lesser galago (*Galago senegalensis*), anubis baboon (*Papio anubis*), patas monkey (*Erythrocebus patas*), and the green monkey (*Cercopithecus aethiops tantalus*).

Manova-Gounda-St. Floris certainly holds a very diverse and healthy primate fauna. It is rather ironic that the very place which marks the extreme limit of the range of these species is where they are found at their greatest abundance outside the lowland forest. Although eastern Central African Republic contains unknown, but undoubtedly abundant primate reserves, the southwestern portion of the country possesses only remnants of the populations that existed in the past. As the larger mammals are exterminated, people are looking more and more to primates as a protein source. Even in the predominantly Moslem north of the country, truckloads of baboon meat are shipped to Bangui on a regular basis as the demand for primate flesh in the capital is high indeed.

Obviously more research is needed to establish the exact status of each species within the park. As the habitat in this area is undisturbed, the park provides a perfect setting for research on the natural history of these primates. It also provides a unique opportunity to study these species at the very limit of their known ranges. Every effort should be made to see that this park receives adequate protection in years to come.

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## Primates and their Conservation in the Impenetrable (Bwindi) Forest, Uganda

### Introduction

Tropical moist forests probably covered more than 6% of Uganda's land area at one time (Butynski, 1984). Due to agricultural expansion, these forests have been reduced by at least half. By 1981, Uganda had but 5,500 km<sup>2</sup> of tropical moist forest and this was being felled at a rapid rate (FAO & UNEP, 1981).

Of the forested areas which remain, the Impenetrable (Bwindi) Forest (Fig. 1) is undoubtedly one of the most significant, and is currently gazet-



Fig. 1: Scenic view of the mountainous Impenetrable Forest in southwestern Uganda (photo by R. A. Mittermeier).

### Acknowledgements

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ted as a Central Forest Reserve (Forest Department) and as an Animal Sanctuary (Game Department). Located in southwestern Uganda (0° 53'S to 1° 8'S; 29° 35'E to 29° 50'E) (Fig. 2), it is by far the largest tract of forest (321 km<sup>2</sup>) in the region. However, nearly all of the land surrounding the Impenetrable has already been cleared for agriculture (Fig. 3).

The vegetation in the Impenetrable is generally classified as Moist Lower Montane Forest (Hamilton, 1982), but this varies considerably with altitude. The topography is extremely rugged with narrow, steep-sided valleys. Mean annual rainfall is about 1,440 mm.

The Impenetrable is the only forest in East Africa — and one of the few in all of Africa — where continuous forest vegetation extends from 1,160 to 2,600 m in altitude. Due to its extensive altitudinal range, and the probable role of this region as a Pleistocene Refuge for many species (Hamilton, 1982), the Impenetrable has one of the richest floras and faunas in Africa (Carcasson, 1964; Keith et al., 1969; Kingdon, 1973; Hamilton, 1976). Of particular note are its 10 species of primates, including the endangered mountain gorilla (*Gorilla g. beringei*).

In this report I present an overview of the number, distribution and conservation status of the primate species in the Impenetrable, utilizing data gathered in 1983-84 during a preliminary ecological survey of this forest.

### Distribution and Abundance of Primates

During this survey, a total of 38 primate censuses were conducted along approximately 189 km of footpath and road. In addition, opportunistic observations were made during walks totalling 20 km within the reserve and 54 km outside the reserve in neighboring, remnant forest patches. In total, 102 species groups and eight apparently solitary adult males were observed during 85 encounters with primates.

Population estimates for each species were obtained after taking into account the following variables: detectability, distributional range, and

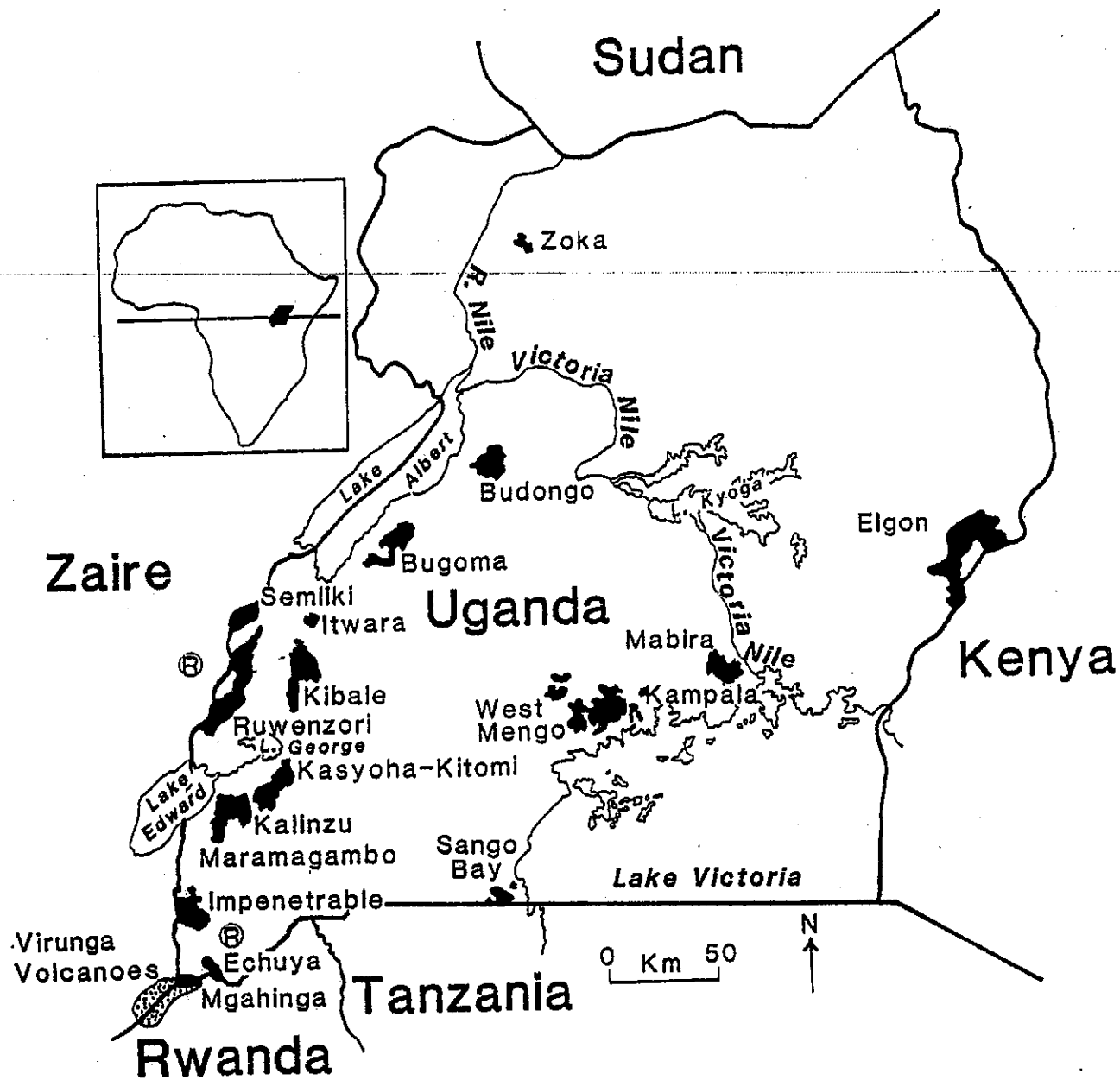


Fig. 2: Location of the Impenetrable Forest and other natural forest blocks in Uganda. The Impenetrable Forest and the Virunga Volcanoes are the only two sites in the world where mountain gorillas are found (map courtesy of the author).

preference for fringe or interior parts of the forest. Estimates were derived using the "Maximum Reliable Perpendicular Sighting Distance (MRSPD)" method (National Research Council, 1981). In the Kibale Forest (also located in western Uganda), the actual group densities of blue monkeys (*Cercopithecus mitis*), redtail monkeys (*Cercopithecus ascanius*), red colobus (*Colobus badius*) and grey-cheeked mangabeys (*Cercocebus johnstoni*) are fairly well known on two study sites. There the MRSPD method tends to overestimate the densities of these species by 16% (red colobus) to 37% (redtail monkey) (Butynski, in prep.). Therefore, to avoid overestimating the numbers of primates in the Impenetrable Forest, all densities obtained using the MRSPD method were "corrected" by reducing them 37%. The results are considered conservative estimates of species' densities (Table 1), and in cases of small sample size (e.g., chimpanzees and gorillas) should be used cautiously.

All seven of the region's diurnal primate species are sympatric over the altitudinal range of 1,500 to 1,800 m (Fig. 4). The three nocturnal primates, the potto (*Perodicticus potto*), Demidoff's galago (*Galago demidovii*) and needle-clawed galago (*Galago inustus*), were observed at 1,500 m, but little is known about their altitudinal distribution in this

forest. There are an estimated 37 diurnal primates/ km<sup>2</sup> in the Impenetrable, or about 12,000 in the entire forest. This is a relatively low primate density when compared to some other western Uganda tropical moist forests. The Kibale Forest, for example, harbors from 300 to more than 500 diurnal primates/ km<sup>2</sup> (Butynski, in prep.; Struhsaker, 1975). Much of this difference is indirectly attributable to the higher mean altitude in the Impenetrable since primate densities above 1,700 m are especially low in most areas. One striking feature is the considerably lower density of fruit for primates in the Impenetrable, particularly figs. This was especially noticeable above 1,700 m and likely accounts for the general decline in primate densities with increasing altitude.

The redtail monkey is probably the most abundant primate in the Impenetrable. The total number of redtail monkeys is roughly 5,500 (Table 1), with a density of 17 individuals/ km<sup>2</sup>. This species is followed in order of abundance by blue monkeys, baboons (*Papio anubis*), L. Hoest's monkeys (*C. lhoesti*), guereza (*Colobus guereza*), chimpanzees (*Pan troglodytes*) and mountain gorillas.

The most widely-distributed diurnal primate in the Impenetrable is undoubtedly the blue monkey (Fig. 5). This animal, and probably

With the exception of the redbtail monkey, all species of monkeys make more use of the fringes of the forest (areas within 1.4 km of a boundary or road) than the interior (areas further than 1.4 km from a boundary or road). L'Hoest's monkey does not seem to occur in the interior, and blue monkeys and baboons are rare there. Guereza were neither seen nor heard more than 2.8 km from the fringe. In contrast, gorillas, and perhaps chimpanzees, prefer the interior of the reserve. Above 1,800 m, a large portion of the Impenetrable's interior (approximately 180 km<sup>2</sup>) is nearly devoid of monkeys. This area, however, is favored by gorillas.

Human presence is highest on the fringe of the Impenetrable and declines with distance into the forest. It seems likely that those primates using the slightly disturbed areas on the fringe are also capable of tolerating a high level of human activity. Other species, such as gorillas, may prefer less altered habitats and are intolerant of people, or both.

Table 1: Preliminary Estimates of the Distribution, Density and Numbers of Seven Species of Diurnal Primates in the Impenetrable Forest, Uganda. All Estimates Derived from Census Data (1983-1984)

Species	Sightings*	Altitudinal range (m)	Distributional range (km <sup>2</sup> )	#/km <sup>2</sup>	Total # in forest
Redtail monkey	14	1,160-1,800	112** (35)	49.1*** (17.1)	5,504
<i>Cercopithecus ascanius</i>					
Blue monkey	17	1,160-2,600	321 (100)	9.6 (9.6)	3,113
<i>C. mitis</i>					
L'Hoest's monkey	5	1,160-2,600	115 (36)	9.9 (3.6)	1,138
<i>C. lhoesti</i>					
Guereza	6	1,160-2,400	103 (32)	3.8 (1.3)	396
<i>Colobus guereza</i>					
Baboon	5	1,160-2,000	96 (30)	14.0 (4.2)	1,343
<i>Papio anubis</i>					
Chimpanzee	2	1,160-2,300	302 (93)	0.4 (0.4)	133
<i>Pan troglodytes</i>					
Mountain gorilla	1	1,500-2,300	182 (56)	0.6 (0.4)	115
<i>Gorilla g. beringei</i>					
Total				(36.6)	11,742

\*: Number of encounters within the "maximum reliable perpendicular sighting distance" for each species.

