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.

A Word from the Editors

As you can see, this is by far the largest *Primate Conservation* produced to date, and is essentially two issues in one. We had intended to produce a shorter issue at the end of 1986, but so much excellent material arrived that we kept delaying publication to include it all. We thank you for sending your articles and announcements, and for helping to make this issue the best ever.

Included in this *Primate Conservation* is a Special Section with papers presented at a conservation symposium held at the XIth Congress of the International Primatological Society in Göttingen, West Germany in July, 1986. This 1½ day symposium, organized by John F. Oates and Russ Mittermeier, included a number of outstanding papers on primate conservation activities around the world. We are pleased to be able to publish a major portion of them in this issue.

At long last, we are also providing a complete PSG membership list in the Appendix. As you can see, the PSG has grown to 187 members from over 45 different countries, and has become a major force in international primate conservation.

With this growth has come a need for greater internal coordination, and we have therefore decided to create a Steering Committee for the PSG. This committee will make it possible to delegate certain responsibilities to key PSG members, and to respond more rapidly to critical issues in primate conservation and to the wide range of inquiries from the membership. Names of Steering Committee members are indicated with a cross (+) in the Appendix.

With the growth of *Primate Conservation* itself, we have also found it necessary to enlist your help in reviewing articles and in determining directions for our publication. As a result, we have established a small Editorial Board for *Primate Conservation* and have indicated the names of the 11 members in the Appendix with an asterisk (*). If any of you are interested in participating more in the editing of the journal, please let us know and we will add your name to the list.

Finally, we are happy to announce that the second of our regional Action Plans for Primate Conservation, the *Action Plan for Asian Primate Conservation — 1987-1991*, compiled by Ardith Eudey, has been published, and is enclosed with this issue of *Primate Conservation*. This outstanding piece of work complements the earlier *Action Plan for African Primate Conservation* by John Oates, and will make a major contribution to ensuring the survival of Asia's primate fauna. Dr. Eudey is to be congratulated for her efforts in making this publication possible.

We thank you again for all your help and support, and we look forward to hearing from you. Please address all future correspondence to World Wildlife Fund's new Washington office at the address given below.

Isabel D. Constable
Editor, *Primate Conservation*

Russell A. Mittermeier

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ANNOUNCEMENTS

Fig. 1. South American participants in the IPS Congress visit Apenheul in the Netherlands following the meeting. From left to right: Claudio Padua, Carlos Peres and Ilmar B. Santos from Brazil, and Mariella Leo from Peru.

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

The XIth Congress of the International Primatological Society was held from July 20 - 25, 1986 in Göttingen, West Germany, hosted by the German Primate Center and its Director, Dr. Hans-Jürg Kuhn. The meeting included a 1 ½ day Conservation Symposium organized by IPS Vice-President for Conservation, John F. Oates, and PSG Chairman, Russ Mittermeier, and another paper session on Primate Conservation and Ecology chaired by PSG member, Benjamin Beck. Of great significance is the fact that, for the first time, many of the papers presented at the Conservation Symposium were by researchers from the tropical countries where most primates occur (Fig. 1). Papers from the Conservation Symposium are published in a special section at the end of this issue.

The PSG would like to take this opportunity to thank and congratulate Dr. Kuhn, Dr. M. Schwibbe and the other organizers of this Congress for the outstanding job that they did.

The next IPS Congress will be held in Brasilia, Brazil, in July, 1988. For further details, please write to the Congress organizer, PSG member Dr. Milton Thiago de Mello.

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Instituto de Ciências Biólogicas
Universidade de Brasília
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BRAZIL

Two Key Workshops on Lemur Conservation Held at St. Catherine's Island, Georgia

Two workshops on lemur conservation in captivity and in the wild were held at St. Catherine's Island, Georgia, hosted by the St. Catherine's Island Foundation and the New York Zoological Society. The first workshop, entitled *Lemur Conservation: Strategies for the Future*, was held

April 26-27, 1986. Some 25 specialists from the U.S., Europe, the U.K. and France attended, and developed a set of recommendations for conservation of wild lemur populations and for future action in captive breeding as well. The group also decided that a follow-up meeting involving Malagasy conservationists was a top priority, and should be held in 1987.

This follow-up meeting was subsequently organized by the New York Zoological Society and the PSG, and held at St. Catherine's Island on May 13-14, 1987. Hosted once again by the St. Catherine's Island Foundation and the New York Zoological Society, St. Catherine's II, as it was christened, resulted in the signing of an accord for future collaboration with Madagascar's Ministry of Animal Production (Husbandry, Fisheries), Waters and Forests (MPAEF). The participants also developed a list of priority lemur species, which is summarized in Table 1.

More details on the accord and on the scientific results of these two workshops will be provided in the next issue of *Primate Conservation.*

The PSG would like to thank the New York Zoological Society and the St. Catherine's Island Foundation, and especially William G. Conway, Frank Larkin, James Doherty and Dan Wharton for their efforts in making these two workshops possible, and also our Malagasy colleagues for taking the time to participate in St. Catherine's II and helping to make it such a success.

Table 1. The Most Endangered Species of Malagasy Lemurs

1. **Highest priority** (on the verge of extinction)
   Hapalemur simus
   Hapalemur n. sp. (a new species from SE Madagascar)
   Propithecus diadema perrieri
2. **High priority** (endangered at the generic or familial level)
   Daubentonia madagascariensis
   Indri indri
   Varecia variegata rubra
   Varecia variegata sspp. (*variegata* and possibly 2-3 other subspecies)
   Allocebus trichotis
3. **Priority** (endangered at the species or subspecies level)
   Lepilemur septentrionalis
   Lemur mongoz
   Lemur macaco flavifrons
   Hapalemur griseus alaotrensis
   Propithecus diadema diadema
   Propithecus diadema candidus
   Propithecus verreauxi coronatus

Delegation of Malagasy Conservationists Visits the U.S. and Europe

Immediately following the St. Catherine's Workshop described above, the Malagasy delegation spent 2½ weeks (May 15-30, 1987) visiting a number of zoos, botanical gardens and other institutions in the U.S., the U.K. and France. This delegation was the largest and most important ever to travel abroad on matters related to conservation, and was headed by the Minister of Animal Production (Husbandry, Fisheries), Waters and Forests (MPAEF), M. Joseph Randrianasolo, who is responsible for protected areas and species conservation in Madagascar. Other members of the delegation included M. Henri Rasolondraibe, Secretary-General of the Ministry of Scientific Research and Technology for Development (MRSTD), Mme. Berthe Rakotosamimanana, Technical Counselor for the Ministry of Higher Education, M. Barthelemi Vaohita, Director of the World Wildlife Fund Representation in Madagascar, M. Voara Randrianasolo, Director of the Zoo and Botanical Garden at Parc Tsimbazaza in Antananarivo, and M. Joelina Ratsirarson, Chief of the Division of Fauna, Flora and Environment of the Dept. of Waters and Forests of MPAEF.

Fig. 2. Members of the Malagasy delegation inspect the fossil collection at the Duke University Primate Center with Alison Jolly and Elwyn Simons (photo by R. A. Mittermeier).

Among the institutions visited were the Bronx Zoo in New York; the Duke University Primate Center in Durham, North Carolina (Fig. 2); World Wildlife Fund and the National Zoo in Washington, D.C.; the San Diego Zoo and Wild Animal Park (Fig. 3); the Los Angeles Zoo and Huntington Botanical Garden in Los Angeles; the St. Louis Zoo and Missouri Botanical Garden in St. Louis; the Vincennes Zoo in Paris; and the Jersey Wildlife Preservation Trust on Jersey, Channel Islands. This trip was coordinated by the PSG, and sponsored by the World Wildlife Fund, the New York Zoological Society, the Duke University Primate Center, the San Diego Zoo, the Los Angeles Zoo and Greater Los Angeles Zoo Association (GLAZA), the St. Louis Zoo, the Missouri Botanical Garden, and the Jersey Wildlife Preservation Trust.

We believe that this trip accomplished a great deal in furthering mutual understanding of the need for conservation of lemurs in captivity and in the wild, and that it helped to lay the groundwork for much more international cooperation on behalf of these animals and their natural habitats in the future.

Fig. 3. Minister Joseph Randrianasolo and Diane Brockman of the San Diego Zoo admire "Houdini", an infant red ruffed lemur (photo by R. B. Mast).

Symposium on Primates Held in India in December, 1986

A symposium entitled "Primates-the New Revolution" was held at the Dept. of Anthropology of the University of Delhi this past December 26-31, 1986. The symposium was organized by PSG member, P. K. Seth, and S. C. Tiwari, Prof. and Head of the Anthropology Dept., and was sponsored by the University Grants Commission. Among the many topics discussed were primate radiations, behavioral dynamics, evolving genes and proteins, reproductive biology, data reduction and statistical

analysis, applications of VCR in field studies, endangered species and conservation. There are plans to publish the proceedings of the symposium, and further information can be obtained from Dr. Seth:

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INDIA

Symposium on Mexican Primates and the Formation of a Mexican Society of Primatology

From March 26-28, 1987, a symposium-workshop entitled "Ecology, Behavior, Conservation and Use of Nonhuman Primates in Mexico," was held at the National University of Mexico's (UNAM) field station in Los Tuxtlas, Veracruz. The field station (Fig. 4), is situated in 700 ha of tropical rain forest with populations of *Alouatta palliata mexicana* (Fig. 5) and *Ateles geoffroyi vellerosus* (Fig. 6) which have been studied for the past ten years. Two other primate taxa are also present in southern Mexico, *Alouatta pigra* (Fig. 5), and *Ateles geoffroyi yucatanensis* (Fig. 6). These primates are the most northern representatives of the Ceboidea.

Unfortunately, the natural habitats of these primates have been disappearing at an alarming rate as a result of a high human growth rate, 3.4% per year (Mexico's population is now 80 million and according to government predictions will double in the next 14 years) and the accompanying pressures this puts on forested land. Deforestation rates in the lowlands of southern Mexico presently range from 10-20 ha per day. Ninety percent of the original habitat of *Ateles* and *Alouatta* has been destroyed, and both species are now restricted to forest fragments varying in size and period of isolation in the southern states of Veracruz, Tabasco, Campeche, Chiapas, Yucatan, Quintana Roo and parts of Oaxaca. This radical and rapid habitat destruction, coupled with illegal hunting and trafficking of live individuals of all three primate species, has resulted in their local extinction in parts of southern Mexico. Many of the remaining wild populations show significant decreases in their population size and dramatic alterations in their demographic and breeding structures.

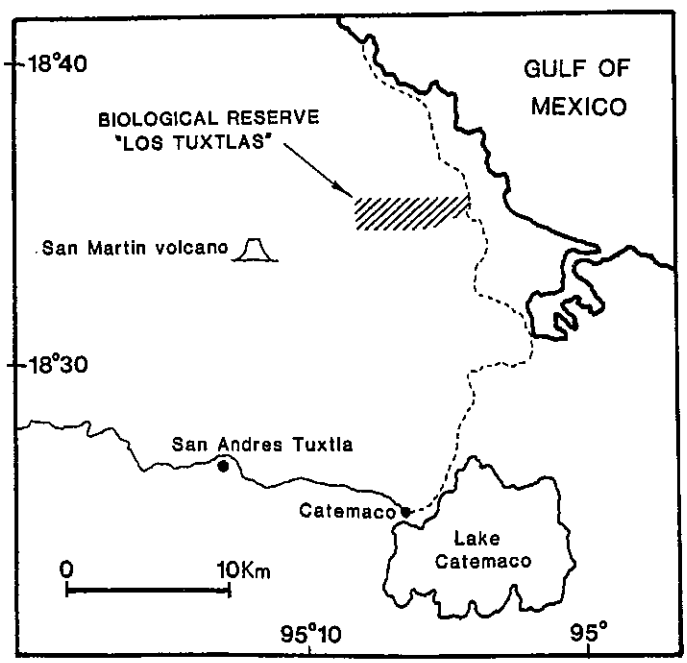

Fig. 4. The location of the Los Tuxtlas Biological Reserve and field station in southern Mexico (map by S.D. Nash based on author's original).

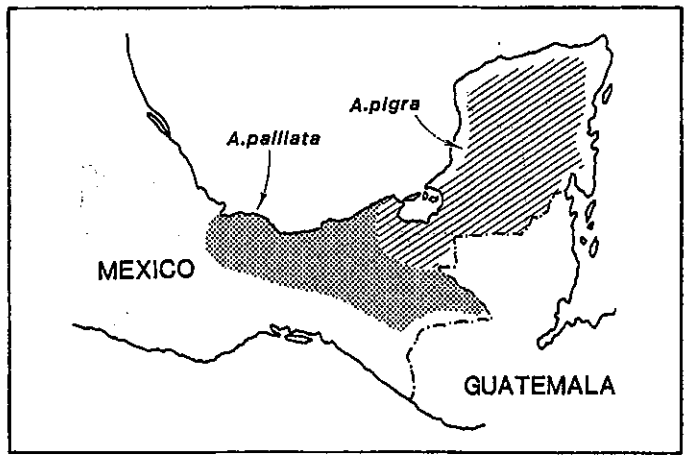

Fig. 5. The original geographical distribution of *Alouatta palliata* and *Alouatta pigra* in Mexico (map by S. D. Nash based on author's original).

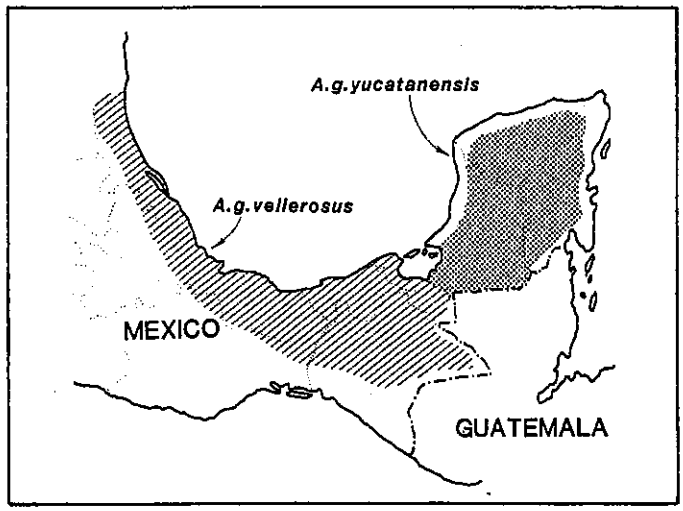

Fig. 6. Original geographical distribution of *Ateles geoffroyi vellerosus* and *Ateles geoffroyi yucatanensis* in Mexico. Today the species is restricted to fragments throughout southern Mexico (map by S. D. Nash based on author's original).

The purpose of the symposium, which included representatives from 14 different institutions involved with Mexican primates, was to update information about the use of primates in basic and applied research in Mexico. The main subjects covered are listed below. Published proceedings will be available by the end of 1987.

The Ecology and Conservation of Wild Populations

— An update on the continuing ecological studies of *A. palliata* and *A. geoffroyi vellerosus* at Los Tuxtlas, Veracruz. Little is known about the ecology of these animals in other areas, or about *A. pigra*.

— A description of the vegetation types preferred by the different species.

— A comparison of the past and present distributions of wild populations of *Alouatta* and *Ateles* in Mexico, and an attempt to quantitatively evaluate the present and future impact of rapid human population growth and deforestation.

— The identification of four different natural areas in southern Mexico as high priority for the conservation of the two genera. These include two biosphere reserves already in existence and two areas which could be made into national parks or ecological reserves.

— The need for a national conservation appeal.

— A review of the historical uses and attitudes towards monkeys in prehispanic Mexico, and the role primates play in present popular culture.

— An update on the significant advances made in breeding *Alouatta* and *Ateles* in captivity by the Institute of Natural History in Tuxtla Gutierrez, Chiapas.

Fig. 7. Estación de Biología "Los Tuxtlas", a fully-equipped field station with a library, laboratories and dormitories, belonging to the Institute of Biology of the National University of Mexico (photos by A. Estrada).

Primates Used in Research

— A review of the primates used in scientific research in Mexico. Mexico currently imports between 200-250 African and Asian primates each year. Most of these are *Erythrocebus patas* to manufacture polio vaccine (from tissue cultures) and *Macaca fascicularis* to run the neurovirulence tests necessary to maintain the quality of the vaccine. These animals provide half the country's need for polio vaccine, the rest is imported as a finished product. Neither *E. patas* or *M. fascicularis* are commercially bred in Mexico. Other primates used on a smaller scale are *Saimiri sciureus, Macaca mulatta, Cercopithecus aethiops,* and *Pan troglodytes.*

— A discussion of Mexico's primate research needs, and the creation of a data bank on primates being used in research. This data bank will include information such as names and locations of institutions using primates, research aims, species used, rates of utilization, reproductive success, mortality rates, and publications.

— An update on the research on mother-infant relations and the early development of social behavior in captive groups of *Macaca arctoides* being done at the Institute of Psychiatric Research in Mexico City.

Formation of a Mexican Primatology Society

— It was unanimously agreed during the symposium to form a Mexican Society of Primatology (Sociedad Mexicana de Primatologia, SMP). The Society aims to promote the conservation and rational use of nonhuman primates in basic and applied research in Mexico, and to promote the conservation of Mexico's wild primate populations. We hope that through SMP research groups in Mexico will be able to coordinate their efforts, and further the development of primatology in Mexico by continuous and constructive communication. By representing all primatologists in Mexico, the SMP can become an active, articulate and powerful voice for primatology in Mexico in national and international forums.

As a first activity, SMP, with the help of educational and government agencies including the Ministry of Urban Development and Ecology (SEDUE), is initiating a national primate conservation education campaign. Through the distribution of leaflets, posters, t-shirts, and the production of audiovisuals, radio capsules, documentaries, and lectures, the campaign aims to educate the scientific and public communities about the importance of primates in national research, and the need to conserve, study and use in a rational way our natural primate populations and other natural resources. Emphasis will also be put on the important role primates play in Mexican culture.

For information on obtaining copies of proceedings of the symposium, *Primatology in Mexico: Behavior, Ecology, Use and Conservation of Non Human Primates,* and for further information on the Mexican Society of Primatology and the national primate conservation appeal, please contact PSG member:

Alejandro Estrada
Estación de Biología "Los Tuxtlas"
Instituto de Biología
Universidad Nacional Autonoma
de México
Apartado Postal 176
San Andres Tuxtla, Veracruz
MEXICO

Second Lion-Tailed Macaque Symposium Held in Seattle in May, 1986

The Woodland Park Zoological Gardens, in cooperation with the Seattle Zoological Society, hosted the Second Lion-tailed Macaque Symposium May 20-23, 1986. The meeting, which was held on the grounds of the Woodland Park Zoo, included sessions on captive management, behavior, physiology and animal health. Special emphasis was placed on the feasibility of reintroducing surplus lion-tailed macaques back into their natural habitat in south India. This meeting was a follow-up to the First Lion-tailed Macaque Symposium held four years earlier at the Baltimore Zoo (May, 1982), the results of which have now been published (P. G. Heltne, ed., 1985, *The Lion-tailed Macaque: Status and Conservation,* Alan R. Liss, Inc., New York).

For information on the results of the second symposium, contact:

Laurence G. Gledhill
Woodland Park Zoological Gardens
5500 Phinney Avenue North
Seattle, Washington 98103-5897
U.S.A.

Third Brazilian Primatology Congress Held in Juiz de Fora, Minas Gerais

The Third Brazilian Primatology Congress, a biannual event, was held February 2-6, 1987 in Juiz de Fora, Minas Gerais, Brazil, in conjunction with the XIVth Brazilian Zoology Congress. The Primatology Congress featured a "Mini-course on Primatology" lasting five days with presentations highlighting the ecology, behavior and conservation of wild populations of Brazilian primates. Organized by PSG members Anthony Rylands and Celio Valle, the Congress was attended by 200-300 students from all over Brazil.

At the end of the meeting, a new slate of officers for the society was elected, with Rylands replacing Valle as President for the next two-year period. Roberto da Rocha e Silva was elected Vice-President, Eduardo Marcellino Veado Secretary, and Ilmar Bastos Santos was re-elected Treasurer.

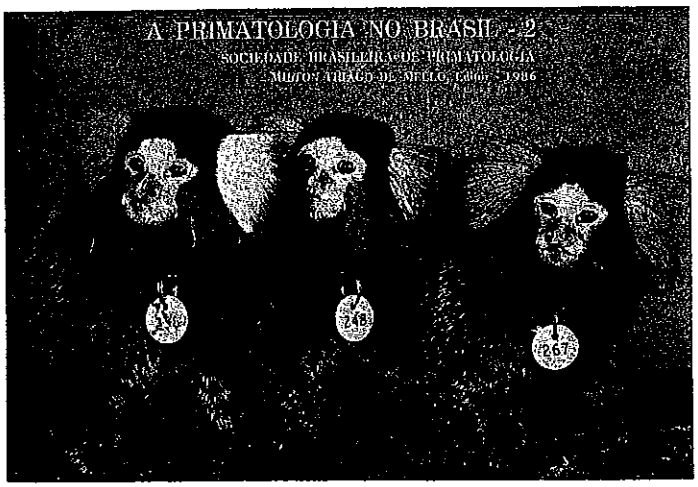

Fig. 8. The Proceedings of the Second Brazilian Primatology Congress can be obtained by writing the editor, Milton Thiago de Mello.

The Proceedings of the Second Brazilian Primatology Congress, *A Primatologia no Brasil - 2* (Fig. 8), edited by former society President, Milton Thiago de Mello, was also distributed at the Congress. Anyone interested in purchasing a copy of this book should send a check for $12.00 U.S. made out to the Sociedade Brasileira de Primatologia to:

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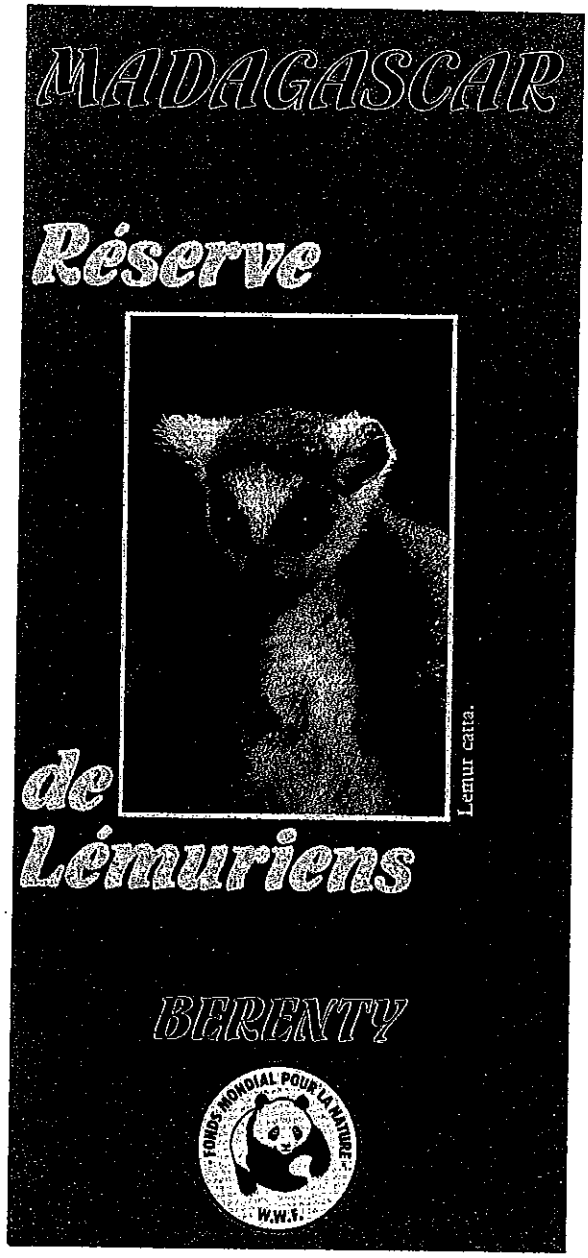
BRAZIL

Getty Prize for Conservation Given to Jean and Henri De Heaulme and to Sir Peter Scott

The 1985 J. Paul Getty Wildlife Conservation Prize, sometimes called the "Nobel Prize of International Conservation", was awarded to a father and son team, Jean and Henri De Heaulme (Fig. 9), in recognition of their contribution to conservation in Madagascar. The De Heaulmes created the Berenty Reserve in southern Madagascar more than 30 years ago, and it has been the site of more lemur studies than any other place in Madagascar, beginning with Alison Jolly's classic work in the early 1960's. The De Heaulmes have also been responsible for the protection of the larger Analabe Reserve near Morondava in western Madagascar, which includes a number of Malagasy species found nowhere else. In addition to furthering research and international understanding of

Fig. 9. M. Jean De Heaulme and a collared lemur at the Berenty Reserve (photo by R. A. Mittermeier).

Fig. 10. Sir Peter Scott attending the opening of the Nubel Bird Propagation Center at Jersey Wildlife Preservation Trust (photo by W. R. Konstant).



Figs. 11,12. Brochures and stickers for the Berenty Reserve.

Madagascar's unique fauna and flora, the De Heaulmes have also pioneered lemur-watching tourism (Figs. 11,12), and have shown that it can provide many economic benefits to the country.

The 1986 Getty Prize was awarded to Sir Peter Scott (Fig. 10), past chairman of SSC and one of the greatest conservationists of this century. His many contributions to the field certainly need no introduction to SSC members, since SSC would not be where it is today without his long years of leadership.

The PSG would like to take this opportunity to congratulate the De Heaulmes and Sir Peter Scott for these well-deserved awards.

SSC Updates List of the World's Most Threatened Animals and Plants

At its October, 1986, meeting in Soesterberg, the Netherlands, the SSC selected a new Top Twelve Threatened Species of Animals and Plants in the World. Once again, a primate made the list, this time the black lion tamarin (*Leontopithecus chrysopygus*) from the state of São Paulo, Brazil. Restricted to only two forest remnants in the interior of São Paulo, Brazil's most developed and most populous state, this monkey is without a doubt the rarest and most endangered of all Neotropical monkeys. A number of studies are underway to ensure its survival, and captive colonies currently exist at the Rio de Janeiro Primate Center and the São Paulo Zoo. The muriqui, another highly endangered Brazilian primate, was on SSC's first Top Twelve list issued in November, 1984 (see *Primate Conservation* 5).

Other animal and plant species on the list include:

Animals

Cuban and Hispaniolan solenodons (*Solenodon cubanus, Solenodon paradoxus)* — Cuba and Hispaniola

Jentink's duiker (*Cephalophus jentinki)* — eastern Liberia and possibly western Ivory Coast

Baiji dolphin (*Lipotes vexillifer)* — China

Madagascar serpent eagle (*Eutriorchis astur)* — Madagascar

Gurney's pitta (*Pitta gurneyi)* — Thailand and southern Burma

Ivory-billed woodpecker (*Campephilus principalis)* — Cuba

Kemp's ridley sea turtle (*Lepidochelys kempii)* — Mexico

Round Island keel-scaled boa (*Casarea dussumieri)* — Round Island, Mauritius

Relict Himalayan dragonfly (*Epiophlebia laidlawi*)

Moorean viviparous tree snails (*Partula* spp.) — Moorea, Society Islands

Valencia toothcarp (*Valencia hispanica)* — Spain

Plants
Euphorbia handiensis — Canary Islands, Spain
Kerriodoxa elegans — Thailand
Thrysopteris elegans — Juan Fernandez Islands, Chile
Cattleya dowiana — Costa Rica, Colombia
Amentotaxus formosana — Taiwan
Abies beshanzuensis — China
Ramosmania heterophylla — Rodrigues, Mascarene Islands
Dicliptera dodsonii — Ecuador
Swainsona recta — Australia
Cephalanthera cucullata — Crete, Greece
Medemia argun — Egypt, Sudan
Erica pilulifera — South Africa

For more information on this list, contact SSC headquarters:

Species Survival Commission
IUCN
Avenue du Mont Blanc
CH-1196 Gland
SWITZERLAND

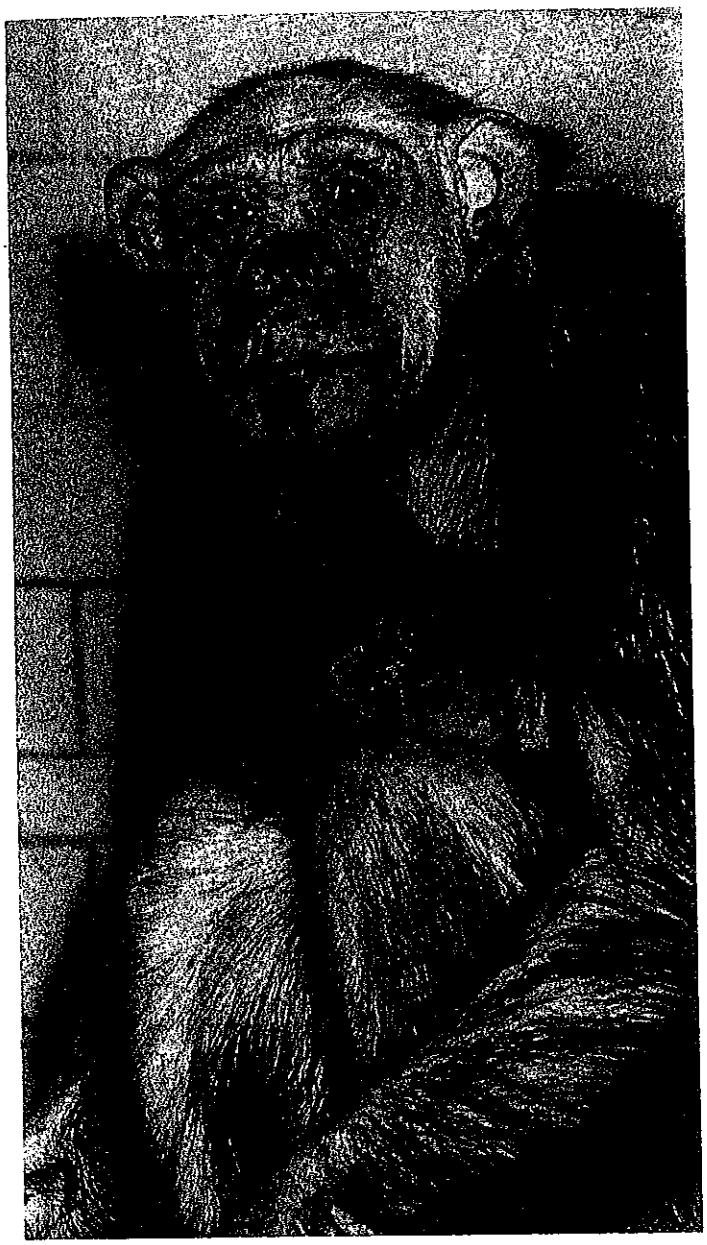


Fig. 13. Chimpanzee mother and infant from the Detroit Zoo, 1974 (photo provided by Detroit Zoo).

North American Regional Studbook for Chimpanzees Established

A Regional Studbook for Chimpanzees *(Pan troglodytes*, Fig. 13) has been established for animals in zoos and other exhibit facilities in North America. Questionnaires have been sent to all facilities currently or historically working with this species to compile and verify information necessary for the completion of the studbook.

The chimpanzee population in both the wild and captivity is seriously threatened. Factors such as forest destruction and illegal smuggling and hunting are diminishing wild populations, while the captive population is not reproducing at satisfactory levels. It is hoped that information derived from this studbook will help to better manage the captive population.

Those facilities not yet contacted which wish to contribute data to the studbook are requested to contact Kathy Latinen, the studbook keeper, for additional information.

Kathy Latinen
Curator of Mammals
Detroit Zoological Park
P.O. Box 39
Royal Oak, Michigan 48068-0039
UNITED STATES

Formation of a Committee for Conservation and Care of Chimpanzees

In the quarter century since intensive studies on the behavior of wild and captive chimpanzees began, scientists specializing in non-invasive research had never convened at a single location to discuss their findings and philosophies. This opportunity arose for the first time on 7–11 November 1986 at an international symposium solely devoted to "Understanding Chimpanzees," sponsored by the Chicago Academy of Sciences. Some 30 experts in the non-invasive study of chimpanzee behavior, society, mentality and ecology assembled in Chicago on that historic occasion, from as far afield as Africa, Asia, Europe and North America, with Jane Goodall, Toshisada Nishida and Roger Fouts among the participants.

One topic of central concern to the symposium participants was the urgent need to form a scientific coalition dedicated to promoting the survival of wild chimpanzee populations in Africa, where numbers are now rapidly declining across the continent, and to improving the care of captive chimpanzees in user countries, where standards of maintenance are all too often unacceptably crude. If chimpanzees are of supreme importance to mankind, scientifically and otherwise, as is widely acknowledged, then the genus *Pan* merits special respect. Accordingly, a consensus resolution was passed in Chicago to form a special Committee for Conservation and Care of Chimpanzees, or CCCC, in order to pursue the following basic goals:

(a) to ensure the long-term preservation of wild chimpanzees in all African countries where remnant populations are being severely threatened by escalating habitat damage, wasteful hunting and trapping for local markets, and rising commercial exploitation for a global trade linked mainly to biomedical/pharmaceutical demand; and

(b) to improve the physical, psychological and social conditions within which captive chimpanzees are currently maintained by various institutions in user countries, and particularly in biomedical/pharmaceutical laboratories where individuals are routinely stressed and mistreated while serving the medical needs of mankind.

To launch these goals, the founding members of the CCCC appointed Geza Teleki, who has been professionally involved with chimpanzee conservation and care issues for many years, to serve as ad hoc Chairman for a formative period of at least three years, in a full-time post devoted

to organizing an international membership, establishing productive long-range objectives, and initiating formal action on four priority tasks identified at the symposium. The four initial objectives of the CCCC can be described as follows:

1. To prepare a field research plan defining the critical areas, in terms of both habitats and nations, where surveys of wild populations are most urgently needed, and pinpointing key sites where the presence of scientists can positively influence conservation of the species (Coordinator: T. Nishida).
2. To prepare a detailed scientific report on the present status and future survival prospects of wild chimpanzee populations in Africa, with the specific aim of petitioning the Department of the Interior in Washington to upgrade this species from Threatened to Endangered on the U.S. Endangered Species Act list (Coordinator: G. Teleki).
3. To draft a consensus statement, in the form of a well documented scientific report, on options for creating better physical, social and psychological standards for maintaining chimpanzees in captivity, with concrete guidelines for institutions holding chimpanzees for various utilitarian purposes (Coordinator: F. de Waal).
4. To prepare a detailed report on the extent and nature of international trafficking in chimpanzees, tracking that trade from source to user and focusing not only on the numbers involved but also on the inhumane treatment associated with such commercial trade (Coordinator: G. Teleki).

Each of these core projects has been assigned to a specially qualified CCCC member who shall be responsible for collating the input and expertise of professionals throughout the world. Completion of each task thus will depend heavily on active participation by CCCC members as well as advisory conservationists and caretakers, so expansion of the committee's membership base must be a primary objective during the coming two years. Scientists who could not attend the Chicago symposium but who share both professional credentials in the non-invasive study of chimpanzees and a deep concern for chimpanzee survival and welfare will be formally invited to join the CCCC's core membership. Every report issued by the CCCC, therefore, will represent its consensus professional view on how to achieve better standards for preservation of populations and treatment of individuals. This is a key difference between the CCCC and existing organizations working toward similar goals, for the committee as a body of experts can provide the hard information and the ethical guidelines needed by established organizations that are well situated to implement various conservation/care goals.

The four initial projects mentioned above are merely the top priorities of action identified at the CCCC's inaugural meetings in Chicago. Other long-range actions remain to be developed in accordance with the two basic precepts incorporated within the committee's title. In pursuing its work, the CCCC will be assisted and administered by the Jane Goodall Institute for Wildlife Research, Education and Conservation, which in turn is managed by the William M. Clements Foundation, both based in Tucson, Arizona. All statements and reports issued by the CCCC will be published under the auspices of these umbrella institutions, though dissemination of specific documents can be undertaken by other organizations sponsoring particular projects.

Geza Teleki
CCCC Chairman
3819 48th Street, NW
Washington, DC 20016
U.S.A.

IPS Primate Conservation Scholarship Program

This new program, under the supervision of the Conservation Committee of the International Primatological Society (IPS), is designed to replace the IPS Conservation Award scheme, and reflects the view of the committee that one of the very best ways to promote the conservation of primates is to promote the training of habitat-country conservationists.

A small number of IPS Conservation Scholarships will therefore be awarded each year to assist citizens of countries which have indigenous populations of nonhuman primates to acquire substantial further training. Initially, it is expected that individual awards will be in the range of U.S. $2,000-$4,000. Where necessary, the IPS Conservation Committee will encourage successful applicants to seek matching funds from other organizations. While attendance at training courses outside the scholar's home country will be particularly encouraged, appropriate in-country training may also be considered, as well as attendance at conferences which will provide some significant training experience. The chief criteria used in evaluating applications for scholarships will be evidence of an applicant's ability to make a significant contribution to primate conservation, and evidence that the training for which they seek support will significantly further their ability to make this contribution.

Applications for scholarships should be made on a standard application form, copies of which may be obtained from the Vice-President for Conservation. Two letters of recommendation should accompany the completed form. There are two annual deadlines for applications, April 1 and October 1. Applications will be reviewed by the IPS Conservation Committee and results will normally be announced approximately two months after each deadline.

For further information and applications forms, please contact the IPS Vice-President for Conservation:

John F. Oates
Department of Anthropology
Hunter College
695 Park Avenue
New York, NY 10021
U.S.A.

IPS Launches New Conservation Appeal

In addition to the Conservation Scholarship Program, IPS is also launching a new Conservation Appeal through its national affiliate organizations. The earlier Conservation Appeal of IPS was successful in raising $33,000 in the U.S. and over £5,000 in the U.K. through the Primate Society of Great Britain during the past two years. We hope that this new appeal will be even more successful.

The priority projects identified by the Appeal are:

1. Conservation of the gorilla, including threatened lowland populations (coordinated by Amy Vedder);
2. Conservation of the yellow-tailed woolly monkey in Peru (coordinated by Mariella Leo); and
3. Conservation of threatened primates in Thailand (coordinated by Ardith Eudey).

Anyone interested in more details on the Appeal should contact David Chivers, who is coordinating it on behalf of the IPS Conservation Committee.

David Chivers
Sub-Dept. of Veterinary Anatomy
Tennis Court Road
Cambridge CB2 1OS
England

Duke University Launches a New Undergraduate Program in Primatology

Beginning with the spring semester of 1987, Duke University is offering an undergraduate program in primatology. The goal of this program is for students to understand the behavior and biology of primates including the origin and evolution of humans and their morphological relationship to other primates. The investigation of primate evolution involves such diverse areas of study as morphology, social behavior, ecology, and physiology. Linking this diversity requires a cross-disciplinary approach, which utilizes the faculties and facilities of the Duke Primate Center and the Departments of Anatomy, Anthropology, Forestry, Psychology, and Zoology.

A total of six courses are required to complete the program and receive the program certificate. Three of the required courses are fixed and three can be selected from a list of approved electives. Each participant must do a research internship followed by a senior seminar. The research internship provides an opportunity to design and carry out actual research and is meant to be done at the Duke Primate Center or in the laboratories of the faculty advisors. The results of this research experience will be reported in the senior seminar, which is structured as a weekly presentation and discussion by program participants, resident faculty, and visiting primatologists.

For more information please contact the program director:

Dr. Kenneth E. Glander
Department of Anthropology
Duke University
Durham, NC 27706
U.S.A.