\*\*: Values in parentheses indicate the percentage of the Impenetrable Forest which is occupied by this species.

\*\*\*: Upper values indicate the density of the species within its particular range. Values in parentheses indicate species density in relation to the entire forest area.

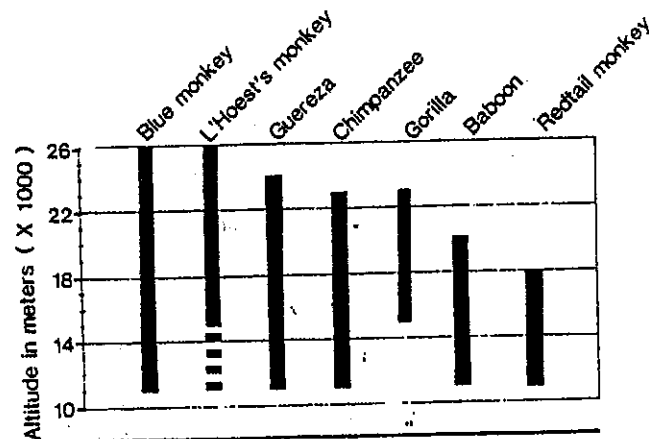


Fig. 4: Altitudinal distributions of seven species of primates in the Impenetrable Forest (bar graph by Stephen Nash).

#### Conservation Status of Primates

There is some taxonomic confusion concerning the blue monkey in the Impenetrable. The literature indicates that three subspecies of *Cercopithecus mitis* occur in the Impenetrable Forest. Although it has been



Fig. 3: Areas immediately beyond the boundaries of the Impenetrable Forest have been cleared of trees and are now under intensive agriculture. The boundary is well demarcated by a row of large introduced cypress trees (photo by T. Butynski).

L'Hoest's monkey, are the only two diurnal primates found at all altitudes in this forest (Table 1, Fig. 4). Although L'Hoest's monkey was not encountered below 1,500 m, this species almost certainly occurs down to 1,160 m, as it does in other western Uganda forests (Kingdon, 1971). Blue monkeys and L'Hoest's monkeys appear to be most abundant in the bamboo zone (above 2,400 m).

Redtail monkeys have the most restricted altitudinal range while baboons have the most restricted distributional range of this forest's primates. Guereza, redbtail monkeys and baboons are most common at the low elevations and become less abundant with increasing altitude.

Chimpanzees and mountain gorillas were encountered only three times within the forest. Census results indicate that each of these species is represented by slightly more than 100 individuals in the Impenetrable. Gorillas are found between 1,500 and 2,300 m and use about 182 km<sup>2</sup> (approximately 56%) of this reserve. This restricted range is more likely due to the considerable human disturbance in areas below 1,500 m and above 2,300 m than to ecological factors. I estimate that there are at least 80 km<sup>2</sup> of equally suitable habitat which is not used by the gorillas, or is used very infrequently.

At the start of this survey I was informed by game guards and guides that the monkeys (blue monkey, L'Hoest's monkey, redbtail monkey, guereza and baboon) were considerably more abundant along the roads and boundaries of the Impenetrable than in its interior. In contrast, they claimed that gorillas kept primarily to the more inaccessible parts of the forest. The findings of this survey bear out the accuracy of this general assessment, as do the results of an earlier survey by Harcourt (unpubl. report).



Fig. 5: The blue monkey (*Cercopithecus mitis*) is the most widely-distributed monkey in the Impenetrable (photo by T. Butynski).

stated that the golden monkey (*C. m. kandi*) is present (Stott, 1960; Williams, 1967), no one claims to have actually seen it in this forest. I found no evidence of this subspecies either from my own observations or from communication with local people, and conclude that it is very unlikely that the golden monkey occurs in the Impenetrable.

Stuhlmann's blue monkey (*C. m. stuhlmanni*) and Doggett's monkey (*C. m. doggetti*) do occur, however. Individuals which I consider to be "good" representatives of these two subspecies were observed, as were many animals intermediate in color. All forms are occasionally observed within the same group. There is obviously considerable interbreeding between these two "subspecies" and most individuals are intermediate in coloration. Because of this, it seems appropriate to view *C. mitis* in the Impenetrable as consisting of one population with considerable color polymorphism, rather than as two populations of different subspecies (Stott, 1960; Hill, 1966).

Of the three gorilla subspecies, the mountain gorilla is by far the most endangered (Harcourt, *et al.*, 1983). This subspecies occurs only in the 375 km<sup>2</sup> Virunga Volcanoes area and in the Impenetrable. The present population of gorillas in the Virungas is about 260.

The mean group size of gorillas in the Impenetrable seems not to have changed much in the last two decades. Nest counts indicate that the mean group size prior to 1961 was 9.0 animals, whereas after 1978 it was 8.2 (Butynski, 1984). During this survey nine groups were located. These groups had a mean of 7.2 members and ranged in size from two to 21.

I combined my data with that of Harcourt (1981) to increase the data base. Using nest counts, evidence for 101 gorillas was found in the 126 km<sup>2</sup> surveyed. This suggests a density of about 0.8 gorillas/km<sup>2</sup>, or a total population of 146, if one uses my estimate that gorillas utilize 182

km<sup>2</sup> of this forest. This figure is similar to Schaller's (1963) estimate for this population in 1959. This is certainly encouraging. However, because of the low numbers of gorillas remaining, their great importance, and the considerable uncertainty as to the actual number of gorillas present, I believe it is necessary to take a conservative view and manage this population on the basis of 115 animals (Harcourt, 1981) until an accurate assessment of numbers can be made.

Poachers using guns and traps are blamed for the extermination of the Cape buffalo (*Syncerus caffer*) and leopard (*Panthera pardus*) in the Impenetrable. They are also surely responsible for the small elephant (*Loxodonta africana*) population, which now numbers fewer than 30 animals (Butynski, unpubl. ms.). Guns and nets are probably seldom used in the Impenetrable at this time, although traps are common.

While poaching is at a high level it does not appear to be directed at primates. I estimate that the density of traps was greater than 5/km<sup>2</sup>, but only three of the 89 traps found appeared to have been set specifically for primates (probably for blue monkey and L'Hoe's monkey). Some primates, however, particularly the more terrestrial L'Hoe's monkey, chimpanzee and gorilla, must occasionally be captured in snares and deadfalls placed for antelope and pigs.

It is particularly noteworthy that no evidence was obtained for the hunting of gorillas, a major problem confronting gorilla conservation efforts in the Virunga Volcanoes (Harcourt, *et al.*, 1983). There is an unconfirmed report, however, that two gorillas were killed in 1981 by villagers using spears. The gorillas were said to be raiding a banana plantation on the edge of the reserve. The fact that this incident was reported at different times by several individuals suggests that these killings did occur.



Fig. 6: The author, lower left, displaying posters of the endangered mountain gorilla to local children (photo by R. A. Mittermeier).

### The Future

The Impenetrable Forest represents one of the last viable remnants of what was once an extensive area of tropical moist forest. It is an important water catchment area for the people of this region, as well as a source of pride and an important cultural and spiritual link to the past. At both the national and international levels the Impenetrable is viewed as a unique forests, representing one of Africa's richest areas in terms of biological diversity. It therefore has considerable potential for tourism, research and education (Fig. 6).

The Uganda Government, Forest Department and Game Department have done commendable work protecting the Impenetrable Forest from agricultural encroachment. In addition, most of the local people have exhibited uncommon respect for this area and constraint in the use of its resources. Nonetheless, there are many problems now affecting its protection and management as the need for resources grows. This reserve lies within one of the most densely populated areas of Africa (140 people/km<sup>2</sup>). Although no people actually reside within the reserve, there



is a high level of human activity, both legal and illegal. Between 512 and 1,049 people enter the forest daily (approximately 1.6-3.2 individuals/km<sup>2</sup>) (Butynski, 1984). Because of the large numbers of people involved, the cumulative effects from removal of wood, bamboo, honey, meat and gold are becoming increasingly apparent and serious. Resolution of these problems is urgent.

A report, based on the findings of this survey, puts forth the following three recommendations to the Uganda Government (Butynski, 1984):

1. Gazette the entire Impenetrable Forest as a national park.
2. Add five small, but critical, areas to the existing reserve. These five areas total only 30 km<sup>2</sup>. One of them, now unprotected, provides habitat for 10 to 20 gorillas.
3. Establish a permanent field station to undertake applied research on the ecology of the Impenetrable.

At this time the Uganda Government is giving serious consideration to gazetting the Impenetrable as the Country's first forested national park and first World Heritage Site. In addition, World Wildlife Fund — U.S. is initiating a three year project aimed at assisting the Uganda Government in conserving the Impenetrable Forest, focusing in particular on its mountain gorilla population. The Mountain Gorilla Project in Rwanda has already demonstrated that these animals can greatly benefit national economies by stimulating tourism. It is hoped that similar success can be achieved in the Impenetrable Forest.

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## Ecological Status of the Lion-tailed Macaque and its Rainforest Habitats in Karnataka, India

### Introduction

The lion-tailed macaque (*Macaca silenus*, Linn.: Fig. 1) is a rare primate whose distribution is now confined to the tropical wet evergreen forests of the Western Ghat mountain chain in the southern Indian states of Karnataka, Kerala and Tamil Nadu. This highly arboreal macaque has evolved to occupy a specialized ecological niche in these rainforests (Fooden, 1975). Being an indicator species for this habitat, the lion-tailed macaque can be focused on in developing a conservation strategy for the biologically diverse forests of southern India.



Fig. 1: The lion-tailed macaque (*Macaca silenus*) is an arboreal primate confined to the tropical moist evergreen forests of the Western Ghats in India (photo by R. A. Mittermeier).

In recent times the lion-tail's distribution and conservation status in the wild has been assessed by Sugiyama from 1961-63, Daniel and Kannan in 1967, Kurup from 1971-77, Green and Mikowski from 1971-77 and Bhat from 1978-81 (Kurup, 1978; Bhat, 1982). Except for the systematic survey by Bhat (1982) in the Uttara Kannada and Shimoga Districts of Karnataka, the other surveys have concentrated primarily on habitats in Kerala and Tamil Nadu, neglecting Karnataka. Green and Minkowski (1977), in their pioneering survey which highlighted the precarious status of the lion-tailed macaque, stated that, "Though 800 km<sup>2</sup> of Dipterocarpus dominant evergreen forests were available in Kar-

nataka, . . . these Karnatakian forests nowhere comprise a single tract of undisturbed *shola* large enough to support a viable population of monkeys and remote enough from human interference to make their long term preservation feasible." This view has been generally accepted by other primatologists and the lion-tailed macaque is stated to "have become rare in its northern range and is now probably confined to Kerala (Krishnan, 1972) and scattered areas in the hills of southern Tamil Nadu" (Roonwal and Mohnot, 1977). Consequently, specific conservation efforts have virtually bypassed the state of Karnataka. At the 1982 Lion-tailed Macaque Symposium in Baltimore no participants were familiar with this species in its Karnataka habitats. However, at this symposium, based partly on incidental data that I collected, Rauf Ali (1982) placed the Karnataka population of lion-tailed macaques at about 12 troops. This figure contrasts with that of 2-3 troops estimated by Green and Minkowski (1977) and Kurup (1978) several years earlier. According to the consensus at the Symposium, the total wild population was estimated to be somewhere between 915-2,000 animals, though Ali felt the higher figure was impossible based upon existing information (Ali, 1982).