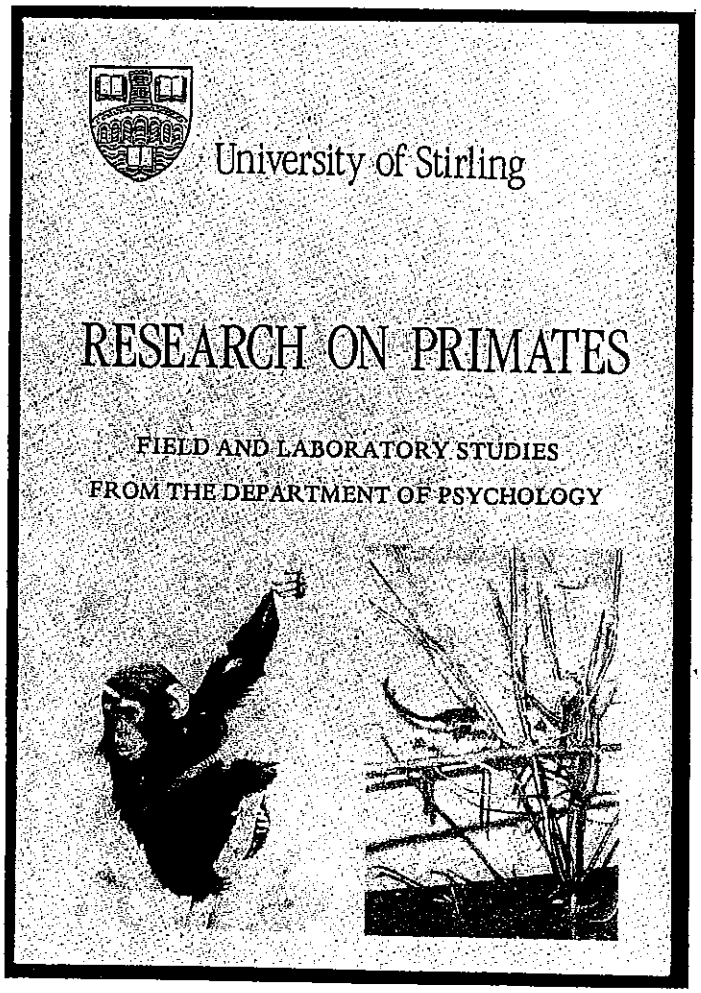


Fig. 14. Booklet on the University of Stirling's primate research program.

University of Stirling's Program of Primate Research

The University of Stirling in the U.K. has produced a booklet entitled *Research on Primates*, which describes the Department of Psychology's research program on primates in the field and in the lab (Fig. 14). To obtain the brochure and further information on this program, please write to PSG member Bill McGrew at the following address:

W. C. McGrew
Department of Psychology
University of Stirling
Stirling FK9 4LA
Scotland
UNITED KINGDOM

Primate Conservation Course Held in Madagascar

Fig. 15. Participants in the Anamalazoatra Reserve session of the Primate Conservation course (from right to left): Rakotomanana Ely-Johns (representative from the Dept. of Waters and Forest office in Antananarivo), Ranjokiny Alfred Martin (head of the Anamalazoatra Reserve Fauna section), Laibosaka Raymond (head of Zahamena — Reserve No. 3), Patrick Daniels (in back, Duke University Primate Center), Joseph (forester from Anamalazoatra Reserve), Jaosolo Besoa (head of the Anamalazoatra Reserve Fishery section), Deborah Overdorff (graduate student at Duke University), Patricia Wright (Duke University Primate Center, photo by K. Petras).

Fig. 16. Participants in the Reserve No. 5 session of the Primate Conservation course (from right to left): Louis Andre Rafiringa (from Ambalavao), Pelera Rasoja (assistant warden of Reserve No. 5), Alphonse Ravoavy (chief warden of Reserve No. 5), Rakotomanana Ely-Johns (representative from the Dept. of Waters and Forests, Antananarivo), Ferdinand Kasambo (chief warden of Isalo National Park), Randria Zigzag (manager of Reserve No. 11 at Andohahela-Amboasary-Sud), Patricia Wright (Duke University Primate Center, photo by K. Petras).

In 1986, as part of a Duke University accord with the Department of Water and Forests of Madagascar, Patricia C. Wright and Patrick S. Daniels offered a three-day Primate Conservation course for managers of the country's eastern reserves. One session was held at Anamalazoatra Reserve from July 18-21 (Fig. 15), a second session took place at Andringitra (Reserve No. 5) from August 22-25 (Fig. 16). Topics included in both sessions were (1) an introduction to primates around the world, past and present; (2) field techniques for studying primates including censusing, darting, analyzing vocalizations, making botanical plots, observing and recording behavior; (3) conservation of natural resources; (4) endangered species of primates; (5) practical problems in resource conservation such as hunting and deforestation.

Creation of the Primate Society of Japan

A new Primate Society of Japan has recently been created by our Japanese colleagues. The first issue of a newsletter, *Primate Research*, was published in December, 1985. A more detailed report on this new society will appear in the next issue of *Primate Conservation*.

A New Latin American Primatological Society

A new Latin American Primatological Society (Sociedade Latino Americana de Primatologia) was founded in November, 1986, at Águas de Lindóia, in the state of São Paulo, Brazil. The aims of this society are (1) to promote the development of the field of primatology as a whole; (2) to facilitate interchange and cooperation among Latin American scientists and institutions and others interested in primate research; and (3) to promote the conservation of all Neotropical primate species and the natural habitats in which they live.

Those present at Águas de Lindóia elected a provisional Directorate, including PSG members Orestes J. Colillas as Provisional President and Milton Thiago de Mello as Provisional Secretary, charged with putting together draft statutes for later discussion and ratification by the membership. Anyone involved in primate research or interested in helping the Society achieve its aims may apply for membership by contacting either Dr. Colillas or Dr. Thiago de Mello:

Orestes J. Colillas
Grupo Argentino de Especialistas
en Primates (GADEP)
Serrano 665
Buenos Aires (1414)
ARGENTINA

Milton Thiago de Mello
Departamento de Biologia Celular
Instituto de Ciências Biológicas
Universidade de Brasília
70910 Brasília, D.F.
BRAZIL

New Conservation Association Created for Muriqui Reserve in Minas Gerais

On May 29, 1987, in a town meeting in Manhuaçũ, Minas Gerais, the Friends of the Environment Association (associação dos Amigos do Meio Ambiente - AMA) was created to protect a rare population of muriquis discovered three years earlier in the region (Fig. 17). Eduardo Pinheiro (Fig. 18), who has led the impressive grass roots campaign to protect this 800 ha Atlantic forest habitat, was unanimously elected President of the Association by over 60 members of the community. With World Wildlife Fund support, a fundraising drive was launched at the first meeting of the Association to purchase the land to establish

Fig. 17. A sticker produced by a local biscuit company advertises the conservation of the muriqui in the Mata do Sossego.

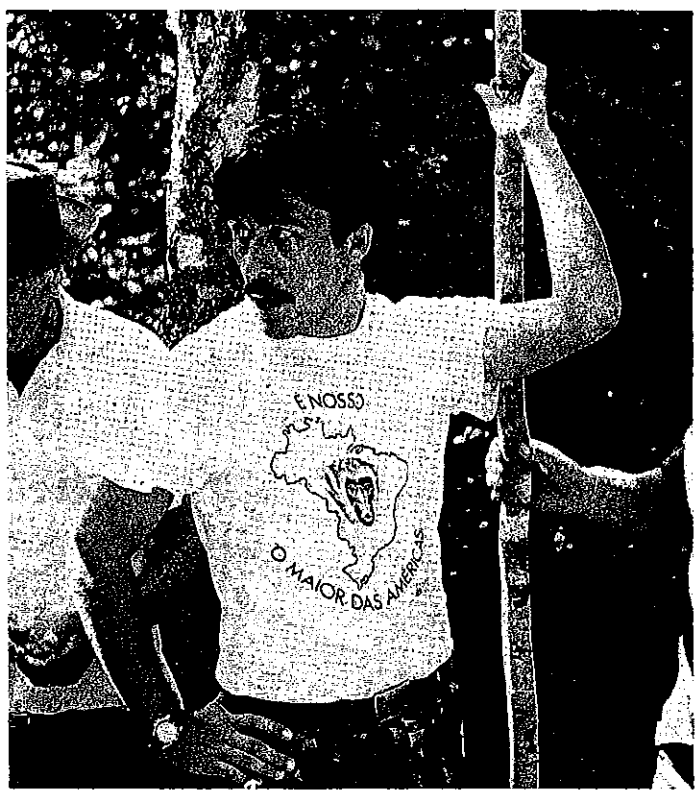


Fig. 18. Eduardo Pinheiro, leader of the campaign to save the forest known as Mata do Sossego (photo by P. Oyens).

the Mata do Sossego Muriqui Reserve in the municipalities of Manhuaçú and Simonésia. Mr. Pinheiro and colleagues have already purchased two old houses at the entrance to the forest which are being converted into a laboratory and a visitor center with the help of neighbors. The PSG extends its congratulations to Eduardo Pinheiro and wishes success to this important new association.

Souza Cruz Tobacco Company Builds Research Facility for the Rio de Janeiro Primate Center

The Souza Cruz Tobacco Co., which has been helping to support the Rio de Janeiro Primate Center (FEEMA-CPRJ) for several years, recently constructed a new facility for visiting scientists on the grounds of the Center (Fig. 19). This new building, overlooking the picturesque Serra do Mar mountain range, can accommodate up to 10 researchers. Further studies on the Center's colonies of endangered monkey species endemic to the Atlantic forest region of eastern Brazil will now be made more convenient by this new facility.

The PSG would like to congratulate Souza Cruz for its outstanding efforts on behalf of primate conservation in Brazil.

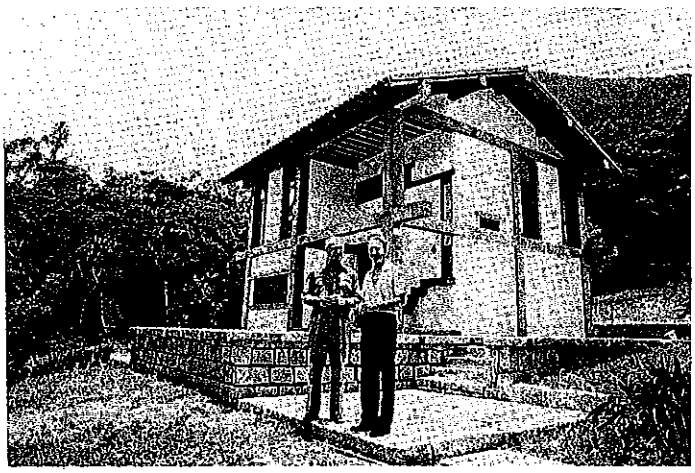


Fig. 19. Admiral Ibsen de Gusmão Câmara, President of the Brazilian Conservation Foundation, and Dr. Adelmar Coimbra-Filho, Director of the Rio Primate Center, stand in front of the new building available to visiting researchers at the Rio Primate Center (photo by R. A. Mittermeier).

The Jane Goodall Institute Moves to Tucson, Arizona

The William M. Clements Foundation recently announced the opening of The Jane Goodall Institute's office in Tucson, Arizona. The office will be sending out progress reports on field research on Lake Tanganyika at Gombe Stream National Park, on Jane Goodall's lecture/seminar schedules, and on other activities of the Institute's wildlife research, education and conservation programs.

Ann Pierce, Goodall's assistant and National Coordinator of *ChimpanZoo*, is compiling data from the national captive chimpanzee study inaugurated by Goodall in 1984, and helping to plan the habituation of the Kalande Community of chimpanzees in southern Gombe Stream National Park for future tourism.

The new address of the Institute is :

The Jane Goodall Institute for Wildlife
Research, Education and Conservation
c/o William M. Clements Foundation
P.O. Box 26846
Tucson, Arizona 85726
U.S.A.

A Dutch Foundation Successfully Shelters Unwanted Primates

The Amstelveen Primate Sanctuary (Apen Adoptie & Protectie or AAP) is a private Dutch Foundation concerned with sheltering unwanted exotic animals. It started in 1966 and now occupies a house and greenhouse in the town of Amstelveen, Holland. Between 70-160 primates, more than 150 parrots, and several other animals such as an ocelot, a fennec, and a Vietnamese pig, are cared for by APP. These animals have either been confiscated or donated by unhappy pet owners. Since 1977, the Netherlands has had legislation regulating animal trade and requiring licenses for endangered species. In 1985, these laws were strengthened by the signing of CITES. Importing any species of primate is now banned but animals are still occasionally smuggled in. Since it is illegal, government funds are not available and the foundation must depend on donations from private individuals and organizations such as WWF Holland and an anti-vivisectionist group which is interested in expanding the facilities to house chimps used for hepatitis research. The foundation is known throughout Europe and now receives so many requests it has had to consider refusing animals. Some animals which have stayed at AAP are donated to zoos, most are not in a condition to be released in the wild without close supervision. The Foundation is interested in discussing establishing similar sanctuaries in countries of origin where overhead would be cheaper and space more easily available. The secretary of the foundation would appreciate hearing from any readers with ideas on this subject:

Jan B. Kaiser
Apen Adoptie & Protectie
Legmeerdijk 118
1187 NH Amstelveen
THE NETHERLANDS

Primate Report Under New Editorship

The German-based primate publication, *Primate Report*, focuses on topics such as: information on primate holding institutions and their colonies; behavioral, physiological and technical aspects of holding primates; captive propagation and conservation; and laws and regulations.

As of issue no. 15, this publication is under a new editor, Dr. M. H. Schwibbe of the German Primate Center in Göttingen, West German. *Primate Report* now has some 200 subscribers and is available at $8.00 U.S. or 15 DM per issue. Anyone interested in subscribing, or sending articles, technical notes or announcements, should write to the new editor at the address given below.

Although published in Germany, articles in this journal are in English. Issue no. 14 includes all the abstracts of the XIth Congress of the International Primatological Society, and is still available.

Michael H. Schwibbe
Editor, *Primate Report*
German Primate Center
Kellnerweg 4
D-3400 Göttingen
WEST GERMANY

New Series Entitled *Illustrated Monographs of Living Primates* to be Launched in the Netherlands

A new series of monographs entitled *Illustrated Monographs of Living Primates* is soon to be launched in the Netherlands, with Jan B. Kaiser as Editor and PSG member, Marc G. M. van Roosmalen, as Associate

Editor. This series of folio-sized monographs of all primate species will be issued on a subscription basis. Each monograph will have a color painting of the species in its natural habitat (see sample in Fig. 20), and a review of what is known of the animal in question, including systematics, nomenclature and historical background, a description of the species, distribution and habitat preferences, diet and feeding behavior, group size and composition, home range and population density, circadian activity, relationships with other animals, social behavior, reproduction, communication, conservation status and action, synopsis of naturalistic studies, and bibliography.

Fig. 20. Painting of *Lemur catta* for the new series to be published in the Netherlands.

For more information on this important new publication, please contact:

Marc G. M. van Roosmalen
The Institute
Zuiderzeestraatweg 415
8091 PA Wezep
THE NETHERLANDS

A New Journal of Wildlife and Wildlands Research and Management in the Neotropics

Vida Silvestre Neotropical is a new journal for publication of articles on wildlife and wildland research and management in the Neotropics. This publication responds to a need for an outlet to disseminate the new technical information being rapidly generated in the field. *Vida Silvestre Neotropical* focuses on the conservation of endangered species and their habitats, sustainable use management, control of pest species, maintenance of biological diversity, indigenous use of wildlife, and methods for designing protected area systems, among other issues. It is published biannually by World Wildlife Fund. Feature articles, notes and announcements are published in the language in which they are submitted: Spanish, Portuguese or English.

Requests for information about subscriptions and guidelines for submitting manuscripts should be addressed to:

Curtis Freese
Co-Editor, Vida Silvestre Neotropical
World Wildlife Fund
1250 24th Street, N.W.
Washington, D.C. 20037

From The Forest

New Newsletter, *From the Forest,* Produced by the Duke University Primate Center

The Duke University Primate Center (DUPC) is a "living library" devoted to the conservation and study of prosimian primates: lemurs, bushbabies, lorises and tarsiers. Currently DUPC houses over 700 animals belonging to 31 species and subspecies of 12 prosimian genera. In addition to its impressive colony of living primates, it holds an important fossil collection of North American Eocene, African Oligocene and subfossil Malagasy primates. The center's animals , materials and research facilities are open to all qualified researchers whether local, national or international.

Recently, the DUPC has undertaken publication of a newsletter, *From the Forest*, to inform the general public and scientific community of its programs. *From the Forest* provides information on the center's breeding programs, field studies, research activities and conservation programs. The newsletter will be published one to three times a year depending on available funding. A minimum $10 donation to the DUPC will entitle you to an annual subscription of *From the Forest.* Please make checks payable to DUKE PRIMATE CENTER and send your name and complete address to:

Donna S. Macedonia
Promotion Assistant
Duke University Primate Center
3705 Erwin Road
Durham, NC 27705

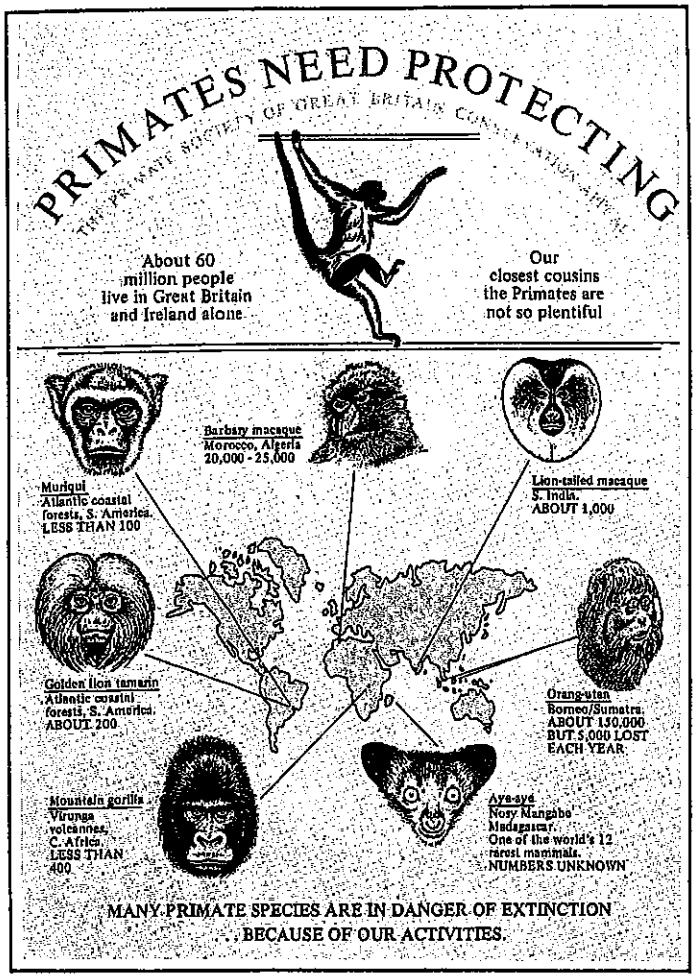


Fig. 21. "Primates Need Protecting", a new education booklet being distributed by the Primate Society of Great Britain.

Primate Society of Great Britain Publishes Results of a Conservation Symposium and a New Education Booklet on Primates

The Primate Society of Great Britain has published the proceedings of a symposium entitled "Current Issues in Primate Conservation". Held at the Zoological Society of London on December 7, 1985, this symposium included 14 papers on conservation in West Africa, Rwanda, Madagascar, Indonesia, Malaysia and Brazil, with several contributions on captive breeding as well. Produced as a supplement to *Primate Eye* 26, this 68-page booklet was edited by Miranda F. Stevenson, David J. Chivers and Jennifer C. Ingram.

An 8-page education booklet entitled "Primates Need Protecting" (Fig. 21), focuses on the threat of tropical forest destruction to primates, and human dependence on primates and tropical forest.

Both of these publications are available from:

Hilary Box
Dept. of Psychology
University of Reading
Earley Gate
Whiteknights
Reading RG6 2AL
U.K.

New Books by PSG Members

A number of new books on various aspects of primatology have been written or edited by PSG members recently. They are listed here, together with prices and ordering information where available.

***Frugivores and Seed Dispersal* edited by Alejandro Estrada and T.H. Fleming (1986)**

This book offers a new perspective on the biological and practical implications of frugivore-plant interactions. Contributors focus on the ecological and ultimately evolutionary advantages of seed dispersal; the general and explicit environmental forces influencing timing and mode of dispersal; and the ecological consequences of seed disperal for the heterogeneity of tropical ecosystems, for plant and animal succession, competition and coexistence, and for the management and conservation of tropical ecosystems. The 398-page text is divided into four sections: Plant Strategies, Frugivore Strategies, Consequences of Seed Dispersal, Community Aspects of Frugivory and Seed Dispersal. The hardcover volume is available for $275.00 U.S. from:

Kluwer Academic Publishers Group
Distribution Center
P.O. Box 322
3300 AH Dordrecht
THE NETHERLANDS

***Comparative Primate Biology* by Joe Erwin, series editor (1986)**

This series is an in-depth review of primate biology and will serve as an important reference for people working in the social, behavioral, biological and health sciences. The major emphasis is comparative analysis with reviews including data on human as well as nonhuman primates, and making direct comparisons of characteristics and processes across biological communities. The series is divided into four volumes, available at the prices indicated per volume, or at a 10% discount for the entire set.

Vol. 1	*Systematics, Evolution and Anatomy* Edited by Daris R. Swindler and J. Erwin	$190.00
Vol. 2	*Part A. Behavior, Conservation and Ecology* *Part B* (forthcoming in 1987). *Behavior, Cognition and Motivation* Edited by G. Mitchell and J. Erwin	$150.00 price not set
Vol. 3	*Reproduction and Development* Edited by W. Richard Dukelow and J. Erwin	$120.00
Vol. 4	(forthcoming in 1987) *Neurosciences* Edited by Horst D. Steklis and J. Erwin	price not set

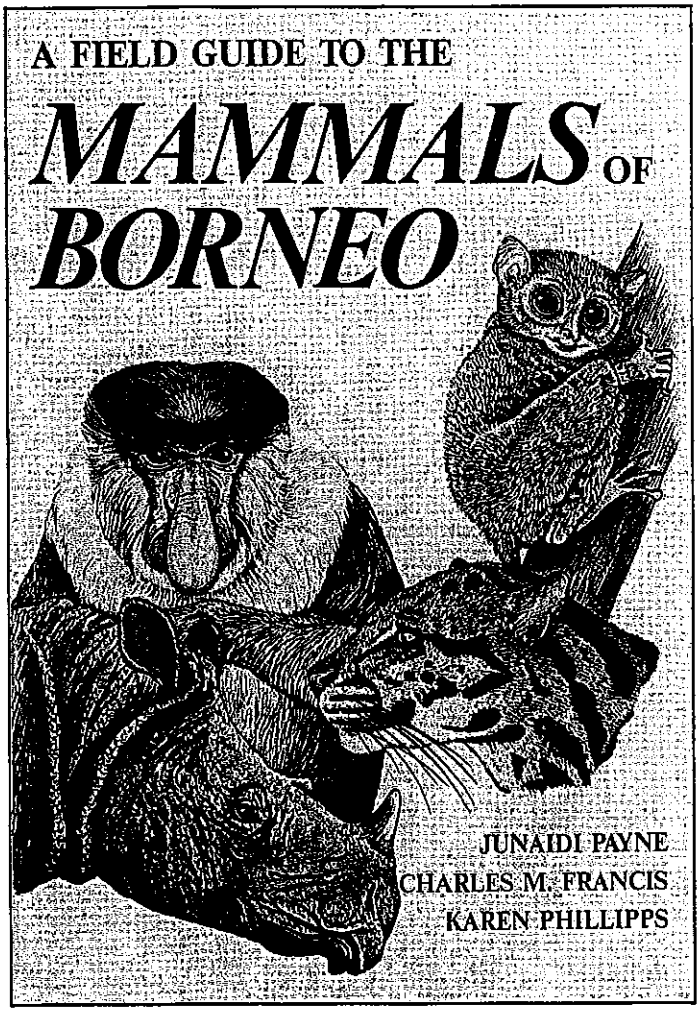
All are available from the publisher:

Alan R. Liss, Inc.
41 East 11th Street
New York, N.Y. 10003
U.S.A.

***Selected Proceedings of the Tenth Congress of the International Primatological Society* edited by James G. Else and Phyllis C. Lee (1986)**

This three-volume set is a compilation of selected papers from the Tenth Congress of the IPS held in Nairobi, Kenya in July, 1984. The three volumes are entitled: *Primate Evolution; Primate Ecology and Conservation; Primate Ontongeny, Cognition and Social Behavior.* They are available from the publisher for $59.50 each in hardcover and $19.95 each in paperback, with a 20% discount to IPS members.

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



A Field Guide to the Mammals of Borneo **by Junaidi Payne, Charles M. Francis and Karen Phillipps (1985)**

A comprehensive guide to all of Borneo's mammals, this outstanding new publication updates Lord Medway's 1977 *Mammals of Borneo* and includes 60 color plates of Bornean mammals, among them the 13 species of primates found on the island. Each species is described, with notes on ecology, habitat and distribution, and a considerable amount of previously unpublished information. The guide also features sections on footprints, finding and identifying mammals, parks and reserves in Borneo, local names for mammals, a gazetteer, a map and a bibliography. This book is available for $16.50 hardback and $12.50 softcover from either of these addresses:

Sabah Society
P.O. Box 10547
88806 Kota Kinabalu
Sabah
MALAYSIA

World Wildlife Fund Malaysia
P.O. Box 10769
50724 Kuala Lumpur
MALAYSIA

Primate Conservation in the Tropical Rain Forest **edited by Clive W. Marsh and Russell A. Mittermeier (1987)**

This book is designed to bridge a gap between scientific studies of endangered primate species and their tropical rain forest habitats, and the very practical problems of achieving conservation objectives in developing countries. The 14 contributions are organized into three sections: Problems, Approaches, and Priorities, which analyze the reasons for primate decline, discuss methods in use to reverse these trends, and identify priority areas for further conservation action.

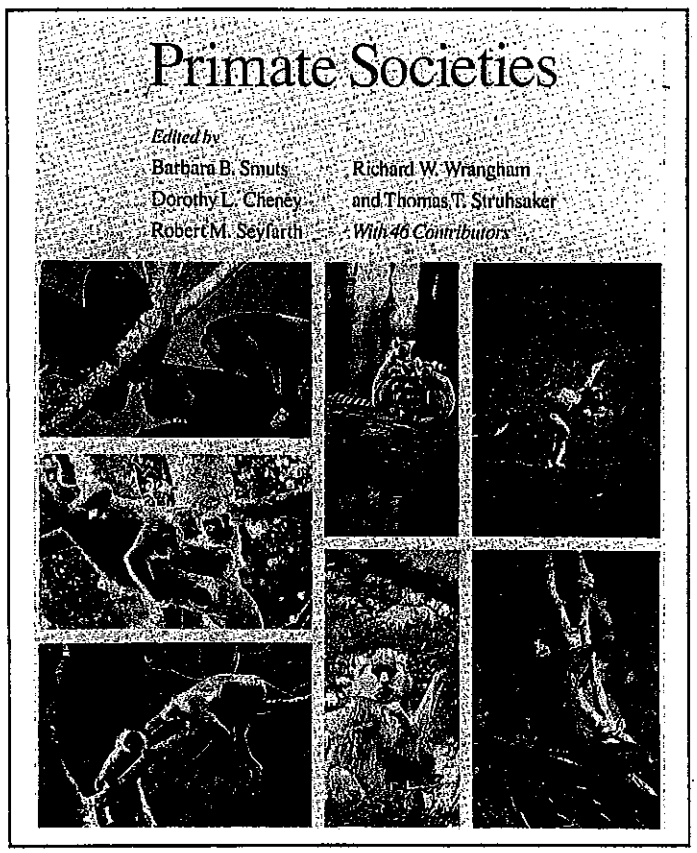
This book is available from the publisher for $90.00.

Alan R. Liss, Inc.
41 East 11th Street
New York, N.Y. 10003
U.S.A.

Primates, the Road to Self-Sustaining Populations **edited by Kurt Benirschke (1986)**

The proceedings of a meeting held from June 24-28, 1985, in San Diego, California, this 1044-page volume is probably the most up-to-date treatment of primate conservation in print. It includes a number of review papers on status of wild primate populations, and a wide variety of papers on all aspects of captive management. It is available from the publisher for $79.00.

Springer-Verlag
175 Fifth Avenue
New York, N.Y. 10010
U.S.A.



Primate Societies **edited by Barbara B. Smuts, Dorothy L. Cheney, Robert M. Seyfarth, Richard W. Wrangham and Thomas T. Struhsaker (1987)**

This book is a systematic, detailed description and analysis of primate social behavior in the wild. With contributions from 46 experts, *Primate Societies* provides a synthesis of the most current information collected from the field. Part 1. Evolution of Diversity, reviews the relation between taxonomy and social variation across the primate order. Part 2. Socioecology, synthesizes recent information on primate ecology, demography, and life histories and discusses their effects on social organizaton. Part 3. Group Life, covers major theoretical problems of social evolution and possible solutions. The contributors show that many aspects of behavioral variation can be understood in terms of modern evolutionary theory. This theme is continued in the discussions of primate cognition in Part IV. Communication and Intelligence. Part V. The Future, examines the interwoven issues of primate conservation and primate research.

This book will be useful as a text for advanced students, a reference work for primatologists and other field researchers and a convenient synthesis of new knowledge for social and behavioral scientists. Softcover copies ($27.50) and hardback copies ($70.00) are available from the publisher.

The University of Chicago Press
11030 South Langley Avenue
Chicago, Illinois 60628
U.S.A.

Fig. 22. This 32-page brochure is a beautiful introduction to Kilverstone, a zoo specializing in Neotropical animals. The brochure is lavishly illustrated with color photos of the many cebids and callitrichids present. It is available for $5.00 U.S. by writing Kilverstone Wildlife Park, Thetford, Norfolk IP24 2RL, U.K.

Primates in Nature by Alison Richard (1985)

A comprehensive review of primate behavior and ecology, this 558-page volume is an excellent textbook for primatology classes. It can be ordered from the publisher for $17.95 paperback, $27.95 hardcover.

W. H. Freeman
4419 West 1980, S
Salt Lake City, Utah 84104
U.S.A.

The Evolution of Primate Behavior by Alison Jolly (1985)

This second edition of Alison Jolly's classic book on primate behavior (1972) is an entirely new, greatly expanded book rather than a second printing. Like the original edition, it covers primate ecology, social behavior and intelligence. Besides updating the literature, there are new emphases on conservation, on sociobiological interpretation and on the evolution of consciousness. It too is an excellent text for classroom use, and is available through college bookshops or from the publisher for $24.95 .

Macmillan Publications
Front and Brown Streets
Riverside, N.J. 08075
U.S.A.

White-faced Saki Used as Conservation Symbol in Suriname

Fig. 23. A saki sticker with text in Dutch reads, "Learn to know your own country."

Fig. 24. The Raleigh Boys, a band made up of guards from the Raleighvallen-Voltzberg Nature Reserve, wearing their saki t-shirts while performing for visitors (photo by R. A. Mittermeier).

The male white-faced saki (*Pithecia pithecia*), with its striking white face set off against a black body, is being used as a conservation education symbol in Suriname. Thus far, a poster of all eight native primate species (see *Primate Conservation* 5), and a sticker and a t-shirt depicting the saki (Figs. 23,24) have been produced by the WWF Primate Program for the Suriname Nature Conservation Foundation (STINASU). These are being distributed within the country, especially to protected area personnel in Suriname's reserve system.

Panamanian Conservation Association Adopts Geoffroy's Tamarin as its Symbol

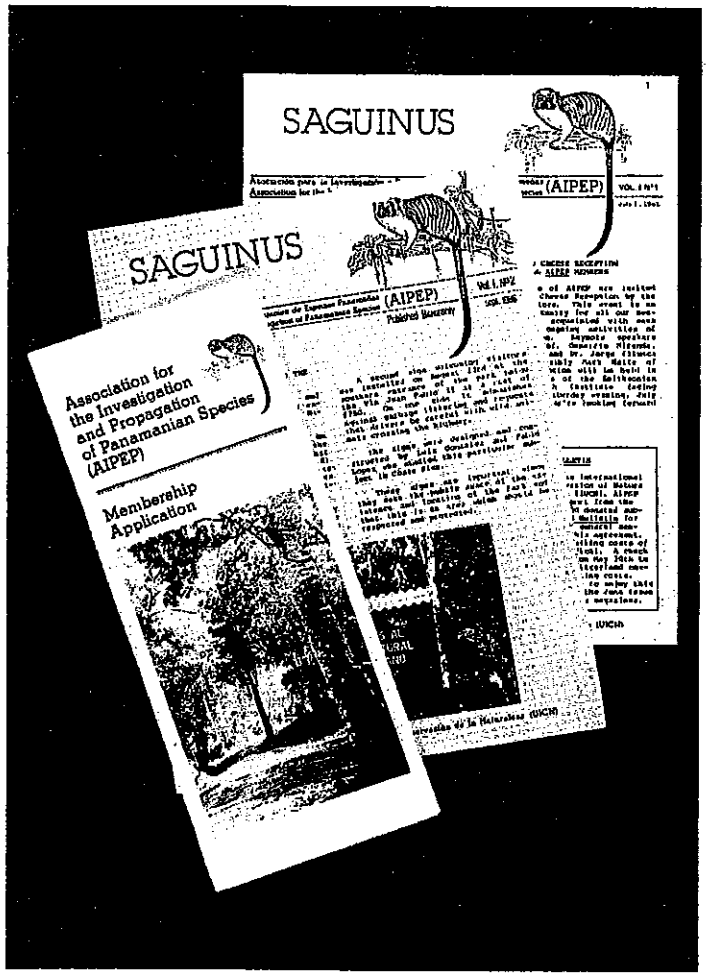


Fig. 25. *Saguinus*, the newsletter of AIPEP.

The Association for Investigation and Propagation of Panamanian Species (AIPEP) has adopted Geoffroy's tamarin (*Saguinus geoffroyi*) as its symbol, and has named its newsletter *Saguinus* (Fig. 25). Geoffroy's tamarin is found mainly in Panama and also extends into adjacent areas of Colombia, and perhaps Costa Rica as well. AIPEP and World Wildlife Fund have jointly produced a sticker and a t-shirt for this species (Figs. 26,27).

For more information on AIPEP and its many conservation activities in Panama, please write to the following address:

Asociación para la Investigación y
Propagación de Espécies Panameñas
(AIPEP)
Apartado 2320
Balboa
Ancon
PANAMA

Fig. 26. A two-toned sticker of Geoffroy's tamarin with this message in Spanish, "My name is Titi monkey. I also am Panamanian. I live on the insects that eat your harvests. Don't hurt me. Don't kill me. I'm not a good pet. I will disappear if you do not protect the forests in which I live."

Fig. 27. A t-shirt of Geoffroy's tamarin. The text on the front reads, "Panamanian species in danger of extinction"; the text on the back is identical to the sticker. Illustrations are by S. D. Nash.

Great Ape Sticker for Central Africa

A sticker (Fig. 28) produced jointly by the WWF Primate Program and the Department of Anatomical Sciences of the State University of New York at Stony Brook, encourages local people not to hunt chimpanzees and gorillas. Made for use in the Central African countries of Zaire, Gabon, Cameroon, Central African Republic and Congo Republic,

the sticker reads in French, "Don't kill gorillas or chimpanzees". A t-shirt with the same design has also been produced and has already been circulated in Zaire and Gabon.

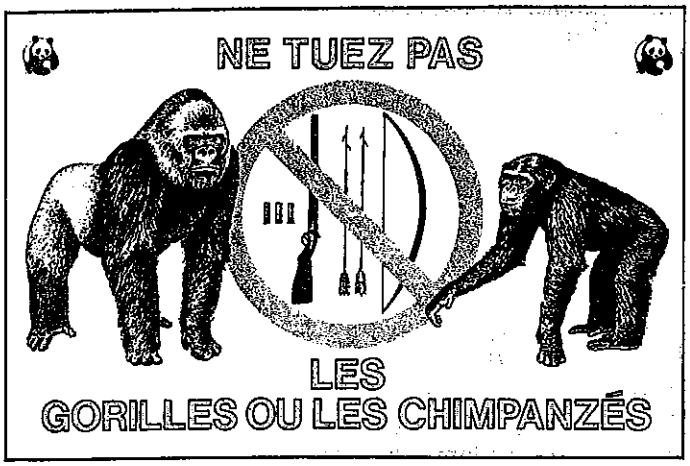


Fig. 28. A new sticker for use in Central Africa. Illustration by Luci Betti and Randall Susman.

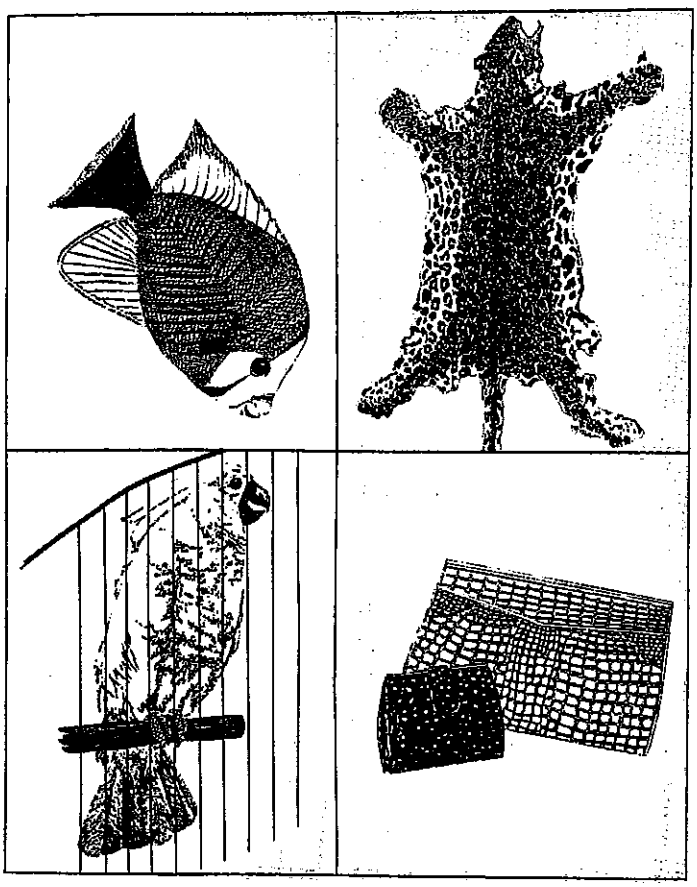


Fig. 29. Wildlife Trade Education Kit by Lynne Hardy of TRAFFIC (U.S.A.).

Wildlife Trade Education Kit Available From TRAFFIC(U.S.A.)

Primate trade is a serious conservation problem with illegal and excessive trade directly endangering some species such as cotton-top tamarins and chimpanzees. TRAFFIC(U.S.A.) has developed a Wildlife Trade Education Kit (Fig. 29) to assist educators in raising awareness about this conservation problem to many species of wildlife. The 132-page kit was produced for a general audience of high school level and above. It includes an 80-slide show entitled "Wildlife Trade: The Poacher, the Law, and the Consumer;" an educator's guide with suggested activities, glossary, and bibliography; fact sheets on five frequently traded groups of animals, including primates; and a full-color poster of 23 endangered Neotropical primates protected from trade by CITES. These materials emphasize the effect trade has on wildlife, the effectiveness of current legislation, and the ways in which we can all help. The kit costs $40.00 and is available from:

TRAFFIC (U.S.A.)
World Wildlife Fund
1250 24th Street, NW
Washington, D.C. 20037
U.S.A.

New CITES Primate Poster

A new primate poster has been jointly produced by the WWF Primate Program and CITES (the Convention on Trade in Endangered Species). It depicts the 23 Neotropical primate species currently listed on Appendix I of the Convention, including 11 callitrichids, *Callimico*, and 11 cebids (Fig. 30). The color artwork for the poster was prepared by Stephen D. Nash. Copies are availabe for $5.00 U.S. from the WWF Primate Program.