In view of the lion-tail's endangered status, I approached the Government of Karnataka (Department of Ecology and Environment) to sponsor my status survey of this species in Karnataka, to the south of a small area surveyed by Bhat earlier (Fig. 2). The results of the survey are reported here. They form the basis of a management plan for the concentration of the lion-tailed macaque and its habitats, which I will also

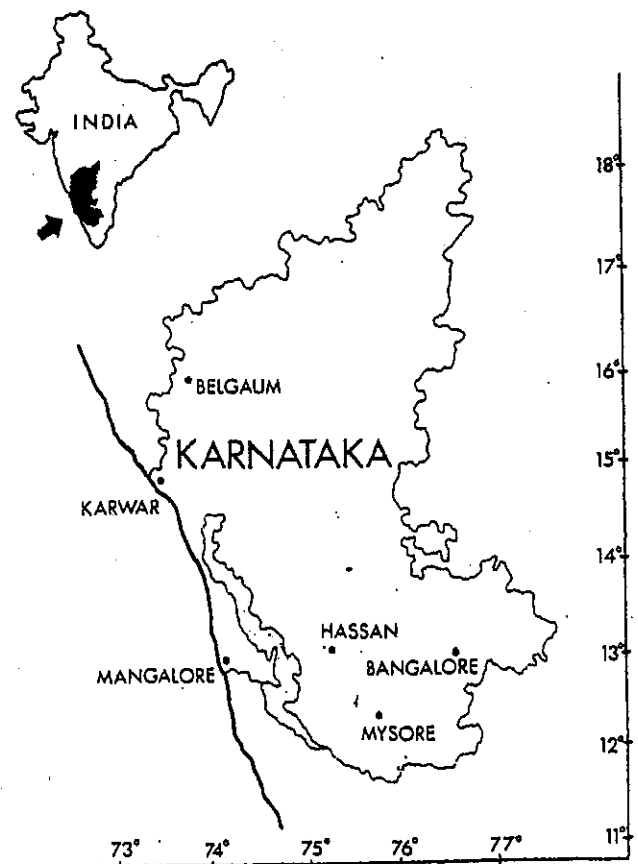


Fig. 2: The location of Karnataka state in southwestern India and extent of the forest tracts depicted in Figure 3 (map by Stephen Nash from author's original).

present to the Government of Karnataka. A brief outline of recommended conservation measures is included, in addition to the data collected by Bhat (1982), thus presenting a consolidated picture of Karnatakan habitats.

**Table 1: Local Names Used for Different Monkey Species Within the Lion-tailed Macaques Range in Karnataka**

Bonnet macaque	<i>Kapl, Kothi, Manga</i> (in Kannada, Tulu and Kodava); <i>Mankad</i> (in Konkani)
Hanuman langur	<i>Musiya, Muchcha, Bukka, Book Manga, Koda</i> (in Kannada); <i>Muju</i> (in Tulu); <i>Bommuchcha*</i> (in Kodava)
Nilgiri langur	<i>Karimuchcha*</i> (in Kodava)
Lion-tailed macaque	<i>Singalika</i> (in general in Kannada); <i>Karikodiya</i> (in Kannada); <i>Kaygadaka</i> (in Mudugere and Koppa Forest Ranges); <i>Chingalika, Bali, Evo</i> (in Tulu - the latter two names being specific to the Subramanya and Naravi areas); <i>Karingada, Monnamuchcha*</i> (in Kodava in the northern and southern portions of the Kodagu District, respectively); <i>Neela</i> (in Konkani/Marati among Kunbi tribals)

\*: In Kodagu District, where all four species occur, the Hanuman langur is known as "white langur", the Nilgiri langur as "black langur" and the lion-tailed macaque as "stump-tailed langur" or "black macaque".

The Kannada name for the lion-tailed macaque literally means "lion-like" or "black macaque".

## Objectives and Methods

The objectives of this survey were to: 1) locate as many surviving troops of lion-tailed macaques in Karnataka as possible, assessing the population status and distribution; 2) assess the availability of potential lion-tailed macaque habitat, as well as the degree of pressure exerted by poaching and habitat destruction; and 3) based on the above, prepare an overall management plan that identifies key conservation areas.

In view of the large tract (approximately 5,000 km<sup>2</sup> PT) to be covered (Fig. 2) and considering the recommendations of other field primatologists familiar with lion-tailed macaque ecology and behavior (Ali, 1982; Ajith Kumar, pers. comm.), direct methods using line transects were ruled out for this survey. Instead, the survey was based on local informants who reported troop sightings within the past two to three years, coupled with personal assessment of the habitat. Information was collected systematically, ensuring the following:

1. Most of the informants belonged to the Tribes/Castes/Occupational groups who spent most of their time in the Ghat forests collecting minor forest produce items like fruits, nuts, myrobolans, resins, bark, climbers, canes, leaves and honey, rather than cultivators and foresters who tend to be less knowledgeable about forest animals.

2. The identity of the lion-tailed macaque was clearly established at the outset of the interview by careful questioning in the local languages/dialects, utilizing photographs of different primate species and the common local names (Table 1). This was generally an easy process because neither the Nilgiri langur (*Presbytis johnii*) nor any other black monkey likely to be confused with the lion-tail occur in Karnataka, except in the extreme southern part of the state.

3. The troop locations were identified with the help of prominent geographical features and forest logging compartments on Survey of India Topographic Maps of 1:50,000 scale. Since the recorded home range for the lion-tailed macaque is reported to be 2-4 km<sup>2</sup> (Green and Minkowski, 1977; Ajith Kumar, pers. comm.), troops sighted more than 5 km apart on the ground were considered as distinct troops. This cautious approach is likely to have underestimated total troop numbers.

4. Information was collected on relative abundance now as compared to 10-15 years prior, troop size and the presence of young animals, numbers of different troops seen on any single day, and the pressure from traditional hunting.

5. The habitat was assessed by on-site visits and by discussions with local foresters, reference being made to maps prepared by the French Institute, Pondicherry (Pascal *et al.*, 1982) and the State Forest Depart-

ment.

The field work required approximately 60 days between November 1983 and May 1984.

## Study Area

The tract surveyed stretched through the Western Ghats between 14° 15' - 11° 55' north latitude and covered a length of about 220 km, the average width varying from 15-25 km. The tract is administered under various forest divisions and ranges (Table 2). During the last few centuries, the lion-tailed macaque habitats have shrunk to this remnant strip, receding from the coastal plains because of agricultural expansion, shifting cultivation, exploitation in the forms of overgrazing, burning, timber removal, and fuel wood and forest product gathering, and major forestry operations (Stebbing, 1929; Davis, 1934). Despite a forest reservation policy of the late 19th century, which protected Reserved Forests from earlier onslaughts, many of these pressures continue at an intensifying rate. The habitat of the lion-tailed macaque is now confined to the Reserved Forests of the Western Ghats, primarily on the western slopes. These dense forests generally occur at elevations ranging between 100-1,800 m, the higher elevations having Shola Montane forests. The annual precipitation varies locally between 2,500-8,000 mm and is received primarily in the June-September monsoon period. The length of the dry season increases progressively from south to north. The soils are inherently poor in nutrients, the bulk of which are stored in the living vegetation and litter. When the forest cover is disturbed there is a rapid loss of nutrients due to leaching (Rai, 1982).

**Table 2: Forest Administration Within Lion-tailed Macaque Habitats in Karnataka**

Forest Division	Ranges Covering Past/Present Lion-tailed Macaque Habitat Within Division
Karwar	Anshi*, Kumbarawada*
Yellapur	Vajrahalli*, Jannana*
Sirsi	Siddapur
Honnarav	Kumta, Honnarav*, Gersoppa, Manki*, Bharkal
Bagar	Sagar, Hosanagar
Shimoga	Agumbe
Kundapur	Bairidur, Kundapur, Shankaranarayan, Hebri, Karkal, Mudabidre, Venur
Koppa	Sringeri, Kalasa
Chicknagalur	Mudugere
Hassan	Sakaleshpur, Yenalur
Mangalore	Belthangadi, Uppinangadi*, Subramanya, Sullya*
Madikeri	Sampaja, Bhagamandala, Mundrote, Makut, Srimangala

\*: No recent sightings reported from these ranges; Lion-tailed macaque is probably extinct.

The lion-tailed macaque occurs in dense evergreen forests and sometimes utilizes semi-evergreen formations. The Karnataka habitats have been mapped and described in detail by Pascal *et al.* (1982) and Puri *et al.* (1983), according to the Holistic classification system. Descriptions of the different forest types are given below:

Forest Type	Description
22:	<i>Schleffera</i> spp.- <i>Gordonia obtusa</i> - <i>Meliosma amottiana</i> type Shola Montane forest at 1,250-1,800m elevation
25:	<i>Persea macarantia</i> - <i>Diospyros</i> spp.- <i>Holigarna</i> spp. type dense evergreen forest at 0-850m elevation
26/1:	<i>Dipterocarpus indicus</i> - <i>Kingiodendron pinnatum</i> - <i>Humboldtia brunonis</i> type dense evergreen forest at 0-850m elevation
26/2:	<i>Poeciloneuron indicum</i> facies of the above type at 0-850m elevation
26/3:	<i>Dipterocarpus indicus</i> - <i>Humboldtia brunonis</i> - <i>Poeciloneuron indicum</i> type dense evergreen forest at 0-850m elevation
26/4:	<i>Dipterocarpus indicus</i> - <i>Diospyros cordilleana</i> - <i>Diospyros oocarpa</i> type dense evergreen forest at 0-850m elevation

- 26/5: *Poeciloneuron indicum* facies of the above type at 0-850m elevation  
 26/6: *Dipterocarpus indicus*-*Persea macarantha* type dense evergreen forest at 0-850m elevation  
 26/7: *Poeciloneuron indicum* facies of the above type at 0-850m elevation  
 26/8: *Mesua ferrea*-*Palaquium ellipticum* type dense evergreen forest at 800-1,400m elevation  
 26/9: *Palaquium ellipticum*-*Poeciloneuron indicum*-*Hopea ponga* type dense evergreen forest at 800-1,400m elevation

Of the above forest types, Type 22 is found only in small patches at high elevations, the best examples occurring around Kudremukh Peak in the Kalasa Forest Range. Type 26 occurs in fragmented patches in the Gersoppa Range. All of the remaining habitats are different subtypes of the main forest Type 26 *Dipterocarpus-Mesua-Palaquium* (Puri *et al.*, 1983). In the semi-evergreen degradations of the above evergreen forest there are characteristic species like *Dysoxylum malabaricum*, *Tetrameles nudiflora*, *Bombax ceiba*, *Caryota urena*, *Lagerstroemia lanceolata*, *Xylia xylocarpa* and *Bambusa arundinacea*, not commonly found in the dense evergreen types.

According to official statistics, about 4,350 km<sup>2</sup> of evergreen forest and 1,450 km<sup>2</sup> of semi-evergreen forests are found in the Karnataka tract that I surveyed. However, a significant portion of this area is not climax vegetation. It is estimated that of the 3,521 km<sup>2</sup> of Reserved Forests in the Ghats that I surveyed, only about 1,985 km<sup>2</sup>, a little more than half, contains reasonably good evergreen forest and even this has been subjected to selective logging. An estimated 50% of the good evergreen forest is located higher up the slopes and is generally inaccessible to the village communities at the foot of the Ghats. Overall, I estimate that approximately 1,000 km<sup>2</sup> of suitable habitat remains for the lion-tailed macaque in the Western Ghats of Karnataka.

#### Status of Some Sympatric Species

The status of some sympatric species of frugivorous mammals and birds were also assessed during this survey to obtain a better idea of habitat quality. Among large frugivorous birds, Imperial pigeons (*Ducula bedia* and *D. jerdoni*) and hornbills (*Tockus griseus*) were found to be common, but the large pied hornbill (*Buceros bicornis*), an indicator species of climax evergreen forest, has become rare.

Among frugivorous mammals, the giant fruit bat (*Pteropus giganteus*), giant squirrel (*Ratufa indica*), large brown flying squirrel (*Petaurista petaurista*), and common palm civet (*Paradoxurus hermaphroditus*) are reasonably common. The Nilgiri marten (*Martes gwatkinsii*) has almost vanished from the Shiradi Ghat-Sampaje stretch of its former range, but still occurs in the Madikeri Forest Division further south.

The bonnet macaque (*Macaca radiata*) is common everywhere, but the Hanuman langur (*Presbytis entellus*) is common only to the north of Kudremukh where it is not persecuted intensively. The Nilgiri langur (*Presbytis johnii*) has become extremely rare and is probably confined to the Makut and Srimangala Ranges, where it is rarer than the lion-tailed macaque due to severe poaching.

#### Habitat Continuity

Former lion-tailed macaque habitats in the extreme north in the Anshi, Kumbarawada, Vajrahalli, Honnavar, Janmane and Kumta forest Ranges have been almost totally degraded into semi-evergreen and deciduous forest types. The habitats in Gersoppa and Siddapur are also fragmented, though a good block exists in Mastimane Ghat (Fig. 3). South of this, the Sharavati River probably interrupts the habitat. The evergreen forests in the Gersoppa, Manki, Bhatkal and Sagar Ranges between the Sharavati River and the Bhatkal-Kogar Ghat road are also somewhat fragmented. South of Kogar Ghat the habitat runs in a thin but continuous strip to Kollur Ghat. There is reasonably good forest between Kollur Ghat and the Varahi Project where a break occurs, in spite of disturbance created by the Chakra Project. South of Varahi continuous evergreen habitat stretches to Yelaneeru at the southern end of the Kalasa

Range. In the area of the Ghats between Yelaneeru and the Bandajearbi waterfall there is a complete break in the forest due to the presence of private coffee estates, and the western face appears to have been degraded to deciduous formations. Within this tract, the Kyasanur forest, a disease lethal to primates is said to be rampant. The evergreen forest south to the Subramanya Range has been disturbed by large scale, government plantation farming projects and by the Hassan-Mangalore Railway Project. Some good evergreen forest remains, however, at the higher elevations in the Belthangad, Mudugere and Sakleshpur Ranges, as well as in the Neriya and Banjar estates. The degradation is rather severe in the Uppinagadi Range, apparently due to the Hassan-Mangalore Railway Project.

South of Subramanya, a large tract of evergreen forest remains intact in the Subramanya and Kadamakal Forest Reserves of the Sampaje Range. There is a wide break in habitat in the Sampaje and Sulya Ranges where the forest is now mainly deciduous. Further south in the Bhagamandala, Mundrote and Srimangala Ranges, the forest habitat is extensive and largely continuous, though the adjoining forests of Kerala have been almost totally cleared by the encroaching human population.

#### Pressures on the Lion-tailed Macaque and its Habitat

**Habitat.** The local communities in settlements at the foot of the Ghats exert significant pressure on the surrounding forests, resulting in steady but almost imperceptible habitat degradation. Though most of the lion-tailed macaque habitat at the middle and upper elevations in the Ghats do not seem to be adversely affected at this time, the lower elevation forests in the foothills and the coastal plains, such as the Kidu Forest Reserve in the Subramanya Range and parts of the Karkal, Kundapur and Gersoppa Ranges, are being encroached upon. At higher elevations, fires set by grazers and people collecting forest products reduce the remaining Shola forest patches. In the forests of the Madikeri Division leases have been granted for extensive cardamom cultivation.

The good evergreen forests at higher elevations are subject to pressures from logging to produce plywood, matchwood and railway sleepers. There has, however, been a noticeable decline in the general intensity of exploitation of Karnatakan forests since the mid 1970's. Despite large scale forest clearance for the Chakra and Varahi Projects, the removal of forest products from Forest Reserves has declined considerably over the past decade, due largely to the use of more conservative methods of extraction. The total production of all kinds of timber and fuelwood from Karnataka forests declined from 3,219,200 m<sup>3</sup> in 1975-76 to 1,562,523 m<sup>3</sup> in 1982-83, amounting to a decline of 52%. Tree removal for plywood and matchwood, which is entirely from evergreen species, showed a similar decline of 46%; 176,000 m<sup>3</sup> to 80,956 m<sup>3</sup> in this same period. Earlier working plans allowed the removal of 15 trees greater than 1.8 m in girth per hectare. In 1976, this upper limit was reduced to 10 trees/ha and then further reduced to 5 trees/ha in 1982-83. The practice of clear felling evergreen forests to practice monoculture was also abandoned in the mid 1970's (Shyamsunder, pers. comm.).

Despite more conservative exploitation practices within Karnatakan forests, it was determined that approximately 38-89 km<sup>2</sup>, or 4% of the total estimated lion-tailed macaque habitat in this region was under pressure from selective logging for the plywood and matchwood industries in 1983-84. It should be noted that these practices are the results of political and administrative decisions beyond the control of local forest and wildlife managers.

**Poaching.** Traditional poaching of lion-tailed macaques, Nilgiri and Hanuman langurs is most severe in the Madikeri Forest Division adjoining Kerala State. The belief in alleged aphrodisiacal and medicinal properties of 'Black Monkey' flesh are firmly rooted in this region, particularly among settlers from Kerala. In the forest tract between the Sampaje and Mudugere Ranges, on either side of the ridge of the Ghats, local people are known to hunt lion-tailed macaques, though not as persistently as they do the Hanuman langur. North of the Belthangadi and Mudugere Ranges, lion-tailed macaques are not shot or eaten, though the Hanuman is shot up to the northern boundary of the Karkal Range.

Due to cultural tradition, the lion-tail enjoys some protection from hunting throughout approximately half of its range in Karnataka. It was noticed, however, that settlers from Kerala who have encroached upon the reserved forests in the Uppinangadi, Kundapur, Baindur and Sagar Ranges hold no such traditions and were reportedly poaching the lion-tailed macaque. On the whole, since implementation of the Wildlife Protection Act in 1974, there has been a considerable reduction in the level of poaching throughout the state, particularly broad daylight poaching that was common at one time. Being a diurnal species, the lion-tail has probably benefited greatly from the decline of this practice.

#### Present Status of the Lion-tailed Macaque

**Relative Abundance.** Historically, the lion-tailed macaque must have been fairly well known in this tract since literary classics in the Kannada language such as "Torave Ramayana" (16th century) and "Kaushika Ramayana" (17th century) clearly mention it as being distinct from other monkey species. During the "Krishnashtami" religious festival in Udupi, Dakshina Kannada District, folk dancers masquerade as lion-tailed macaques and other animals. Locally, the lion-tailed macaque is recognized by the Kannada name "Singalika". In addition, it has several other interesting names in local languages and dialects which distinguish it from other primates (Table 1).

At the turn of the century, religious mendicants sporting lion-tailed macaques as mascots were a common sight in Dakshina Kannada (South Kanara) District (K. S. Karanth, pers. comm.). Lion-tails were reported from as far north as Anshi Ghat in 1955 (Kurup, 1978). According to data collected by Bhat (1982) and me, the lion-tailed macaque has probably become extinct in the extreme northern part of Karnataka in the Anshi, Kumbharwada, Varahalli, Janmane and Honnavar Ranges. A remnant population probably occurs in the Kumta Range (Bhat, 1982).

Of the 28 forest ranges covered in this survey, in only eight ranges did informants not notice a marked decline in lion-tail populations over the past 10-15 years. Even within these eight ranges, in the foothill forests of the Andar and Someshwar Forest Reserves in the Karkal and Hebri Ranges, some decline was noted.

In the 20 other ranges surveyed a general population decline was reported. The lion-tailed macaque has probably become extinct in the Sullya and Uppinangadi Ranges, and in most portions of the Manki and Sampaje Ranges. Similar local extinctions appear to have occurred within the Sagar, Siddapur and Gersoppa Ranges. Decline in abundance seems to have been severe in all four ranges of the Madikeri Division.

**Distributional Continuity.** From the data collected on troop sightings (Table 3) and other information, the distributional discontinuities of lion-tailed macaque populations within Karnataka appear to be closely linked to habitat discontinuities mentioned earlier. The major breaks appear to be at the Sharavati River valley, the Varahi Project, the Yelaneeru-Bandajearbi stretch and Sampaje Ghat, in addition to interrupted habitats north of the Sharavati River. The reported absence of the lion-tailed macaque in most parts of the Koratikulbare Forest Reserve of the Baindur Range is surprising since reasonably suitable habitat seems to exist and there is no local tradition of poaching. Evergreen forests occur patchily within semi-evergreen formations in the region north of the Bhatkal-Kogar Ghat road. Scattered sightings and lower reported densities indicate that this habitat distribution affects population continuity of the lion-tail.

**Troop Size.** Previous studies (Green and Minkowski, 1977) indicate troop sizes for the lion-tailed macaque to be between 6-34 individuals. Informants contacted during this survey were asked only for approximate figures (Table 3). Sightings of solitary monkeys probably indicate adult or subadult males not associated with larger troops. In many other cases it is likely that only a portion of the entire troop was viewed. Ajith Kumar (pers. comm.) estimated the average troop size to be between 18-20 animals in the Anamalai Sholas. On three earlier occasions that I saw lion-tailed macaques in Karnataka forests, troops of 18 (Agumbe Ghat, 1967-1968) and 10-15 (Samehakluhole, Hebri Range, 1974) individuals were recorded. During this survey, on both occasions when

lion-tailed macaques were sighted (at Kudlu and Kuringal) only solitary adult males were observed, though the movement of the associated troops could be discerned at a distance. For the purposes of this report an average troop size of 15 animals has been assumed.

**Density and Status.** The intensive line transect censusing necessary to estimate distributional density of troops was outside the scope of this study. During the field survey, I attempted several walks through the forest, counting the number of troops at each locality. The following results are reported:

Location	Distance Walked: (km)-and-Time	Monkeys Seen-# Troops
Kerti Forest Reserve (Makut Range)	5 km - morning	Hanuman langur - 1 (call) Bonnet macaque - 2
Madibare Forest Reserve (Kundapur Range)	5 km - evening	Hanuman langur - 3 Bonnet macaque - 1
Someshwar Forest Reserve (Karkal Range)	8 km - afternoon	Hanuman langur - 1 Bonnet macaque - 1 Lion-tailed macaque - 1
Tungabhadra State Forest (Sringeri Range)	3 km - afternoon	—
Tungabhadra State Forest (Kulasa Range)	5 km - morning	Hanuman langur - 3 Lion-tailed macaque - 1
Tungabhadra State Forest (Kulasa Range)	4 km - evening	Hanuman langur - 2

During this survey, three reliably good informants who covered 48 km<sup>2</sup> in adjoining sections of the Andar Forest Reserve estimated a total of 23 troops of lion-tailed macaques there. Though nothing conclusive can be stated from these observations, it does appear that in areas of suitable habitat the density of lion-tailed macaques can be expected to be fairly high.