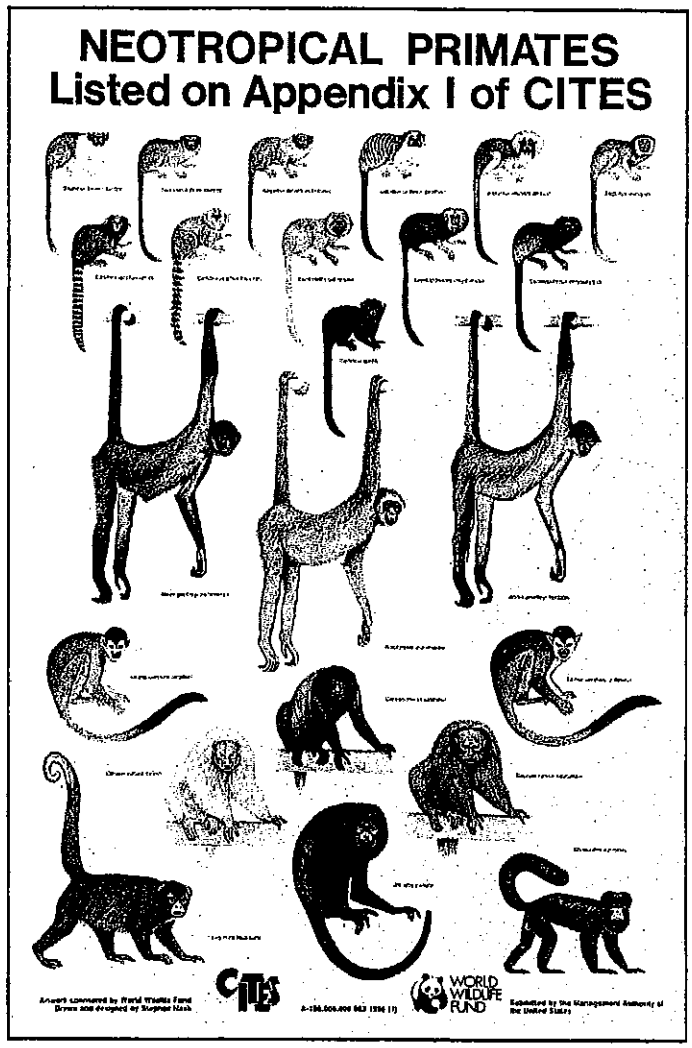


Fig. 30. New CITES poster available through WWF Primate Program.

Poster for the Pileated Gibbon in Thailand

A poster of the endangered pileated gibbon (*Hylobates pileatus*) from a painting by the well-known Thai nature artist Kamol Komolphalin, has been issued by WWF (Fig. 31). The poster depicts the devastating effects of deforestation on wildlife in Thailand: a mother gibbon and her infant sit beside a recently-felled tree in a desolate landscape, and proclaim "How can we survive without forest!" Beneath is an explanation in Thai and English that *H. pileatus* is protected by Thai law but presently endangered by habitat destruction and hunting for the pet trade. The painting has also been used on another poster celebrating Thailand's 1983 National Wildlife Day.

The Wildlife Conservation Division of the Royal Forest Department and Wildlife Fund Thailand are distributing this poster in Thailand as part of their conservation education programs. The poster is also being promoted by the Primate Conservation Appeal of the International Primatological Society and its affiliates. For more information contact:

Dr. David J. Chivers
Sub-Department of Veterinary Anatomy
University of Cambridge
Tennis Court Road
Cambridge CB2 1QS
ENGLAND

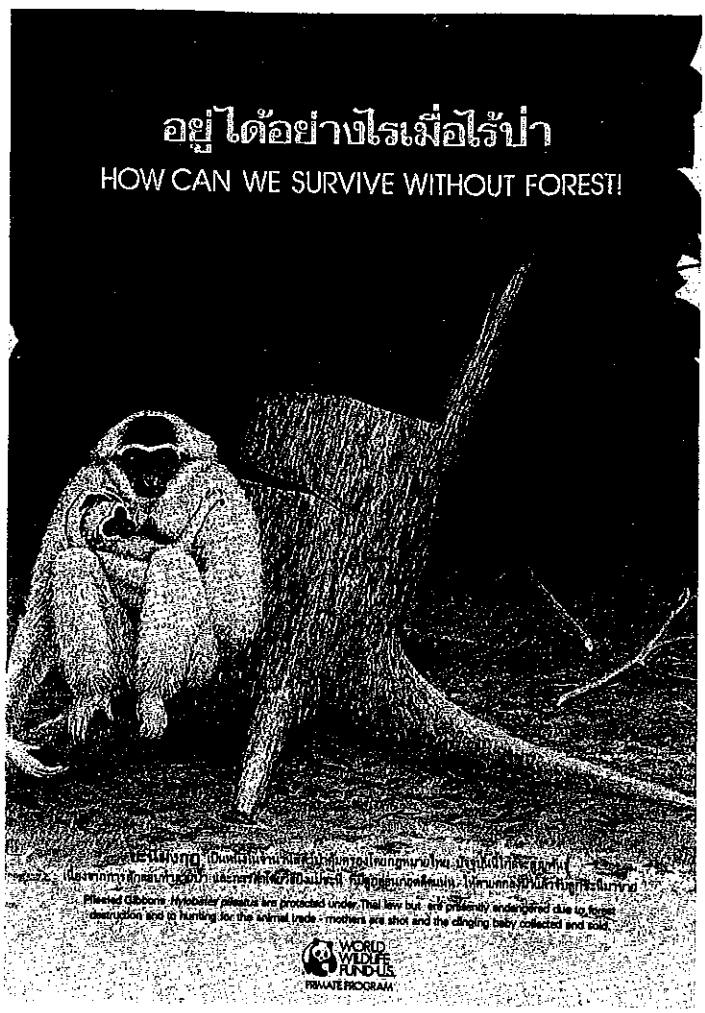


Fig. 31. A poster by Thai artist K. Komolphalin explains threats to the endangered pileated gibbon.

New Conservation Posters, T-Shirts and Stickers for Madagascar

Fig. 32. Sticker produced by WWF for the Beza-Mahafaly Reserve in southwestern Madagascar. The text reads, "University Forest Reserve — Beza-Mahafaly" (design by S.D. Nash).

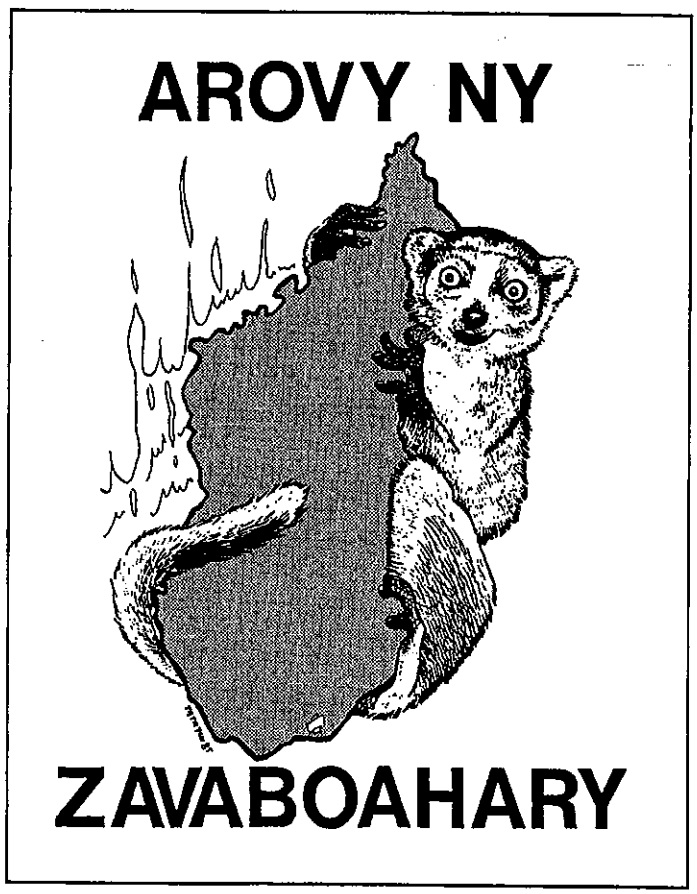
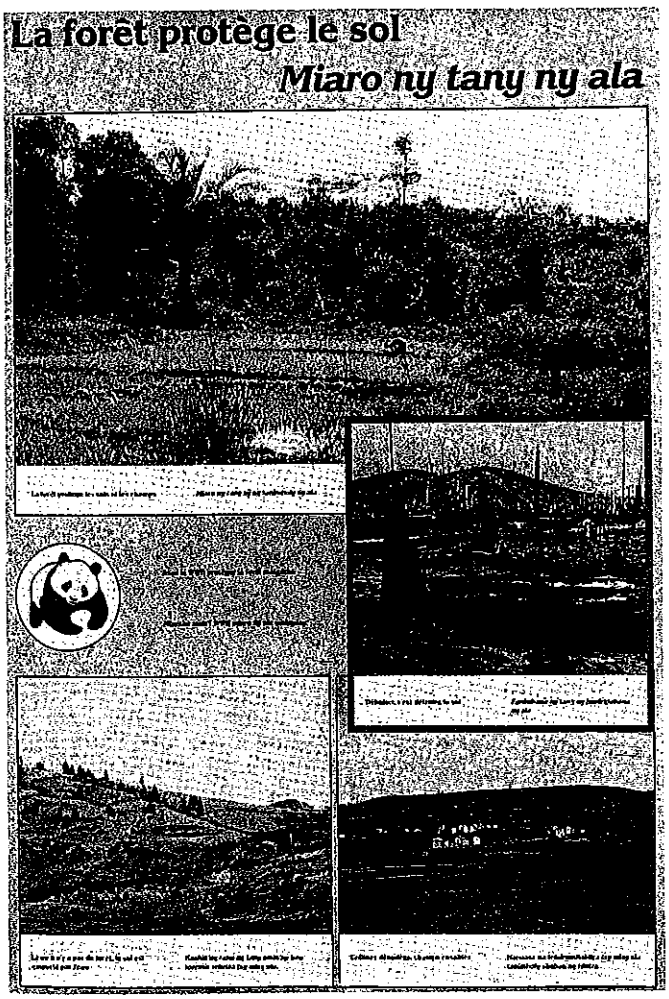
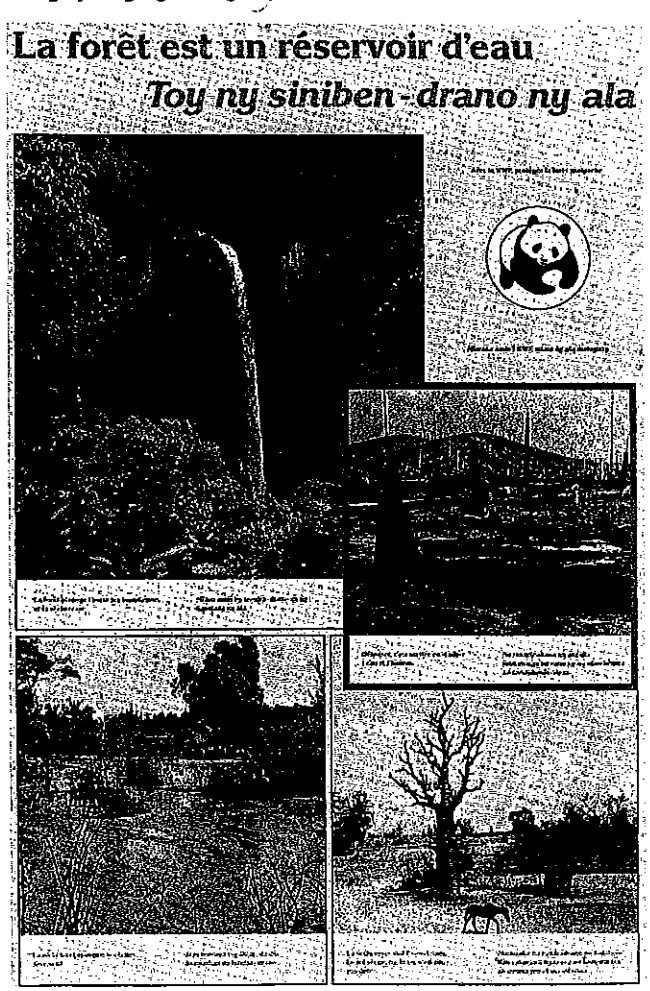


Fig. 33. Sticker depicting the crowned lemur, produced by WWF for use in the region of Diego Suarez in northern Madagascar where this species occurs. The text reads, "Protect Nature" (design by Patryck Vaucoulon).

Fig. 34. Sticker produced by WWF depicting the indri. The text is in the Malagasy language and reads, "Protect Nature" (design by S. D. Nash).

Fig. 35. Sticker depicting the ruffed lemur produced by WWF for the Parc Tsimbazaza Zoo in Antananarivo. The text reads, "National Heritage," in the Malagasy language (design by S. D. Nash).





Figs. 36,37. Posters produced by WWF for use in Madagascar. The texts in French and Malagasy read, "The forest protects the soil" and "The forest is a reservoir of water".

Fig. 38. Poster produced by the Sodafruit soft drink company in Madagascar as part of a country-wide public awareness campagin organized by Barthelemi Vaohita, head of the WWF Representation in Madagascar.

World Wildlife Fund has produced a number of new conservation education materials for use in Madagascar, including four posters, three stickers and several conservation t-shirts (Figs. 32-38). These depict lemurs, forest and other Malagasy flora and fauna, and carry some basic conservation messages about the relationship between forest, water and soil. One of the posters was sponsored by the Malagasy soft drink company, SodaFruit, and is being used in a country-wide contest for Malagasy students. These materials are being distributed by a WWF Conservation Education Program, headed by Barthelemi Vaohita, the WWF representative in Madagascar.

More Conservation Education Materials for Primates in the Atlantic Forest

Conservation education campaigns using primates as symbols have been carried out in the Atlantic forest of eastern Brazil since 1980, and have been described in previous issues of *Primate Conservation*. As part of this continuing effort, several new materials were introduced during the past year, by World Wildlife Fund and Brazilian organizations.

Two howler monkey t-shirts have been produced for the recently discovered red-handed howler monkey (*Alouatta belzebul*) population in the state of Paraiba in northeastern Brazil (see article in News from the Field section of this issue), and for the brown howler monkey (*Alouatta fusca*) in the state of Minas Gerais (Fig. 39). Three new muriqui stickers and another t-shirt have also been added to the growing list of

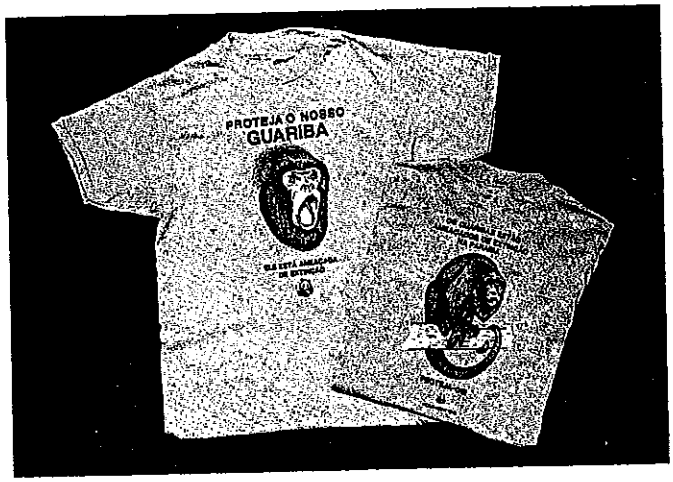


Fig. 39. T-shirt celebrating the recent discovery of the red-handed howler monkey (*A. belzebul*) in Paraiba.

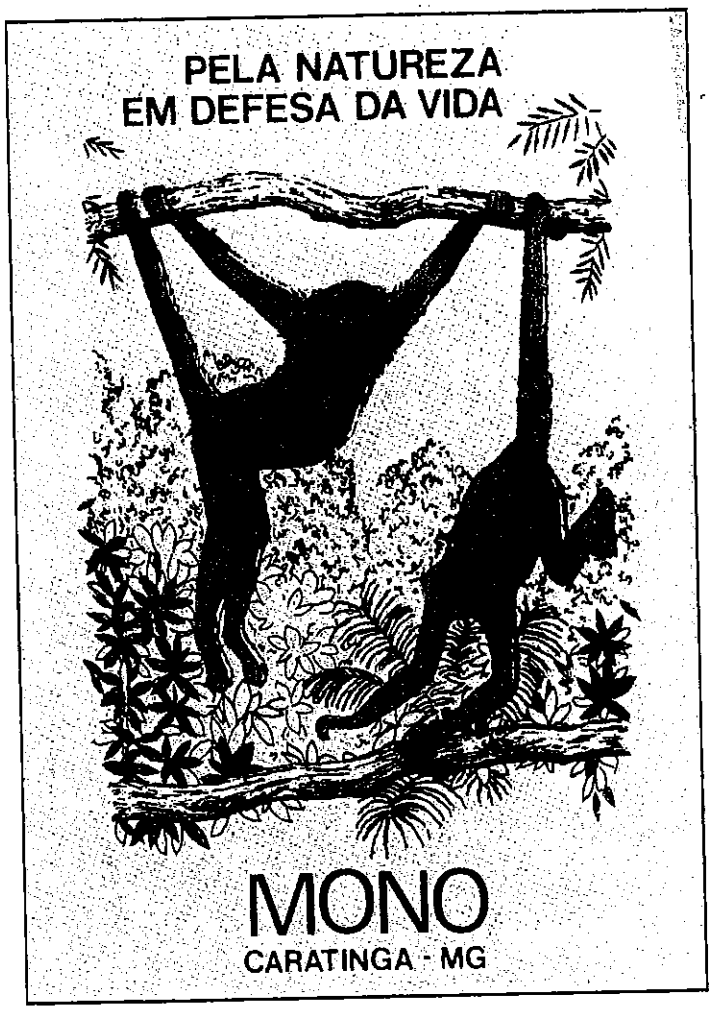


Fig. 40. Sticker produced for the campaign to save the Mata do Sossego Forest.

materials for this important monkey. Two of the stickers (Fig. 40) and the t-shirt were produced by Eduardo Bazem in Minas Gerais, leader of a campaign to save the forest known as Mata do Sossego (see announcement on page 16).

The third sticker, for the Caratinga Ecological Station, located at Fazenda Montes Claros in Minas Gerais, was produced with WWF support by Eduardo Veado, Director of the Station and the new Secretary of the Brazilian Primatological Society (Fig. 41). Finally, a poster for the

black lion tamarin from São Paulo (Fig. 42) has been prepared by the Energy Company of São Paulo, which has been very active in conservation efforts to save this species in its last major stronghold, the Morro do Diabo State Reserve in western São Paulo.

These materials are being sold locally in Brazil, and the two t-shirts depicting the howler and the Caratinga muriqui stickers are also available through the WWF Primate Program. The t-shirts cost $10.00 each and the sticker $1.00.

Fig. 41. Sticker produced for the Caratinga Ecological Station.

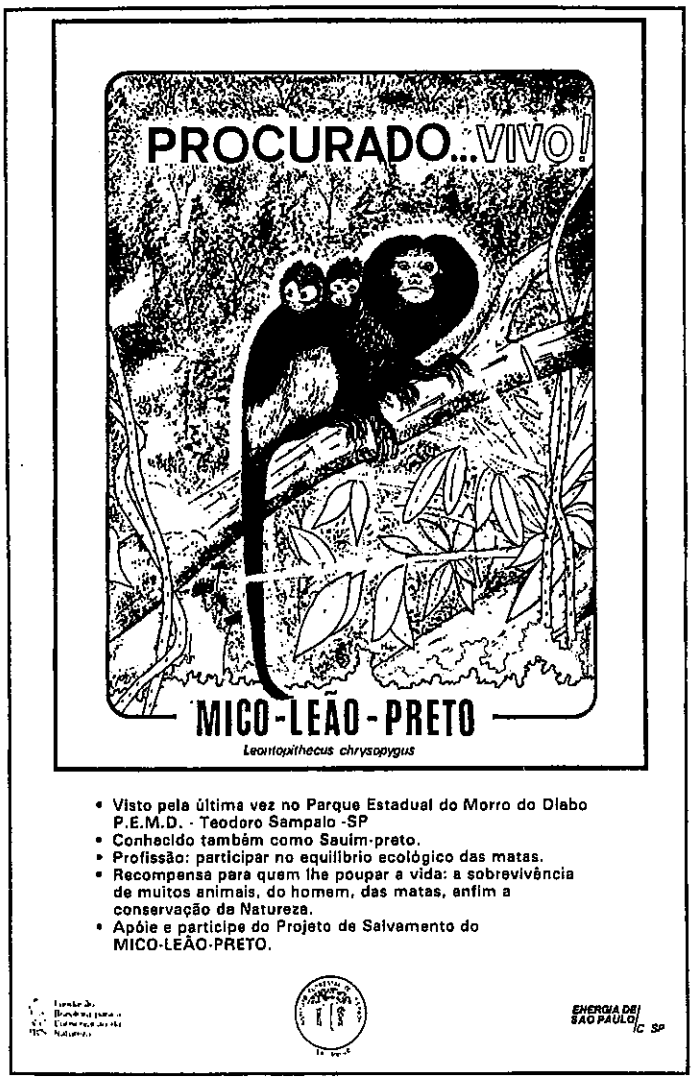


Fig. 42. Poster of the black lion tamarin *(Leontopithecus chrysopygus)* by the São Paulo Energy Company.

New Primate Stamps

Several countries have issued new primate stamps during the past year. Rwanda has produced a new series of four stamps (including the WWF logo), and a souvenir sheet of the mountain gorilla (Fig. 43); Grenada and the Grenadines now have a large souvenir sheet depicting the mona monkey (*Cercopithecus mona*, Fig. 44), a species introduced to Grenada from Africa; Suriname has four new cebid stamps (Fig. 45) depicting two species which occur in the country, the red howler (*Alouatta seniculus*) and the squirrel monkey (*Saimiri scuireus*), and two species which do not, the night monkey (*Aotus trivirgatus*) and the red uakari (*Cacajao calvus rubicundus*); and the German Democratic Republic issued a series of primate stamps celebrating the 125th anniversary of the Dresden Zoo. Included in the German series are the mandrill (*Mandrillus sphinx*), the guereza (*Colobus guereza*), the orang-utan (*Pongo pygmaeus*), and the ringtailed lemur (*Lemur catta*) (Fig. 40).

Fig. 43. New stamps of the mountain gorilla from Rwanda.

Fig. 44. A mona monkey souvenir sheet from Grenada and the Grenadines.

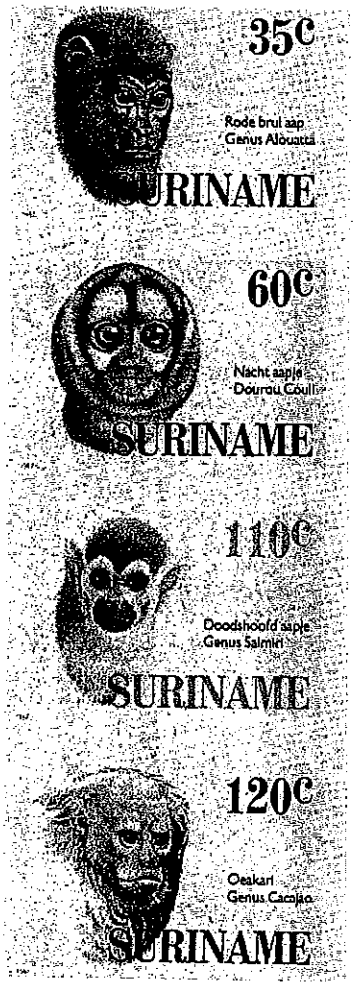


Fig. 46. Four new primate stamps honor the Dresden Zoo.

Availability of Volunteer Field Assistants

As in past issues, 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. If any of you require assistants with specific skills, please feel free to advertise here.

Volunteer field assistants:

Mr. Ramesh Boonratana
Department of Anthropology
Panjab University
Chandigarh 160014
INDIA

Mr. Boonratana is working towards an M.Sc. in anthropology from the Panjab University. He recently submitted a thesis on the social behavior of a newly-formed group of rhesus macaques, and presented a paper at the XI IPS Congress on the development of mating relations amongst rhesus. Mr. Boonratana is a Malaysian citizen who speaks Hindi, Thai, Malay, Indonesian, and English.

Rachel Bramson
5734 37th NE
Seattle, WA 98105
U.S.A.

Ms. Bramson has a bachelor's degree in Biology from the University of Chicago, a master's degree in Anatomy from the University of Washington, and has completed the first year of medical school. She is interested in working on a field study anywhere, anytime from September 1987 to September 1988. She speaks French and rudimentary Spanish.

Ms. Andrea Grosse
94 Common Street
Belmont, MA 02178
U.S.A.

Ms. Grosse has studied several mammal species in the field at three Smithsonian project locations: Barro Colorado Island, Panama; Mt. Lake Biological Station, Virginia; and Carrot Island, North Carolina. She has a BA in Biology and Environmental Science and is fluent in Spanish, Portuguese, German, and French. She is looking for a project in South America which emphasizes social behavior.

Ms. Amy L. Hetrick
214 North First West
Missoula, MT 59802
U.S.A.

Ms. Hetrick has a MA in Anthropology and Museum Studies from the University of Arizona. She has worked in the field on upland-nesting ducks (U.S. Fish and Wildlife Service), black-footed ferrets (Bureau of Indian Affairs), mule deer and beaver (Montana Power Company), and large game mammals (Montana Dept. of Fish, Wildlife and Parks). These projects gave her experience in radiotracking, radiotriangulating, animal identification, aging and sexing, vegetation surveys, habitat use analysis, transect and capture/recapture censusing, spotlight search methods, chain-drag nest search, hunter check stations, four-wheel-drive vehicle maintenance, power-boating, and advanced first aid. She is also an adept scientific illustrator and photographer. She is available to do primate field work for the next two years, preferably, but not necessarily, in Madagascar and Southeast Asia. She can probably pay her own travel expenses.

Mr. Eric Horstman
School for International Training
Kipling Road
Brattleboro, VT 05301
U.S.A.

Mr. Horstman is a senior at the School for International Training, completing a Bachelor's degree in International Studies. A requirement of the program is to serve for up to one year as an intern abroad. Mr. Horstman is looking to participate in an environmental education or conservation project. He has worked as a survey and forestry aide and preserve patroller for the U. S. Bureau of Land Management, the U.S. Forest Service and The Nature Conservancy. He has also participated in wildlife studies of grizzly bear, gray wolf, and bald eagles through San Francisco State University. Mr. Horstman can pay his own expenses.

Ms. Laurie Myers
Mather House 189
Harvard University
Cambridge, MA 02138
U.S.A.

Ms. Myers is a senior at Harvard University majoring in primate behavior and ecology. She is especially interested in questions relating to ecological variables and female reproductive success, but she would be more than willing to participate in other research projects. She speaks and writes French and is familiar with statistics. She is free from June 1987 through January 1988, and will try to provide her travel fare.

Ms. Helen O'Leary
33 Red Lion Square
London WC1R 4AB
ENGLAND

Ms. O'Leary is a 1986 graduate of Cambridge University, with first class honors in Applied Biology. She is interested in any sort of summer volunteer fieldwork. She has some experience in primate field work in Sierra Leone, and has participated in an avian and insect ecology project in the American prairies. She can provide her own travel expenses.

Mr. Alexandre Ribeiro dos Santos Vasconcellos
Rua Sérgio Milliet, 269
São Paulo, CEP 04663
BRAZIL

Mr. Vasconcellos has a degree in Environmental Engineering from the Mauá School of Engineering. He has worked as an environmental impact research superintendent for CETESB, the Company of Technological Environmental Sanitation. He has attended conferences on world environment and development and on industrial waste disposal. He speaks Portuguese, English, and some German. He is interested in working on an environmental protection project or an ecological project to learn new skills.

OBITUARY
Emmanuel Rwelekana

Emmanuel Rwelekana and four other members of the Karisoke Research Center staff were imprisoned after the murder of Dian Fossey without being charged. Seven months later four of these men were suddenly released, but Emmanuel continued to be held, incommunicado. In October, 1986, he died in prison, supposedly by suicide. Last December, the authorities publicly accused both Wayne McGuire and Emmanuel Rwelekana of Dian Fossey's murder. Emmanuel Rwelekana does not have the opportunity to put forth his case and protest his innocence. Perhaps he will be remembered in his country as a murderer; but by his family, his friends, and his colleagues, who believe he died an innocent man, he will be remembered with the greatest of respect, as an extremely fine man, prepared to risk his life for the sake of the gorillas. His contribution to science and conservation should be acknowledged.

Emmanuel Rwelekana was neither famous, nor a scientist, yet this man did more than most to advance the causes of science and conservation in this region of Africa. Like Dian Fossey, he was a vital and intimate part of the whole mountain gorilla story. Emmanuel Rwelekana was with the Karisoke Research Center for fifteen years. His work encompassed a myriad of activities and talents, from collecting valuable scientific data, to training new field workers and helping to administer the center. Those of us who worked with him came to rely heavily on his skills, advice, and integrity. Because of his immense dedication and courage, particularly when carrying out anti-poaching patrols, he was regarded at Karisoke as a hero. We counted it a privilege to have worked with him and will consider ourselves lucky, indeed, to meet another like him. With his death, research has lost a valuable contributor, and the gorillas have lost a dedicated ally.

Sandy Harcourt
Kelly Stewart
Dept. of Applied Biology
University of Cambridge
Pembroke Street
Cambridge CB2 3DX
UNITED KINGDOM

Correction to an Article in *Primate Conservation* 7

The editor would like to make the following correction to the News From The Field report entitled "Conservation Program for the Andohahela Reserve, Madagascar" (*Primate Conservation* 7: 48-52), by Sheila O'Connor, Mark Pidgeon and ZigZag Randria. In the article (p. 50), it is stated that, ". . . species such as *Alluaudia procera,* popular for charcoal, are particularly vulnerable along roads." However, the authors point out that neither *A. procera* nor *A. ascendens* is used for charcoal production, because they are too thick and soft. Instead, the trunks of these two species are used to support kilns and, most commonly, they are made into wood planks.

NEWS FROM THE FIELD

Central and South America

Development of the Community Baboon Sanctuary in Belize: An Experiment in Grass Roots Conservation

by Robert H. Horwich and Jon Lyon

We are now conducting a small but significant experiment in wildlife conservation in rural Belize in the Bermudian Landing area on the Belize River. This unusual experiment has been to create a sanctuary on private lands with community support. It is not a sanctuary in the traditional or legal sense, but one which is based on and depends on private individuals as well as community government. Private landowners have voluntarily pledged to use their lands in accordance with a management plan which will benefit the black howler monkey and other wildlife, as well as the river and its forests. In turn, the program will benefit the landowners by reducing erosion, conserving the water table, and allowing more rapid replacement of the forest and its nutrients following slash-and-burn agriculture. This program, while limited and tailored specifically to the local area, has unlimited possibilities for similar situations in other areas of the world for other wildlife, archeological, or historical situations which could come under partial or total community control and management.

Before 1970, the black howler monkey, *Alouatta pigra*, was considered a subspecies of *A. palliata* which ranges throughout Central America. A study of skull characteristics exhibited two distinct populations of howlers (Smith, 1970). Further behavioral observations have confirmed these species differences (Horwich, 1983a; Horwich and Johnson, 1986). A recent survey of *A. pigra* noted a shrinking of the original range given by Smith (1970) as a result of habitat destruction, to isolated populations in forest islands often occurring along rivers in southern Mexico, northern Guatemala, and Belize (Horwich and Johnson, 1984, 1986; Fig. 1). Smith (1970) stated that *A. pigra* seemed to be more specific to tropical rainforest areas while *A. palliata* was more generalized and could utilize secondary forests and thus displace *A. pigra* due to habitat destruction. However, recent observations on *A. pigra* habitat in the Bermudian Landing area indicate that the species ranges through all successional stages of riverine forest, including areas of secondary growth (Fig. 2).

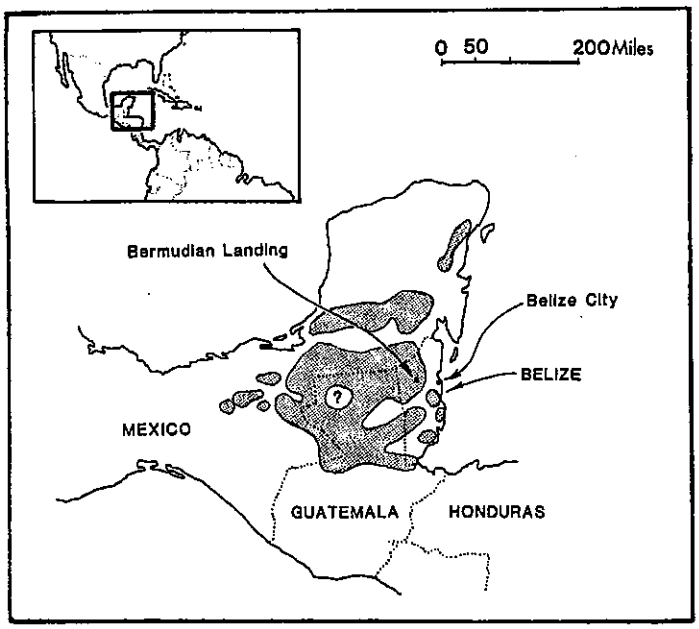


Fig. 1. The probable range of the *Alouatta pigra* in Central America. Its current range has been reduced to island populations which are continually shrinking in many areas (map by S. D. Nash from Horwich and Johnson, 1986).

Fig. 2. Riverine forest habitat of *Alouatta pigra* showing various successional stages (photo by R. Horwich).

Belize, and particularly the area around Bermudian Landing along the Belize River, has long had high howler populations, and was the site of a film, "Amate — the Great Fig Tree," filmed by Richard Foster, and earlier studies of howlers (Bolin, 1981; Horwich, 1983a, 1983b; Horwich and Gebhard, 1983, 1986). With rapid habitat destruction through much of its range, especially in Mexico, we targeted Bermudian Landing as an area for conservation based on the high howler population, its continuity with other howler areas, and the favorable disposition the local Creole people showed toward the howlers, which are locally called baboons. Although the land is all privately owned or is being leased for eventual purchase from the Government of Belize, slash-and-burn agriculture is proceeding at a slow enough rate to allow for mutual use of the forest by howlers and humans. This may be due to high nutrients and rapid regeneration, as noted in similar *cohune* forests (Arnason and Lambert, 1982; Arnason *et al.*, 1984).

In 1983, we approached the villagers and Village Council members of Bermudian Landing with the idea of beginning a sanctuary for the howler, using their private lands. We circulated a petition and secured signatures of 16 landowners and all seven council members. In 1984, we received permission to proceed from the Ministry of Natural Resources through the Chief Forest Officer, and support from the area representative. The following year, with financial support from WWF-U.S., we introduced the issue at a village meeting. We explained our plan and stressed the voluntary nature of the project as well as the conservation benefits to the land and to Belize. The voluntary nature of the

plan especially excited these rural landowners, who understand the importance and inherent independence of owning their own land.

In 1985, we mapped almost eight km² closest to Bermudian Landing and drew up individual land management plans for each landowner. These included requests to retain strips of forests along the river, between property boundaries, surrounding milpas, and as aerial pathways across large cut milpas. Our long-term goal is to retain a skeletal corridor system of forests for the howlers and other wildlife. We then approached the landowners with the help of a local Belizean, and obtained signed witnessed pledges from all 11 landowners (Fig. 3). These pledges read: "I, _____, a landowner in the Bermudian Landing vicinity, voluntarily pledge to accept the following management plan regarding my land and my farming practices, to enhance the environment of the baboon on my land. I understand that this pledge is not legally binding but I will nevertheless attempt to live up to its stipulations. If I cannot do so, I will inform the Village Council of Bermudian Landing or any biologist working on the Community Baboon Sanctuary, to attempt to make my farming practices work in harmony with the needs of the baboon and other wildlife." In our conversations with the landowners, we stressed such proper land use practices as preventing riverbank erosion, using trees that are food for both cattle and howlers, and the more rapid nutrient recycling due to quicker reforestation during the fallow time.

Fig. 3. The author, R. Horwich, with Fallett Young obtaining a voluntary conservation pledge from a landowner in Double Head Cabbage (photo by R.Horwich).

In 1986, with additional funds from WWF-U.S. and under the auspices of the Belize Audubon Society, using aerial photographs, we mapped an additional 39 km² on either side of the Belize River from Big Falls to Flowers Bank (Fig. 4). We have similarly drawn up individual land management plans for the new landowners and have already signed up over 60 landowners along a 32 km stretch of the river. We have also obtained formal support from the other villages, including Big Falls, St. Paul's Bank, Willow's Bank, Double Head Cabbage, Isabella Bank, and Flower's Bank. Landowners will receive from us a vegetation map of their lands with the management plan, and a copy of the pledge they signed. We additionally hope to award a certificate of participation, a t-shirt commemorating the sanctuary, and an aerial photograph of the land.

While working on a conservation plan for the area, the project has also stressed education, tourism, and research programs, which we hope will benefit the local people. Education has included lectures at all levels within the community and in Belize, as well as the development of written materials and video programs about the project and selected biology and conservation subjects. We wrote a 60-page, illustrated guidebook about the project which has been sold to tourists and locals. We are also developing a tree propagation program to help replant eroded areas along the river. This will be done initially in an area which we have fenced

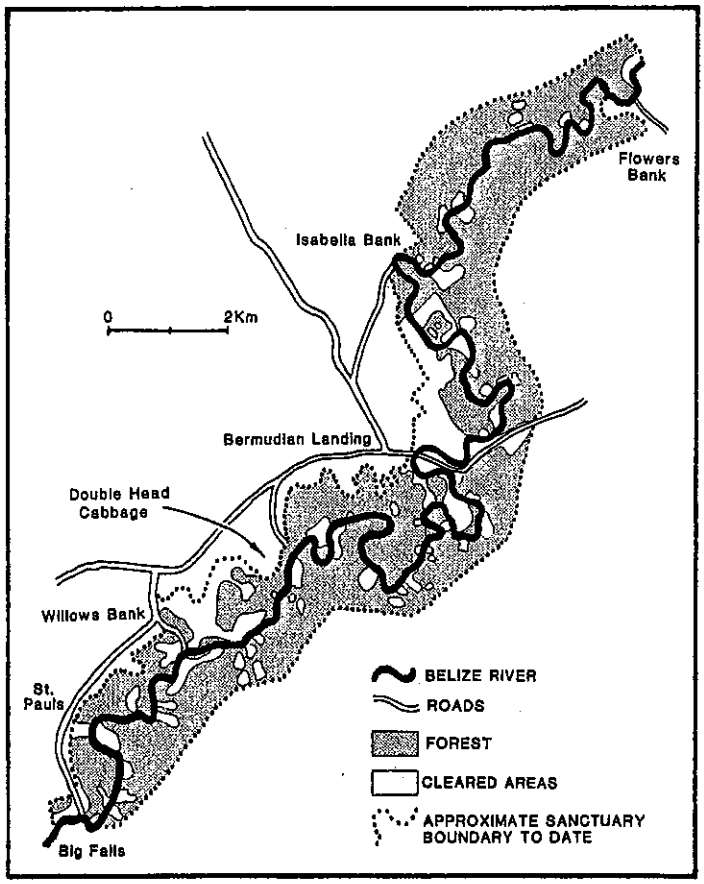


Fig. 4. The current boundaries of the Community Baboon Sanctuary which include over 60 landowners and seven villages along the Belize River (map by S. D. Nash).

Fig. 5. Villagers of Bermudian Landing building a tourist shelter from local materials (photo by R. Horwich).

for a community garden plot as well. Additionally, at the suggestion of the villagers, we are helping them to develop a "bed and breakfast" tourism which will encourage visitors to take meals with local farm families. The villagers have also built a small shelter for overnight camping (Fig. 5), acted as guides, and are selling traditional and innovative crafts made from local materials.