Based on the information collected and my own habitat assessment, I have classified the 28 forest ranges that I surveyed into four distinct categories based upon relative distributional density of lion-tailed macaque troops (Table 4). These categories are:

**Absent** - no troops reported, habitat degraded and unsuitable;

**Low** - described as rare, habitat in fragmented patches;

**Medium** - described as present, not more than one troop seen on the same day by informants, habitat reasonably good; and

**High** - described as *not* uncommon, informants reporting more than one troop encountered on the same day, habitat very good.

From Table 4 it can be seen that only nine ranges are in the high density category. All are in a cluster on either side of the crest of the Ghats between Kollur Ghat road in the north and Yelaneeru in the south. Despite the existence of large projects like Chakra, Varahi and Kudremukh, which have disrupted this tract in the last decade, the remaining habitats are in good condition with reasonable continuity and isolation from human settlements. There is apparently no local tradition of poaching lion-tailed macaques within this tract.

Among the medium density ranges, those in the north, such as Gersoppa and Agumbe, have been disturbed by severe logging in the past. The lion-tails, however, are not subjected to poaching pressure. The medium density ranges in the south, such as Subramanya, Bhagamandala, Mundrote, Makut and Srimangala, have a tradition of poaching, but the forest habitat is remote and fairly undisturbed.

In the remaining 14 ranges low densities are reported. Of these, in the Siddapur, Sagar, Manki and Bhatkal Ranges the habitat has been disturbed and fragmented, mainly by forestry. Though the local people do not kill lion-tailed macaques, some poaching by settlers from Kerala in the Sagar and Baindur Ranges is reported. Within the other low density ranges, poachers have easy access to lion-tailed macaque habitat in Mudugere, Sakleshpur and Yesalur. In the Belthangadi and Uppinangadi Ranges, wholesale habitat degradation as well as poaching have wiped out the lion-tail, except in the most inaccessible regions of the Kudamakal Forest Reserve.

**Population Estimates.** In the absence of any hard ecological data on densities in different habitat types, no serious estimate of the lion-tailed macaque population can be made. The following points are put forth only tentatively.

An estimated 1,000 km<sup>2</sup> of habitat suitable for the liontailed macaque remains in Karnataka State. The home range of this species has been estimated at 4 km<sup>2</sup> in *Cullenia exarillata* dominant evergreen forests of the Ashambu Hills, Kerala by Green and Minkowski (1977). In the floristically more diverse Anamalai Sholas the home range is said to be 2 km<sup>2</sup> (Ajith Kumar, pers. comm.), probably indicating smaller home ranges in more diverse habitats relative to single dominant species habitats. The Karnataka forests are mostly low and medium elevation evergreen formations, floristically diverse, and the home range size is probably similar to that found in the Anamalai Sholas. Home ranges of neighboring lion-tailed macaque troops are reported to overlap considerably (Sugiyama, 1968; Green and Minkowski, 1977; Ajith Kumar, pers. comm.). Assuming an overlap of 20% and considering home range sizes of 4 km<sup>2</sup> and 2 km<sup>2</sup> respectively, there are potentially 312 to 625 troops of liontailed macaques in the estimated 1,000 km<sup>2</sup> of evergreen forest remaining in Karnataka.

Such theoretical considerations aside, I am quite certain that the 133 distinct troops reported here (Table 3) do not represent all the existing troops for the following reasons:

- 1) The separation of distinct troops based on only sighting records more than 5 km apart is probably overcautious, resulting in neighboring troops being considered as one.
- 2) Of the more than 300 informants questioned, approximately 150 reported sightings. It seems likely that these individuals could not have seen all the troops existing in the areas that they routinely traveled.
- 3) I was unable to contact many good informants with experience in areas of suitable lion-tail habitat such as Kalasa, Venur, Mundrôte, Makut and Srimangala Ranges, where more troops are likely to be present.

Considering all these factors, it seems reasonable to propose that at least another 50% more troops than those reported are likely to be present. Therefore, the minimum population of wild lion-tailed macaques in Karnataka is likely to be about 200 troops, or approximately 3,000 monkeys.

### Conservation

From the results of this survey it is clear that the earlier assessments of lion-tailed macaque distribution and populations in Karnataka by Green and Minkowski (1977) and Kurup (1978) are gross underestimates. The fears expressed on the basis of these estimates that viable conservation efforts are not feasible are also without any factual basis. Within the 1,000 km<sup>2</sup> or so of habitat available, the lion-tailed macaque appears to be reasonably well distributed and many localities offer good opportunities for conservation efforts. Presuming that the earlier assessments of lion-tailed macaque status in Kerala and Tamil Nadu are reasonably accurate (Ali, 1982), the Karnataka populations appear to be larger than those in Kerala and Tamil Nadu combined.

All previous surveys of the lion-tailed macaque in Karnataka, except that by Bhat, appear to have relied on informants such as forest officials and castes/occupational groups among the local people, these individuals usually being unaware of the lion-tail. This has led to underestimates in all regions. In addition, lion-tailed macaques are probably more numerous than earlier estimates would indicate due to the fact that they are now known to occur in selectively logged forest, forestry practices in Karnataka have become more conservative over the past decade and in most localities in Karnataka the lion-tail is not poached as it is in Kerala and Tamil Nadu.

Despite all of the above, it is inadvisable to be complacent concerning the status of the lion-tailed macaque in Karnataka as it is definitely becoming scarcer throughout the state. Developmental projects such as hydroelectric dams, mines and new roads are opening up previously in-

accessible areas. Low elevation habitats are steadily decreasing under pressure from local inhabitants and the steep upper level Ghat forests are being exploited by the plywood and matchwood industries. In addition, a steep increase in the market value of forest produce during the last two years has resulted in serious smuggling problems.

Based on this study, a comprehensive management plan identifying seven key conservation areas (see Fig. 3) is being prepared for the lion-tailed macaque and its evergreen forest habitat in Karnataka. Support from the international primatological community will be important in ensuring that this plan will be implemented by the State and Indian Government.

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On pages 78-84 following:

Fig. 3 (a,b,c): Probable distribution of lion-tailed macaques in forests of Karnataka state, based largely on information supplied by local informants. Maps show both existing and proposed nature reserves, and forest ranges outside protected areas (maps by Stephen Nash from author's originals).

Table 3: Distinct Troop Sighting Records of Lion-tailed Macaques in Karnataka

Troop #	# Seen	Date	Location Details
KT 1 *	8-10	1979	Armudighatta/Gumatadevara Honda about 10 km from Hulidevara Kollu on Doddamane-Kumta Road
SD 1 *	20	1979	Chiksuli Forest 5 km south of Doddamane Village
SD 2 *	30-40	1979	Forests near Kudgund Village 5 km north of Malemane Village
SD 3	10-15	3/1984	1 km from Melemanc on the path to Sutlimane
GR 1	4-5	6/1983	On the ridge to the north of Mahime Village on the path to Kodgi Village
GR 2	10-15	1/1984	Mastimane Ghat near Vate Hallu Block 28 Plywood Coupe 4 & 9 km above Gersoppa on main road
GR 3	10-20	2/1984	Ambeput Gudda Block 28 Plywood Coupe 1 & 2
GR 4	1	3/1983	On the ridge 4 km above Hessagi & 3 km below Govardhanagiri Fort on the path to fort
BT 1	2-3	5/1983	1 km from Kurundur on the path going up the ridge to Basavanabavi Ghat
BT 2	2	3/1982	On the ridge above Hejjala about 8 km below the Yedamale Gudda Peak
SG 1 *	3	1978-81	Between Kanur & Govardhanagiri Fort near to fort in Govardhanagiri SF
SG 2	10-15	2/1983	Near Sukrasetty Halla Stream 5 km from Kugar Cross on Kogar-Bhatkal Ghat Road
SG 3	3-4	7/1983	Within 1 km Kyadgod in Govardhanagiri SF
SG 4	2-3	1982	Within 1 km of Temple on Basavabavi Ghat footpath in Karni SF
SG 5	4-5	1979	5 km from Karni on the Padubeedu Ghat footpath to Bajindur in Karni SF
BD 1	4-5	1/1982	8 km to the north of Kosalli water fall in Humlimurdibare RF
BD 2	4-5	1/1981	On the footpath from Onkodlu to the fort ruins 1 km above teak plantations in Humlimurdibare RF
BD 3	8-10	8/1981	On the ridge above Ganganad about 9 km from the village & 6 km below the crest between Chalkinbare and Madlabare peaks
BD 4	8-10	12/1983	On the ridge 5 km above rubber plantations in Hejjala along the stream in Koratikalbure RF
BD 5	20-25	2/1984	To the north of Halliberu 1 km below Golgodubare Peak in Meguni Valley RF
BD 6	1	1982	On the ridge 10 km above Halliberu & 8 km below Toskarbare Peak in Meguni Valley RF
KD 1	3	10/1983	At Arukattimuri on the main road from Kollur to Nagodi about 2 km above the turn off point to Duli in Madibare RF
KD 2	2-3	5/1982	On the ridge above Salgeri 5 km away from village in Madibare RF
KD 3	2-3	3/1983	3 km from Luksal on the footpath to Busriberu in Madibare RF
KD 4	1	9/1983	On the ridge above Busriberu 4 km below Kodachadri Peak in Madibare RF
KD 5	10-15	11/1983	2 km below the top of Umigudda hillock inside Mudur Estate of Mr. Kutty
KD 6	10-15	9/1983	On the ridge top of Nagankalbure RF 5 km from Ashkodu
HN 1	1	4/1983	At Kurighutta near Nagodi in Kodachadri SF
HN 2	2	11/1983	At Hullarki about 3 km from Chakranagar on the road to Savehuklu Dam in Killandur SF
HN 3	5-6	10/1983	On Nimbesalgudda about 5 km from Savehuklu Dam in Killandur SF
HN 4	10-15	10/1983	Near district boundary (Kalluguppe) on Haklumane Ghat footpath to Hallihole Valley in Killandur SF
HN 5	4-5	10/1983	In the Sholas within 0.5 km of Savehuklu Dam in Killandur SF
HN 6	10-15	11/1981	On the ridge peak beyond Chakra Dum on footpath to Hallihole Valley in Chakra SF
HN 7	5-10	1982	Near temple on the main Balebare Ghat road in Hulikal SF
HN 8	5-6	7/1983	At Hosur-Bisilure in Varahi SF
HN 9	4-5	11/1983	1 km from Hulibaglu in Varahi SF
SN 1	4-5	5/1983	3 km from Baregundi in Baregundi RF
SN 2	5-6	12/1983	On the ridge 8 km away from Sulluniru in Baregundi RF
SN 3	10-15	3/1984	Below the rocky cliff on the ridge above Hosabalu (Kallahalli) 2 km below District boundary on Baregundi RF
SN 4	4-5	12/1983	2 km downstream of Kunchikulabbi water fall along Varahi River in Merkalgudde RF