The final step in the development of the sanctuary will occur next year when we hope to hire and train a local Belizean, under the auspices of the Belize Audubon Society, to act as the sanctuary manager. The manager's main job will be contacting and working with local landowners to honor their earlier pledges, especially during the dry season when milpas are cut and burned. In addition, the manager will census howlers; make regular observations on plant phenologies; lecture to school groups and tourists; help to make connections for tourists with villagers for room, board, and guides; cut and develop trail systems; and maintain educational signs on the trails.

Our final plan is to construct a small, rural, holistic museum that will be an additional tourist attraction and a site for local education. We expect to have exhibits on paleontology, archeology, cultural anthropology, zoology, and botany. The museum grounds will be planted with local trees and plants as a small arboretum. All exhibits will have conservation as a theme and will relate to the natural history of the area.

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Sightings of Red Uakaris, *Cacajao calvus rubicundus*, at the Rio Blanco, Peruvian Amazonia

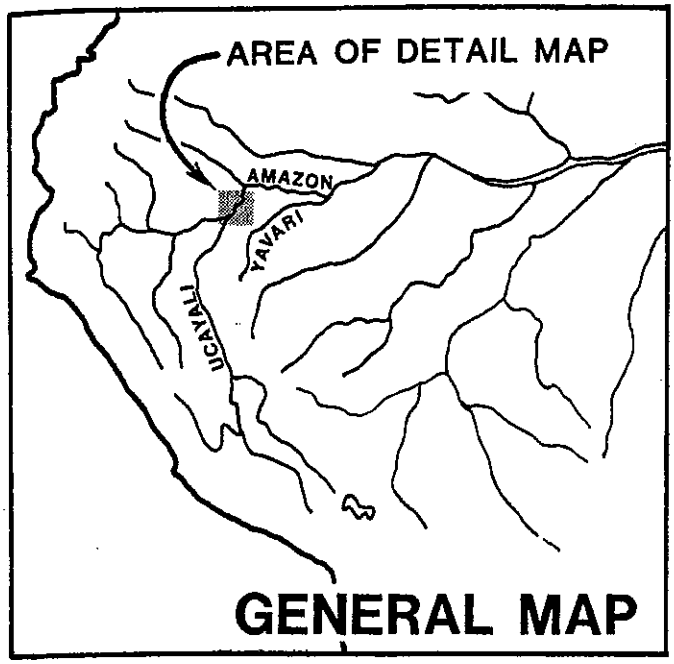
by Ursula Bartecki and Eckhard W. Heyman

Two species are distinguished within the genus *Cacajao*, *C. melanocephalus* and *C. calvus*. The latter is traditionally subdivided into two subspecies, *C. c. calvus* and *C. c. rubicundus*, the white and the red uakari. Only the red uakari is found in Peru. Like the other uakaris, *C. c. rubicundus* is listed as vulnerable by the IUCN (1982) and has already disappeared in some areas (Aquino, 1978; Soini, 1982). Neither population densities nor the exact distribution are known. Red uakaris do not occur west of the Rio Ucayali (Hill, 1960; IUCN, 1982; Napier and Napier, 1967; Soini, 1972), but whether the northern boundary is formed by the Amazon (Chiarelli, 1972) or by the Rio Putumayo-Ica (IUCN, 1982; Mittermeier and Coimbra-Filho, 1977; Napier and Napier, 1967; Soini, 1972) remains unclear.

Unlike the white uakari, which has been studied by Ayres (1986) at the Rio Japurá in Brazil, little is known about the ecology and behavior of free-ranging red uakaris. Some brief sightings are reported by Aquino (1978), Fontaine (1979), and Mittermeier and Coimbra-Filho (1977). During the course of etho-ecological studies on moustached tamarins and saddle-back tamarins in 1985-1986, we had four encounters with *C. c. rubicundus* at our study site on the Rio Blanco (Fig. 1) in May 1986. [According to the recent taxonomic revision of the genus *Cacajao* by Hershkovitz (1987), the species *C. calvus* is subdivided into four subspecies and therefore the animals seen by us belong to the subspecies *C. c. ucayalii* which is living between the Rivers Ucayali and Yavari. To avoid confusion we maintain the traditional taxonomy.]

The first sighting took place on May 4 at 1530 h, when a group of 20-30 red uakaris passed near our camp. The group included young animals estimated to be less than one year of age. Some animals were feeding in a *leche huayo* tree (Apocynaceae, possibly *Couma* sp.). Visual contact was maintained for about half an hour and was disrupted due to a heavy shower. However, from the camp we heard vocalizations of the uakaris until about 1900 h, indicating that they spent the night nearby. The next morning we met the uakaris at 0550 h at the presumed sleeping site. Some animals were feeding in a *shiringa* tree (Euphorbiaceae, *Hevea* sp. or *Sapium* sp.), others were allogrooming, and one animal was observed to mark anogenitally. When the group started to move, it split into subunits. Group progression was rapid and always at heights of more than 15 m. The uakaris often moved in file, which twice gave us the opportunity to count members. One subunit contained at least 43 individuals, the other 25-30 animals. Thus total group size was about 70-80 individuals. One of the subunits was associated temporarily with a group of squirrel monkeys, *Saimiri sciureus*. Individuals of both species used the same arboreal pathways. Two more feeding trees were recorded, but not yet identified. The fruits of these two trees had thick shells (5 mm and 14 mm, respectively), similar to the *leche huayo* (7 mm) and the *shiringa* (7 mm).

Contact with the uakaris was maintained for 2.5 hours. During most of this time, the main activity was travelling (Fig. 2). It was difficult to keep up with the animals, although they moved around in an area which was made accessible by a trail system. Contact was lost when the uakaris left this area.



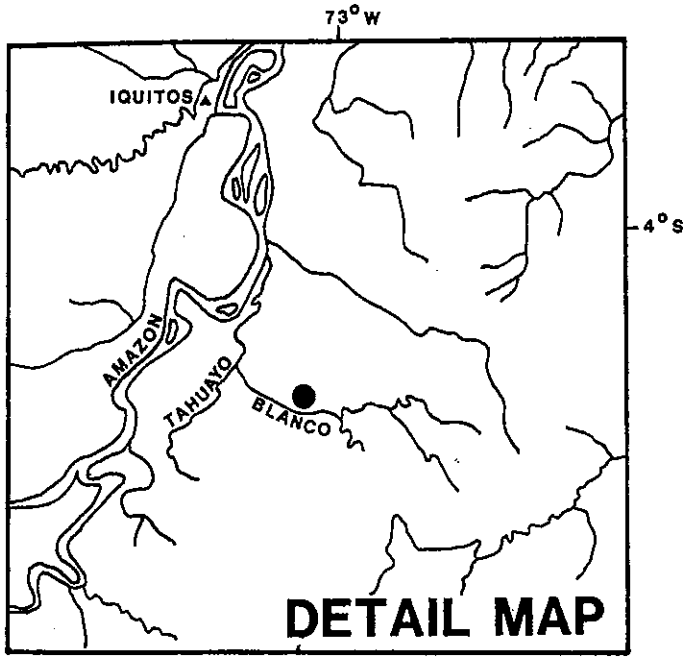


Fig. 1. The location of the study area on the Rio Blanco, in western Amazonia (map provided by the authors).

The third encounter with red uakaris took place on May 22 at 1725 h. Our attention was attracted by a troop of *Saimiri sciureus* before we detected the uakaris. No attempt was made to follow the animals since it was becoming dark.

On May 23 at 0610 h, contact was made with a group of uakaris, presumably the same one seen the day before. The uakaris were associated with squirrel monkeys. The group circulated several times within an area of about 16 ha. It was not discernible whether they did so in an attempt to escape from the observers or whether this was a normal pattern of range use. On one opportunity, 37 individuals were counted, but more individuals were present. From 0750 h on, we only had contact with four adult uakaris. They entered an undetermined feeding tree, whose fruits also had thick shells (7 mm). After feeding for about 15 minutes, they rested in the same tree for about half an hour. Then they moved on rapidly (about 500 m within 10 minutes) and contact was lost.

Fig. 2. Two red uakaris *(Cacajao calvus rubicundus)* at the Rio Blanco study area (photo by U. Bartecki).

Apart from the four sightings reported here, red uakaris have been seen twice at the study site in 1984 and 1985 (Castro, pers. comm.). Other sightings are reported from the left bank of the Rio Blanco some 2-3 km away from our study site (Bodmer, pers. comm.; Garber, 1986; Ramirez, 1984; Soini, pers. comm. to Fontaine, 1979). Furthermore, a local hunter told us about regular sightings of red uakaris near the upper Rio Blanco. The study site, located on the right bank of the Rio Blanco, is characterized by *tierra firme* forest (Fig. 3) which is never inundated. The area on the left bank of the Rio Blanco where red uakaris also had been sighted may be inundated partially during some months of the year (Garber, 1986). Apparently, red uakaris are not restricted to flooded black-water forests or swampy forests only as has been assumed by Fontaine (1979, 1981).

Fig. 3. *Tierra firme* forest at the Rio Blanco study area (photo by U. Bartecki).

We were present at the study site between July 1985 and July 1986 for a total of 19 weeks, covering every month of the year with the exception of December and January. We regularly surveyed an area of about 200 ha. If red uakaris were using this area regularly throughout the year we would have expected to encounter them more frequently. It is more likely that the study site is only part of a very large home range. For white uakaris, Ayres (1986) gives 500-600 ha as the home-range size. We presume that home-ranges of red uakaris are within this order of magnitude or even larger.

On three of the four sightings, the red uakaris were associated with squirrel monkeys. Such an association has also been recorded by Mittermeier and Coimbra-Filho (1977). Nothing is known, however, of the nature of the interspecific relation between these two species. Red uakaris

have also been seen associated with woolly monkeys (*Lagothrix lagotricha,*) as was reported to us by a settler on the Rio Blanco.

Red uakaris are not represented in any of the national parks or reserves of Peru, and are also not protected in any Brazilian reserve (Rylands & Mittermeier, 1983a, 1983b). Although protected by law in Peru since 1970, they are still hunted for food (*carne de monte*) and for skulls which are sold in tourist markets in Iquitos. Together with increasing habitat destruction this may be a serious threat to the future survival of red uakaris. Effective protection can only be achieved by the installation of a reserve. The area of the Rio Blanco could be suitable for such a reserve. Apart from the red uakaris, moustached tamarins (*Saguinus mystax*) which also are unrepresented in reserves, and ten other primate species (*Cebuella pygmaea, Saguinus fuscicollis, Saimiri sciureus, Cebus albifrons, Cebus apella, Callicebus moloch, Aotus nancymai, Pithecia hirsuta, Alouatta seniculus, Lagothrix lagotricha*) would be protected in such a reserve (Bartecki *et al.*, 1986).

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The Red-handed Howler Monkey in Northeastern Brazil

by Alfredo Langguth, Dante Martins Teixeira, Russell A. Mittermeier and Cibele Bonvicino

The howler monkey genus, *Alouatta,* includes at least six species that range from southern Mexico through Central America and northern South America south as far as southern Brazil and extreme northern Argentina — the largest range of any Neotropical primate genus. Two of these species, *Alouatta pigra* and *Alouatta palliata,* are largely Middle American in distribution, with *A. palliata* also extending along the Pacific coast of South America as far south as extreme northwestern Peru. Two others, *Alouatta seniculus* and *Alouatta belzebul,* are mainly Amazonian in distribution, whereas *Alouatta fusca* is restricted to the Atlantic forest region of eastern Brazil and a small adjacent portion of Misiones in Argentina. The sixth species, *Alouatta caraya,* is found in the drier regions of central Brazil, northern Argentina, Paraguay and Bolivia. Although the ecology of this genus is the best documented of all the Neotropical primate genera, its taxonomy and distribution remain among the most poorly understood (see, for example, Froehlich, this issue). The purpose of this paper is to report on several important new localities for *Alouatta belzebul,* probably the least known member of the genus. A more detailed analysis of the taxonomy and distribution of this species is currently in preparation (Bonvicino *et al.*) and will be published in a future issue of *Primate Conservation.*

Alouatta belzebul is endemic to Brazil, and found mainly in lower Amazonia. The majority of localities are from the south bank of the Rio Amazonas, east of the Rio Purus and the range extends as far east as Miritiba in the state of Maranhão (Fig. 1). Within this region, one can identify five different types, ranging from entirely black to entirely rufous, but the best known form is black with reddish or rufous on the hands, feet and tip of tail.

The continued existence of this species in the Atlantic forest region of northeastern Brazil has long been uncertain. It was first mentioned from this region in 1648 by Marcgrave and Piso, who recorded it from the state of Pernambuco in their classic work on the natural history of Brazil (Marcgrave, 1648). However, there were no subsequent references to this species in Pernambuco or elsewhere in the northeast for the next 350 years, leading Ihering (1914) to state, in his review of the genus *Alouatta,* that there "was no further confirmation of its presence there". He goes on to recommend that, "it is time that the government of Pernambuco pay more attention to the scientific exploration of the fauna and flora of its state . . ." (Ihering, 1914, p. 250). Ihering does show the range of *A. belzebul* as covering northeastern Brazil north of the Rio São Francisco, but this is based only on Marcgrave's (1648) reference as far as we have been able to determine. Hill's (1962) map shows arrows extending from Maranhão into the northeast, based entirely upon Ihering, but he quotes Ihering as saying that the region of Pernambuco is no longer occupied.

During the course of recent field investigations of remnant forest tracts in northeastern Brazil, we have succeeded in locating surviving populations of *Alouatta belzebul* in two northeastern states, Alagoas and Paraiba,

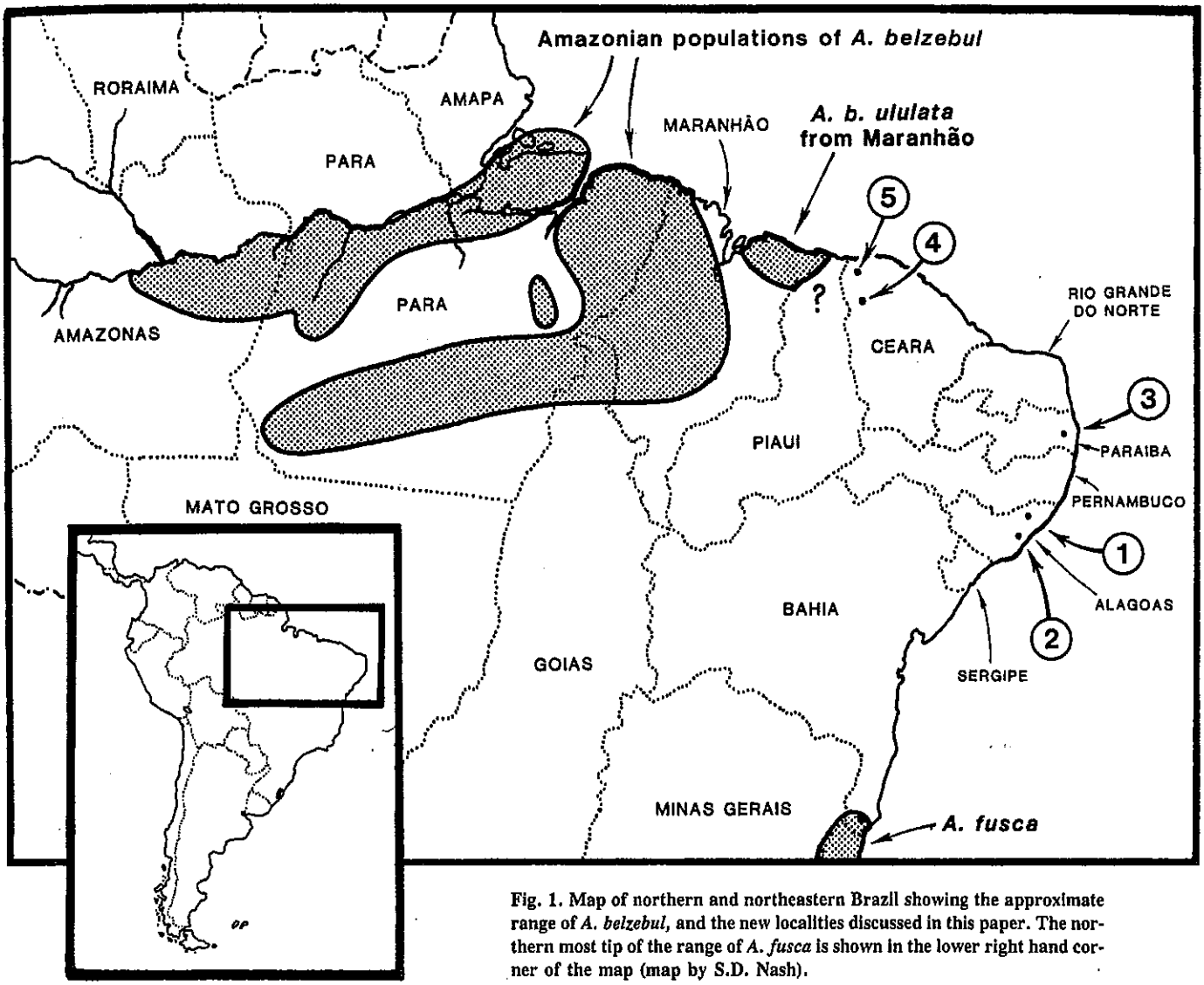

Fig. 1. Map of northern and northeastern Brazil showing the approximate range of *A. belzebul*, and the new localities discussed in this paper. The northern most tip of the range of *A. fusca* is shown in the lower right hand corner of the map (map by S.D. Nash).

Table 1. Museum localities for *Alouatta belzebul* in the northeastern Brazilian states of Alagoas, Paraiba and Ceara. Map numbers refer to Fig. 1.

Alagoas

Serra Branca, municipality of Murici, Alagoas (9° 15'S, 35° 50'W), 1800' (MNRJ 25671, 25672)
collected May, 1984 Map no. 1

Usina Sinimbú, Alagoas (9° 55'S, 36° 08'W) (MZUSP 8298, 2880)
collected Feb. 22, 1967 Map no. 2

Paraiba

Fazenda Pacatuba, Usina Santa Helena, 10 km NE of Sape and approx. 40 km west of João Pessoa, Paraiba (7° 03'00"S, 35° 9'30"W) (MUFPb 414, 415, 416)
collected August 18, 1979 Map no. 3

Ceará

Bom Jardim, municipality of São Benedito, Ceará (MNRJ 23141, 23142)
collected November 2, 1973 Map no. 4

Cinta Sulidon, municipality of São Benedito, Ceará (4° 03'S, 40° 53'W) (MNRJ 21096)
collected July 4, 1953 Map no. 4

Goiabeira, municipality of Granjá, Ceará (3° 05'S, 40° 50'W) (MNRJ 23140)
collected November 2, 1973 Map no. 5

MZUSP = Museu de Zoologia, São Paulo
MNRJ = Museu Nacional, Rio de Janeiro
UFPb = Mammal Collection, Universidade Federal de Paraiba

and have heard reports of their continued existence in Ceará. These findings confirm the presence of *A. belzebul* in the Atlantic forest region of northeastern Brazil, and include several important range extensions as well. This work has been carried out by the Universidade Federal da Paraiba and the Museu Nacional in Rio de Janeiro, with support from World Wildlife Fund, and is part of a long term collaborative program aimed at conserving the biological diversity of Brazil's Atlantic forest region, one of the highest conservation priorities in the world.

Alagoas

The presence of *A. belzebul* in the state of Alagoas was first confirmed by the Brazilian ornithologist Oliverio Pinto, who collected two specimens at Usina Sinimbú (9° 55'S, 36° 08'W) in 1967. These were deposited in the Museu de Zoologia in São Paulo, and were only recently mentioned by Silva (1981) in the literature. It is interesting to note that Pinto, in an earlier publication on the same area, comments, "during our whole visit to Alagoas we were impressed by the absolute absence of monkeys other than *Callithrix*, which itself appears to be represented by only one species, *Callithrix jacchus* (Pinto, 1954, p. 9)". This indicates that *A. belzebul* must have been extremely rare in Alagoas even in the early 1950's and that the specimens collected by Pinto in 1967 were among the last individuals in lowland Alagoas.

During the course of further ornithological research in Alagoas carried out in the period 1979-1987, Teixeira succeeded in locating a popula-

tion of the species in the Pedra Branca massif in the municipality of Murici (09° 15'S, 35° 50'W), probably the largest remaining tract of Atlantic forest in the state. This area will soon be established as an ecological station by SEMA, the Secretary of the Environment of the Brazilian government, and it is hoped that this protected area will save a population of *A. belzebul* in Alagoas.

In 1979, it was also possible to observe this monkey in isolated lowland forest in the municipality of São Miguel dos Campos (approx. 9°, 47'S, 36° 50'W), but these remnants were cleared for sugarcane plantations around 1982 and *Alouatta belzebul* appears to now have been exterminated in this area as a result.

Fig. 2. *Alouatta belzebul* in the forest at Fazenda Pacatuba in the state of Paraiba. Both the Paraiba and Alagoas populations closely resemble typical *A. b. belzebul* from Amazonia, with black bodies and rufous coloration on the hands, feet and tip of tail (photo by R. A. Mittermeier).

Local people also reported *A. belzebul* in other parts of Alagoas, but Teixeira was not able to confirm any of these reports during months of field work there.

It is clear that *A. belzebul* is highly endangered in Alagoas and that its main hope for survival lies in the protection of the forest at the proposed Murici Ecological Station.

Paraiba

The first record of *A. belzebul* in the state of Paraiba was obtained by Langguth in 1979, when he located a population in a forest at Fazenda Pacatuba in the municipality of Sape. This forest, (7° 03'00"S, 35° 09'30"W) which covers some 275 ha, is entirely surrounded by cleared sugarcane fields and has a population of no more than a few dozen individuals (Fig. 2). Thus far, this population is the only one known to persist in Paraiba. Local people indicated that the species also occurs at the neighboring Usina Montealegre and until recently in the Mamanguape Ecological Station belonging to SEMA, but that is has now been exterminated from the latter by poaching. Consequently, as in Alagoas, *A. belzebul* must be considered highly endangered in the state of Paraiba.

Ceará

Several museum specimens of *A. belzebul* (identified as *A. b. ululata*) exist from the state of Ceará, and have been mentioned in the literature by Silva (1981; p. 899). They are listed in Table 1, and extend the range of *A. b. ululata* westward from Maranhão, across Piauí (where there are no *Alouatta* records whatsoever) into Ceará (Fig. 1).

Furthermore, there is a reference to the presence of this species in Ceará in a paper by Paiva (1973), which gives the following information: "Black howler: Practically extinct in the state of Ceará. A few individuals of this species still inhabit the humid forests of *chapadas* and *serras*, descending into cooler low-lying areas in search of fruit trees. The distribution of the species in Ceará is limited to the coastal area, the central *sertão* (interior), the central-northern *sertão*, the *sertão* of the lower Jaguaribe, the *sertão* of Salgado and the upper Jaguaribe, Baturite, Ibiapaba and Cariri. It is already extinct in the *sertão* of the southeast, the *sertão* of the middle Jaguaribe, Araripe and Pereiro. Urgent protective measures are required (Paiva, 1973, p. 446)."

Although this reference and the most recently collected museum specimens date back to 1973, Teixeira heard reports of this monkey in February, 1986, from local people in the Serra do Baturite (4° 20'S, 38° 66'W), meaning it probably still persists in remote parts of the state. However, as indicated by Paiva (1973), urgent protective measures are required if this animal is to survive, since it appears that *A. b. ululata* is one of the most endangered Neotropical primate taxa.

These records from northeastern Brazil are particularly interesting in that they indicate that the forests of Amazonia must once have been continuous with those of the northeastern Atlantic forest to enable this Amazonian monkey to extend its range into this region. The differences between the Ceará and the Paraiba/Alagoas populations and the similarity between the *A. b. belzebul* populations of the lower Amazon and those of Paraiba and Alagoas further indicate that some of these connections were probably in the interior and not along the coast (Teixeira *et al.*, 1986).

The gap in howler monkey distribution in northeastern Brazil is also interesting, since the northernmost populations of *A. fusca* occur (or occurred, see Santos *et al.*, this issue) in extreme southern Bahia, whereas the southernmost *A. belzebul* populations are in Alagoas. This leaves a large area covering most of coastal Bahia and all of Sergipe with no known *Alouatta* populations. Whether this is a natural hiatus, an artifact of limited collecting in the region, or the result of human disturbance and hunting remains to be determined.

The discovery of these important populations of a large and conspicuous monkey shows how little we still know of the fauna of the Atlantic forest formations of northeastern Brazil, a point already made by Teixeira in various publications on the birds of the region (e.g., Teixeira and Gonzaga, 1983a, 1983b). Furthermore, the highly precarious state of these usually adaptable monkeys is indicative of the critical situation in the region as a whole. An education and research program on *A. belzebul* is currently underway in Paraiba (see p. 26 in Announcements) and efforts are being made to protect the Murici forest in Alagoas, but a great deal more research and conservation will be needed in the immediate future if the few representative remnants of Atlantic forest in northeastern Brazil are to have any hope of surviving.

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Choice of Feeding Trees by Three Species of Brazilian Primates: Effects of Slope and Tree Size

by Cris Cristoffer

Human development is limiting arboreal primates to smaller and smaller forest fragments of often suboptimal habitat. Frequently these habitats are forests growing on terrain too hilly for conventional agriculture. In September and October 1986, I studied such a hilly forest at Estaçaõ Biologica de Caratinga (EBC), Fazenda Montes Claros, in Minas Gerais, Brazil. The four species of primate occurring at EBC are *Alouatta fusca, Brachyteles arachnoides, Cebus apella,* and *Callithrix flaviceps.*

Although the *Callithrix* were too uncommon to observe systematically, I was able to record observations of the feeding habits of the three larger species. For each tree ›10 cm dbh that I observed the monkeys feeding in, I recorded the dbh and the inclination of the ground from the vertical about 0.3 m from the base of the tree. No data were recorded more than once for individual trees even though some trees were fed in frequently. I hypothesized that monkeys would prefer large or robust trees, as has been found for several species of primates in Manu National Park in Peru (Terborgh, 1983), for canopy frugivore bats in Panama (Bonaccorso, 1979), and for Neotropical vertebrates in general (Emmos and Gentry, 1983; Cristoffer, in press). I also hypothesized that trees growing on more level ground would be preferred to those growing on rugged slopes. My standard of comparison was a transect of trees ›10 cm dbh, growing on one of the hillsides. The transect originated at a randomly-chosen point on a dirt road and climbed diagonally up the slope.

To determine whether monkeys use trees that are larger and on more level ground than average, I compared the means of inclination and dbh for feeding trees with means of transect trees. For statistical analysis of means for *Brachyteles* (for which my sample sizes were small) I used a "t" test; for *Alouatta* and *Cebus* I used "z" tests (Agresti and Agresti, 1985; Table 1). All three cebids fed in trees significantly larger than the mean of the transect trees. Two of the genera, *Brachyteles* and *Cebus*, preferred trees growing on significantly more level ground than the mean of the transect trees. The reasons that topography affects the feeding habits of these primates are open to speculation; however, it seems unlikely that elevation is an important factor because changes in vegetation along altitudinal gradients at EBC have been attributed to natural and human disturbance rather than to altitude *per se* (Hatton *et al.*, 1983).

Table 1. Characteristics of Primate Feeding Trees

Measurement Source	DBH (cm) (X)	Inclination (degrees) (X)	DBH & Inclination Similarity of Transect & Feeding Trees*
Transect	13.8	120.3	----
Alouatta	20.0**	117.5**	20 / 40
Brachyteles	12.1**	111.6	20 / 100
Cebus	31.7**	109.5**	15 / 20

*Expressed as % transect trees w/in one st. dev. of mean of primate feeding tree
**p ‹.01 that feeding tree mean = transect mean

A conservation implication of this study is that only a portion of the approximate 800 ha forest at EBC is heavily used for feeding. Although the data are too limited for a comprehensive analysis, a rough estimate of the fraction of the forest that is heavily used by primates can be obtained by calculating the fraction of the forest trees that fall within one standard deviation of the dbh and inclination means of feeding trees. The results are shown in Table 1. Thus, depending on species, the monkeys do 20-100% of their feeding in the more level forest. Extrapolating from the transect to the forest as a whole, this amounts to approximate 160-800 ha. Also, almost 15-20% of the trees are of optimal size for feeding. Further research is needed to determine whether the uneven habitat quality of hilly forest prevents resident primate populations from reaching as high a density as those of forests that have larger trees or are more level. Perhaps knowledge of feeding tree sizes and inclinations should be used in writing temporary prescriptions for the management of wild primate populations when detailed information about resource use, abundance, and distribution are unavailable.

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Africa

Report of Gorillas from Nigeria

by David Harris, J. Michael Fay and Neil MacDonald

The original range of the western gorilla *(Gorilla g. gorilla)* in Nigeria was centered around the Cross River drainage close to the Cameroon border. Destruction of gorilla habitat has considerably reduced their range and numbers. Dixson (1981), in the most recently published report, stated that the species was probably extinct in this country.

In late December 1986, I conducted a brief expedition into southeastern Nigeria to the Obudu Cattle Ranch, close to the Cameroon border, specifically to determine if gorilla are still present in the country. Three local hunters from a village near the ranch were hired to find gorillas. Their descriptions of gorillas and chimpanzees were contradictory and although they were shown illustrations of both, each hunter had his own notion of ape systematics. All, however, indicated that there were two species of apes in the area, one of which was present only in the wet season.

Less than an hour's walk from the village, close to cultivated fields, recent ape trails were found. These were very obvious and quite easy to follow through the forest. Along one of these trails a fresh nest was found 2.5 m up in a tree. Close to this nest, tree saplings of a maximum of 10 cm diameter, were found broken over at a height of 2 m with the bark of the twigs completely removed. Two fresh (24-48 hours old) droppings below the nest consisted of fibrous material. The first contained one segment and the second six segments each ca. 6 cm long and 5.5 cm wide and connected by strands of fibrous material. Less than 40 m from this nest, another was found at ground level which was heavily soiled with the same type of droppings. This nest did not appear to be as recent as the first, and was perhaps a week old. Local informants reported that two days previously gorillas had been seen or heard (not clear which) in the area.

More trails and nests were later located that were probably about one week old. The highest nest found was 4 m off the ground and, without exception, at least one nest was found on the ground in each nest group. The maximum number of nests in any one group was three. None of these nests had dung in them.

Local informants claimed that not very many gorillas were killed in the area. However, they are aware of the laws prohibiting gorilla hunting and obviously have an interest in concealing the fact that they hunt gorillas. We were shown one smoke-blackened gorilla skull.

Upon inquiry at the local forestry division, three more gorilla skulls were produced. The officials said that both gorillas and chimpanzees occurred in the area and were hunted, but no recent arrests had been made.

Based on this information we conclude that gorillas still occur in Nigeria but that their status is completely unknown. An effort should be made to survey all remaining gorilla habitat in Nigeria and the appropriate conservation measures implemented to ensure their protection, especially in view of the isolation of this population from the main western lowland gorilla population in southern Cameroon, Gabon, Congo, Central African Republic, and Equatorial Guinea. In March 1987, a survey will be carried out on the Cameroon side of the Nigerian border to determine the status of the Takamanda population.

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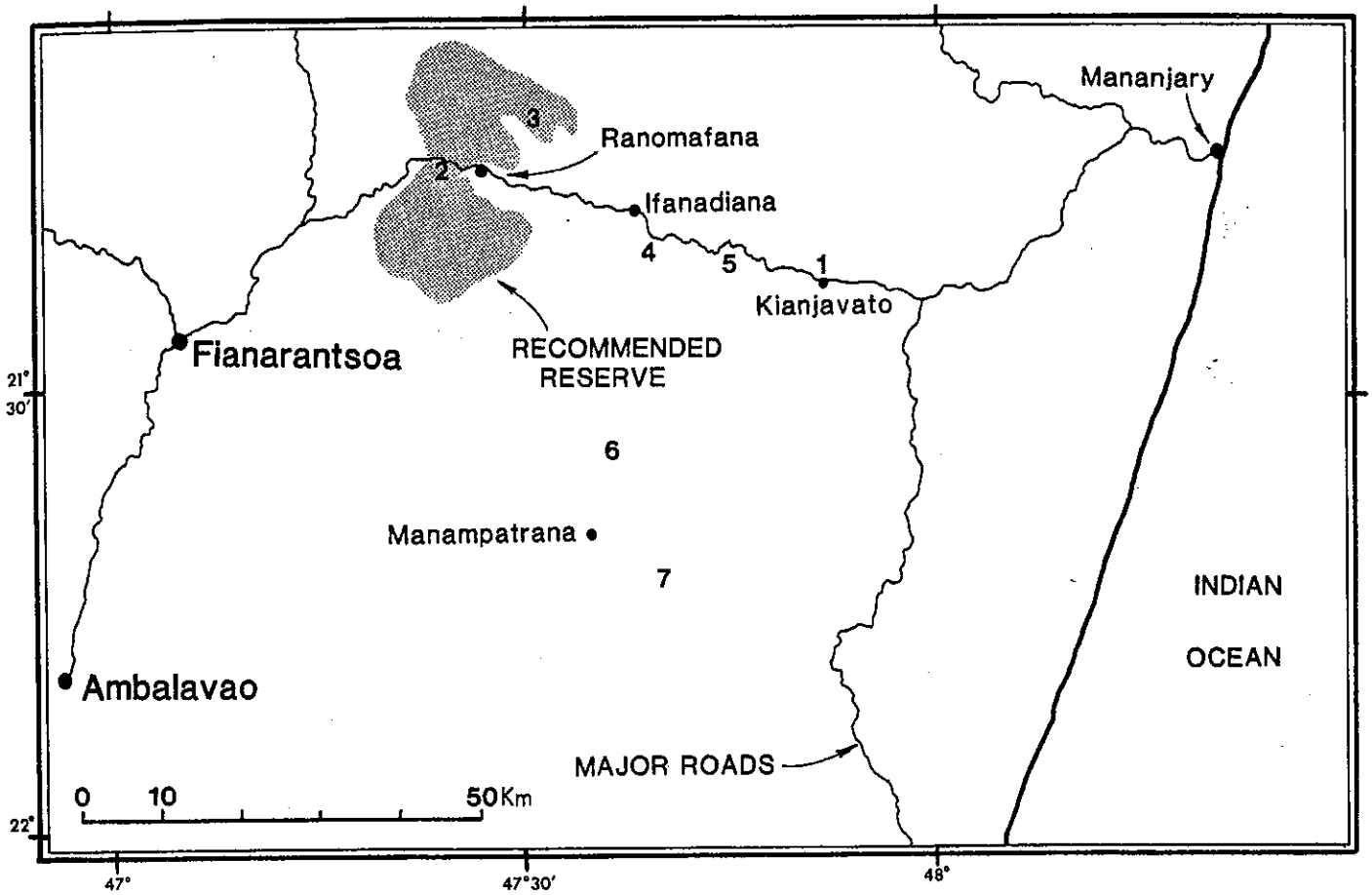
Preliminary Survey of *Hapalemur simus* and of a New Species of *Hapalemur* in Eastern Betsileo, Madagascar

by Bernhard Meier and Yves Rumpler

Although the greater bamboo lemur (*Hapalemur simus*, Fig. 1) once was widespread in northern, central and eastern Madagascar (Godfrey and Vuillaume, 1986), it is now considered to be one of Madagascar's most endangered lemur species. In the twentieth century no *H. simus* was seen until 1964, when A. Peyrieras (pers. comm.) rediscovered the species in the market of Vondrozo in southeastern Madagascar (Fig. 2). In 1972, with Petter and Albignac, Peyrieras discovered a living population in Kianjavato, 80 km east of Rianarantsoa (Petter *et al.*, 1977). Until very recently this was the only known site for *H. simus* (Tattersall, 1982; Jolly *et al.*, 1984).

Fig. 1. *Hapalemur simus* in Kianjavato (photo by B. Meier).

In 1985, C. Dague found an unusual colored bamboo lemur (Figs. 3-5) living sympatrically with *H. griseus* in Ranomafana, 45 km east-northeast of Fianarantsoa. This population of bamboo lemurs was independently studied by P. Wright (see Articles-Africa this issue) and B. Meier (in press) in 1986. Originally this form was believed to be an undescribed subspecies of *H. simus*. Subsequent observations, however, have convinced us that this form in fact represents a new species which we are calling the golden bamboo lemur and have just finished describing (Meier and Rumpler, in press). In this paper we present new findings concerning the status and distribution of *Hapalemur simus*, and of this new species of *Hapalemur*. Because both species are extremely difficult to observe, much of our data is based on the characteristic teeth marks that *Hapalemur* makes while feeding on bamboo (Fig. 5). It was not possible to distinguish between the two species of *Hapalemur* on the basis of these feeding traces.



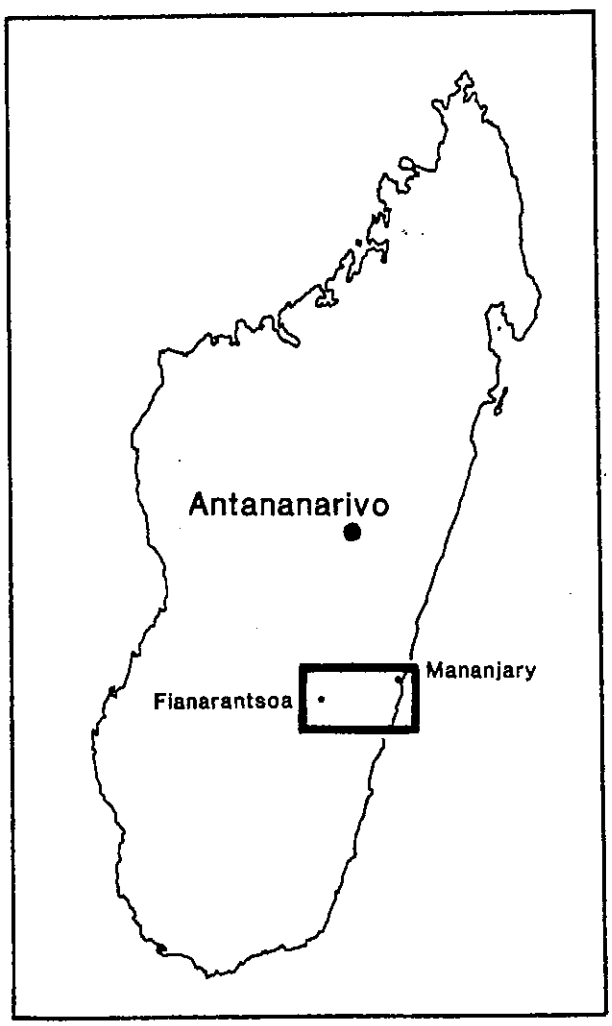


Fig. 2. A map of southeastern Madagascar showing the seven areas surveyed by the authors and the 44,225 ha area they recommend be made into Reserve Ranomafana (stippled, map by S. D. Nash).

Key: 1. Kianjavato
2. Ranomafana
3. Bevoahazo
4. Antafotenina
5. Ambongo
6. Ambatovory
7. Ambandrika=Ambohitsarabe

Kianjavato

During a one-week survey, we observed *H. simus* on nine occasions. The animals were rather shy and the maximum time we were able to follow them was 8 h 45 min. The maximum group size was seven individuals. All observations were made in an area of less than 100 ha inside or beside the agricultural research station, FOFIFA, on the slope of Sangasanga Mountain. This is an area of sacred but degraded primary forest. The animals were feeding on the culm shoots of the medium-sized bamboo, *volojatsy* (not yet identified), , leaf shoots of a bamboo creeper, flowers of *Ravenala madagascariensis*, *palbe* fruit (*Artocarpus integrifolius*, Moraceae), mango (*Mangifera indica*, Anacardiaceae), figs (*Ficus* sp., Moracae), palm fruit (*Dypsis* sp., Palmae) *longoja* leaves (*Aframomum* sp., Gingerberaceae) and *kikuju* leaves (*Pennisetum claudestinum*, Gramineae). They also raided rice crops.