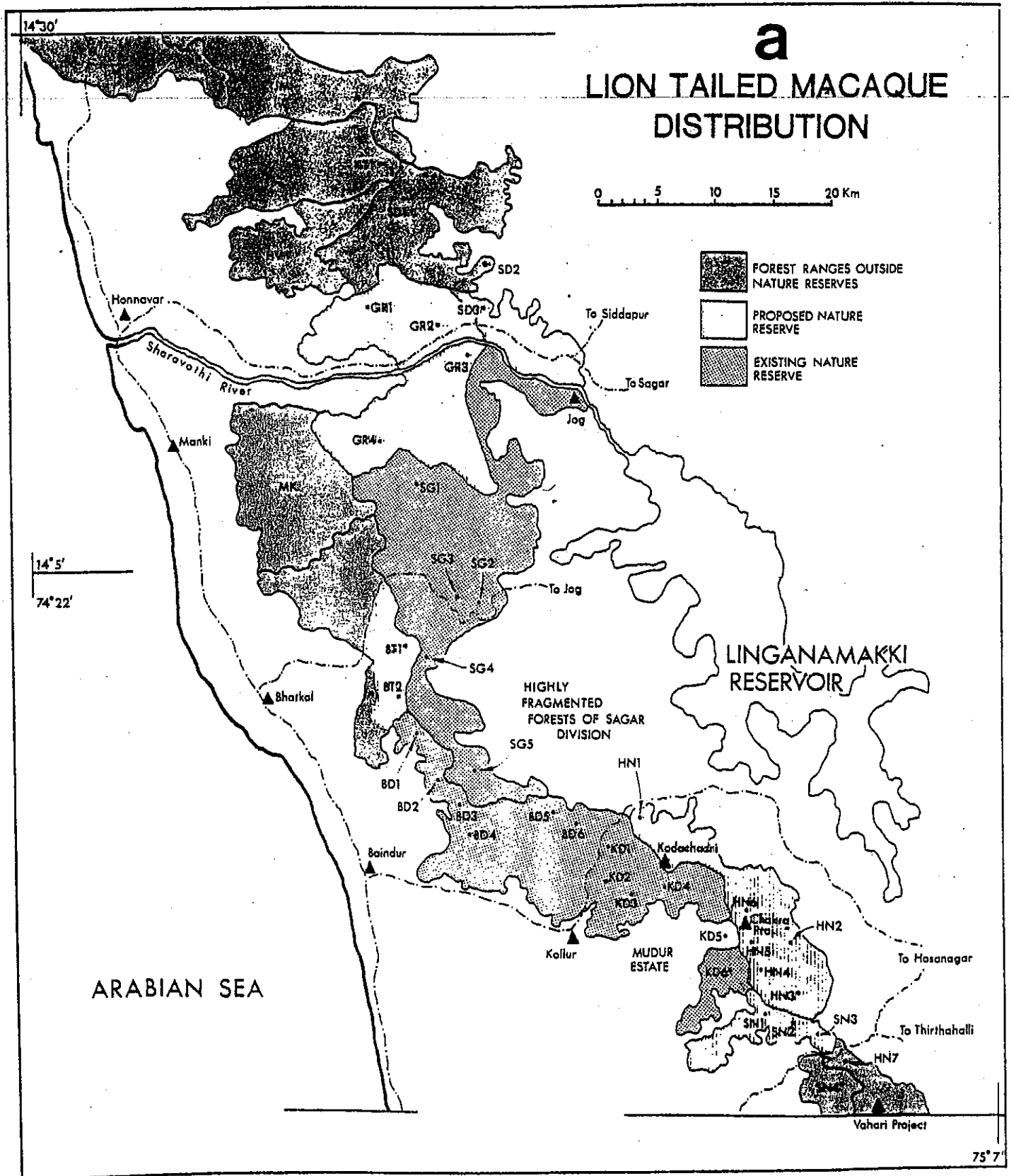


Fig. 3 (a,b,c): Probable distribution of lion-tailed macaques in forests of Karnataka state, based largely on information supplied by local informants. Maps show both existing and proposed nature reserves, and forest ranges outside protected areas (maps by Stephen Nash from author's originals).






Table 3 (Cont'd.)

SN 5	2-3	2/1984	On the footpath going up ghat in Ganapathigudda Hillock Compartment 5 block 15 of Tombattu RF
SN 6	10-12	1/1984	Near the top of Umigudda Peak 5 km from Kalmakki in Tombattu RF
SN 7	7-8	2/1984	On the ridge above Jaddinagadde 1 km below Masebare Peak in Tombattu RF
SN 8	4-5	1981	On the ridge above Kelsunka on the Ulthiga Ghat footpath in Tombattu RF
SN 9	7-10	3/1983	On the ridge above Jaddinagadde 2 km below Hullugudda Peak & 8 km from the village in Tombattu RF
AG 1	7-8	11/1982	10 km from Agumbe along Meenahalla Stream in Agumbe SF
AG 2	10-15	10/1983	Along the path to Vanakeabbi water fall 1 km from main road in Agumbe SF
AG 3	3-4	9/1983	Near Muthuganahole on the ridge 8 km from Burkana View Point in Balehalli SF
AG 4	3-4	10/1983	Within 0.5 km of Burkana View Point in Balehalli SF
HB 1	15-25	1/1984	On the ridge 5 km above Hanja below Senkolubare Peak alongside Nudubettuhole Stream in Ballimane RF
HB 2	5-6	1/1984	On the ridge 4 km southwest of Hanja 3 km below Haddinabare Peak in Ballimane RF
HB 3	15-20	10/1983	Below the District boundary on the main Agumbe Ghat road above Someshwar in New Someshwar RF
HB 4	10-20	12/1983	On the ridge 8 km above Megadde near water fall below Narasimha Parvata Peak in Someshwar RF (North)
KR 1	10-20	1/1984	On the ridge 3 km above Kudlu along Kudluthirta Stream in Someshwar RF (South)
KR 2 *	25-30	2/1984	2 km from Kudlu along Nemmarhole Stream in Someshwar RF (South) (5 km from KR 1)
KR 3	10-20	2/1984	5 km from Kudlu on Baradanegudda hillock in Someshwar RF (South)
KR 4	8-10	1/1984	8 km from Kudlu on footpath to Thingaimakki in Someshwar RF (South)
KR 5	2-3	12/1983	2 km from Sanguramale Tota in Andar RF
KR 6	5-6	1/1984	On the ridge 4 km above Mairoli below Valkunje (Ajjikunje) Peak in Andar RF
KR 7	7-8	3/1983	On the ridge 10 km above Yermala (Kunjadabakyar) between Shanthije halla Stream & Payanade halla Stream in Andar RF
KR 8	20	1/1983	On the ridge above Shanthije 5 km to the north of KR 7 in Andar RF
KR 9	10-20	2/1983	On the ridge 1 km above Berkala along the stream in Andar RF
SR 1	8-10	11/1982	In the Shola at Maik betta 12 km from Karki in Narasimha parvata SF
SR 2	1	4/1983	In the Shola between Valkigudda & Balekal gudda 5 km from Karki in Narasimha parvata SF
SR 3	8-19	10/1982	2 km from Nemmar-Kerekatte Road on the road to Mathuli in the Sholas of Tungabhadra SF
SR 4	8-10	11/1983	In the Shola near Edguru on the Nemmarkere katte Road in Tungabhadra SF
SR 5	25	10/1983	In the Shola 1 km from Kerekatte near Gulgunjmane on Nemmar-Kerekatte Road in Tungabhadra SF
SR 6	25	12/1983	In the Shola 3 km beyond Kerekatte on the road to S.K. border before Ganapathi Katte in Tungabhadra SF
SR 7	10-15	10/1983	In the Shola of Gurgulthota 2 km from Keregrama on the path to Muduu in Narasimhaparvata SF
SR 8	4-5	5/1982	At Gulmanehadya near district boundary 10 km from Kerekatte in Narasimhaparvata SF
SR 9	30	4/1984	On the main Kudremukh road 3 km from S.K. border gate towards Malleshwary near Shiva temple in Tungabhadra SF
MD 1	10-15	1983	5 km below S.K. border gate towards Mullur Ghat main road to Karkal in Naravi RF
MD 2	10-20	10/1983	On Hullugudda ridge 4 km above Heranje Jois Garden along a stream in Naravi RF
MD 3	7-8	1/1984	On the old path to Gangamoola 5 km above Mallar (Mala) on the ridge in Naravi RF
MD 4	20-30	1/1984	1 km from Bejal enclosure on the footpath to Kuringal (Korankal) on the ridge above Mallar in Naravi RF
MD 5	10-12	7/1983	On the ridge near Kudandalaje 4 km below Bejal enclosure in Naravi RF
MD 6	10-12	2/1983	On the ridge 2 km above Mapala & about 7 km from MD 5. in Naravi RF
MD 7	10-15	1/1984	3 km below Kuringal Peak to the south in Naravi RF
MD 8	10-15	1/1984	Within 2 km of Kaniyala enclosure in Naravi North Beat of Naravi RF
MD 9	5	2/1984	Near Gundi enclosure in Naravi North Beat of Naravi RF
MD 10	6-7	12/1983	At Edishere 6 km from Gundi enclosure in Naravi RF
MD 11	10-15	12/1983	On the ridge above Oddudaka 8 km south of Gundi enclosure in Naravi RF
MD 12	10-15	12/1983	4 km below Panjala enclosure in Naravi South Beat of Naravi RF
VN 1	10-15	10/1983	On the ridge 8 km above Malige in Aladangadi Beat of Naravi RF
VN 2	10-15	11/1983	Plywood Coupe 12 km to northeast on the ridge above Malige (6 km from VN 1) in Aladangadi Beat of Naravi RF
VN 3	10-15	10/1983	8 km further above VN 2 along stream side near District border in Aladangadi Beat of Naravi RF
VN 4	8-10	10/1983	On the ridge above Siralu 8 km from it along Handelhulla Stream in Siralu Beat of Naravi RF
VN 5	20-30	1981	1 km above the Pela enclosure near stream bank Sholas in Savunulu Beat of Naravi RF
VN 6	20	2/1983	At Ballekana below Hirmarguppe Peak 10 km up ghat from Navur in Navur Beat of Naravi RF
VN 7	10-20	1/1984	In the valley adjoining Gundalpade Rock on the bridle path from Navur in Navur Beat of Naravi RF
KL 1	4-5	1982	Near Gangamoola on the footpath leading to it in Tungabhadra
KL 2 **	15-20	3/1984	On the jeep track to P&T Microwave Tower near Kuringal 0.5 km below it in South Bhadra SF
KL 3	5-6	4/1983	On the deadwood extraction Coupe Road 1 km from Bhagavati in South Bhadra SF
KL 4	10-15	4/1982	Near the bridge at the entrance of the jeep track to Kuringal into the forest Shola in South Bhadra SF
BL 1	5-6	2/1984	1 km from Bolle enclosure above Ragikumri in Mithabagil Beat of Naravi RF
BL 2	10-20	2/1984	On the ridge at Kunchila 6 km above Kolli Temple in Mithabagil Beat of Naravi RF
BL 3	5	11/1983	8 km from Didipe on the footpath through Yelanir Ghat in Mithabagil Beat of Naravi RF
BL 4	2-3	12/1983	In the Sholas 2 km from top of Bandaljeurbi waterfall in Charmadi-Kanapadi RF
BL 5	1	2/1983	0.5 km from 3rd hairpin bend on the main Charmadi Ghat road on the tract to IPM Coupe in Charmadi-Kanapadi RF
BL 6	4-5	1/1984	On the ghat slopes near Chickmagalur border to the left of Charmadi Ghat Road 15 km from Hosmata and 11 km from Maduguni Estate in Charmadi-Kanapadi RF
BL 7	1	5/1983	4 km further up on the footpath to Ammedhikal Peak above Neriya Rest House in Neriya-Hebbur Rubber Estate
MG 1	8	8/1982	In the valley below Biligalagudda Peak near Jai Bharath Plywood Coupe in Balur SF
MG 2	4	12/1982	Near Uliyamalekadu close to d-line beyond Bairapur Estate in Balur SF
SK 1	1	12/1982	2 km below Jenukalbetta Peak in Mafatal Plywoods Coupe in Kabbinala SF
SK 2	10-20	9/1983	At Anegundi 1 km from hotel at Kemphole on Shiradi Ghat main road in Kagenari SF