This *Hapalemur* population is threatened by hunting with slingshots and bamboo cutting, as well as habitat destruction. In the last five years more than 50% of the bamboo in the research station area has been converted to rice plantations by *tavy* or slash-and-burn methods.

We found no signs of *H. simus* in the surrounding forests, including a sacred forest on Mt. Vatovavy, eight km east of Kianjavato.

More surveys are urgently needed. There is almost no forest left in this region. Perhaps other relict populations exist three km east of the village of Ambolotara, on the western slope of Mt. Ambatoloaka; close to Mt. Kirinjo, six km south of Kianjavato; and on the slopes of Mt. Androrangabe, west of Kianjavato, especially north of the village of Ankofafamalemy.

Fig. 3. A new *Hapalemur* species from the Ranomafana/Ambatolahy area (photo by B. Meier).

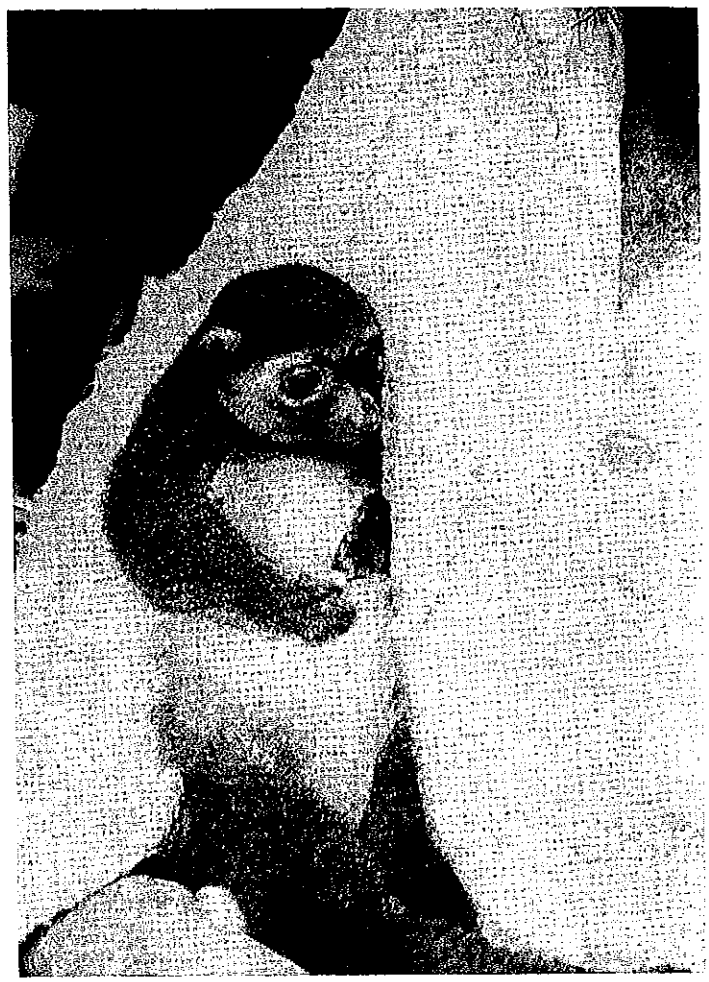


Fig. 4. More photos of the new species of *Hapalemur* by B. Meier.

Ranomafana

One group of the new species of *Hapalemur* was followed over a period of seven months in the Ranomafana forest. This group fed almost exclusively on *gramineae*, primarily the giant bamboo *volohosy* (*Chephalostachium viguieri*; Soderstrom and Wright, pers. comm.) Other groups were observed in forested areas in an endemic bamboo, *volotsangana* (not yet identified), and in another bamboo (*Bambusa sarbacum*).

It is difficult to estimate the size of this population. The forest of Ranomafana probably contains more than 10,000 ha of suitable habitat for the new species of *Hapalemur*. This habitat, however,is threatened by *tavy* at its borders and timber exploitation in its core (in October 1986, a logging road was started in the southern region of the Ranomafana forest). What appears in a 1973 map as a 60 km wide patch of forest has been reduced to a narrow stripe of 7-15 km.

Bevoahazo

The giant bamboo, *volohosy*, also occurs eight km northeast of Ranomafana, near the village of Bevoahazo. In this region we found the characteristic feeding marks of one of the bamboo lemur species, and we heard the new species of *Hapalemur* vocalizing. The area probably is threatened by *tavy*.

Antafotenina

Two to five km south of Ifanadiana existed nine *volohosy* fields, seven of which were cut for *tavy* some weeks before our visit. In a *volohosy* field of about two ha, 500 m west of the village of Antafotenia, we found several-month-old feeding traces inside an impenetrable *savoka* thicket. We found no evidence of either *Hapalemur* species in an isolated forest patch with about three ha of very dense, tall *volohosy*, two km south of Antafotenina .

South of Ifandiana, was probably an important locality for bamboo lemurs some 25 years ago. Now nearly all the bamboo and the forest is destroyed, and any *Hapalemurs* still present will probably soon be extinct.

Ambongo

Between Ifanadiana and Kianjavato, two km south of the village of Ambongo on the eastern slope of Mt. Masoarivo and on the eastern bank of Mangovoina Creek, are several large *vologatsy* fields. No *Hapalemur* were seen , but feeding marks were found. No estimate of the population size is yet possible. This area is highly endangered by *tavy*.

Ambatovory

Eight km east of the town of Tolongonina, in the triangle formed by the three villages of Mandoharanana, Ambinanitsohy and Ambohimanga,

Fig. 5. *Hapalemur* **teeth marks on a** *volojatsy* **culm shoot (photo by B. Meier).**

and on both sides of the Farony River, both bamboo species *volohosy* and *volojatsy* grow in many patches, covering altogether 30-40 ha. Four *H. simus* were seen in this area. We found evidence of *Hapalemur* feeding on both sides of the Farony River. Although almost all the forest is destroyed, *H. simus* may occur in many of the bamboo patches, especially those which are continuous with older *savoka* thickets and coffee plantations.

These animals are endangered by hunting and by habitat destruction. Because of the dense human population, protection efforts may be difficult.

Ambandrika — Ambohitsarabe

Ten km southeast of the town of Manampatrana, where the railroad from Fianarantsoa to Manakara crosses the River Ionilahy, many small patches of *volojatsy* grow on the southern slope of Mt. Ankelana. This mountain includes a privately protected forest patch of about 75 ha. No animals were seen, but feeding traces were found, and *H. simus* is well known to the local people. The bamboo lemurs are endangered by *tavy*, but it may be possible to protect the Ankelana forest patch and the attached bamboo fields, because of geography and concern on the part of local people.

We found at least three more areas where populations of greater bamboo lemurs died out in the 1980's: (1) Seven km north of Manampatrana and two km west of the village of Amboanjobe on Mt. Marosatroka, people described two species of bamboo lemurs, but we found nearly all the *volohosy* bamboo and forest destroyed by *tavy*. (2) Seventeen km south of Ifanadiana around the village of Ambalavoly, several *volojatsy* fields flowered synchronously in 1982, and all the bamboo died. Villagers burned the dry bamboo to plant crops. They described a bamboo lemur with white ear tufts. (3) Twelve km southeast of Ranomafana and two km southeast of the village Sahavoemba, a *volohosy* field flowered synchronously in 1984 and died. Parts of it were burned, in other areas we found new, very small plants. Villagers reported two different bamboo lemurs used to inhabit the area and described the feeding traces left by greater bamboo lemurs.

Local people informed us of two more bamboo fields on the topographical map "P 53 sud": (1) a *volojatsy* field, 12 km south of Ifanadiana, and three km east of the Namorona River, around the village of Ambalafasina; (2) probably a mixed-species field, 22 km south of Ifanadiana on the west bank of the Namorona River, close to the village of Mandriampontsy. Greater bamboo lemurs may be present in both these locations.

Fig. 6. A patch of *volhosy* **is burned for** *tavy* **north of the Namorona River in the Ranomafana area (photo by B. Meier).**

Conclusions

All known populations of *H. simus* and the new *Hapalemur* species are highly endangered, and without immediate help, probably will not survive the next 20 years. For some of the populations, protective measures will be extremely difficult. In all the areas we visited east of Ranomafana, shifting cultivation has been practiced for a long time. With the exception of a few sacred tomb forest patches which are probably too small for the two species' long-term survival, most of the forest has been cut down in this area. In the Ranomafana region, the destruction of forest has started recently. We suggest stopping timber exploitation in the Ranomafana area as soon as possible, banning the expansion of slash-and-burn cultivation, especially around the village of Ambatolahy, and creating a reserve (see Fig. 1). This plan will also help to guarantee a continuous water supply for the hydroelectric power plant in Ranomafana, and protection for the paddy fields downstream. Around the borders of the proposed reserve, *tavy* should be replaced with less destructive forms of agriculture. We recommend including agricultural techniques in a conservation education campaign throughout the Ranomafana area. With the help of the Malagasy people and with foreign cooperation, this area could become an important sanctuary for the two species of *Hapalemur*.

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Status of the Aye-aye in Madagascar

by Roland Albignac

In March 1986, I made an expedition to study aye-aye (*Daubentonia madagascariensis*) in northeastern Madagascar. The expedition had several objectives: (1) to capture a pair of aye-aye to study in captivity the reproduction and diet of this unusual and little-known animal, (2) to establish a new lemur center at the National Zoo at Vincennes in cooperation with the Paris Museum's Breeding Program for Endangered Species, and (3) to examine the present status of the aye-aye in the regions of Maroantsetra and Mananara, where the species seems to be best represented.

We questioned local inhabitants on the presence of aye-aye. However, we found the information provided was often scanty and sometimes false because of the taboos surrounding the aye-aye, and the belief that it is a reincarnation of the dead. To confirm the aye-aye's presence, we looked for eaten coconuts, gnawed gum trees, and nests. Aye-ayes leave distinctive marks when they open food with their continually-growing incisors. With practice, we could determine from these signs how recently and frequently the animal had passed.

We began our survey near Maroantsetra based on A. Peyrieras's earlier experience, and the sighting of an aye-aye in November 1985 by A. Visage about 30 km south of the town. After three days of surveying this area, we concluded that only a few individuals could be found in this part of the country. The fairly numerous signs of aye-aye we found were all several months old. Indications of their recent presence were rare and always rather far from villages.

The forest in this area has been cut back from the coast. One must now travel five to ten kilometers inland to find aye-aye in a forest habitat. Slash-and-burn cultivation and expanding new villages seriously threaten the future of the aye-aye.

One hundred kilometers south of Maroantsetra, in the region of Mananara, A. Peyrieras caught eight individuals in 1965-1966. Nobody has surveyed this area since, but we heard reports of recent sightings of aye-aye, including the killing of five individuals between November 1985 and March 1986. Unfortunately, older people frequently kill aye-aye because of the taboo, and younger people kill aye-aye because of the damage they do to coconut and sugar cane crops.

After four days of tracking and inspecting 14 nests in the vicinity of Mananara, we caught the first aye-aye, probably a young male. The next day, we caught a female 3 km away (Fig. 1). She had been sighted the night before feeding on coconuts in the middle of a village. The inhabitants had tried to kill her by throwing heavy sticks. We caught her sleeping in a nest in a dense clump of vegetation barely 100 m from the village, and 15 m off the ground.

During our expedition we gathered some data on aye-aye distribution and habitat destruction within their range. We began by surveying the Mananara area, and then radiated out according to reports of recent (sometimes as recent as three weeks ago) aye-aye killings. We did not locate any more aye-aye in these areas. We also surveyed 1 km^2 around each of the widely separated capture sites. We hoped to find mates, but were not successful. We conclude that aye-ayes are greatly dispersed in the coastal zone.

Fig. 1. One of the captured aye-ayes being held by the author (photo by A. Visage).

Fig. 2. A three-week-old aye-aye (photo by A. Visage).

This degree of dispersion presents two problems. 1) The chances of a male meeting a female in estrus (females are seasonally polyestrous) are small. This might explain the animal's unpredictable reproduction rate. The female we caught at the end of March had conceived late in the breeding season and was with a three-week-old infant (Fig. 2). 2) Aye-ayes are particularly vulnerable to hunting. Recolonization of areas where aye-ayes have been killed is slow, although it does occur (we found fresh signs of an aye-aye in areas where A. Peyrieras had captured aye-aye twenty years previously).

The aye-aye diet is varied and can include sugar cane and cultivated fruits such as mangos and coconut. We saw numerous signs of aye-aye in abandoned agricultural areas which suggest that aye-ayes can inhabit disturbed habitats. Aye-ayes also frequent forest which has undergone little or no degradation. These forests are often on slopes rising from the coast to a few hundred meters above sea level. Tracking aye-aye in this habitat is more difficult. We suspect that densities are lower.

The high demographic growth in this section of Madagascar and the still-prevalant tradition of *tavy* (slash-and-burn) agriculture are causing greater and greater degradation of the coastal environment. The situation is especially critical in the Maroantsetra region. The human population is now moving inland and increasing pressure on the less exploited interior.

The Malagasy Government and local Mananara authorities have suggested establishing a reserve in the region of Mananara. This area is particularly suitable for a reserve because it has high diversity and can easily be protected. It is now urgent to go ahead with this plan. Since the aye-aye appears to adapt to secondary habitats, it will not be necessary to expel the indigenous people. Cultivation could continue in a part of the protected area. A conservation education campaign with an emphasis on improved agricultural methods must also be started. Killing aye-aye must be prohibited and a program of compensation for any damage the animals do to crops begun. Limited tourism could also be encouraged to give the local people an additional income. An investigation into this multi-use reserve is now being conducted by the Malagasy authorities.

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Acknowledgements

Although this project was planned several years ago, we had to wait for the establishment of a well-managed facility capable of keeping aye-ayes, and for funding. The funding was made possible thanks to the Paris Museum, French television's Channel Five, *Figaro* magazine, and Air Madagascar. I would like especially to thank the following Malagasy authorities without whose cooperation and participation we could not have succeeded: the Ministry of Animal Production, Waters and Forests (MPAEF), Bureau of Waters and Forests; the Ministry of Scientific and Technical Research, Bureau of Research on the Environment; the Ministry of Higher Education, and the Ministry of Information and Tourism.

Asia

The *Presbytis* of Sumatra

by Anthony J. Whitten

Sumatra and its adjacent islands have an amazing variety of *Presbytis* leaf-monkeys. There are three species on the mainland, one species found only on the Mentawai Islands, and together at least 21 subspecies and other forms, of which at least one subspecies is undescribed.

Between 1982-1984, I worked at the Center for Environmental Studies at the University of North Sumatra on a UNDP/World Bank Project for environmental education and training. During the latter half of that period, I worked with staff of the center preparing a book entitled *The Ecology of Sumatra* (see *Primate Conservation* 6). This is an ecosystem-by-ecosystem look at Sumatra's natural and man-made environment intended primarily for scientists and government officials involved with environmental impact analyses, but of use also to visitors and others interested in tropical ecology. As an illustration of the variation within a single group of animals in Sumatra, I prepared a color painting of *Presbytis* (reproduced here in black and white, Fig. 2) based on museum specimens, field observations, formal descriptions, and Wilson and Wilson (1976). The nomenclature I used originally has been improved by V. Weitzel who is currently conducting doctoral research into the differentiation of *P. femoralis* from its congeners.

Figure 1 shows the present extent of evergreen lowland forests in Sumatra based on Whitmore (1984). Note that these areas include selectively logged forest, and exclude freshwater and peat swamp forests. Swamp forests are not favored leaf monkey habitats although the monkeys do occur within them, generally at low densities. Comparison of the two figures shows that certain forms, notably the white unnamed *P. melalophos* (if indeed it is a valid form) and *P. m. mitrata* in the south have had their ranges severely reduced. For *P. m. mitrata* this is largely as a result of forest clearance by a program of government sponsored transmigration for Javanese farmers and by the informal migration that follows in its wake. *P. f. catemana* would appear to live in a very small area but large areas of peat and freshwater swamp forest still exist within its range, and the western boundary may in fact lie slightly further to the west.

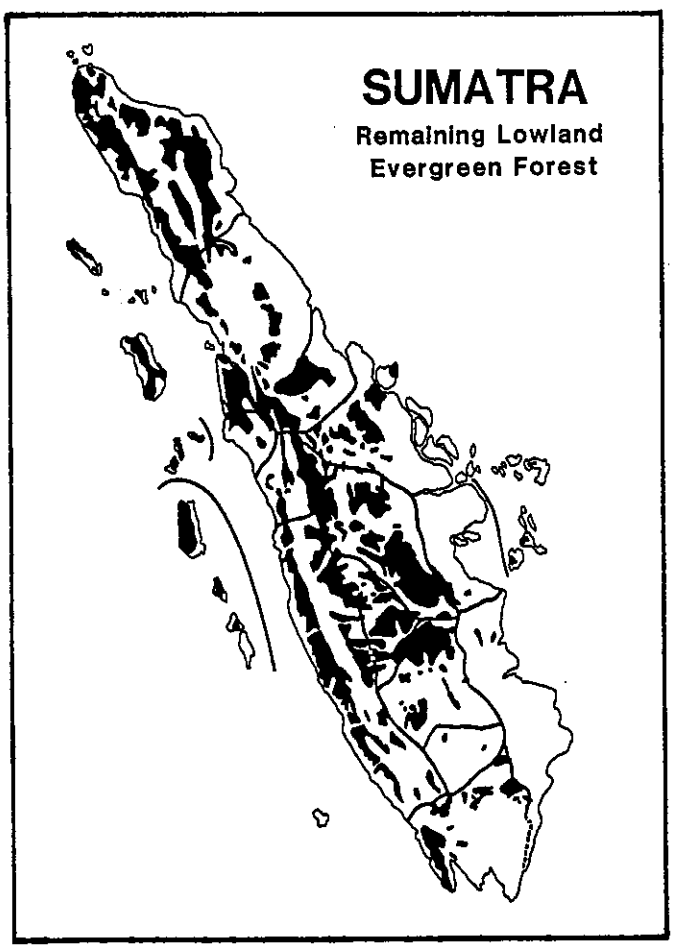

Fig. 1. A map of Sumatra showing the present extent of lowland evergreen forests (by S. D. Nash based on author's original after Whitmore, 1984).

Of the island forms, those on the east are threatened. There is little forest left on the islands of the Riau Archipelago south of Singapore as a result of mining for bauxite and tin, the recent development of a free port, and other harbor and agricultural activities. The total population of *P. f. rhionis* (and *P. f. cana?*) must be very small. The isolated Natuna Islands, which lie closer to Borneo than to Sumatra, have some forest left. Development on these islands — offshore gas production and construction of defense facilities — has had relatively little effect on the habitat of the rather attractive *P. f. natunae.* On the west coast, *P. f. batuanae* occupies small but relatively secure areas of forest, and *P. potenziani siberu* also has some (temporary?) security. The nominate subspecies, however, may soon be found only on Sipora, the middle Mentawai island, because the trees being replanted on the southern Pagai Islands are mainly exotic species.

The other forms are in no immediate danger and all are able to exploit resources in plantations and orchards, and along roads if allowed by people.

A year's study of Sumatran *Presbytis* would be extremely rewarding. The ease of travelling on the main island and to the outer islands has improved enormously since the Wilsons' survey of 1972. High priorities are recording calls of the various forms to clarify the validity and identification of the *melalophos/femoralis* forms (Wilson and Wilson, 1974); surveying the boundary areas to see if hybridization occurs and to what extent if any the colors and patterns of the various forms are clinal; surveying the swamp areas to determine their importance for the conservation of the subspecies; and surveying the eastern islands to see if some of the subspecies are already endangered.

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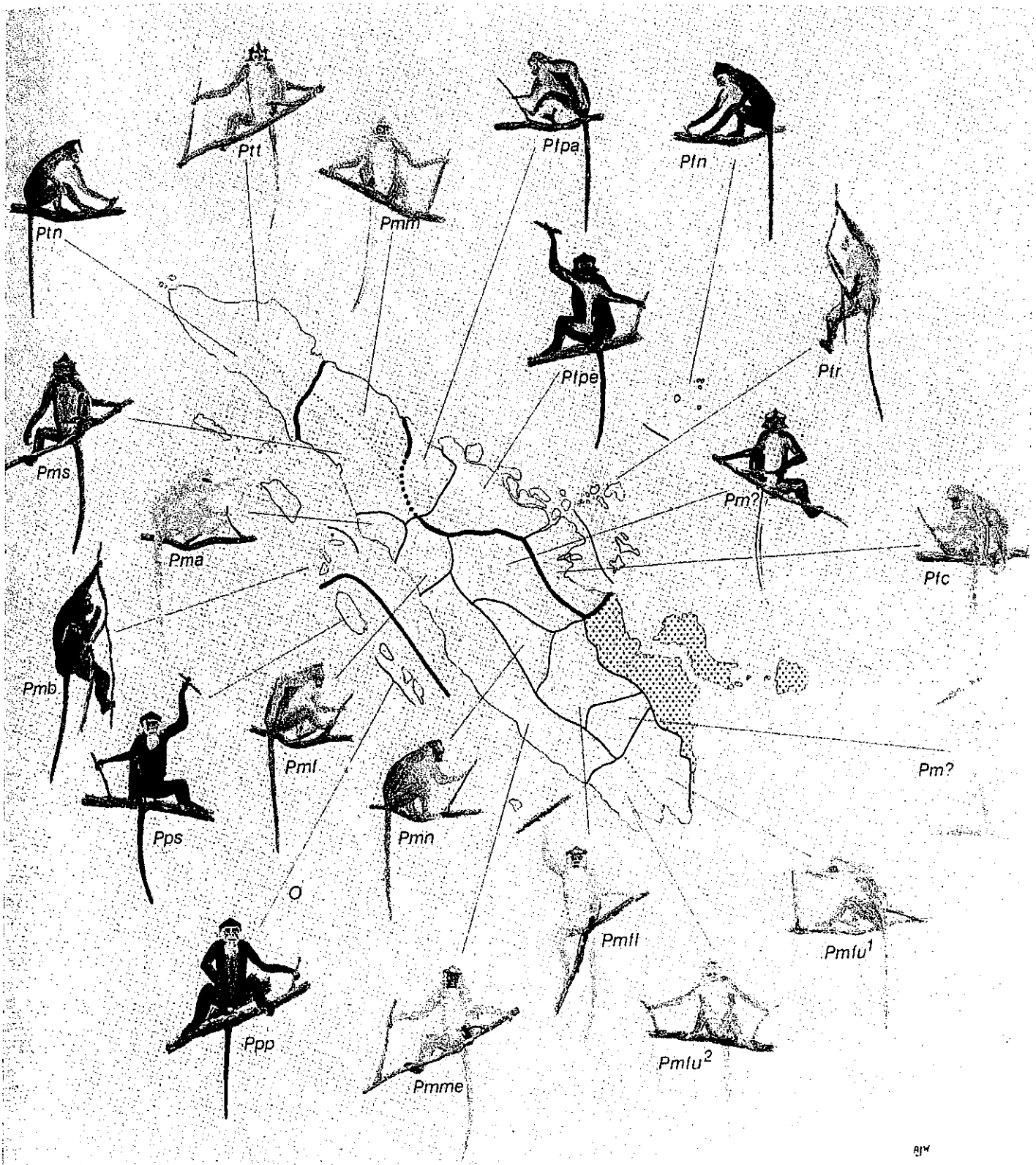

Fig. 2. Black and white version of a color illustration by the author showing the diversity of Sumatra's leaf monkeys. Clockwise from the top left: *Presbytis thomasi nubilis* Miller, 1942; *P. t. thomasi* (Collet, 1892); *P. femoralis maragae* Hooijer, 1948; *P. f. paenulata* (Chasen, 1940); *P. f. percura* Lyon, 1908; *P. f. natunae* (Thos. and Hartert, 1894); *P. f. rhionis* Miller, 1903; *P. melalophos* ssp. black and white; *P. femoralis catemana* Miller, 1908; *P. melalophos* ssp. white; *P. m. mitrata* Eschscholtz, 1821; same; *P. m. fluviatilis* (Chasen, 1940); *P. m. melalophos* (Raffles, 1821); *P. m. nobilis* (Gray, 1842); *P. potenziani potenziani* (Bonaparte, 1856); *P. melalophos flavimanus* (Geoffroy, 1831); *P. potenziani siberu* (Chasen and Kloss, 1927); *P. femoralis batuanae* Miller, 1903; *P. melalophos* var. *aurata* (Mul. and Sch., 1844); *P. femoralis sumatrana* (Mul. and Sch., 1844). *P. f. cana* Miller, 1906 from Pulau Kundur is not included because its distinctiveness from *rhionis* seems dubious. The stippled area is not occupied by any *Presbytis*.

Habitat and Population Changes for the Kowloon Macaques

by Charles H. Southwick and David Manry

Polyspecific groups of macaques (*Macaca mulatta, Macaca fascicularis,* and *Macaca fuscata*) inhabit the Kowloon Reservoir area of the Hong Kong New Territories. These groups have experienced many ecological changes since they were first studied in 1980 and 1981. On a recent visit in January and February 1987, we observed pronounced environmental changes in their home range area, and also a number of changes in the monkey population.

First of all, the area is subject to increasing human disturbance and decreasing monkey habitat. A large, high-voltage power line has been constructed through the area resulting in the loss of considerable forest (Fig. 1). An equipment and supply depot associated with this power line has also been built on previously forested land.

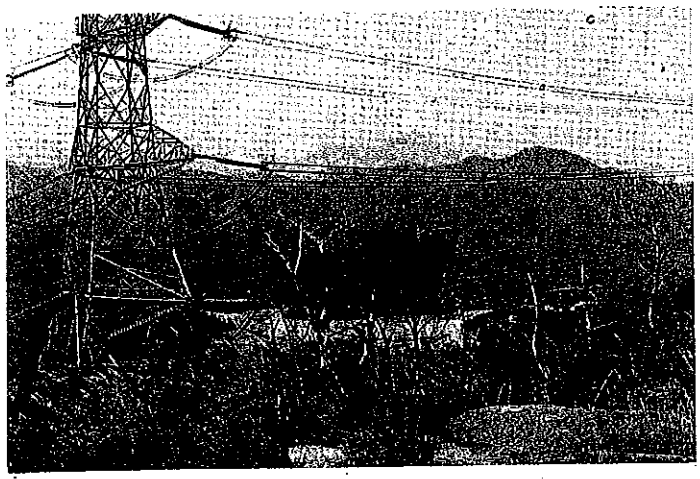

Fig. 1. Power line through the home range of the Kowloon macaques. Also shown is tree mortality from fungal disease (photo by C. H. Southwick).

Secondly, the footpath to picnic areas near the reservoir lakes has been widened and paved to accommodate automobiles, and the picinc areas have been expanded. Despite warning signs (Fig. 2), people feed the monkeys and the monkeys have learned to drink from cans and bottles. There has been a great increase in picnic litter and trash, since the monkeys are often given the remnants of packaged food stuffs and beverages. Many more people now visit and the area is no longer a quiet forest and parkland.

The traffic on Taipo Road has increased from light traffic to a constant line of cars, buses and trucks. This has added pollution to the area and created a much higher degree of disturbance.

Another change is the construction of several new high-rise apartments at the edge of former monkey home ranges bordering the forest.

The forest itself is also changing as pine trees die due to an infectious disease and are replaced by woody shrubs and grasses. In some cases, more desirable broadleaf trees may eventually regenerate, so this change could eventually favor the monkeys.

For the time being, however, all of these changes have resulted in considerable habitat loss for the Kowloon macaques, and a marked increase in human contact.

The rhesus monkeys (*M. mulatta*) seem to be responding to these new conditions with characteristic adaptability, and are doing fairly well. Although fewer monkeys were seen this time (only two groups, instead of three as in 1980 and 1981, and a total of only 72 individuals instead of 113), the Forest Department, and officials in the Department of Agriculture and Fisheries believe the population has actually increased. F. Burton has also confirmed a population increase of monkeys around the Kowloon Reservoir and Taipo Road area. Theoretically this could be due to the monkeys' increased attraction to the picnic areas and the food vendors near Taipo Road. The interaction of monkeys and people is certainly much more frequent and intense now than in 1980.

In any case, only two groups were seen on three separate visits from January 10 to February 3, 1987, with the compositions shown in Table 1.

Table 1. Observed Macaques at Kowloon Reservoir Area, New Territories, Hong Kong, Jan-Feb. 1987

	Adult Males	Adult Females	Infants	Juveniles	Total
Group 1 — Kam Shan Entrance					
M. mulatta	6	13	7	17	43
M. fascicularis		1		1	2
M. m x M. f. hybrid				1	1
Group 2 — Eagle's Nest Trail					
M. mulatta	3	7	4	8	22
M. fascicularis	1			2	3
M. m x M. f. hybrid				1	1

Fig. 2. People feeding the rhesus beside signs which read: "Do not feed or agitate the monkeys — They may attack you and transmit infectious diseases" (photo by C. H. Southwick).

As stated previously, the rhesus are doing fairly well in age structure (55% immatures among the total rhesus observed suggesting population maintenance), but the *M. fascicularis* and *M. mulatta* x *M. fascicularis* hybrids are not holding their own. The *M. fascicularis* have declined from 26% to 7% of the total monkeys seen. The observed *M. mulatta* x *M. fascicularis* hybrids declined from 13% to only 3% of the

total monkeys seen, and no Japanese macaques (*M. fuscata*) were seen on this most recent visit, whereas 5 were present in 1981. These were thought to be *Macaca thibetana* by Burton.

These population changes would fit theoretical expectations for a polyspecific population under ecological pressure. This area is within the natural range of the rhesus, whereas it is outside the normal range of both *M. fascicularis* and *M. fuscata*. It is likely that the winters are too cold for *fascicularis* and the summers too hot for *fuscata* or *thibetana*. In contrast, climatic conditions are ideal for rhesus monkeys, and they are also able to respond more favorably to the increasing human disturbance. Since natural rhesus populations occur on neighboring islands in the Pearl River Delta, on Hainan Island, and in the adjacent province of Guandong, Tan (1985) considers the Kowloon rhesus to be a natural population remnant, and the other species introduced.

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We wish to acknowledge discussion of these problems with M.K. Cheung, of the Department of Agriculture and Fisheries, Government of Hong Kong, and with Dr. F. Burton, University of Toronto, who conducted an Earthwatch group to this area in 1986.

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Field Report on the Hainan Gibbon

by Liu Zhenhe, Jiang Haisheng, Zhang Yongzu, Liu Yanhua, Chou Tigon, David Manry and Charles Southwick

Gibbons are rare in China and limited to the southern provinces, primarily Yunnan, the island of Hainan in Guandong Province (Fig. 1), and possibly in Guangxi southwest of Nanning, though their presence in the latter province has not been confirmed for many years. Those few gibbons which remain in China are the remnants of formerly wide and probably abundant populations many centuries ago (Van Gulik, 1967).

Three species of gibbon still remain in China in small, scattered populations. *Hylobates concolor*, the black-crested gibbon or white-cheeked gibbon, is known to exist in central and southern Yunnan and has been recently studied by Haimoff (1986) and Haimoff *et al.* (1986). A distinct subspecies, *H. concolor hainanus*, remains as a very small endangered population on Hainan Island. The two other gibbon species apparently still present in remote areas of Yunnan are *H. hoolock*, the white-crested gibbon, in western Yunnan; and *H. lar*, the white-handed gibbon, in southwestern Yunnan near the Burmese border (Tan, 1985).

The Hainan gibbon was on the very edge of extinction in 1978, when only seven or eight individuals were known to be alive in the mountains of west-central Hainan. This was a shocking change from an estimated population of 2,000 only 30 years earlier (Wang and Quan, 1986).

In the late 1970's, the senior author worked hard to establish the Bawanglin Nature Reserve, primarily for the protection of the Hainan gibbon. Earlier this area had an estimated 200 gibbons, but by 1978, only seven or eight individuals remained. The loss was a result of hunting and deforestation around the lower slopes of the mountains. The Bawanglin Reserve was established in 1980 to protect 13 km² of mature

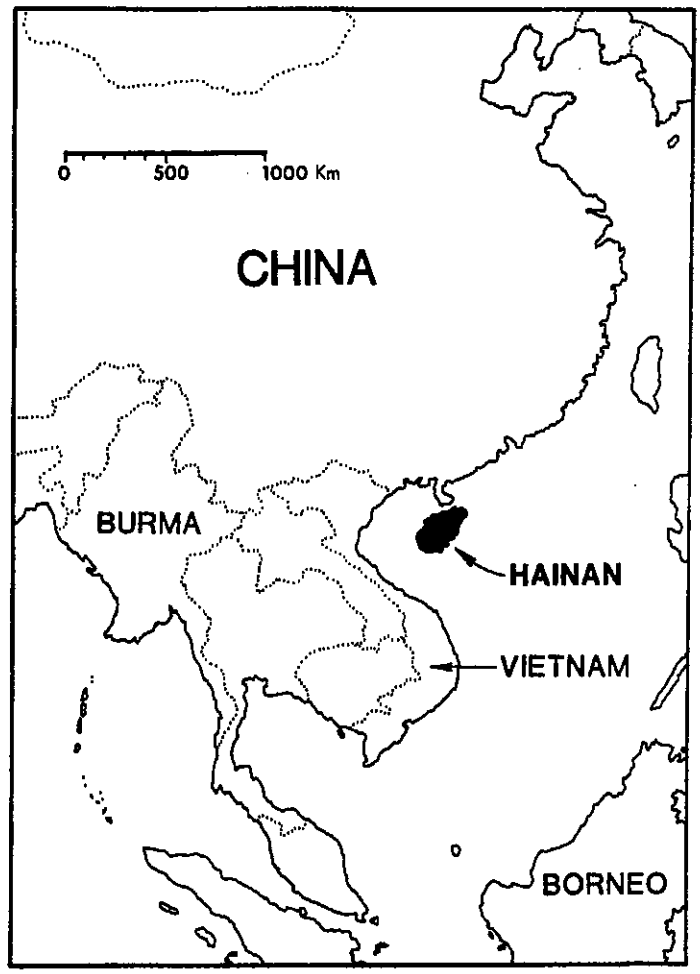

Fig. 1. The island of Hainan off the southern coast of China (map by S. D. Nash).

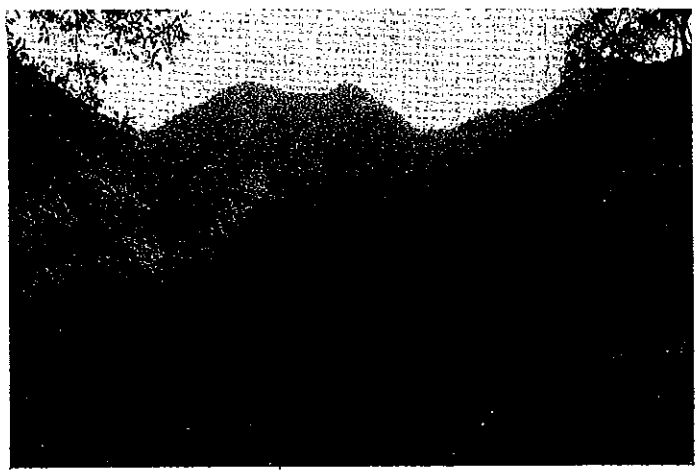

Fig. 2. Forest habitat in the Bawanglin Nature Reserve, Hainan Island, elevation 1,500 to 1,800 m (photo by C.H. Southwick).

subtropical forests on a rugged mountainous topography with elevations from approximately 800 to over 1,600 m (Fig. 2). A field station was established in the reserve in 1985.

We visited the Bawanglin Reserve in January 1987, and heard at least two, possibly three, gibbon groups. The vocalizations of the Hainan gibbon are hauntingly beautiful — a long, clear ascending whistle by the male, often accompanied by a duetting trill by the female. These vocalizations have been analyzed in captive specimens by Haimoff (1984). In the montane forests of Hainan they are an unforgettable experience. Even at an estimated auditory range of only 200 m, we were not successful

in seeing these groups, although both males and females vocalized for two periods from 7:05–7:15 and from 9:05–9:15 on one morning. The gibbons are very shy, usually becoming silent and retreating upon the approach of people. Furthermore the terrain is so steep in many places that movement on the ground is difficult, and the canopy is often dense with sufficient intermediate foliage to make observations difficult. Despite these field problems, the senior author has studied the Bawanglin gibbons on many occasions in the past ten years (Liu, 1981, 1984) and has precise census counts.

Fortunately, the population has rebounded since its near extinction in the late 1970's and now consists of 22 individuals in four groups. The four groups range in size from 4–7 individuals per group with the approximate composition shown in Table 1.

Table 1. Total Known Population of the Hainan Gibbon in the Wild, January 1987

Group	Adult Males	Adult Females	Young	Total
1	1	2	4	7
2	1	2	3	6
3	1	2	2	5
4	1	1	2	4

Three groups have the unusual composition of one adult male and two adult females, a social structure previously reported by Haimoff (1986). Also the presence of four young in the largest group is a very unusual situation for gibbons. Again this has been reported by Haimoff from Yunnan Province. These groups may represent a natural social structure for *H. concolor*, or they may conceivably be a result of limited habitat and crowding, with insufficient space for new territories, encouraging individuals to remain in their natal groups. Our observations suggest, however, that there is sufficient habitat at Bawanglin for new groups.

Although the recovery of the Hainan gibbon is encouraging, the population is still in a precarious situation. The total breeding population consists of only four adult males and seven adult females. All the others are subadults. Two infants were born in 1986, the last in November.

The senior author is optimistic about the future of this population, since it has increased steadily since 1978. Due to the very low population from which it recovered, the increase has averaged 13.5% per year in the past nine years. We are recommending to officials of the Forestry Department that the protected area of Bawanglin Nature Reserve be doubled from 13 to 26 km², and that the utmost efforts be made to protect this valuable gibbon population from illegal hunting.

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NEWS FROM CAPTIVITY

Update on the Primate Colony at the Duke University Primate Center

by Elwyn Simons

The Duke University Primate Center (DUPC) has the world's largest captive colony of prosimians, including 31 different taxa representing 12 genera. The greatest emphasis is placed on Malagasy lemurs, but several African and Asian species are included as well. As of April 20, 1987, the DUPC housed the following animals.

Species		# of animals at DUPC
Lemur fulvus fulvus	Brown lemur	18
Lemur fulvus albifrons	White-fronted lemur	18
Lemur fulvus collaris	Collared lemur	22
Lemur fulvus rufus	Red-fronted lemur	20
Lemur fulvus sanfordi	Sanford's lemur	14
Lemur macaco macaco	Black lemur	29
Lemur macaco flavifrons	Sclater's lemur	5
Lemur catta	Ring-tailed lemur	50
Lemur rubriventer	Red-bellied lemur	5
Lemur mongoz	Mongoose lemur	27
Lemur coronatus	Crowned lemur	12
Varecia variegata variegata	Black-and-white ruffed lemur	35
Varecia variegata rubra	Red ruffed lemur	41
Hapalemur griseus	Bamboo lemur	13
Propithecus verreauxi	Sifaka	11
Cheirogaleus major	Greater dwarf lemur	5
Cheirogaleus medius	Fat-tailed dwarf lemur	78
Mirza coquereli	Greater mouse lemur	32
Microcebus murinus	Lesser mouse lemur	70
	Total # of Lemuriformes	**505**
Perodicticus potto	Potto	4
Nycticebus pygmaeus	Pygmy slow loris	9
Nycticebus coucang	Slow loris	20
Loris tardigradus	Slender loris	17
Galago demidovii	Demidoff's bushbaby	6
Galago senegalensis moholi	Lesser bushbaby	52
Galago garnettii	Brown bushbaby	30
Galago crassicaudatus crassicaudatus	Thick-tailed bushbaby	5
Galago crassicaudatus monteirii	Thick-tailed bushbaby	61
Galago crassicaudatus argentatus	Thick-tailed bushbaby	18
	Total # of Lorisiformes	**222**
Tarsius syrichta	Philippine tarsier	14
Tarsius bancanus	Bornean tarsier	2
	Total # of Tarsiiformes	**16**

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Fig. 1. A male Philippine or Mindanao tarsier, *Tarsius syrichta* (photo by D. Haring).