# **b** LION TAILED MACAQUE DISTRIBUTION

0 5 10 15 20 Km

-  FOREST RANGES OUTSIDE NATURE RESERVES
-  PROPOSED NATURE RESERVE
-  EXISTING NATURE RESERVE

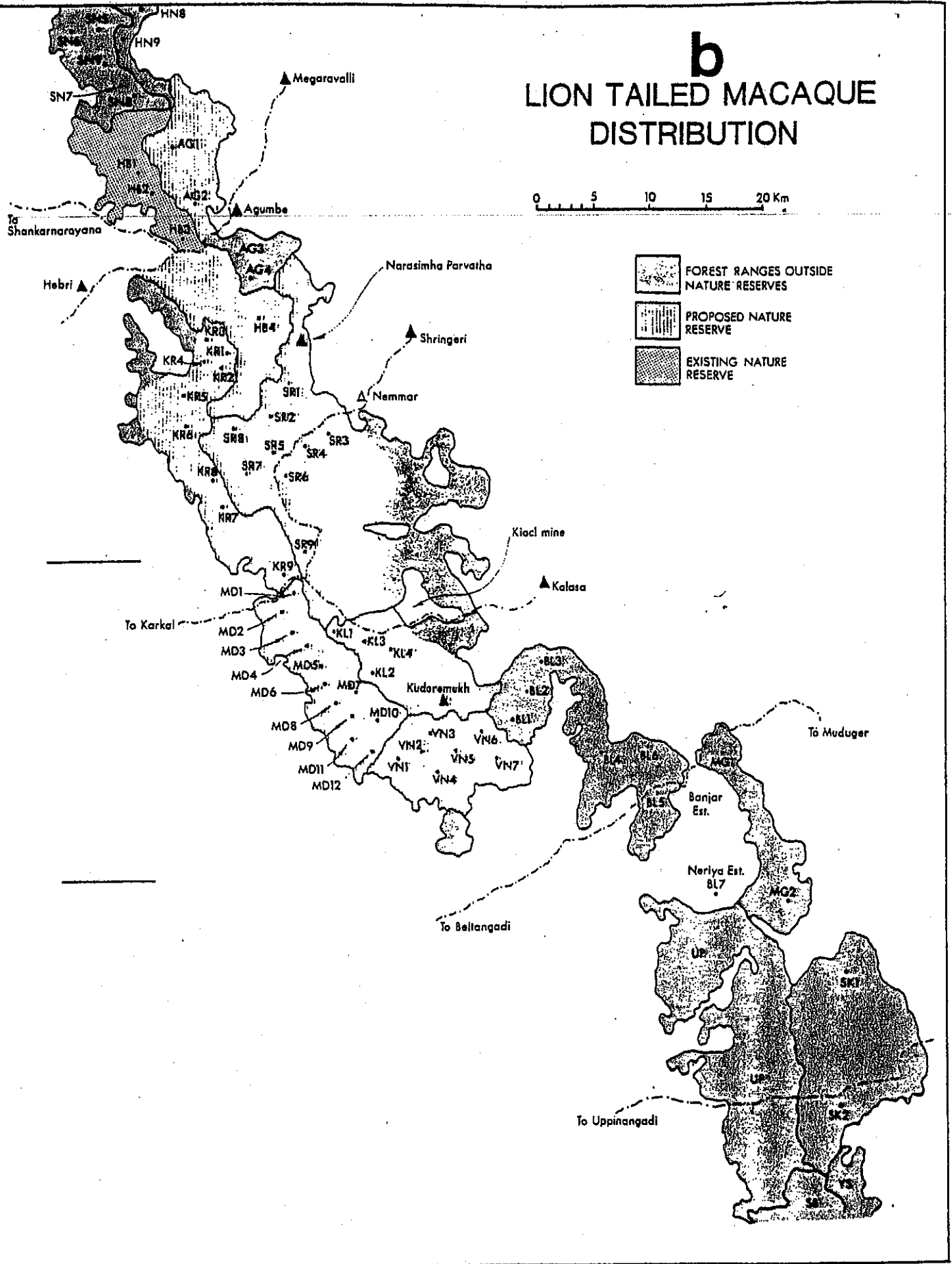


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Table 3 (Cont'd)

YS 1	2	6/1983	At the bridge across Addahole River on Bisale Ghat main road in Bisale SF
SB 1	10-15	1/1983	Above Koonadka in MPL 1980 Plywood Coupe 5 km from Kaikamba in Bagimale RF
SB 2	2	8/1983	2 km from Kaikamba at Bainkodi in Kidu RF
SB 3	4-5	2/1984	On the ridge 3 km above Balagodu along Padakahole stream near district boundary in Kiribag RF
SB 4	4-5	4/1983	On the ridge 3 km above Uppangala within 2 km of River Uppangalahole in Kiribag RF
SB 5	3-4	2/1984	On Umigudde hillock 5 km from Kollamogaru in Kilarmale RF
SB 6	5-6	2/1984	On Thingalagudde hillock 3 km above Kotegudde Thota in Kilarmale RF
SJ 1	7-8	3/1983	5 km above district boundary along Garadimottethodu (tributary of Meenugundi Hole) in Kadamakal RF
BG 1	10-15	1/1984	Along Kumekolli Stream at the edge of Kodangimale cardamom estate in Padinalknad RF
BG 2	10-15	1/1984	At Kudukollikodange near Betemale cardamom estate in Padinalknad RF
BG 3	10-12	12/1983	On the edge of forest touching Belathmale cardamom estate in Padinalknad RF
BG 4	10-15	11/1983	At Paisarimale 8 km from Karike Forest nursey in Pattighat RF
BG 5	8-10	8/1983	At 8th mile stone on Karike-Bhagamandala main road in Pattighat RF
BG 6	4-6	10/1983	2 km above Thodikana on the Pattighat Road in Pattighat RF
BG 7	4	1/1983	In Yelolimala cardamom estate 6 km from Belihmale cardamom estate in Pattighat RF
BG 8	10-12	1/1984	In Paduvalthmale cardamom estate opposite side of the valley from Bachimale & 6 km from Talakaveri in Pattighat RF
MN 1	6-7	12/1983	In Parivarthmale 9 km from Nadumale in Padinalknad RF
MN 2	3-4	9/1983	In Pathalamale area 5 km from Nadumale in Padinalknad RF
MT 1	10-15	1/1983	In OC Jose Plywood Coupe near Palemankolli 10 km from Matre in Matre Section of Kerti RF
MT 2	1	10/1982	P. K. Plywood Coupe 16 km from Koolimakki in Koolimakki Section of Kerti RF
MT 3	5-6	12/1983	7 km from MT 2 in the same section of Kerti RF also in P. K. Plywood Coupe
MT 4	5-6	10/1983	3 km from Chelavara in Chelavara Coupe of Udumbe Section in Padinalknad RF
MT 5	1	1981	At Bannadapare 10 km from Heggala in Kerti RF
MT 6	5-6	1/1983	8 km above Makut on the Main Ghat Road in Kerti RF
MT 7	5-7	12/1983	12 km above Makut at Memanakolli off the Main Ghat Road and about 5 km from MT 6 in Urti RF
MT 8	5-6	1982	Along Kariyapole River (tributary of Barapole) 5 km from Sollekolli & 12 km from Parkatgeri in Urti RF
SL 1	3-4	11/1983	At Kamberimalagundi on Nadkanibetta hillock 6 km above Parkatgeri in Pookala Section of Brahmagiri RF
SL 2	10-12	8/1983	At Ubbakallu-Balyabugari area on the ridge 10 km above Ponnambare. Theralu in Pookala Section of Brahmagiri RF

\*: Troop sightings recorded by informants of H. R. Bhut (1982).

\*\* : Troops actually seen by author.

Note: The first two letters in the column titled Troop # indicate the Forest Range in which the troop is located and the subsequent number indicates the serial number given to the troop within that range. The abbreviations used for the various ranges are:

KT - Kumta	MD - Moodabidre
SD - Siddapur	VN - Venur
GR - Gersoppa	KL - Kalasa
BT - Bhatkal	BL - Belthangadi
SG - Sagar	MG - Mudugere
BD - Baindur	SK - Sakaleshpur
KD - Kundapur	YS - Yesalur
HN - Hosanagar	SB - Subramanya
SN - Shankaranarayana	SJ - Sampaje
AG - Agumbe	BG - Bhagamandala
HB - Hebri	MN - Mundrote
KR - Karkal	MT - Makut
SR - Sringeri	SL - Srimangala

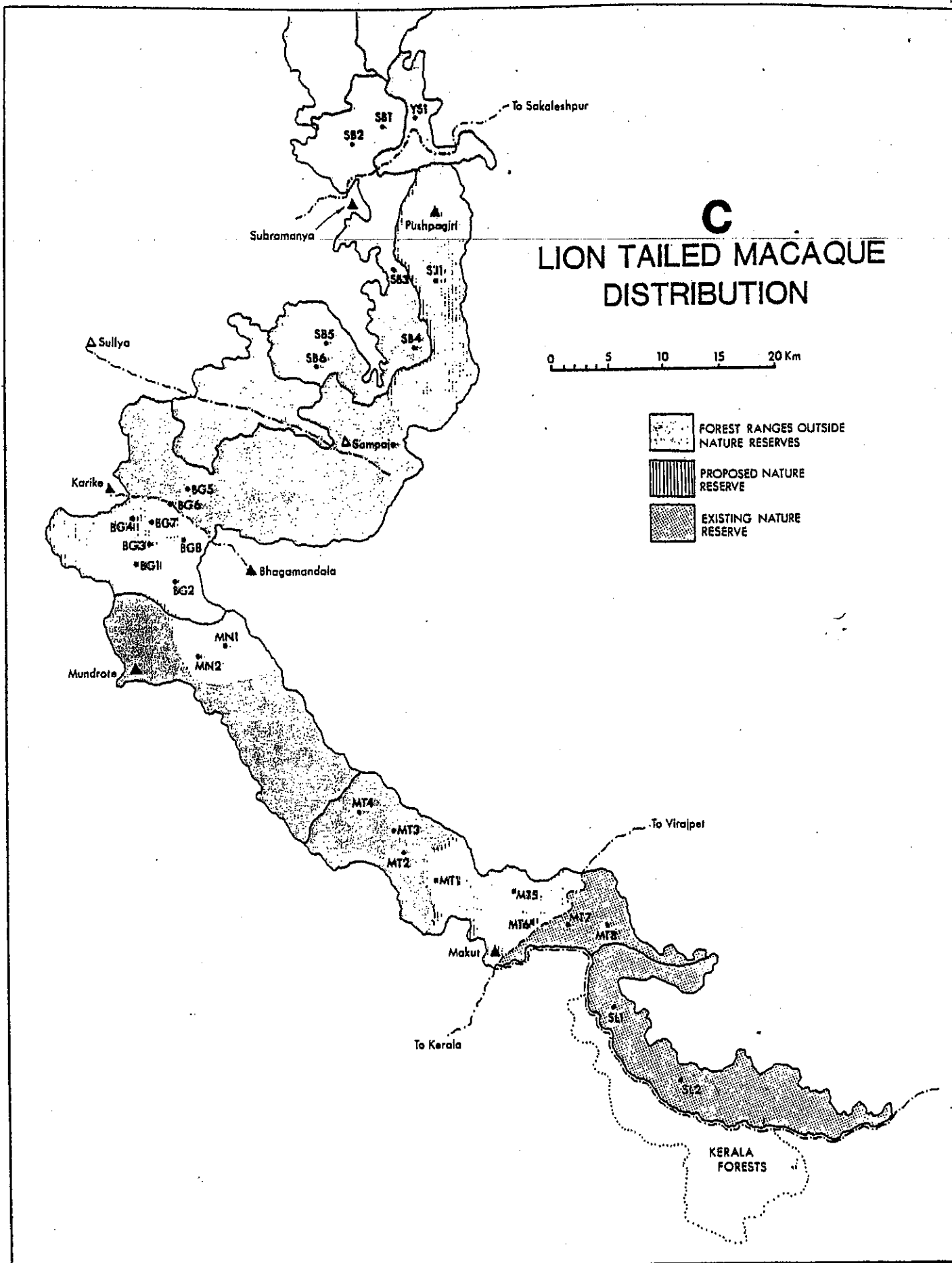


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Table 4: Status Summary of Lion-tailed Macaque and its Habitat in Karnataka