Tarsiers: A Conservation Perspective

by Patricia C. Wright, David Haring, Elwyn L. Simons, and Patrick Andau

Tarsiers are small (100-150 g), nocturnal primates with enormous eyes, long legs for leaping, and a diet unique among primates consisting of only live animal prey. Although 40-50 million years ago tarsier-like primates were abundant in North America and Europe, today tarsiers only survive as relict populations on several Asian islands. There are four species: the western, Horsfield's or Bornean tarsier, *Tarsius bancanus* (see front cover), which is distributed across Borneo and on the most eastern tip of Sumatra; the Philippine or Mindanao tarsier *Tarsius syrichta* (Fig. 1), which occurs on the large southern Philippine island of Mindanao and on the smaller islands of Bohol, Leyte and Samar (just north of Mindanao); the spectral tarsier, *Tarsius spectrum*, restricted to the island of Sulawesi; and a dwarf species, *Tarsius pumilis*, found only in mountainous cloud forest on Sulawesi. *T. bancanus* and *T. spectrum* are found primarily in second-growth forest and are not currently in danger of extinction. However, *T. syrichta* is already listed as threatened, and due to heavy deforestation and increasing agriculture in its natural habitat, this species is rapidly becoming rarer. *T. pumilis* is known

only from a few museum specimens and was only recently given separate species status (Musser and Dagosto, 1987). It has never been studied in the wild and censuses in its natural habitat are needed to determine whether it still exists, and if so, the extent of its current range.

Status of Captive Populations

Although tarsiers have been kept in captivity for more than half a century, it has been with very limited success. For example, in 1948 Wharton brought 30 *T. syrichta* to the U.S. of which only one survived more than a few years. This survivor lived alone in the Philadelphia Zoo for 12 years until it died during a winter storm when the heat went off (Ulmer, 1963). Until recently no tarsiers have been in the U.S.A.

In 1983 as part of an NSF grant awarded to E. Simons, Director of the Duke University Primate Center (DUPC), P. Wright traveled to Sandakan, Sabah, to capture 12 tarsiers. With the help of the Game Department under the direction of Patrick Andau, all 12 animals were mist-netted within a month. These *Tarsius bancanus* were caught in adult male-female pairs and all females were pregnant (Table 1). No infants or juveniles were captured or seen. Their apparent breeding seasonality may be an artifact of an unprecedented nine-month drought on Borneo the preceding January–August. Previous studies indicate that births can occur in all months of the year (Hubrecht, 1902), but this species may have a seasonal birth peak (Niemitz, 1979; 1984).

Table 1. *Tarsius bancanus* wild-caught in Sabah in 1983 by P.Wright and P. Andau

Capture date	Sex	Weight (g)	Location	Reproduction condition
Oct. 11	F	126	Lungmanis	3 months pregnant
Oct. 11	M	116	Lungmanis	–
Oct. 16	F	124	Gum-gum-A	2 months pregnant
Oct. 16	M	126	Gum-gum-A	–
Oct. 25	F	140	Sukau	2 months pregnant
Oct. 26	M	136	Sukau	–
Oct. 30	F	125	Gum-gum-B	1 month pregnant
Nov. 6	M	128	Gum-gum-B	–
Nov. 3	M	134	Gum-gum-C	–
Nov. 3	F	132	Gum-gum-C	2 months pregnant
Nov. 7	M	126	Gum-gum-D	–
Nov. 8	F	138	Gum-gum-D	4 months pregnant

Comment: In contrast to *T. syrichta* where males weigh 10-30g more than cycling females, these data give no indication of sexual dimorphism in body weight. Adult male-female pairs were often caught in the same mist net within an hour. Five to ten mistnets were monitored in the same site for several days in an attempt to catch additional tarsiers, but each location yielded only the pair.

Fig. 2. A three-week-old female *Tarsius syrichta*, "Mandarin", born at the DUPC on January 29, 1987 (photos by D. Haring).

The 12 tarsiers travelled as hand luggage with P. Wright who fed them grasshoppers and water during the flight. Six animals were given to the National Zoo and the other six were taken to the DUPC. In captivity, pairs caught together were maintained as pairs.

As part of the same NSF project, P. Wright surveyed the Philippine island of Bohol for *Tarsius syrichta* in 1985, and obtained and transported 20 *T. syrichta* to the DUPC. All animals arrived alive and well at their destination. Since that time, other *T. syrichta* have been imported to the U.S.A. The Lincoln Park Zoo in Chicago presently has five, and the Cincinnati Zoo has eight (ISIS report, Dec. 1986).

Two *T. bancanus* infants were born at the DUPC, but one survived only three days (birthweight, 26.0 grams) and the other was stillborn at 28.5 grams. Four captive-bred *T. bancanus* infants were born at the National Zoo of which two survived. The Cincinnati Zoo has had two *T. syrichta* recently born, and the Lincoln Park Zoo has had one infant born at the zoo which was conceived in the Philippines. Duke has had one captive tarsier born and bred which is now being hand-reared (birthweight, 20 g; Fig. 1), and a second full-term infant which was stillborn (birthweight 31.5 g).

Husbandry

The DUPC is the only institution that maintains colonies of two species of tarsier - *T. bancanus* and *T. syrichta*. The tarsiers are housed in rooms measuring approximately 2 x 2 x 3 m, and containing a variety of bamboo and vine substrates of varying dimensions and angles. The animals are on a 12:12 light cycle with lights going out at 11:30 a.m. allowing time for cleaning rooms in the morning, and feeding and observations in the afternoon. White light is provided by Duro-lite flourescent bulbs. Incandescent red light bulbs provide sufficient illumination for night time behavioral observations. All *T. bancanus* are kept in male-female pairs; *T. syrichta* are kept in pairs, or groups of two females and one male, or three females and one male. Each tarsier room is maintained at a temperature of 28°-31° C with relative humidity levels of 80% optimal. Low humidity causes problems with tarsiers; their tails become rough and sore, and their hands and feet scaly. Each room contains at least one water bowl, and is sprayed with a misting hose 3-4 times a day. The animals lick water droplets from the poles after the rooms are sprayed and rub their forehands or entire bodies on wet branches. The DUPC purchases thousands of crickets and 200 anole lizards (*Anolis carolinensis*) each month. Lizards are relished primarily by *T. syrichta*, although occasionally *T. bancanus* will eat them. Bowls of mealworms are also periodically offered, but only a few individual tarsiers eat mealworms. During the summer, tarsiers are given grasshoppers, dragonflies, cicadas, praying mantis, and scarabid beetles. Due to availability, however, these "wild-caught" insects only play a limited role in captive tarsier diets.

Crickets are bought from a local dealer twice a week and stored in a large bin where they are fed apples, crushed high-protein Purina monkey chow, Zeigler Brothers' cricket diet, and fresh water. Since crickets are deficient in calcium, it is important that the diet of the crickets is supplemented to keep the tarsiers healthy. Live crickets are placed in the tarsier rooms three times a day. Each tarsier pair receives approximately 12 oz of crickets per feeding. Cups holding crickets are tipped against a vine so that the crickets will crawl out and onto the vines where they can be caught by the tarsiers. Crickets often congregate on the ground but *T. bancanus* will not forage on the floor (see also Roberts and Cunningham, 1986), and *T. syrichta* will do so only to retrieve a highly desirable prey item like a praying mantis.

Tarsiers at the DUPC are caught for routine examination and weighed four times a year. The animals spend the majority of their active periods sleeping and sitting motionless. The greatest level of activity occurs immediately after the white lights go out and "night time" begins. During the rest of the night, they feed and travel for 20 minute periods at roughly three hour intervals. It is important, therefore, that the caretaker monitor each individual for foraging success at the beginning of the evening to spot animals that are not doing well. During the resting phase of the tarsier day, a sick tarsier may appear normal. A sick tarsier should be placed immediately in a small cage where it has easy access to insects. If illness is not detected at an early stage, a tarsier's health will usually rapidly decline in an unattended large cage.

It is important to have some substrates with rough surfaces in the rooms (such as grapevines, branches), for crickets will not climb on smooth substrates such as stalks of bamboo. Tarsiers do not seem to recognize large masses of insects as prey, but typically seize and eat a solitary insect moving along a branch. Both insects and lizards can be stimulated to move along branches by spraying water.

Behavior

There are clear differences between *T. bancanus* and *T. syrichta* in their activity patterns and use of substrates. *T. syrichta* is in general more active than *T. bancanus* at the DUPC. After waking, *T. bancanus* is slow to begin hunting. *T. syrichta*, on the other hand, almost always begins foraging for crickets immediately after the lights go out. Individual *T. syrichta* seem far more curious of their surroundings and, if allowed, will hop from room to room exploring areas. *T. bancanus* do not explore from room to room.

T. syrichta and *T. bancanus* in captivity also display different sleeping and resting site preferences. *T. bancanus* always choose the tops of vertical poles for sleeping. *T. syrichta*, on the other hand, often sleep on horizontal poles, stumps, shelves and even the ground. If a *T. bancanus* were to be discovered sleeping on the ground in the morning, it could mean that the animal was deathly ill and unable to cling to a vine. A *T. syrichta* sleeping on the ground (most likely hiding behind some object) would be a normal occurrence. During resting periods at night, *T. bancanus* choose vertical or near vertical poles and use their tails as props, while *T. syrichta* will sit on shelves or horizontal vines with their tails dangling down. Differences in captive behavior suggest differences in habitat use and behavior of the animals in the wild. Frequencies of scent marking and calling are much higher in *T. syrichta* than in *T. bancanus* and may indicate differences in their social systems. (Haring *et al.*, 1985).

Research

We determined at DUPC that the gestation length of tarsiers is 180 days (Izard *et al.*, 1985), an extremely long period for an animal that weighs only 125 g. The infants weigh 20-31.5 g at birth (20-25% of the mother's weight), and are fully furred and with erupted teeth. The mother carries the infant in her mouth by the nape of the neck to park it on branches for 20-30 minute intervals while she forages for food. The infant can cling to branches at birth and eagerly looks around at its environment. During nursing, and for 30-60 minute intervals, the mother holds the infant to her ventrum. M. Roberts of the National Zoological Park has determined that *T. bancanus* infants begin to catch prey items at 42 days of age, and are weaned shortly after that. A hand-reared *Tarsius syrichta* with a birth weight of 20 g reached 38.5 g at five weeks of age, and took his first leap at 25 days of age. The infant was raised on esbilac, a formulated dog milk.

At the DUPC, it has been documented that female tarsiers do not menstruate and have estrous cycles at 24 day intervals all year round until impregnated (Wright *et al.* 1986a). Copulations occur only once or twice a night during estrus and are preceded by a one or two hour courtship when males actively call and scentmark (Wright *et al.*, 1986b).

Tarsiers have a low metabolic rate, 65% lower than the expected rate for mammals (McNab and Wright, in press). Tarsiers are sit-and-wait predators, locating moving prey visually before approaching and pouncing. After a large insect or lizard is eaten, tarsiers rest for several hours. Ten to twelve grams of prey are consumed a day. The volume of food consumed nearly doubles when females are pregnant (Izard *et al.*, 1986).

Tarsiers, unlike other prosimians, seem not to synthesize vitamin C in large quantities (Pollock and Mullin, in press). Monkeys, apes and

man also do not manufacture any vitamin C, but obtain it from vegetation. The carnivorous tarsier may obtain this vitamin directly from folivorous insects.

Tarsiers communicate with high-pitched chirps. Loud call structure varies among species and their function may also differ. Male-female pairs of *Tarsius spectrum* have been reported to duet on Sulawesi (MacKinnon and MacKinnon, 1981). However, duetting has not been described in *T. bancanus* (Niemitz, 1986) nor *T. syrichta* (Wright and Simons, 1984), nor has it been observed at the DUPC in either species. *T. syrichta* calls have harmonics in ultrasound (Wright and Simons, 1984).

Conclusion

Several conservation priorities can be suggested for tarsiers. Since neither *T. bancanus* nor *T. spectrum* appear to be endangered or threatened at present, conservation efforts should concentrate on the other two species first.

1) A survey of Sulawesi cloud forests is recommended to determine whether and where *T. pumilis* still exists. If this species is found, a study of population densities, diet, home range size, etc., should be done to determine its conservation status and to specify an appropriate conservation action plan in its behalf.
2) A first study of *T. syrichta* in the wild is needed to give baseline information on the diet, home range size, and social system of this threatened species. A survey of Bohol, Samar, Leyte and Mindanao would give up-to-date estimates of population densities and of the general status of this species.
3) The maintenance of breeding colonies of *T. syrichta* in captivity should be encouraged. In general, the captive breeding record is not impressive; after fifty years of *T. syrichta* being born in captivity, only a single offspring at the Frankfurt Zoo has survived to maturity. Some suggestions for improved offspring survival of this species include (a) allowing natural sunlight to reach the cage, (b) installation of nest boxes and open nests for infant protection in the first two weeks, and (c) pregnancy watches to monitor and assist with possible birthing problems. With these improvements and observant caretaking, we can hope that captive breeding colonies will soon be more successful in rearing tarsiers. A healthy population of *T. syrichta* in captivity would be an excellent second line of defense against their possible extinction in the wild.

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Sclater's Black Lemur Born in Captivity

by Bernard Brun and Yves Rumpler

The recently rediscovered Sclater's black lemur, *Lemur macaco flavifrons* (Koenders *et al.*, 1985), has a very restricted distribution and is now threatened by deforestation. Because of its endangered status, we established two pairs in the Lemur Conservation Center of the Strasbourg University in order to start a conservation-oriented captive breeding program.

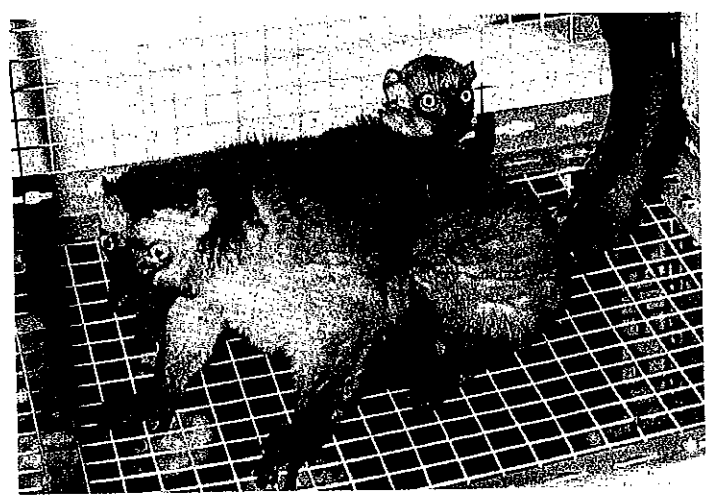

Fig. 1. A female *Lemur macaco flavifrons* with her young (photo provided by the authors).

These two pairs are housed in separate cages, 2x3x3, and richly furnished with branches. The animals are fed similarly to the other lemurs at the center (Koenders *et al.*, 1985): in the morning, fruits (bananas, apples, pears), and greens or carrots; in the afternoon, stale bread, and pellets of monkey food; twice a week, vitamin-enriched water. The temperature is maintained near 20° C and the humidity is kept high.

In these conditions, the animals have inverted their reproductive cycle and adapted to the northern hemisphere. They mated, and both females gave birth to single females on the 15 and 16 April 1986. One infant died 40 days later; the autopsy did not show any abnormality. The second infant is growing well (Fig. 1). On 31 March 1987, a third female was born.

After our initial breeding success of this rare species, one other pair was captured in 1986 and transported to the Lemur Conservation Center. This third pair was sent to the Mulhouse Zoo as part of a cooperative program between Strasbourg University and this zoo. We now have six adult animals and two young females. We hope that after a few years of breeding, these animals will form a captive colony as has been successfully achieved with other species of lemur such as *L. m. macaco*, *Lemur fulvus*, and *Varecia variegata*.

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Recent Advances in Drill Research and Conservation

by Michael Böer

Captive studies on a regularly reproducing drill (*Mandrillus leucophaeus*) family at the Hannover Zoo, and information from other drill-keeping institutions, have provided useful new data about the reproductive physiology and captive status of this highly endangered and sparsely investigated forest baboon (Boër, in press).

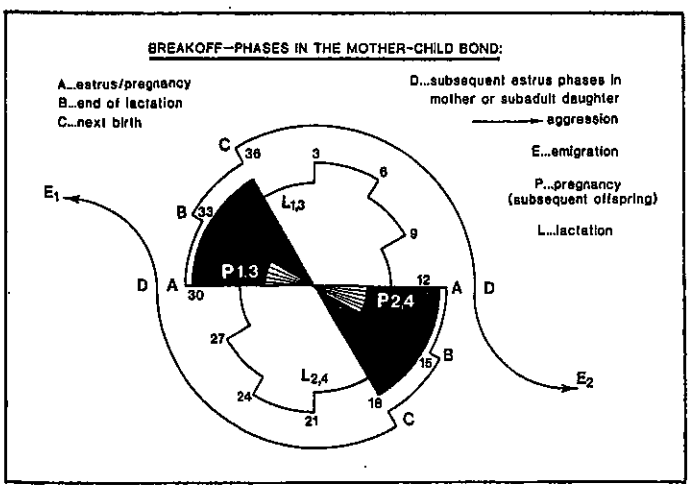

Fig. 1. A 36-month model of reproductivity in female drills (diagram by S. D. Nash based on author's original).

Fig. 2. A drill female with a six week old infant (photo by G. Dierssen).

A hypothetical model of reproduction in female drills (Fig. 1) has been made based on behavioral and reproductive data from the Hannover Zoo. This model shows that physiological factors might be responsible for certain mother-offspring interactions which result in a typical set of family social dynamics.

Females reach sexual maturity at around three years of age, and after a pregnancy of 179-182 days, may give birth to their first offspring at the age of 36 months. The infants are born with a distinctive light face (Fig. 2), which darkens into the adult black face mask at age eight months. Infants are weaned at 15-16 months, and the typical interbirth-interval lasts between 17-19 months. In well-managed captive conditions, a female may rear up to 12 offspring during her reproductive life of 25 odd years. Males reach sexual maturity at the age of six years (Fig. 3), and also remain sexually active until their mid-twenties.

Subadult drills become socially independent between the age of one and a half, to two years. In limited captive conditions, they are forced at age three to leave the group by high ranking adults. Individuals of this age class are commonly sent to other zoos to establish new breeding colonies. Hannover Zoo and Stuttgart have sent animals to Osnabrück and Wuppertal in West Germany, and Arnhem in the Netherlands. In the field, we hypothesize that these subadults may emigrate.

According to studbook data, there are currently 56 individuals in the world's zoos. A large percentage of this population is not yet sexually mature or is younger than ten years of age. In the U.S., the institutions most concerned with breeding drills are the zoological parks of Philadelphia, New Orleans, San Diego and Los Angeles. The captive population should increase to 80 individuals in the next 15 years, and we are moderately optimistic about the future.

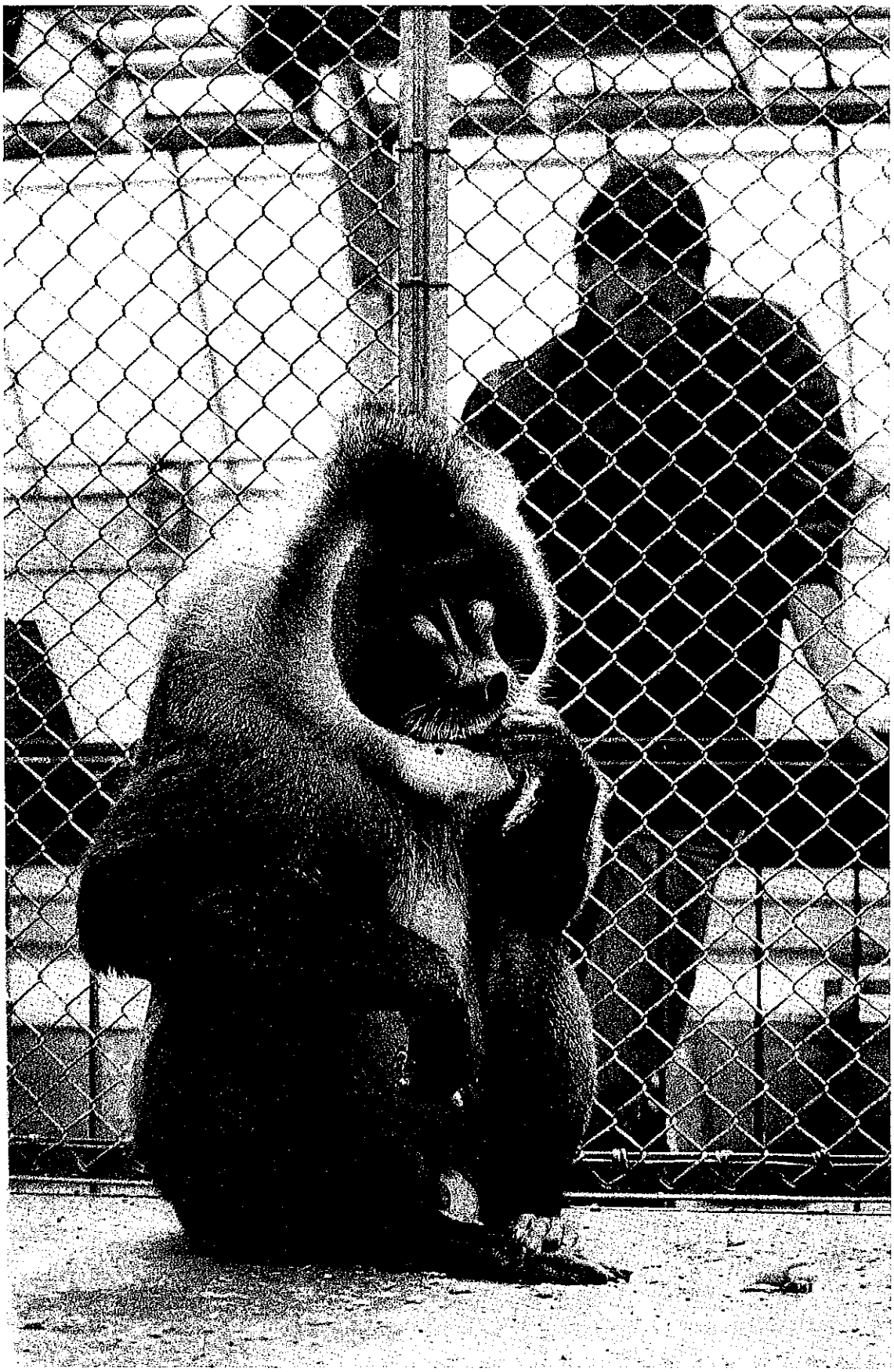

Fig. 3. An 18 year old drill male, "Alexander", at the Hannover Zoo (photo by K. Blüher).

In October, 1986, a IUCN/SSC workshop on the breeding and conservation of drills was held at Soesterberg in the Netherlands. It was agreed by those present that a captive breeding program must now be seriously supported by all zoos keeping drills, and that research on the wild population must begin soon.

Little is known of the status of drills in the wild. Korup National Park in Cameroon is thought to be one of the strongholds of the mainland subspecies. Tutin and Fernandez (this issue) report it from Gabon south of its previously recorded range. An island subspecies also exists on Bioko Island (Fernando Poo). During a survey conducted there in 1986 by T. Butynski (pers. comm.), the Bioko drill was found to still be common in the most remote and undisturbed central parts of the island around Mt. Malabo and in the Gran Caldera region. However, it was heavily hunted for food elsewhere on the island. Further survey work is clearly needed, both on the mainland and on Bioko, to determine the conservation status of this species throughout its range and to clarify its distribution.

We are now organizing a six-month field project to census this highly endangered species in Cameroon and Gabon. The field ecologist will be trained at Hannover Zoo in reproductive physiology and recognition of different sex and age classes before going to Africa. This training will help us to identify healthy wild populations more quickly so we may begin working to conserve them sooner.

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Fig. 1. A *Cebus apella* female with her *C. apella* x *C. olivaceus* infant (photo by J. Moonen).

Hybrid Capuchin in Paramaribo Zoo, Suriname

by Joep M. Moonen

A female *Cebus apella* housed with two male *Cebus olivaceus* (=*nigrivittatus*) in the Paramaribo Zoo gave birth to a hybrid infant last year. The infant is surviving well (Fig. 1).

A review of the literature (*eg.* Gray, 1971) indicates that although many other cases of hybridization between *Cebus* species exist, this is the first case of a hybrid between these two species.

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Fig. 2. "Joe Bugner", a presumed hybrid between *M. fascicularis* and *M. nemestrina* at the Sepilok Rehabilitation Center in Sabah (photo by M. Kavanagh).

Hybrid Macaque in Sabah

by Michael Kavanagh and Junaidi Payne

An extraordinary, probably unique, animal was kept at Sepilok Wildlife Rehabilition Center in Sabah, Malaysia between 1977 and 1986. It was a male macaque, presumed to be a cross between *Macaca fascicularis* and *Macaca nemestrina*, with cream colored hair and pale skin (Fig. 2). Its origins are unknown. The Sabah Forest Department obtained it from a European who left it at Sepilok. It was cared for at the Center along with other animals deemed unsuitable for release in the wild. Its vision was poor and deteriorated until it became virtually blind. It was euthanized in December 1986, and taken by the Sabah Museum.

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ARTICLES

Central and South America

The Status of Panama's Endemic Howling Monkeys

by Jeffery W. Froehlich and Patricia H. Froehlich

Introduction

The first extinction of a Neotropical primate species in this century may occur in Panama unless urgent steps are taken to protect the fauna of the Azuero Peninsula and nearby Coiba Island (Fig. 1). Although it has long been recognized that the howlers of south-central Panama comprise two visually distinctive subspecies (Lawrence, 1933), the view of Goldman (1920) that the monkeys of Coiba Island constitute a separate, smaller species (*Alouatta coibensis*) has not been widely accepted. By using a new approach to the study of systematic variation in the unique primate trait of dermal ridge patterning on the hands and feet of Central American howlers, we recently confirmed that the sampled populations from Coiba Island and the Azuero Peninsula are extremely distinctive genetically (Froehlich and Froehlich, 1986). We did not, however, resolve the question of separate species status, except to note that the Azuero animals are more different than all the *Alouatta palliata* samples from mainland Central America are from each other. Thus, the confusion continues regarding the taxonomy of howling monkeys from Azuero and Coiba.

Meanwhile, tropical forest on the Azuero Peninsula is continuing to be cleared, and extensive development may also be occurring on Coiba at the expense of forest and fauna. Based on human expansion between 1950 and 1977 into the Tonosi region of Los Santos, in the southeast of the Azuero, Heckadon Moreno (1983, 1985) has concluded that before the year 2000 less than 10% of Panama will remain forested, with no forest remaining in the southern and central regions.

With this sense of urgency, we felt it essential to make a case for separate species status of the south-central Panamanian howling monkeys based on our available data and published information. A formal systematic revision must await greater documentation from museum and field studies to confirm our hypothesized classification, but field studies may not be possible without immediate conservation action. In the familiar words of Joni Mitchell, it could be that

Don't it always seem to go
That you don't know what you've got
Till its gone
They paved paradise . . ..

Fingerprint Analysis

It has long been recognized that the dermal ridge patterns on digits, palms, and soles are extremely useful for the study of genetic diversity and the interpretation of prehistorical relationships among human populations (e.g., Froehlich, 1987). Fingerprint traits are permanently established with little or no environmental influence by the end of the first

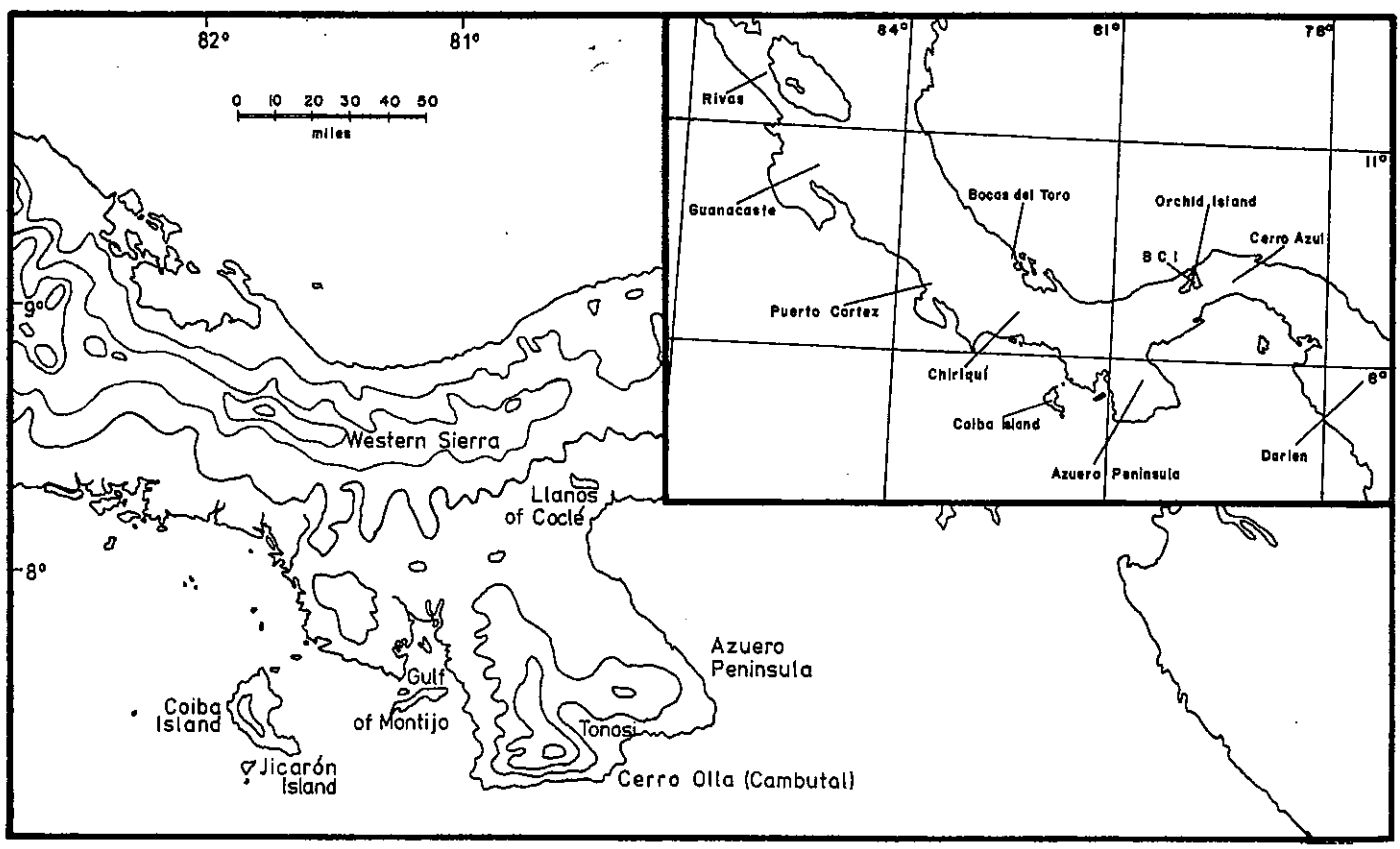

Fig. 1. Topographic map of the Azuero Peninsula and Coiba Island in western and central Panama. Contour intervals are marked at 1,000, 3,000, 5,000 and 8,000 ft., respectively. The inset shows sampling areas for the study of fingerprint diversity (figure by J.W. Froehlich).

fetal trimester. Moreover, numerous studies have shown that these traits constitute a large complex of highly heritable parameters representing a significant portion of the genome (for review see Froehlich, 1976).

Despite a century of such work with human populations, there has been a relative scarcity of such studies among other primates. Moreover, these few studies have been largely descriptive; never have fingerprints been used to resolve a major taxonomic issue (Froehlich and Froehlich, 1986). This is unfortunate, since it is widely accepted that fingerprints constitute a unique, derived characteristic (i.e., synapomorphy) which all primates display to varying degrees and no other living animal shares.

The howler fingerprint data were sampled in 11 regional populations from the eastern border of Panama to the western shore of Lake Nicaragua (see Fig. 1). Three of these samples, from Barro Colorado and Orchid Islands in Gatun Lake, Panama, and from Guanacaste Province, Costa Rica, were from wild-caught animals in contiguous social groups. A previous multiple discriminant analysis of these samples not only showed that regional differences accorded with geographical distances, but within each sample the various troops were grouped almost exactly as one would predict from their spatial, social, and presumed historical relationships (Froehlich and Thorington, 1982).

The remaining eight samples were taken from skin collections in the U.S. National Museum, the American Museum of Natural History, and the Museum of Comparative Zoology (Froehlich and Froehlich, 1986). After exhaustive single variable comparisons demonstrated a highly significant but complex pattern of variation in over half of the 34 coded traits, this complexity was reduced by multivariate analysis to a two dimensional graph of population relationships. Although the eleven populations showed a pattern closely resembling geography, the mainland samples totally intergraded between western Panama and Costa Rica, leaving the animals of the Azuero Peninsula as the only apparently distinct taxon. Similarly, the Coiba sample was also separated as a genetically isolated entity.

In order to further explore these relationships, the present investigation used a similar discriminant analysis in three dimensions of only 20 palmar and plantar traits. The omission of digital data allowed us to maximize small sample sizes, especially on Coiba Island, where the museum skins were poorly preserved. Comparisons of all possible Euclidean distances in this analysis confirmed the graphical relationships and distinctiveness of the south-central Panamanian samples. These were then evaluated for their taxonomic weight using the scale of single variable differences among other South American howling monkey species sampled in the literature.

Results

The genetic relationships among the 11 Central American howler samples are portrayed graphically in Fig. 2. This is a three dimensional plot of the first three significant discriminant vectors from an analysis of 20 palm and sole fingerprint variables; they represent 71% of the total variance among the 11 samples. In other words, this multivariate analysis has reduced the data set to three, completely uncorrelated composite traits while retaining most of the variance of the original 20 variables. More importantly, the graph is easily interpreted in terms of geography and the dramatic separation of the Azuero and Coiba samples.

There is apparent subspecific variation displayed between eastern Panama to the Canal and western Panama to at least Nicaragua. Within these two distinct clusters, the individual samples are represented approximately according to their actual spatial relationships (note lines connecting the bases in the graph). The only major exception to this interpretation is the graphed proximity between Rivas, Nicaragua and Chiriquí in Panama, but this underscores the relative separation between the *A. p. aequatorialis* subspecies of eastern Panama and the *A. p. palliata* subspecies, with western Panama being rather homogeneously included in the latter (i.e. the actual geographical extremes are genetically most similar). This subspecies dichotomy would be even more apparent if the samples of markedly small size (Puerto Cortez, Orchid, and Cerro Azul) were removed from the graph.

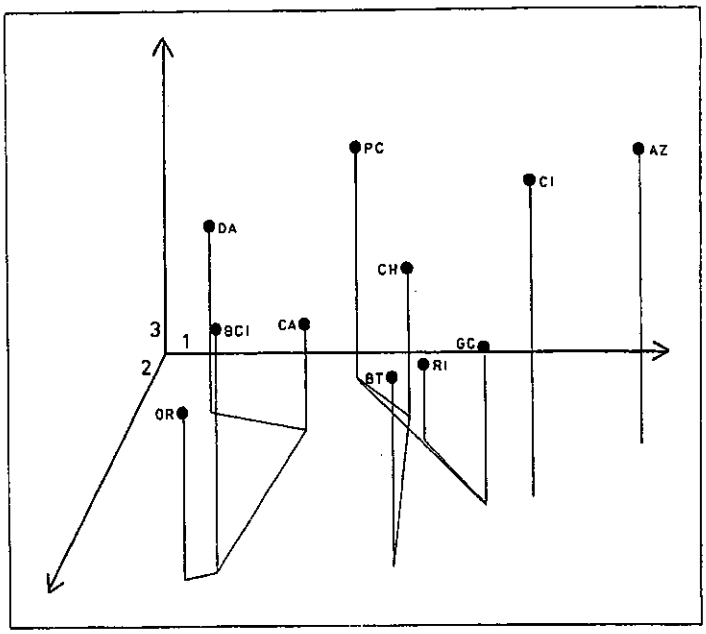

Fig. 2. Three dimensional display of multiple discriminant relationships among 11 Central American *Alouatta* samples, based on 20 dermal pattern areas of the left palm and sole. Lines connecting the bases of the samples reflect actual geographic proximities (i.e. clines). Abbreviations as in Table 1. (figure by J. W. Froehlich).

Table 1. Euclidean distance matrix based on three discriminant functions of 20 palmar and plantar dermal pattern areas in 11 samples of Central American *Alouatta*.

Panama	CA	BCI	OR	CH	BT	AZ	CI	PC	GC	RI
Darien (DA)	1.6	3.8	4.5	2.0	4.8	9.1	5.9	1.6	4.9	3.6
Cerro Azul (CA)		4.2	3.2	0.9	3.1	9.5	6.5	3.7	2.3	0.6
Barro Colorado (BCI)			0.7	4.9	1.1	9.4	4.5	6.0	3.1	5.4
Orchid Island (OR)				5.1	1.3	12.7	7.1	8.3	3.1	4.3
Chiriquí (CH)					3.0	4.8	3.3	1.8	1.3	0.7
Bocas del Toro (BT)						6.6	3.0	6.0	0.7	2.7
Azuero Peninsula (AZ)							0.9	4.0	4.5	7.6
Coiba Island (CI)								3.0	2.3	5.5
Costa Rica										
Puerto Cortes (PC)									4.5	4.5
Guanacaste (GC)										1.2
Nicaragua										
Rivas (RI)										

Against this background of division between the two principal subspecies previously described for Central America, the close proximity between Coiba and Azuero and their outlying genetic separation are noteworthy. One way to quantify this separation is to compare the actual three dimensional Euclidean distances between all possible pairs. These are shown in Table 1, where the parallel lines demarcate the proximity (0.9) between Coiba and Azuero and their consistently high distances from all other samples, especially for the mainland Azuero sample. The mean for the 18 distances between Azuero/Coiba and all others is 6.1, while the mean of 3.2 among all other samples is significantly lower ($t = 4.0$; $P \ll 0.0005$, adjusted for fewer degrees of freedom due to a singular matrix). If the latter value measures subspecific variation, does the former denote a separate species?

One way to weigh this question is to compare the scale of Central American fingerprint variation with other accepted species in South America. Without further data collection, only single variable comparisons are possible from published data (i.e. multivariate approaches are not possible without convariance). As a preliminary example of such taxonomic scaling, we have compared the trait area which most

discriminates the south-central Panama howlers from the rest of Central America. This is the thenar and first interdigital region of the foot, located from the base of the hallux to the middle of the longitudinal arch. In our analysis, we divided this region between distal and proximal portions. (We could not distinguish the former from the interdigital area; consequently our data here are not exactly comparable with the literature). The scale of difference for the distal thenar within Central America is shown in Table 2. The much greater frequency of complex patterning for south-central Panama is highly significant ($X^2 = 25.72$; P«0.00001). Thus, the multivariate discrimination of these animals is based on a very large biological difference.

Table 2. Frequencies of dermal patterning on the distal thenar / first interdigital area of left feet in Central American *Alouatta*.

Taxon	*A. p. palliata*	*A. p. aequatorialis*	*A. coibensis*
Pattern Type			
Open & Single Loop	145	67	16
Double Loops & Whorl	13	9	12

Moving to the proximal thenar pattern area where the data are closely comparable, Table 3 shows the percent frequencies from our three taxa and three South American species. Again, the differences in the table based on the actual frequencies are significant ($X^2 = 25.74$, P«0.005). These same differences in pattern complexity were described by Brehme and Newell-Morris (1981) as distinguishing *A. palliata*, because of its high frequency of open fields (i.e. no patterning), from the three South American species, where pattern complexities were higher and roughly similar to each other. On this scale of continental variation, the Azuero/Coiba animals stand out with at least twice as much pattern complexity as any other species. Clearly, they are different from other *A. palliata* samples, which are distinguished by having the least pattern complexity.

Table 3. Percent frequencies of dermal patterning on the proximal thenar area of left feet in the genus *Alouatta*.

Pattern Types / Taxon	Open Field	Single Loop	Double Loop & Whorl	Sample Number
A. coibensis	43	39	18	28
A. p. palliata	57	39	4	76
A. p. aequatorialis	73	24	3	158
A. seniculus [1] [2]	52	39	9	89
A. belzebul [2]	57	30	13	23
A. caraya [2]	50	45	5	20

[1] Data compiled from Pereira da Silva, *et. al.*, 1972.
[2] Data compiled from Brehme and Newell-Morris, 1981.

Discussion

Taxonomic Considerations

This analysis of fingerprint variation in Central American howling monkeys suggests two alternative classifications for these monkeys. Either all of the mainland samples, except for the Azuero, comprise one subspecies, with the south-central Panamanian animals representing the only recognizable second subspecies; or the latter populations are so different from the other accepted subspecies that they represent a separate species, endemic to Panama. In weighing these two hypotheses, we will adopt the broadest possible definition of a subspecies, as recently discussed by Thorington (1985) and Mayr (1982). In this usage a subspecies is either a geographically isolated or a formerly isolated population, which is recognizable by a consistent stepcline in the secondary intergradation which presently exists between it and its neighbors. If there is no parapatry, as is the case with the historically isolated Azuero Peninsula, then it is necessary to argue by analogy with the degree of difference between accepted species elsewhere.

With regard to the validity of the *A. p. palliata* and *A. p. aequatorialis* subspecies in Central America, our data suggest a morphological stepcline somewhere west of the Panama Canal. With a distinct separation between east and west Panama, the samples on either side of this separation are clinally displayed primarily according to their spatial relationships. This suggests that the intergradation noted by Lawrence (1933) in cranial size and pelage pattern is secondary, after a former period of geographical isolation. A vicariance event which may have produced this isolation was the eruption of El Valle at the western end of the Province of Panama presumably during the Pleistocene. The ejecta probably covered all vegetation for many square miles up to the Pacific Ocean, and possibly also to the Caribbean (Bennett, 1968). Sometimes forming a barrier 46 m deep, this ejecta probably blocked primate dispersal through the isthmus for a significant period of time. Thus, it would appear that even the most general attributes defining a subspecies are met by *A. p. palliata* and *A. p. aequatorialis*, albeit with the boundary between them drawn considerably to the east of the boundary proposed by Lawrence (1933).

With the validity of these two subspecies established, our second hypothesis is favored; namely, that the isolated south-central Panama populations constitute a separate species, as originally suggested for Coiba by Goldman (1920). The results of preliminary comparisons with South American species support this hypothesis by arguing on analogy that the degree of fingerprint difference on the thenar of the foot between Coiba/Azuero and the rest of Central America is greater than the known differences among four other accepted species. Therefore, as a working hypothesis for further testing in museums and the field, we suggest that *A. coibensis coibensis* and *A. c. trabeata* be adopted as probable subspecies of a newly recognized howling monkey species, endemic to Panama.

The visual distinctiveness of the Azuero subspecies *(trabeata)* was well-established by Lawrence (1933). She described the pelage pattern of walnut-colored backs and very long, silky, golden flank hairs extending from the axilla to the groin (Fig. 3), as quite unique and consistent, with only one individual in ten being less golden than the most extreme forms in the rest of Central and northwestern South America. She also noted that this taxon had a greater degree of sexual dimorphism in skull measurements than in other measured populations. This difference in sexual dimorphism may have unrecognized social consequences which would further support separate species status. Horwich (1983) documented analogous morphological and behavioral distinctions in *A. pigra* of Belize. We know of no behavioral report whatever for the Azuero, but Carpenter (1934) and Milton and Mittermeier (1977) found the troop size on Coiba to be much smaller than elsewhere among Central American *A. palliata.*

Although the fingerprint data cluster the Coiba animals very closely with the Azuero, we consider these island monkeys to be a valid second subspecies because of their isolation, small body size, and less distinctive coloration. Indeed, the small size and dull coloration are often associated with island biogeography. Today, Coiba is separated from the mainland by a channel with a minimum depth of 77 m and a width of more than 24 km (it is roughly 51 km to the Gulf of Montijo and the Azuero Peninsula). Interpolating from the Pleistocene data of Bartlett and Barghoorn (1976), the island was last connected to the mainland from approximately 24,000 to 15,000 years ago. Thus the geographical isolation criterion for a subspecies is well-established. Since Goldman (1920) defined the Coiba taxon as a separate species, based on its small size, this name takes precedence and the Coiba subspecies would be the type for the newly recognized species.

Zoogeographical Considerations

Although 15,000 years of isolation is a reasonable period for establishing a subspecies, the remaining close genetic affinities between the Coiba and Azuero populations and their shared differences from the rest

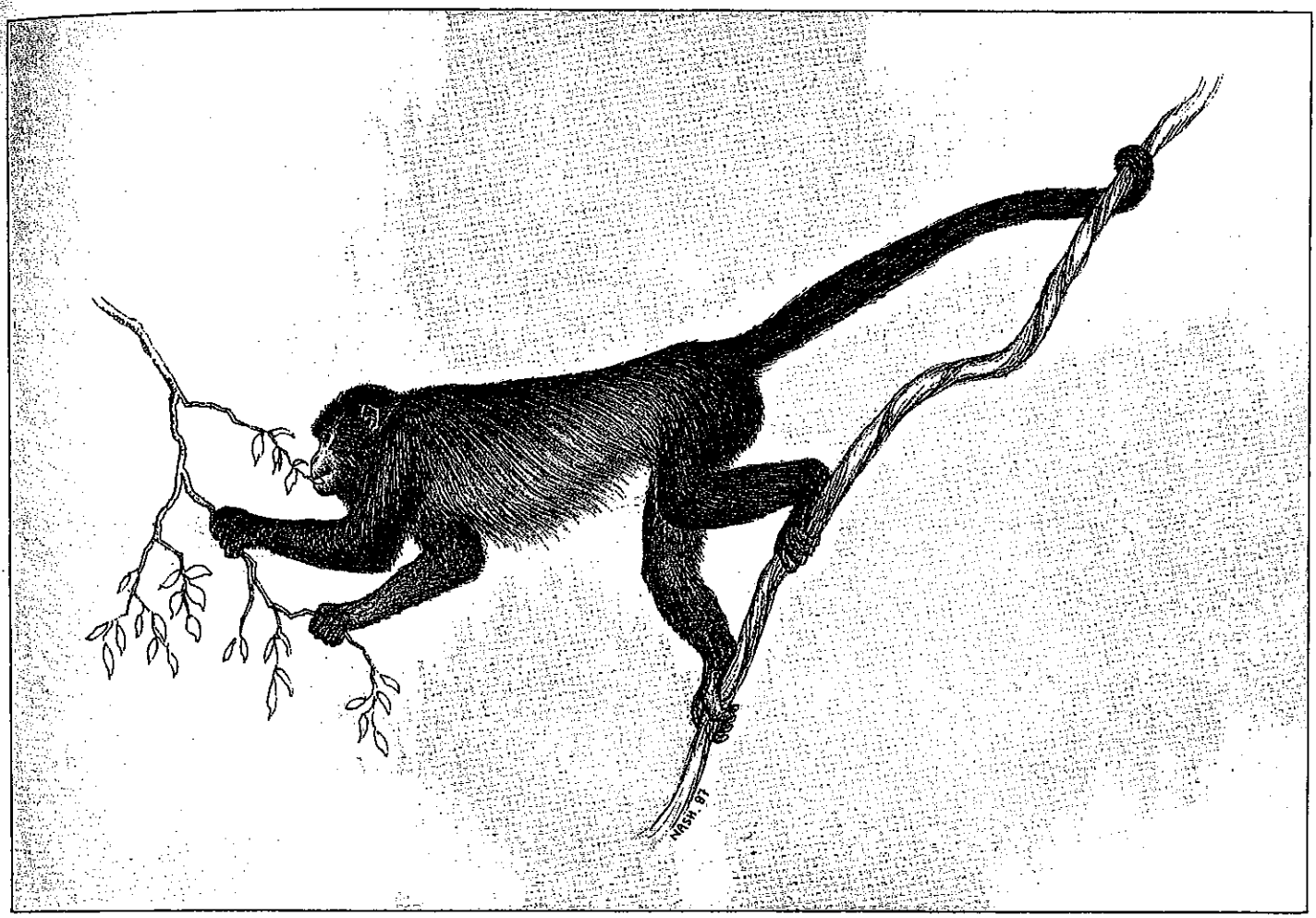

Fig. 3. The golden howler *(Alouatta coibensis trabeata)* from Herrera Province on the Azuero Peninsula, Panama (drawing by S. D. Nash).

of Central America suggest a far longer period of geographic isolation for endemic speciation to have occurred. Bennett (1968) suggested that the elevated part of the Azuero Peninsula was a separate island until the Pliocene. Historically, the lower elevations at the north of the Azuero have been covered by arid grasslands, such as the Llanos of Coclé. These grasslands may also have existed during the Pleistocene. Recent interpretations of the Great American Faunal Interchange, beginning about 3 million years ago, suggest that most isthmus migrants were savanna or grassland animals (Marshall *et al.*, 1982), with the Pleistocene megafauna helping to maintain a forest characterized by patchy grasslands (Janzen and Martin, 1982). It is in the low-lying areas on the Pacific side of the Western Sierra where Bennett (1968) hypothesized a narrow corridor of woodland savanna for the Pleistocene dispersal of such animals as the whitetail deer and the mammoth. Although there is debate over subsequent human impact on isthmian ecology (Cooke, 1984), there is some consensus that the Pacific drainage of western Panama was probbly a woodland savanna before human immigration (Cooke *et al.*, 1985), with hunter-gatherers extending previous grasslands by the use of fire (Bennett, 1968). Recent evidence from Brazil (Guidon and Delibrias, 1986) suggests this human influence may have begun by 50,000 years ago. At the same time, Bennett thought that much of the Atlantic watershed remained forested, permitting the dispersal of animals such as the tapir into Central America. Dispersal of forest animals into the Azuero, however, may only have been by way of a narrow coastal forest from the west as far as Costa Rica. Alternatively, the migration of the questionably endemic *Aotus bipunctatus* (Bennett, 1968) may have been from the east through more open woodland. The absence from the Azuero of animals such as *Bradypus, Mazama, Tapirus,* and the primate *Saguinus geoffroyi*, suggests that these were filtering migration routes at best (Bennett, 1968).

The mammalian fauna of Coiba is even more depauperate with only howler and cebus monkeys, whitetail deer, agoutis, and Virginia opossums reported (Thomas, 1902). Wetmore (1957) also found an absence of many forest bird species, albeit it must be noted that most of his month-long collecting was along the coast in the vicinity of human disturbance. Nevertheless, Bennett argues that the absence of forest birds suggests the absence of forest on the land connection; his unlikely conclusion is that the five Coiba mammals were transported by human hunters to provide game in the Coiba forests! Alternatively, these limited faunas of Coiba result from a complex filter migration, when a land connection existed, and a subsequent island extirpation. Similar to the Azuero, the reduced fauna suggests a long period of relative isolation.

Conservation Considerations

With the spread of agriculture, the extension of open areas and the destruction of forests continued until 1500. At contact, Bennett (1968) concluded that much of the Atlantic coast was cleared and settled, with open grasslands extending across the isthmus from Darien into most of western Panama below the Western Sierra. Between 1501 and 1903, depopulation led to a re-establishment of tropical forests, although Illueca (1985) noted marked fluctuations at great costs to the environment. With the introduction of the robust grass *faragua* in 1914, *roza* farming gradually gave way to extensive commercial cattle ranching, especially in Chiriquí, Veraguas, and Los Santos. Bennett (1968) predicted that the Azuero fauna would shrink to a small remnant more or less coincident with Cerro Olla in the southwest corner of the peninsula.

Heckadon Moreno (pers. comm.) says that howling monkeys still existed on the Azuero in 1986, but he argues that of all the tropical systems in the isthmus, the Azuero Peninsula is the most fragile, due to the region's notorious droughts and poor soils (Heckadon Moreno,

1982). Bennett (1968) described the whole region as one of "zoological poverty" due to permanent pasture and excessive hunting. A ray of hope is offered by the prospect of a 930 km² Parque Nacional Cerro Olla, stretching from the 1,860 m summit to the southern shoreline (Houseal, 1985), but recent satellite photographs show that this is absolutely the last remaining forest on the peninsula.

For Coiba Island, the situation is also grim. Recent rumors are that monkeys are being systematically shot, rather than being hunted for subsistence, and that roads are being built, presumably for commercial lumber. Large stands of the commercially-harvested *cativo* tree (*Prioria* sp.) exist on the southwestern side of the island (Milton and Mittermeier, 1977). Such single taxon tree groves suggest a very old, climax forest, which is probably a unique botanical resource in Panama, if not all of Central America.

A comparison of dry season satellite photographs from 1973, 1986, and 1987 confirms these rumors. Clearings around prison encampments have more than doubled and new clearings have appeared on the southern and western coasts. Just within the last year, a large strip of forest has been cleared around Boca Grande to a new clearing on the east coast. If unabated, such a rate of devastation could clear the 518 km² island of forest in another decade.

There is now hope for the preservation of this forest and the unique monkeys it contains. In a preliminary strategy statement for a national park system, the southern half of Coiba and neighboring Jicarón have been proposed as an "equivalent reserve" (Houseal, 1985). Howling monkeys have been observed on Jicarón within the last century (Alston, 1879). This small island of about 13 km² has been separated from Coiba for over eight thousand years and it is remarkable that monkeys still survive.

From the zoogeographical perspective of mammalian dispersion from the mainland, the Azuero Peninsula, Coiba Island, and Jicarón Island constitute a single biological unit. This unit is an important biological resource for understanding island biogeography and the process of speciation. We suggest preserving this incomparable resource by incorporating all three areas into a single protected area by extending the Parque Nacional Cerro Olla.

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Preliminary Survey of the Primates of the Zona Protectora and La Selva Biological Station, Northeast Costa Rica

by Aimee S. Fishkind and Robert W. Sussman

Introduction

In May 1986, we conducted a preliminary survey of the nonhuman primates of the La Selva Protection Zone ("Zona Protectora La Selva") in Heredia Province, northeastern Costa Rica. This research was funded by the National Geographic Society through the Organization for Tropical Studies (OTS). The Zona Protectora is a recently-protected tract of rain forest on the Atlantic slope of Costa Rica. It is of major importance because it connects two established natural reserves: Braulio Carrillo National Park and La Selva Forest Reserve/Biological Research Station (Fig. 1). Three species of primates are known to inhabit the Zona Protectora and its environs: *Alouatta palliata*, *Ateles geoffroyi*, and *Cebus capucinus* (Fig. 2). Prior to the survey reported here, the primates of this region had never been studied.

During this survey we were able to: (1) obtain estimates of relative abundance and determine altitudinal limits of the three primate species in the Zona Protectora, (2) obtain preliminary estimates of population density of the three species in La Selva Reserve, and (3) determine the feasibility of long-term study of the primates in both these areas.

The Zona Protectora

The Zona Protectora links two major conservation areas to create a continuous strip of protected rain forest spanning an altitudinal gradient from 35 m (La Selva) to approximately 2,900 m (Volcan Barva, Braulio Carrillo National Park). According to the Holdridge (1967) system, four ecological life zones (Tropical Wet Forest, Tropical Premontane Wet Forest, Tropical Lower Montane Forest and Tropical Montane Forest) and four transitional zones are represented along this altitudinal gradient. This area has long been recognized as one of the most biologically rich tropical forest remnants in Central America (World Wildlife Fund, 1986). Eight hundred species of trees and some 500 species of birds are estimated to inhabit the area encompassed by La Selva, the Zona Protectora, and Braulio Carrillo National Park. This represents some 40% of Costa Rica's tree species and some 80% of its avifauna, all in a narrow corridor some 40 km in length (Pringle *et al.*, 1984). Conservation on this basis alone is justified and necessary. However, the need for conservation of the Zona Protectora is underscored when its important role as a pivotal connecting link is considered. If the Zona Protectora is cut, many threatened species of plants and animals in all three protected areas are in danger of extinction. Migratory habitat would be destroyed, drainage and soil erosion patterns would be altered, and serious loss of plant and animal diversity would result.

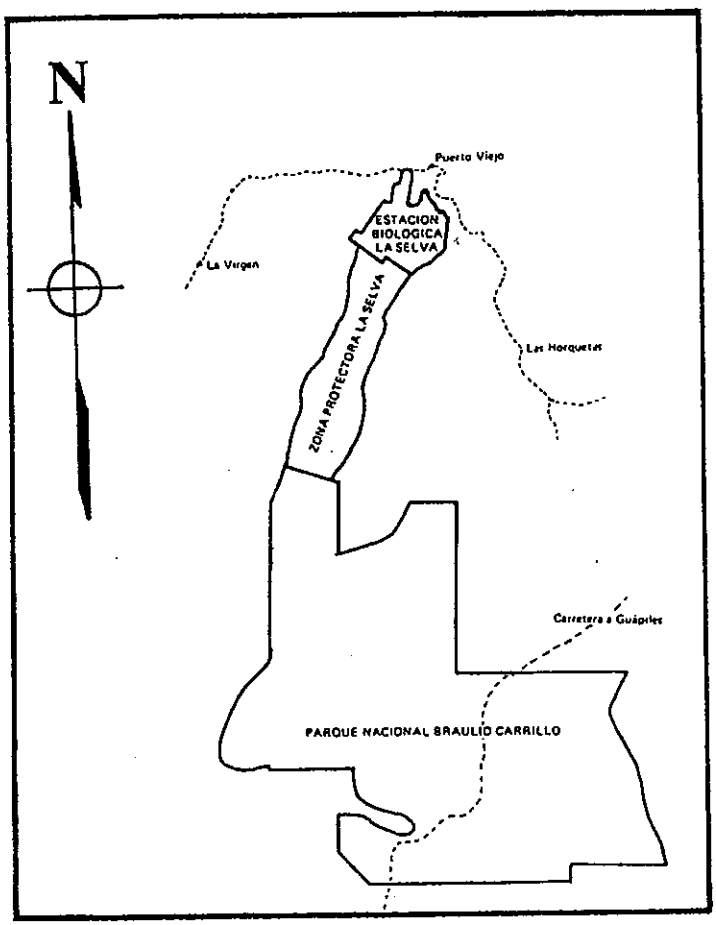

Fig. 1. A map of northeastern Costa Rica showing the location of the La Selva Protection Zone with respect to La Selva Station and Braulio Carillo National Park (map provided by authors).

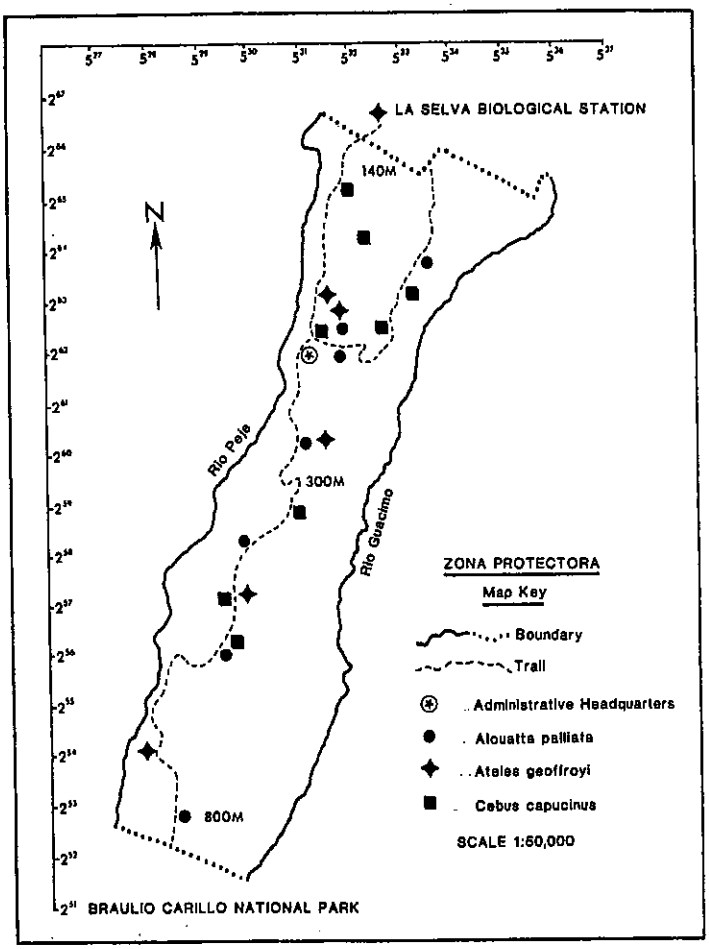

Fig. 2. The distribution of primate sightings in the La Selva Protection Zone from January-May, 1986 (map by S. D. Nash from authors' original).

The Zona Protectora comprises a narrow corridor, some 18 km in length and 3-6 km in width. It is bounded to the north by the La Selva Reserve, to the south by a forest reserve continuous with Braulio Carrillo National Park, to the west by the Río Peje, and to the east by the Río Guácimo. Total area covered by the Zona Protectora is 7,363 ha, of which 73% is undisturbed primary forest. Two life zones (Holdridge, 1967) and two transition zones occur in the Zona Protectora proper: Tropical Wet Forest occurs at the northern, lowland end; and Tropical Premontane Wet Forest at the southern, more highly elevated end. The disturbed areas of the Zona Protectora consist of pasture (16%), secondary growth (10%), and permanent crops (1%) (Pringle *et al.*, 1984).

The Zona Protectora was created in 1982, by Costa Rican presidential decree (OTS, 1986). From 1982 to 1985, landowners in the Zona

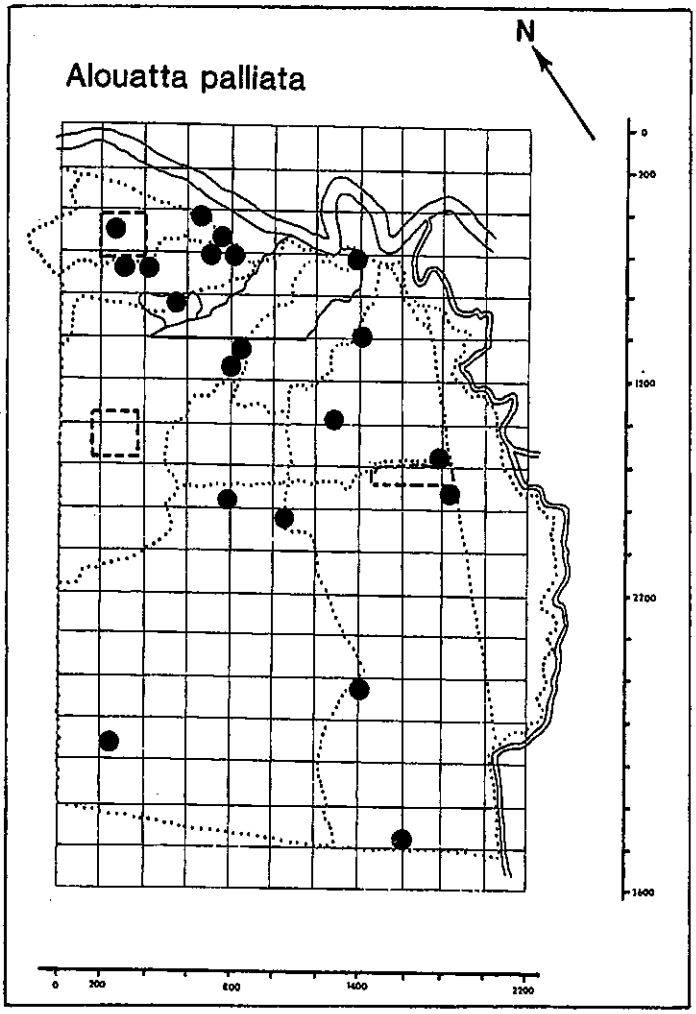

Fig. 3. Distribution of *Alouatta* sightings in La Selva Central Reserve from January-May, 1986 (map by S.D. Nash based on author's original).

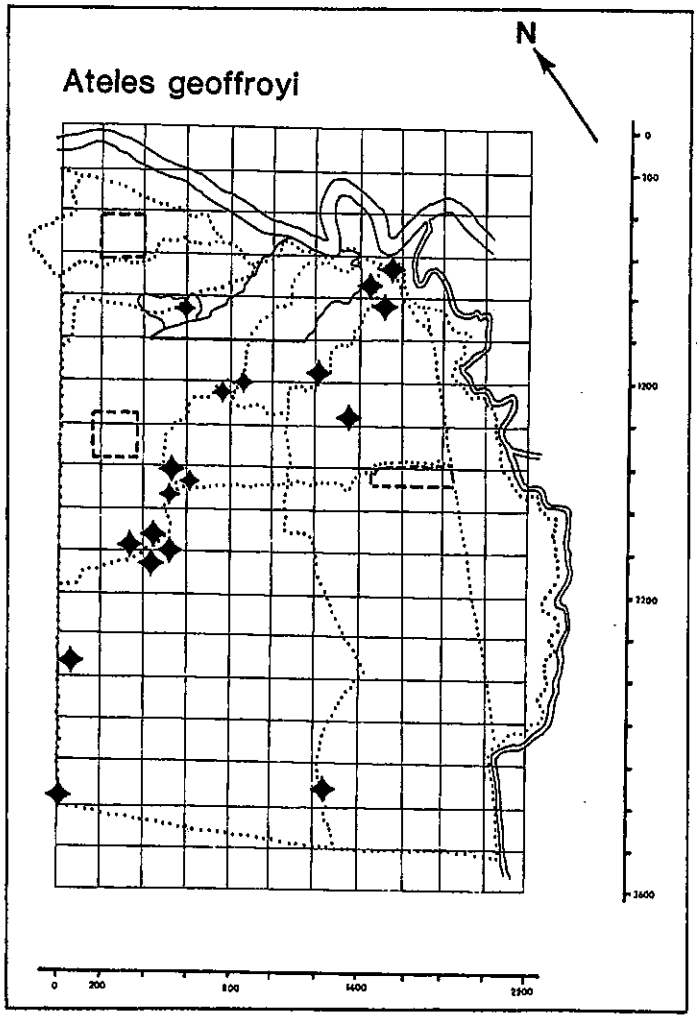

Fig. 4. Distribution of *Ateles* sightings in La Selva Central Reserve from January-May, 1986 (map by S.D. Nash based on author's original).

Protectora were permitted to remain on their property, farming and raising cattle on previously disturbed plots; however, new alteration of forest was strictly prohibited. During this interim period, landowners lobbied either for the removal of imposed restrictions or for the outright purchase of their land by the government. Beginning in 1985, purchase of individual parcels in the Zona Protectora was initiated. This process proceeded rapidly, and as of May 1986, negotiations for the sale of the final privately-owned plots were in progress (OTS, 1986). Meanwhile, in April 1986, the Zona Protectora was officially incorporated as an extension of neighboring Braulio Carrillo National Park, thereby extending the park all the way from the top of Volcan Barva to the southern boundary of La Selva Reserve (Clark and Clark, 1986).

Purchase of the Zona Protecora was made possible, in large part, by the donation of a $1 million challenge grant from the MacArthur Foundation to the Washington-based Nature Conservancy International. During 1985, the remainder of the $2 million purchase price of the Zona Protectora was raised under the direction of the Nature Conservancy with the assistance of OTS, WWF-U.S., the Costa Rican National Parks Foundation, and the Costa Rican National Parks Service (OTS, 1986).

La Selva Reserve

The La Selva Biological Reserve is located at the confluence of the Río Puerto Viejo and Río Sarapiquí in the Atlantic lowlands of northeastern Costa Rica. Geographic coordinates of the reserve are 10° 26″ N and 83° 59′W (Hartshorn, 1983). The reserve consists of 1,366 ha in three distinct parcels: a "buffer zone" of 4 ha on the east side of the Río Puerto Viejo; the central La Selva Reserve, which consists of 731 ha of mostly (90%) primary forest; and the adjacent "Western Annex", a 631 ha plot of mixed primary forest, secondary forest, and pasture, which was acquired in 1981 (Hartshorn, 1972; OTS, 1985). The La Selva Reserve is owned and administered by OTS, a consortium of 40 North American and Costa Rican educational research institutions, dedicated to the study of tropical biology and the conservation of tropical forest environments.

The forest vegetation at La Selva may be broadly classified as Tropical Rain Forest (Richards, 1952). High annual rainfall (X = 4,015 mm, range = 2,891-5,659 mm, N = 26 years), minimally varying warm temperature (X = 24 C ; Frankie, Baker and Opler, 1974), and evergreen appearance are characteristic of this forest. According to the Holdridge (1967) system, La Selva may be bioclimatically and geographically defined as Tropical Wet Forest and Tropical Premontane Wet Forest, warm transition (Hartshorn, 1983).

The undisturbed mature forest in the center of the reserve is tall, multistratal, and evergreen. Some 450 tree species of 61 families have been recorded (Hartshorn and Hammel, 1982). A noticeable feature is that subcanopy, understory, and dwarf palms are strikingly diverse and abundant throughout La Selva. Four forest types are associated with as many soil types: residual, swamp, old alluvial and recent alluvial (McDade, pers. comm.). In all of these undisturbed forests, *Pentaclethra macroloba* is the dominant species (Hartshorn, 1972, 1983; Frankie, Baker and Opler, 1974).

La Selva is the largest, best equipped, and most intensively studied of the three field stations owned by OTS (Gómez and Savage, 1983; Hartshorn, 1983). It has been selected by the U.S. National Research Council Committee on Research Priorities in Tropical Biology as one

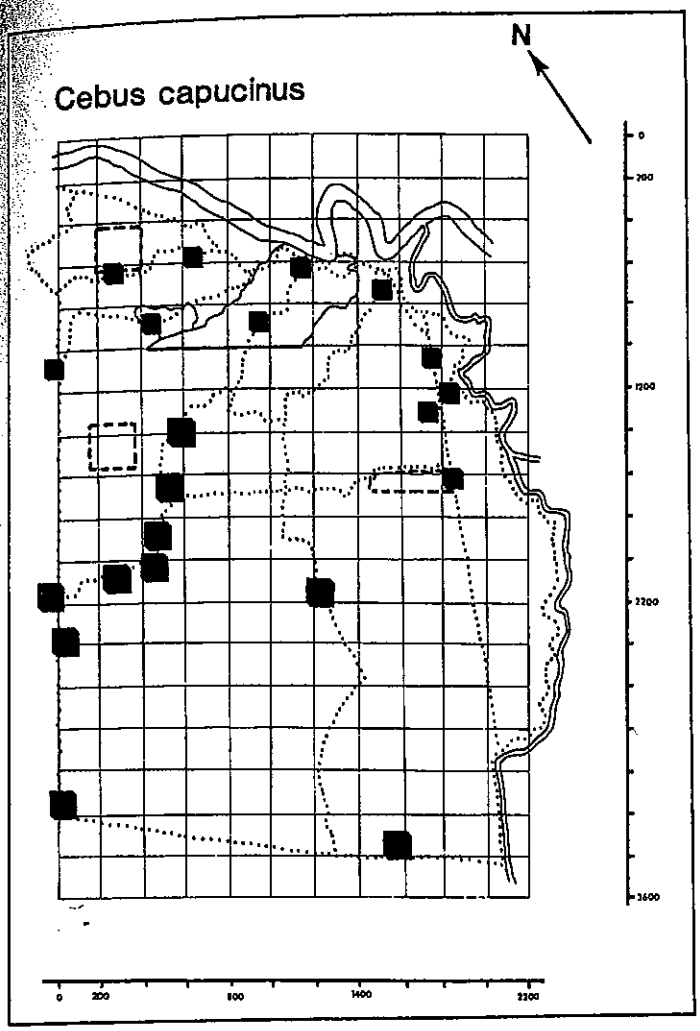

Fig. 5. Distribution of *Cebus* sightings in La Selva Central Reserve from January-May, 1986 (map by S.D. Nash based on author's original).

of the four most promising sites worldwide for intensive long-term ecological research (Norman, 1981; Gómez and Savage, 1983). A major reason for this is that much baseline ecological research has been carried out at La Selva since its inception in 1968. Thus, the forest is exceptionally well studied, as tropical rain forests go. Over the past two decades, a wide variety of evolutionary, behavioral, and general ecological studies have been conducted. Yet very little is known about the primates at La Selva. This is due mainly to the fact that large numbers of primates died in the yellow fever epidemic which swept through Central America in the early 1950's, leaving researchers with the lasting impression that the primate population of La Selva had been decimated, and that the primates were too sparsely distributed to permit study of them. Although extensive nonhuman primate mortality during the 1952-1954 yellow fever epidemic has been documented (Downs, 1982; Yuill, 1983; Hartshorn, pers. comm.), our surveys indicate that the primate populations have recovered in sufficient numbers to permit their study. Other researchers with long-term experience at La Selva have noted in recent years a striking increase in the frequency with which they contact monkeys (Hartshorn, pers. comm.; Schal, pers. comm.). Thus, the primate population appears to be growing at present. It is quite possible that the current primate population of La Selva is derived at least in part from primates from the Zona Protectora. The primates in the Zona Protectora may have suffered less infection and mortality from yellow fever, due to altitudinal preferences of disease vectors (mosquitos). It is therefore likely that the Zona Protectora provided a "buffer zone" of healthy animals from which the increasingly large primate populations at La Selva are derived.

Data Collection

The primary method used to determine the distribution and density of primate species in the Zona Protectora and La Selva was the broad survey (NRC, 1981). Surveys were always conducted from existing trails, with two or three observers present. A record of distance covered in all surveys in both the Zona Protectora and La Selva was maintained. This was facilitated by the fact that in the Zona Protectora, the main north-south trail is marked at 0.5 km intervals, beginning in the central La Selva Reserve. Altitudes are also marked at each of these stations. In La Selva, all trails are marked every 50 m with the distance from the trailhead.

Due to the difficulty of obtaining accurate results using a broad survey in an expedition of such brief duration, we expanded our data base by employing several supplementary methods. A written questionnaire was sent to a number of researchers who have spent extensive periods of time in the Zona Protectora in recent years. We asked these researchers to search their field notes for systematic records of primate sightings. Information requested included date, location, species, and number of animals sighted.

Secondly, we reviewed all entries (January-May, 1986) in the mammal log book kept at the La Selva Station, and posted a large map of the La Selva Reserve for current researchers and visitors to record sightings in our absence. Thus, primate sightings will be cross-referenced both in the mammal log book and on the map at La Selva. This method of data collection was implemented so as to provide a continuous record of primate sightings in La Selva, and is still in progress.

The final method of collecting data involved reviewing reports on primate sightings by a variety of reliable workers, many of whom are Costa Rican National Parks Service employees, and are intimately familiar with the Zona Protectora. One of the Parks Service Guards, Reinaldo Aguilar, was particularly helpful in this regard.

Results

The Zona Protectora

A total of nine days was spent surveying in the Zona Protectora (May 8-14 and May 21-22). During this time, 75 km of trails were covered, from the southern boundary of the La Selva Reserve to 31 km along the survey trail. Maximum altitude reached was 1,240 m.

Due to the limited visibility in forested areas along the trail, our observations of primates were minimal. During the entire broad survey in the Zona Protectora, we actually encountered primates only seven times: *Alouatta* was observed visually once (at 18.5 km, 440 m), and heard an additional five times (at 200, 300, 360, 700, and 800 m). *Ateles* was observed on our return to La Selva from the Zona Protectora, actually just within the boundary of the Western Annex. *Cebus* was never observed in the Zona Protectora, although informants indicate that they are widely distributed there.

Based on our own observations and those of our informants, we conclude that all three primate species are present and evenly distributed throughout the Zona Protectora up to about 1,000 m (Fig. 2). Thus far *Ateles* has not been observed above 1,000 m. *Alouatta* has been observed up to about 1,200 m, and *Cebus* has been observed as high 1,820 m (Fig. 2).

Due to the limited nature of the data, we have not attempted to calculate population densities for the primates of the Zona Protectora. We believe that *Alouatta* is the most abundant primate (at least to 1,200 m), *Ateles* the least abundant, and *Cebus* appears to be of intermediate abundance within the Zona Protectora. These estimates of relative abundance are based on the number of sightings reported for each species over the area, and the fact that *Alouatta* is folivorous, and usually has a smaller home range than the other two species, and was encountered relatively evenly along the transect. Although we cannot give specific densities for the Zona Protectora at this time, we can say that all three species are relatively common.

La Selva Reserve

A total of ten days was spent surveying in La Selva Biological Reserve (May 16-20 and May 22-26). During this time, approximately 60 km of trails were covered. All trails in the 731 ha "central reserve" were surveyed intensively.

Our observations confirm that all three primate species are present in La Selva. The distribution of sightings, by species, is shown in Figures 3-5. These maps were compiled using our own data on first sightings, those of other researchers whom we questioned, and recent (January-May, 1986) entries in the mammal log book at La Selva.

Table 1. Summary of La Selva Survey

Species	% First Sightings (Jan-May 86)	Estimated # Groups	Estimated # Individ	Estimated Population Density
Alouatta palliata	21	6-10	80-140	12-19/km²
Ateles geoffroyi	18	2-4	40-80	6-11/km²
Cebus capucinus	21	2-3	30-45	4-6/km²

Our results are summarized in Table 1. We believe that *Alouatta palliata* is the most abundant primate in La Selva. Based on our composite observations, we estimate that there are 6-10 groups of *Alouatta* at La Selva. If the average *Alouatta* group at La Selva is comparable in size to groups found at other sites (and it seems for all three species that there are fewer groups at La Selva, not fewer animals per group), around 14 animals, there should be 80-140 animals in the central La Selva Reserve. Using the same reasoning, we estimate two to four groups of *Ateles* at 20 animals per group (40-80 animals) and two to three groups of *Cebus* at 15 animals per group (30-45 animals). These estimates are based on area in which animals were sighted and on typical home range size per species. They yield population density estimates of approximately 12-19/km² for *Alouatta*, 6-11/km² for *Ateles*, and 4-6/km² for *Cebus*. These densities are generally at the lower end of the range given for these species in other forests, but our estimates are intentionally conservative. We must strongly emphasize the preliminary nature of these figures.

Conclusions

The results of our reconnaissance research indicate that long-term study on the primates in both areas is feasible. The animals are sufficiently abundant for ecological research to be conducted. We believe that La Selva is an ideal site for extended studies of population parameters and group dynamics with marked and radio-tagged individuals. This future research will be important in establishing a basis for comparison between the unstudied Atlantic slope primate populations and their well-studied Pacific slope counterparts. La Selva Station is also a good site for detailed, integrative research. Accordingly, plans are currently underway for baseline studies of the primates at La Selva, to begin in 1987.

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The Status of *Saimiri oerstedi citrinellus* in Costa Rica

by Sue Boinski

Introduction

An initial survey of squirrel monkey distribution in Costa Rica (Boinski, 1985) concluded that *Saimiri oerstedi citrinellus*, a Costa Rican endemic, was probably restricted to the immediate vicinity of Parque Nacional Manuel Antonio, near Quepos in the Pacific wet lowlands of the province Puntarenas (Fig. 1). The number of surviving animals was estimated to be 300. Formerly the subspecies extended northward to Cerro Herradura (9° 40'N, 84° 35'W) and the Dota Mountains (probably Cerro San Jerónimo; 9° 37'N, 84° 09'W) (Frantzius, 1869; cited in Hershkovitz, 1984). The southern boundary was probably limited by the Rios Sierpe and Terraba (8° 25'N, 84° 25'W). This geographic barrier served to separate *S. o. citrinellus* from the other Costa Rican subspecies, *S. o. oerstedi*, which is found further south.