Forest Range	Forest Type	Area of Reserved Forest in Ghats (sq km)	Est. Area of Evergreen Forest	Area Under Selective Felling (sq km)	Traditional Poaching	Relative Abundance Compared to Past	Number of Troops Reported	Estimated Distributional Density
Siddapur	26/4	NA	15	—	No	Rarer	3	Low
Gersoppa	25	131	36	4.14	No	Rarer	4	Medium
Munki	26/4	79	24	4.00	No	Rarer	0	Low
Bhatkal	26/4	161	84	Nil	No	Rarer	2	Low
Sagur	26/4	239	167	5.4	No	Rarer	5	Low
Hosangar*	26/5.3	107	70	1.00	No	Rarer	9	High
Agumbe	26/3	74	55	1.00	No	Rarer	4	Medium
Baindur	26/4	100	82	Nil	No	Rarer	6	Low
Kundapur	26/5	86	47	Nil	No	Same	6	High
Shankaranarayana	26/5	107	51	0.81	No	Same	9	High
Hebri	26/5	118	66	Nil	No	Same	4	High
Kurkal	26/2.5.9	123	69	0.56	No	Same	9	High
Mudabidre	26/2.9	87	65	1.42	No	Same	12	High
Venur	22: 26/9.2	108	54	0.81	No	Same	7	High
Sringeri	26/9	203	115	1.50	No	Same	9	High
Kulasa**	22: 26/8	135	47	1.62	No	Same	4	High
Mudugere	26/8.1	74	52	0.65	Yes	Rarer	2	Low
Sakuleshpur	26/1.8	139	89	1.28	Yes	Rarer	2	Low
Yenulur	26/1	36	21	1.21	Yes	Rarer	1	Low
Belthangadi	26/1.8	85	51	0.80	Yes	Rarer	6	Low
Uppinangadi	26/1	147	37	NA	Yes	Extinct	0	Absent
Subramanya	26/1	190	93	1.62	Yes	Rarer	6	Medium
Sullya	26/1	80	8	Nil	Yes	Extinct	0	Absent
Sampaja	26/1.8	271	110	2.00	Yes	Rarer	1	Low
Bhagamandala	26/1.8	152	122	2.70	Yes	Rarer	8	Medium
Mundrote	22: 26/1.8	165	115	2.00	Yes	Rare	2	Medium
Makut	22: 26/1.8	195	136	3.72	Yes	Rarer	8	Medium
Srimangala	22: 26/1.8	129	104	0.65	Yes	Rarer	2	Medium
		3,521	1,985	38.89				

\*: Including submersion area of Chakra: part of Vahuri Projects

\*\*: Excluding Kudremukh Mining Lease Area

NA: Not available

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# APPENDIX

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## New Members of the IUCN/SSC Primate Specialist Group

The following members have been added to the group since the appearance of the last issue of *Primate Conservation*.

### Asian Section

Dr. Tan Bangjie  
Advisor  
Beijing Zoo  
Beijing  
CHINA

Dr. Guoqiang Quan  
Institute of Zoology  
Academia Sinica  
Beijing  
CHINA

Dr. Richard Tenaza  
University of the Pacific  
Dept. of Biological Sciences  
Stockton, California 95211  
UNITED STATES

### African Section

Dr. Pius A. Anadu  
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Dept. of Forestry and Wildlife  
Faculty of Agriculture  
Private Mail Bag 1154  
Benin City  
NIGERIA

Dr. Joseph P. Skorupa  
Dept. of Anthropology  
University of California  
Davis, California 95616  
UNITED STATES

### South and Central America

Mario Salvador Caba-Vinagre  
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Universidad Veracruzana  
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Catemaco, Veracruz  
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Dr. Andrew Johns  
Av. Brasil no. 111, apto. 2  
Tefé  
Amazonas 69470  
BRAZIL

### Special Section

Dr. Roland Wirth  
Zoological Society for the  
Conservation of Species and  
Populations  
Franz-Senn-Str. 14  
8000 München 70  
WEST GERMANY

---

## Address Corrections

The following addresses were listed incorrectly in the last issue of *Primate Conservation*:

Mme. Berthe Rakotosamimanana  
Ministère de l'Enseignement Supérieur  
B. P. 4163  
Tsimbazaza  
Antananarivo  
MADAGASCAR

Dr. Gilbert Ravelojaona  
Etablissement d'Enseignement Supérieur  
des Sciences Agronomiques  
Université de Madagascar  
Dept. Eaux et Forêts  
B. P. 175  
Antananarivo  
MADAGASCAR

---

## Address Changes for Current Members

The following members have changed addresses since the appearance of the last issue of *Primate Conservation*.

Dr. James Else  
Institute of Primate Research  
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Dr. Michael Kavanagh  
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MALAYSIA

Dr. Edgardo Mondolfi  
Ambassador of Venezuela  
P.O. Box 34477  
Nairobi  
KENYA

Dr. Jon Pollock  
7 Hillfield Park  
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London N10 3QT  
UNITED KINGDOM

Dr. Voara Randrianasolo  
Head of Scientific Programs  
Zoological Garden Tsimbazaza  
B. P. 561  
Antananarivo 101  
MADAGASCAR

Dr. Alan Rodgers  
Wildlife Institute of India  
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U. P.  
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Dr. Jordi Sabater-Pi  
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Dr. Amy Vedder  
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Kigali (ID)  
Department of State  
Washington, D.C. 20523

Dr. Bill Weber  
Kigali (ID)  
Department of State  
Washington, D.C. 20523

# WWF-US PRIMATE PROGRAM

## Product Order Form

### T-Shirts

Muriqui (Y,BI,B)  
 Pygmy Chimpanzee (Y,BI,B)  
 Golden Lion Tamarin (Y,BI,B)  
 Yellow-tailed Woolly  
 Monkey (Y,BI,B)  
 Lion-tailed Macaque (Y,BI,B)  
 White-throated Guenon  
 (BI,R,G)  
 Cotton-top Tamarin (B)  
 Monkeys of Belize (Y,BI,R)

### Posters

Primates of Rio  
 Primates of Minus Gerais  
 Yellow-tailed Woolly Monkey  
 Primates of Suriname  
 Golden-rumped Lion Tamarin  
 Golden-headed Lion Tamarin  
 Primates of the World

### Note Cards

Muriqui  
 Yellow-tailed  
 Woolly Monkey

All T-shirts are \$10

All Posters are \$5

Note Cards are \$5

T-Shirt Color Code: Y = yellow, BI = blue, B = beige, R = red, G = green

(Text on t-shirts and posters is written in the language of the countries from which the species depicted originate: T-shirts come in S, M, L and XL adult sizes only)

Product Name	Color	Size	Quantity	Price	Total

Total Enclosed \_\_\_\_\_

Checks should be made payable to World Wildlife Fund — U.S. and sent to:

Bill Konstant  
 Dept. of Anatomical Sciences, HSC  
 State University of New York  
 Stony Brook, New York 11794

## PRIMATE CONSERVATION

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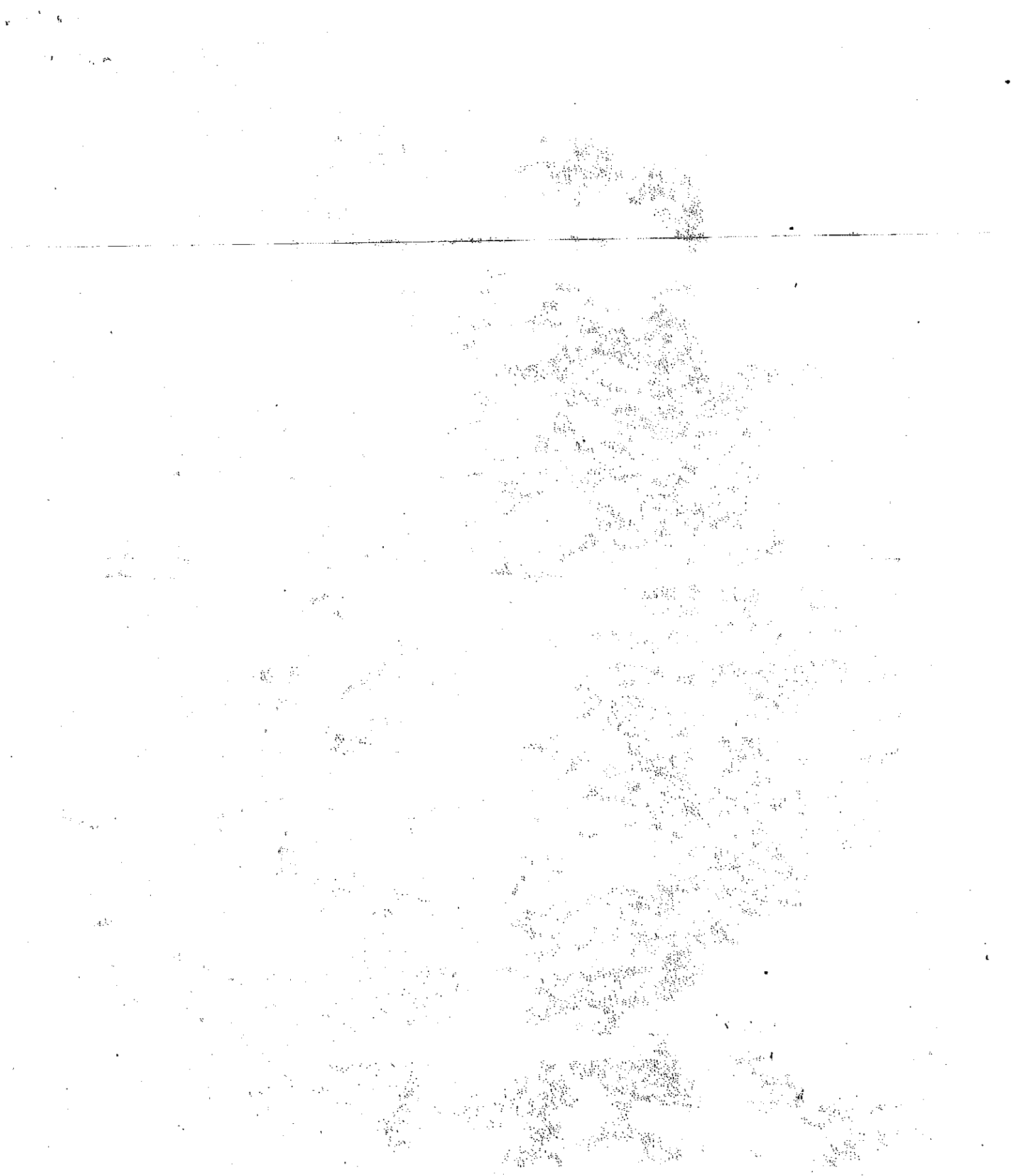
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 Dept. of Anatomical Sciences, HSC  
 State University of New York  
 Stony Brook, New York 11794





*Back Cover:* Adult male mountain gorilla from the Virunga Volcanoes of Rwanda. Restricted to two disjunct populations on the borders of Rwanda, Uganda and Zaire, the mountain gorilla must be rated as one of the highest global primate conservation priorities (photo by R. Weyerhaeuser).