From 28 May to 26 June 1986, I conducted a second survey in the provinces of Puntarenas and San José. The objective of this survey was to (1) obtain detailed information on the current distribution of *S. o. citrinellus* and ascertain its distinctiveness from *S. o. oerstedi*, (2) identify and evaluate the factors that are likely to affect the future existence of the former subspecies, and (3) provide recommendations to aid government and private institutions in Costa Rica to implement a successful conservation program.

Both the observations I made and the information obtained by others were considered in light of more than two years of field work with *S. o. oerstedi* in P. N. Corcovado, Costa Rica. I spent ten days in P. N. Manuel Antonio making detailed observations of individual and group behavior on the two resident troops. Photographs and vocalization recordings were also collected. For six days, I censused additional troops and interviewed local residents within a five km radius of the park. Site visits and surveys of potential *Saimiri* habitat in other areas of the two provinces accounted for another ten days of the study. Twelve captive *Saimiri* were also examined.

Those interviewed, in addition to farmers and villagers, included staff in the Servicio de Parques Nacionales and other agencies in the Ministerio de Agricultura y Ganaderia, banana and oil palm company workers and managers, and biologists familiar with the area. Information was sought regarding (1) sites where *Saimiri* were either currently or formerly present, (2) natural history observations, such as food and range use, birth and breeding seasons, and interactions with potential predators and competitors, (3) human threats to extant populations, such as hunting and capture for pets, (4) predictions for the future utilization of habitat currently supporting *Saimiri*, and (5) attitudes concerning the importance of the maintenance of *Saimiri* populations in Costa Rica.

Natural History

Using ten specimens collected by Underwood and Carriker in 1902 near Parrita, Hershkovitz (1984) listed the characters presented in Table 1 as distinguishing *S. o. citrinellus* (Fig. 2) and *S. o. oerstedi* (Fig. 3).

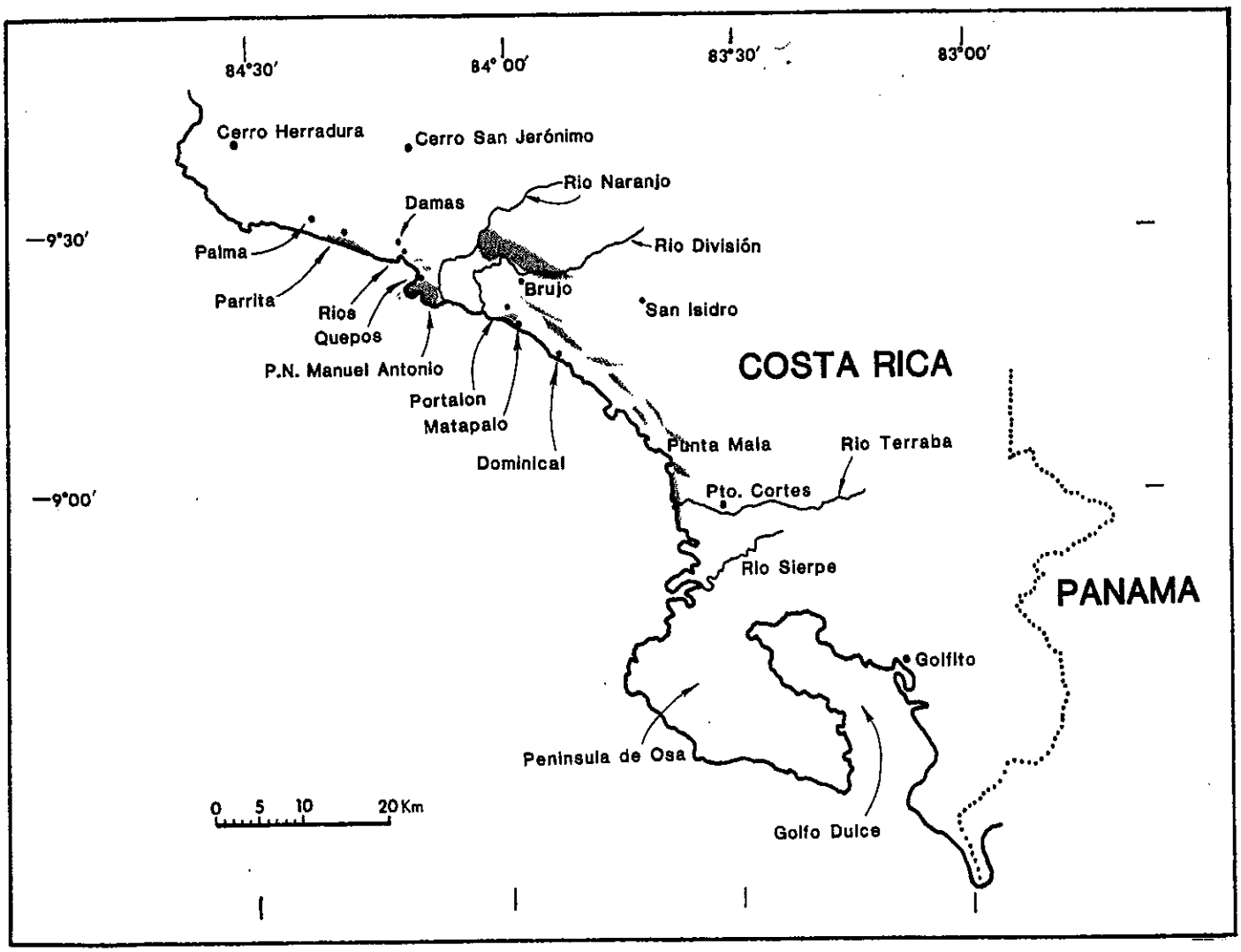

Fig. 1. The known distribution of *Saimiri o. citrinellus* in Costa Rica in 1986 (map by S. D. Nash based on author's original).

In both subspecies the back and side of the trunk is predominantly bright or reddish orange, the ears are tufted, and females have a black crown. My close observations of about 300 individuals of each subspecies corroborate these criteria with the important exception that the sexual differences in crown coloration in *S. o. citrinellus* are not as distinct as the small sample available to Hershkovitz indicated. Two females with agouti colored crowns very faintly edged with black hairs were seen; one of these females was captive. All other females exhibited black crowns, although the bright orange back fur often continued forward to the top of the head, reducing the black crown to a shape better described as a tiara. Most males had agouti crowns, although males with crowns that were very dark grey were not uncommon. The crowns of at least five males were indistinguishable from the black crowns typical of females.

Fig. 2. An adult male *Saimiri oerstedi citrinellus* in Parque Nacional Manuel Antonio (photos by S. Boinski).

Several other differences, not mentioned by Hershkovitz (1984), were also noted. Most importantly, adult *S. o. citrinellus* of both sexes appeared to be 15-20% larger than *S. o. oerstedi*. This qualitative impression was supported by observations of a captive group containing four *S. o. oerstedi* and two *S. o. citrinellus*. The expression of a 'tail pencil', the black fur on the most distal tail segment (see Hershkovitz, 1984), was also expressed more variably in *S. o. citrinellus*. In *S. o. oerstedi* the tail pencil was always full and thick, whereas in about a third of the *S. o. citrinellus* observed the pencil was distinguished only by color, its fur being of the same length and fullness as the more proximal tail sections. This latter condition is typical of the 'Roman-type' *Saimiri* (Maclean, 1964) found in South America.

Three behavioral characters also substantiate the presence of genetic differentiation. While the vocalizations of *S. o. citrinellus* have strong affinities to those of *S. o. oerstedi*, consistent differences in the contact calls, and possibly other call types, are apparent. The genital display, a stereotyped behavior pattern in squirrel monkeys, differed from the 'open' form (Ploog, 1967) exhibited by *S. o. oerstedi*, and instead resembled the 'closed' genital display (Ploog & Maclean, 1963) found in some South American *Saimiri* populations. Finally, it was extremely surprising to commonly observe extensive bouts of grooming (longer than 10 minutes) by mothers of their infants in *S. o. citrinellus*. I have never seen even one example of grooming among *S. o. oerstedi*, and to my knowledge grooming has not been described previously in any squirrel monkey.

Table 1. Characters distinguishing *S. o. citrinellus* and *S. o. oerstedi* (after Hershkovitz, 1984)

S. o. citrinellus	*S. o. oerstedi*
1. males with crown dominantly to entirely agouti	1. both sexes with black crown
2. preauricular patch agouti or buffy like cheek	2. preauricular patch black
3. outer sides of hindlimbs buffy or grayish agouti	3. outer sides of hindlimbs predominantly orange

Fig. 3. An adult female *Saimiri oerstedi oerstedi* in captivity (photo by S. Boinski).

Aside from what can readily be ascribed to locality-specific habitat differences, few differences between *S. o. citrinellus* and *S. o. oerstedi* in foraging behavior, group structure, and habitat use were apparent. Group sizes in *S. o. citrinellus* varied between 20 and 55 animals, with larger troops occupying the larger areas of suitable habitat. Arthropods, especially grasshoppers and caterpillars, were preferred foods, but much fruit was also consumed. Second-growth habitats containing abundant foliage and small diameter (less than 2 cm) branches and vines were also strongly preferred. Primary forest, the little still remaining in their range, was avoided. As has been shown in *S. o. oerstedi*, the amount of range used probably changes seasonally. This is due to fluctuating food availability, which is in turn dependent on seasonal rainfall patterns. June, 1986 was almost certainly a period of relatively great food abundance; troop ranges seldom exceeded 0.8 km². In the late wet season when arthropod and fruit abundance are probably lowest (October–November of a typical year) troop ranges apparently expand to between 1-2 km².

It must be stressed that all the extant troops of *S. o. citrinellus* are very, sometimes completely, dependent on human food crops as fruit resources. Guavas, bananas, mangos, corn, and guanabana are important components of the diet, especially in the season when native fruits are least abundant. The presence of large tracts of second-growth containing many small trees and shrubs such as *Cecropia*, *Inga*, *Piper*, and *Palicourea*, whose fruits and flowers often contribute significantly to *Saimiri* diet, is also dependent on human disturbance.

Range

Few data exist suggesting squirrel monkeys are found at altitudes greater than 300 m. Pacific lowlands and low foothills with large tracts of second-growth, or an older forest interspersed with small farmsteads and mangroves adjacent to lowland forest, are the habitats currently supporting *S. o. citrinellus* populations (Fig. 1). Even quite recently both subspecies of *Saimiri* were probably distributed over a much more continuous range, and concomittantly, had a much larger population. Vaughn (1983), depending on interviews by students with "knowledgeable residents" throughout Costa Rica in 1975-1979, estimated the distribution of *Saimiri* and other species of mammals. No evidence of *Saimiri* in many of the indicated areas now remains. Habitat destruction is the primary cause, but there are at least several sites in which it is doubtful that squirrel monkeys have been present within the past 20 years.

Deforestation has been due mainly to agriculture, and, to a lesser extent, lumbering and tourist development. *Saimiri* are extremely susceptible to deforestation because of the very large range (more than 1.5 km²) required for a typical troop. Annual range use decreases only when relatively greater reliance is placed on cultivated crops. Large areas of the Puntarenas lowlands are being converted into extensive oil palm and banana plantations. Oil palm plantations do not support squirrel monkeys because the fruit is inedible to them and there are few appropriate leaf surfaces from which to glean arthropods. Squirrel monkeys that enter banana plantations are often shot. Because of the very heavy use of pesticides in Costa Rican agriculture (Hartshorn *et al.*, 1982), squirrel monkey troops not eradicated by hunting and loss of habitat suffer from a sharp reduction in arthropod abundance (a vital source of animal protein), and toxic side effects. This is a serious problem; according to a banana company manager, 112 dead squirrel monkeys were found one day following a single aerial spraying of the plantation with pesticides.

Lumbering has the potential of increasing suitable habitat by creating secondary growth. Unfortunately, clear-cutting and not high-grading, is the prevalent technique. The cleared land is subsequently used for agriculture.

Squirrel monkeys also use portions of mangrove swamps adjacent to second-growth forest as foraging areas and sleeping sites. Pollution, both from ocean traffic and nearby factories and sewage outlets, and lumbering are dramatically reducing the mangroves available to *Saimiri* (West, 1976).

Resort development decimates much of the habitat that escapes agriculture and lumbering. Rugged coastal terrain, especially in the vicinity of Quepos and P. N. Manuel Antonio, that was not desirable for farming is now extremely valuable as sites for hotels and vacation houses. Mangroves are also being destroyed to create beachfront.

Squirrel monkeys are considered prestigious pets. Area residents know it is illegal, but despite vigorous denials by owners, squirrel monkey vocalizations were clearly heard in four of the households rumored to have a pet squirrel monkey that I visited. Pets are typically obtained as small infants by shooting the mother. Because the owners usually supply insufficient amounts of animal protein, many of the captives die within a few months. While the pet trade is not one of the primary factors limiting *S. o. citrinellus* populations, it will increase in significance as the remaining troops become reduced in number and more accessible in relict forest patches. Hunting for food is unimportant. What little meat is available in a carcass is considered unpalatable, probably because of the arthropods *Saimiri* commonly eats.

Current Distribution

P. N. Manuel Antonio is the only national reserve or protected area containing *S. o. citrinellus* (Fig. 4). Two troops are year-long residents (n= 55, 35 animals) and a third troop seasonally enters at the northern border. The range of the larger troop includes private land adjacent to the park that provides vital fruit sources. In fact, a frequent sleeping site of the larger troop is in the trees next to the restaurant of the Hotel Manuel Antonio.

Punta Quepos and adjacent beachfront on the western side of the highway between Quepos and Manuel Antonio consists of about 3 km² of excellent *Saimiri* habitat, all of which is privately owned. Unfortunately, this land also includes beautiful beaches and vistas. Three, or possibly four, troops each of about 25 animals use this area. Two of the troops also cross to the eastern side of the highway. There are two discrete crossing points, one at the Restaurante Barbas Rojas at the base of the Punta Quepos, and another 1 km to the south near the La Quinta cabinas. As of June 1986, development was limited to approximately 30 private residences and one major luxury hotel. However, water mains have been very recently installed. More extensive development on Punta Quepos is now possible. In May 1986, the regional office of MOPT, a government agency concerned with transport and development, presented local landowners with a development plan that included a 20 m wide road on the beach on the southern side of Punta Quepos. Electricity and associated services were also planned for an additional 200 vacation houses and several major resort hotels. Two landowners said that they believed wide-spread construction would begin before the end of 1986. On the western side of the highway from the northern edge of Punta Quepos to Quepos there is no evidence of more *Saimiri* or habitat suitable to support them.

On the other side of the highway between the park and Punta Quepos are a series of small farmsteads and vacation residences; the largest of the latter is Si Como No, a well forested estate opposite the road leading to Punta Quepos. At the beginning of 1986, one of the small farms next to the park cut down 60 mango trees and several hectares of second growth to make bean fields. The removal of this wooded area destroyed a major transit route between the park and the forested area on and near the Si Como No estate, and thus ready access to either of the two crossing points across the highway.

Continuing north on the eastern side of the highway from Punta Quepos, much forest which had contained squirrel monkeys has been eliminated in the past two years because of a proliferation of small farms growing corn. The exception is a patch of forest behind the grade school that is tenuously connected by means of small backyard orchards and overgrown pasture edges to a wooded valley about 1 km² in area to the north. At least one small squirrel monkey troop of less than 25 animals remains here, and possibly another troop.

In short, at least six and possibly eight troops, with a minimum population of 200 and an estimated maximum of 300, exist in the vicinity of P. N. Manuel Antonio. Between-troop movement is now extremely difficult because of habitat fragmentation and will certainly become more

difficult. The largest effective population size, in other words, the number of potentially interbreeding individuals, in this area is unlikely to exceed 110 animals.

Two isolated troops were found in the lowlands away from the vicinity of P. N. Manuel Antonio, each consisting of between 20 and 30 animals. One troop inhabits a tree farm 9 km northwest of Quepos. The other troop uses a 19 ha patch of forest next to several large plantings of banana, 2 km north of Quepos. Other troops, similarly isolated, probably exist, but none of these contribute to the maintenance of a stable population. Deforestation for pasture or fields has been so thorough that forested habitat on flat, low lying areas is rarely encountered.

Along the Puntarenas coast within the northern and southern limits of the *S. o. citrinellus* range are approximately 40 km² of mangroves (West, 1976; D. Melton, pers. comm.). I observed one troop of 30 animals on the edge of the mangroves at Matapalo. I also saw two pet *S. o. citrinellus* presumably captured in mangroves near Dominical. It is unlikely that troops are able to survive in mangrove without ready access to second-growth forest or cultivated crops. Probably only a small portion of the mangroves are commonly used. Interviews with local residents and close inspection of accessible mangrove edges at Palma, Parrita, Damas, Paquita, Boca Vieja, Matapalo, and Dominical indicates that population density is sparse. I suspect that a reasonable estimate

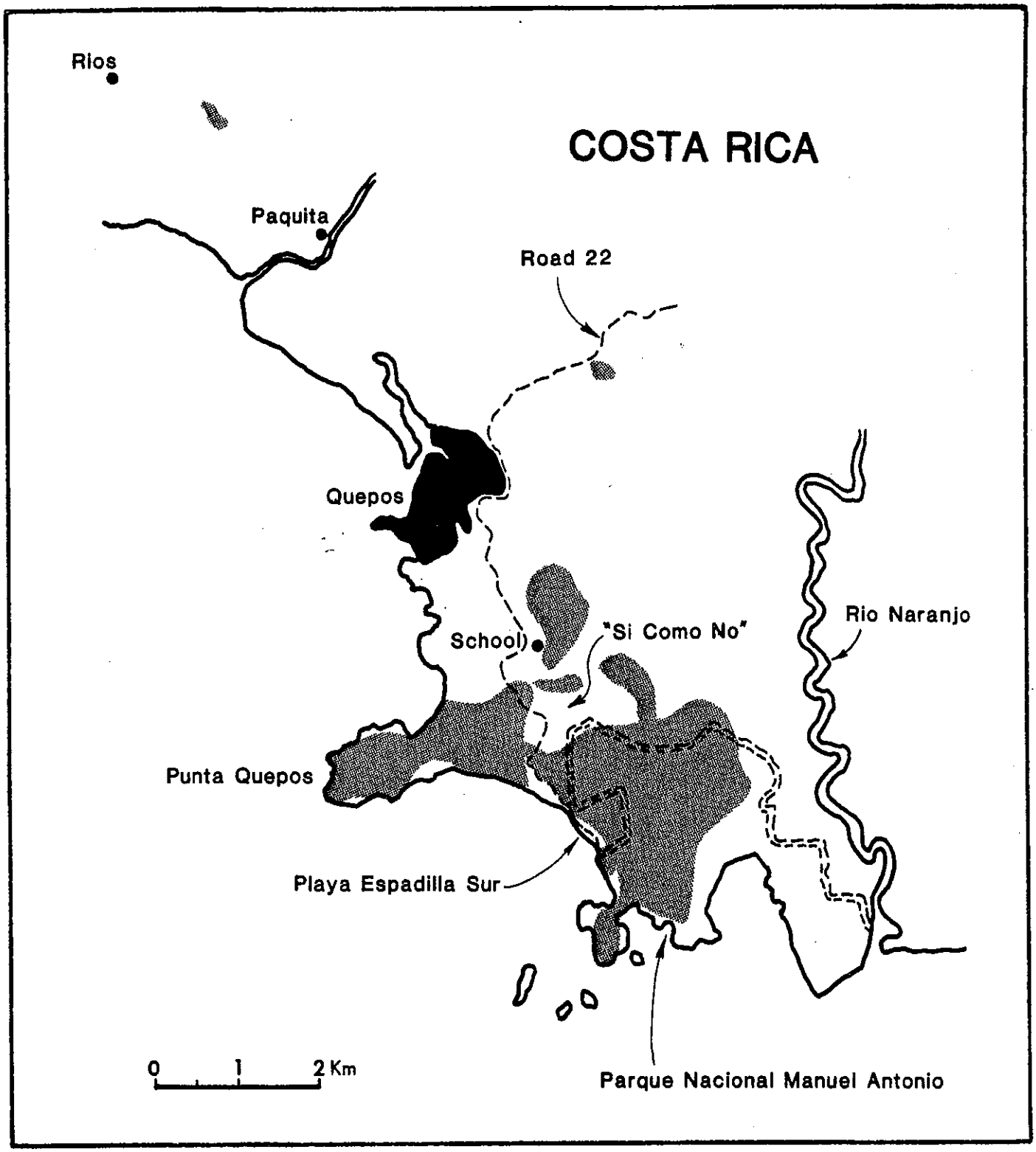

Fig. 4. Distribution of *S. o. citrinellus* in the vicinity of Parque Nacional Manuel Antonio in Costa Rica in 1986 (map by S. D. Nash based on author's original).

of the numbers of *Saimiri* using mangroves and associated forests along the Puntarenas coasts is probably between 400 and 600 individuals subdivided into relatively small troops.

The largest population of *S. o. citrinellus* is found in the low foothills (less than 300 m) straddling the border of Puntarenas and San José provence. Until recently, roads entering this steep terrain were few. The area has, however, long been used for a type of shifting or temporary ranching and farming. The high rate of forest turnover (i.e., tree falls and land slides that create early successional forest patches) and the low density of slash-and-burn farmsteads has created a near ideal habitat for *Saimiri*. *S. o. citrinellus* is apparently present in a near continuous range (more than 10 km²) to the east of Londres and Brujo between the Río Naranjo and the Río División. Another area of suitable habitat supporting *Saimiri* is to the northeast of Portalon and Matapalo. Informants consistently reported that troops were also found in small sections of the Fila Costeña. These latter two areas, however, are being rapidly deforested and converted into pasture. Within several years what troops still survive will be in relict forest patches isolated from each other.

It seems likely a population of 500-600, and possibly as many as 1,000, could be easily supported in the forest between the Ríos Naranjo and División. Little serious disruption of this habitat is now occuring and probably will not in the next five years. On the other hand, areas supporting *S. o. citrinellus* near Matapalo and Fila Costeña are currently undergoing rapid disturbance. I estimate another 500-1,000 animals could be present in these two areas, but in several years the number surviving might easily be halved.

I did not go above 400 m in my survey. Only two informants said they had seen *Saimiri* from 300 m to as high as 1,000 m. If this is true (although it seems unlikely), the Los Santos Forest Preserve, 62,000 ha of montane and lower montane rainforest at 800-4,000 m, might also protect *S. o. citrinellus*. None of the informants in Vaughn's (1983) survey stated that *Saimiri* were present in this area.

Recommendations

The major problem in conserving *S. o. citrinellus* and *S. o. oerstedi* in Costa Rica is the large troop range required in an area increasingly exploited by humans. Suitable habitat is so fragmented that the numbers of potentially interbreeding animals in any single population are few. Deleterious inbreeding is a risk in reproductively isolated groups of less than 500 (Franklin, 1980). Random fluctuations in mortality and birth within such small, effectively insular, populations, and even environmental extremes, can be devastating (Wilson and Bossert, 1971).

A highly conservative estimate of the continuous habitat needed to sustain 500 *Saimiri* is 12 km², based on the optimistic assumption that 40 *Saimiri* can be supported on 1 km² of second-growth forest. The single site that seems to even approximate this criteria is in the low foothills between the Ríos Naranjo and División. A preliminary report (Boinski, 1985) estimated the *S. o. citrinellus* population as unlikely to be larger than 300 animals. Though the total number of this endemic Costa Rican subspecies is probably better estimated at 2,000, their distribution in very small populations in habitats highly susceptible to destruction by human activity warrants the classification of *S. o. citrinellus* as an endangered taxon.

A recent report which gave projections on the future environmental situation in Costa Rica (Hartshorn *et al.*, 1982) stressed that (1) by the year 2000 Costa Rica's human population will increase by 50%; (2) unless government policy changes, continued deforestation will engender crisis conditions; and (3) Costa Rica is in the midst of severe economic difficulties with few immediate opportunities for recovery. Within this socio-economic context, the creation of suitably large reserves for the specific protection of *S. o. citrinellus* is difficult to advocate. On the other hand, these monkeys are a unique aspect of Costa Rica's biotic heritage that are readily appreciated and enjoyed by those few of its populace sufficiently fortunate to observe them in the wild. The following recommendations are not intended to be either final or sufficient. Instead, they should be used as an initial focus for discussions on the conservation of squirrel monkeys involving both public and private agencies in Costa Rica.

1. Public Information

Squirrel monkeys should be more prominently included in arguments for creation of forest reserves within the provinces of Puntarenas and San José, especially between the Ríos Naranjo and División. This taxon would be a very appropriate and appealing symbol for forest conservation in Costa Rica.

The precarious status of both *Saimiri* subspecies in Costa Rica is not recognized by the populace within its former range, or even by recent publications discussing threatened wildlife in Costa Rica (i.e., Hartshorn et al., 1982; Vaughn, 1983). Material concerning the conservation and natural history of *Saimiri* should be included in environmental information distributed to the Costa Rican public media, education system, and government agencies including forestry and agricultural stations, especially within the Pacific lowlands.

2. Capture of Wild Animals

Capture of *S. o. citrinellus* for reintroduction or placement in captivity should be seriously considered in the very near future. Vulnerable troops now exist in relict habitats, with little probability of maintenance, much less expansion, of population size. P. N. Carara, 30 km northwest of Quepos, is within the former range of *S. o. citrinellus*. Much of the forest in this park appears suitable for *Saimiri*, especially if temporary plantings of fruit crops or food supplementation occurs. I have not identified any other site that appears worth a reintroduction effort. Of course, a more detailed study of the annual cycle of food availability and potential interspecific interactions in P.N. Carara would be needed before reintroduction.

S. o. citrinellus is an extremely valuable genetic resource. *Saimiri* spp. are the second most commonly used research primate in the world (HEW Report, 1978). A population as genetically differentiated as *S. o. citrinellus* offers unique opportunities for comparative studies at many levels of biological processes. Two individuals of this subspecies are currently maintained in legal captivity and I would guess at least 50, and possibly many more, are pets throughout Costa Rica. A breeding group of *S. o. citrinellus* should be maintained in captivity. I stress that captivity must only be attempted if sufficient funds and access to quality veterinary care are committed for an extended period of time. It would be preferable to establish a captive group in Costa Rica, perhaps initially with confiscated pets. Yet there does not seem to be any institution within Costa Rica whose research focus or funding would encompass a long-term commitment to a colony of *Saimiri*. P. N. Bolivar, the national zoo, is infamous for its failures in maintaining squirrel monkeys in captivity. Though I have a conflict of interest in this matter, being associated with a research institute in the United States, I believe that some animals should be transferred to a permanent facility outside of Costa Rica.

If in the coming years continued deforestation reduces the population of *S. o. citrinellus* to even lower levels, serious discussion should occur regarding the capture of isolated troops and their placement in captivity. Possibly a multi-purpose facility allowing maintenance, study, and public exhibition could be established. This is not being advocated for the present, but should be considered as an alternative ten years from now.

3. Management of *S. o. citrinellus* in P. N. Manuel Antonio and Vicinity

Further development within the section of private land encompassed by P. N. Manuel Antonio that fronts on the Playa Espadilla Sur must stop immediately. The larger of the two troops residing in the park relies heavily on this area for foraging and sleeping sites. In 1985, a patch of forest along the Quebrada Camaronera was cut to allow construction of resort cabins. This resulted in the loss of a major foraging area and was associated with a large change in the typical travel routes of the troop. More extensive construction is planned on the hillsides in the private land that border the park.

The movement patterns and foraging behaviors of *S. o. citrinellus* in the park should be studied over an annual cycle. Great emphasis in data collection should be given to determining the distribution and availability of food to these monkeys in the late wet season. The late wet season is probably the time period when food shortages are most severe. This research project would be very suitable for a student pursuing an advanced degree.

Given the extensive and costly development planned on Punta Quepos, direct efforts to conserve *Saimiri* habitat appear futile. Landowners should be strongly encouraged to both minimize deforestation and plant fruit trees used by *Saimiri*, especially those bearing ripe fruit in the late wet season. Special attention should also be given to ensure that the two wooded locations allowing troops access to and from the eastern side of the highway are preserved.

Development should be stopped, if at all possible, on the eastern side of the highway from the northern park boundary to the valley beyond the grade school. Critical areas are those zones, often merely trees on pasture and field edges, that connect forested areas. There is a deforested gap between the estate opposite the Punta Quepos and the grade school to the north created by small farmsteads growing corn. If these small properties could be acquired and allowed to regenerate the probability of maintaining *Saimiri* in and about the park would be greatly increased. Though recent aerial photographs of this area exist, I was unable to gain access to them. These would certainly be quite useful in identifying critical travel routes and land with the highest priority for possible purchase.

Within the coming 15 years a significant portion of the forest within the park will succeed to more mature types of forest providing less food for *Saimiri*. Management of segments of forest to maintain areas of second-growth forest is strongly recommended. Appropriate fruit sources should be planted about the abandoned buildings and pasture near the park headquarters and on any additional land acquired by the park in the privately owned section near the Playa Manuel Antonio or to the north of the park border.

4. Centralization of Information

No agency or individual in Costa Rica is currently collecting information on the conservation of squirrel monkeys. A government agency, such as the Servicio de Parques Nacionales, should monitor the conservation status of squirrel monkeys throughout the country, and act as a clearing house — collecting information from and redistributing information to pertinent agencies and individuals. People capable of providing long-term care and housing of confiscated animals should also be identified.

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Demographic Patterns in One Group of Muriquis

by Karen B. Strier

This paper describes changes in group size and composition of one group of muriquis or woolly spider monkeys (*Brachyteles arachnoides)* monitored over a five-year period from June 1982-June 1987 at Fazenda Montes Claros in Minas Gerais, Brazil. The 800 ha forest at Fazenda Montes Claros is privately owned, and both the forest and the monkeys have been protected by the owner since 1944. The forest supports a second group of *Brachyteles* consisting of at least 18 individuals, as well as brown howler monkeys (*Alouatta fusca*), tufted capuchin monkeys (*Cebus apella nigritus*), and buffy-headed marmosets (*Callithrix flaviceps*).

During the five years since systematic observations began on the study group, the group has increased by over 50% from 22 individuals to 34 individuals. Changes in group size and composition have been due primarily to births, immigrations, and the maturation of nonadults; only one individual, born in 1982, was not accounted for in June 1987 (Table 1).

Table 1: Composition and Size of Study Group

Age-Sex Class	July 1982	July 1983	July 1984	Sept 1985	July 1986	June 1987
Adult males	6	6	6	8	8	8
Adult females	8	8	8	9	9	10[b]
Subadult males	0	2	2	0	0	0
Subadult females	0	0	2[a]	1	1	1
Juveniles—2	2	0	6	7	8	10[c]
Juveniles—1	0	6	1	1	3	4
Infants	6	1	1	3	4	1
Group Size	22	23	26	29	33	34

[a]Two subadult females immigrated into group.
[b]One adult female immigrated into group.
[c]One of juvenile—2's, born in 1982, was not present with group.

Brachyteles at this site have distinctive facial pigmentations which permit individual identifications. However, young juveniles and infants can not generally be distinguished because of their uniformly black faces.

Group members were classified by sex and the following age categories: adult, subadult, juvenile—2, juvenile—1, and infant. Criteria for assigning age classes are described below:

Adults: Both sexes have pendulous genitalia, with extremely large testes on males and elongated clitori and labia on females.

Subadults: In males, the scrota are distinct and enlarged by comparison to the juvenile state, although still smaller than full adults. In subadult and nulliparous females, the nipples are small; subadult female genitalia are smaller and less pendulous than those of adults.

Juveniles: Small juveniles (J—1) and large juveniles (J—2) were distinguished solely by body size, which did not differ notably among cohorts of known age. Small juveniles were approximately two to three and a half years old; large juveniles were estimated to be three and a half to six years old.

Infants: Two developmental stages were recognized : new infants, from 0-8 months old, nursed frequently and were always carried on their mothers' ventrums during group movements; older infants, from 8-24 months, continued to nurse until weaning at approximately 14-18 months, and were carried jockey style on their mothers' backs until the final months.

In June 1982, the 22 individuals in the group included six adult males, eight adult females, and two "J—2" males. Six of the eight adult females were carrying infants whose size and dependency indicated that they had been born during the preceeding six months. One of the two remaining adult females was nulliparous, but gave birth to her first infant the following year. The other adult female was not associated with an infant or juvenile, although her elongated nipples suggested that she had previously nursed an offspring. Although she was the most sexually-active female in the group during an intensive 14-month study period from June 1983-July 1984, this female has never been associated with an infant (Strier, 1986, 1987).

All six of the infants born in 1982 were present in June 1983; their mothers continued to nurse and carry them until August 1983; when some of the mothers began to wean their young. In early October, the first of these females was seen copulating. All of the other adult females, with the exception of the primiparous female, copulated during the 14-month study period in 1983-1984 (Strier, 1986). These copulations resulted in four births between June 1984 and January 1985. It was possible to estimate gestation at between seven and eight and one half months by counting back from parturition to observed dates of copulation for three of these females. Based on all subsequent known births, the minimum interbirth interval appears to be slightly longer than two years.

In June 1986, the first birth of twins in this species was documented. The female who had given birth to her first infant in June 1983 was carrying twins approximately one month old. Two other females were carrying infants who appeared to be between four and eight months of age.

Two subadult females joined the group during the 1983-1984 study period. The larger of the two had begun to copulate by March 1984, but was not carrying an infant as late as September 1985. If the infant she was nursing in June 1986 was indeed her first infant, it suggests that female *Brachyteles* experience a period of adolescent sterility of approximately 15 months.

Fig. 1. Muriquis at Fazenda Montes Claros in Minas Gerais (photo by A. Young).

The smaller of the female immigrants was observed in the study group in July 1986 and in June 1987. However, between these dates she was positively identified with muriquis from the other group (F. Mendes, pers. comm.). Mendes' description of her renewed efforts to associate with the study group conform to previous observations of female immigration attempts (Strier, 1986).

No emigrations from the study group have been observed, although one female, born in 1982 and sighted with the group on consecutive censuses through July 1986, was not present in June 1987. However, it is still unclear whether this female has joined the second group of muriquis, is traveling alone, or has died.

The possibility that this natal female has emigrated, together with the two female immigrations in 1983-1984, and a third new female who had joined the group by June 1987, suggest that in *Brachyteles* it is the females who typically transfer between groups while the males remain. Such preliminary evidence of female transfer in the muriqui is of theoretical interest, as it contradicts the more common pattern of male transfer found in most Old World monkeys. Further evidence of such behavior will also be important to managment plans to protect this endangered species (see Mittermeier *et al.*, in this issue).

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Fig. 2. More muriquis at Fazenda Montes Claros (photos by A. Young).

Africa

Report from the Gorilla Advisory Committee on the Status of *Gorilla gorilla*

compiled by Amy Vedder

The Gorilla Advisory Committee of the IUCN/SSC Primate Specialist Group has prepared the following summary of the current status of *Gorilla gorilla* in the hope that a better understanding of gorillas will improve their conservation. If we sincerely intend to prevent the disappearance of gorillas, we must continue studies of their population status and distribution, their ecological requirements, and threats to their continued existence. We must also apply this knowledge to active programs of conservation. Fortunately, a series of projects are in progress to aid in the protection of this species. The earliest are already beginning to show positive results. These projects, however, require continued support, and new projects must be initiated in areas where no efforts are currently being made. We hope that this document will serve to increase host country governments' and international conservation groups' commitment to gorilla conservation.

Status and Distribution of *Gorilla gorilla*

The species *Gorilla gorilla* (Savage & Wyman) is the single representative of its genus (although it has been proposed that the species *gorilla*

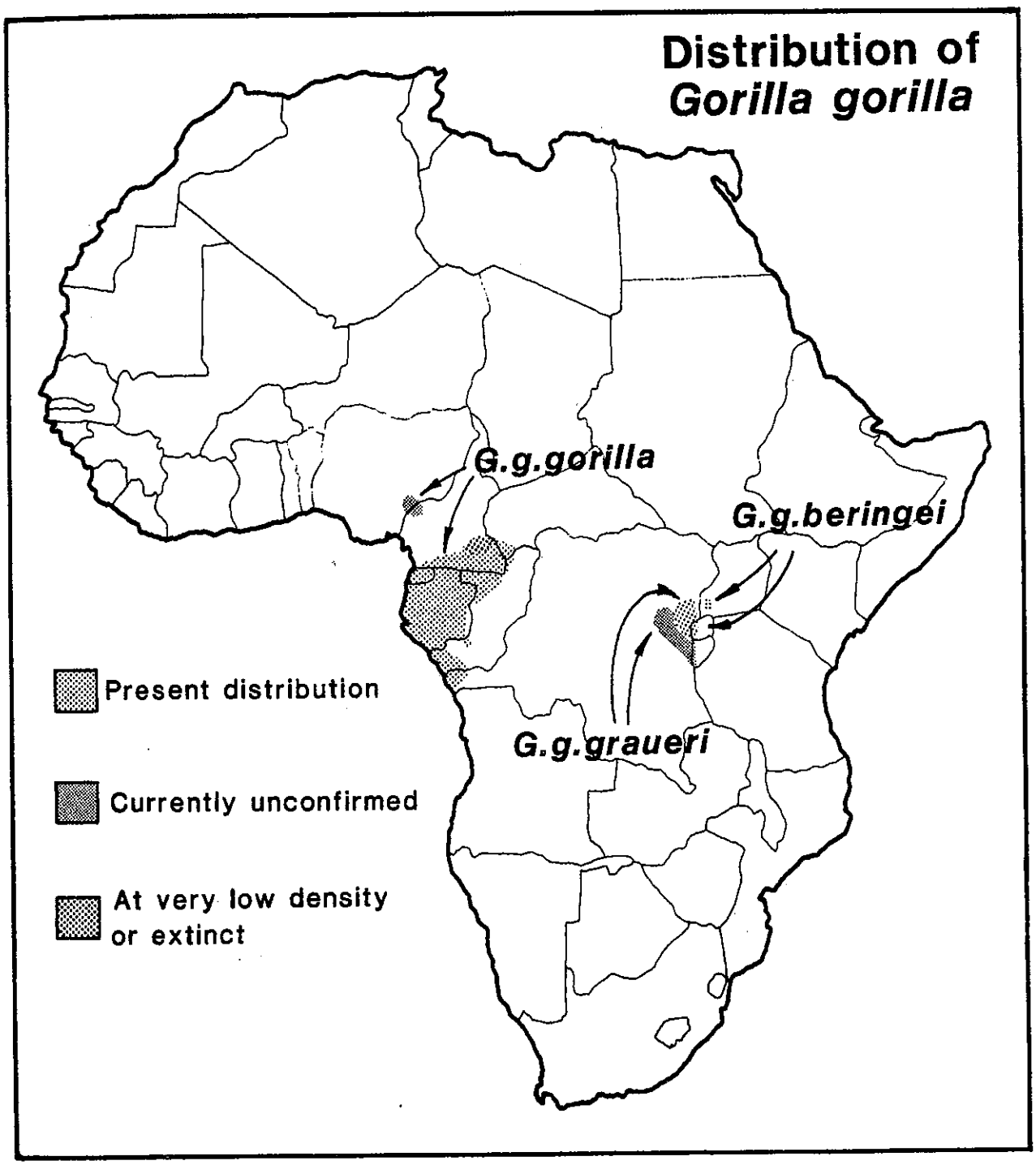

Fig. 1. The distribution of *Gorilla gorilla* (map by S.D. Nash based on author's original).

be included in the genus *Pan* (Hill, 1981), we presently conform to the more widely-accepted *Gorilla gorilla*). Gorillas are found in equatorial Africa in two distinctly separate regions: west Africa from Nigeria/ Cameroon to Cabinda and east to the southwestern corner of the Central African Republic; and east-central Africa from eastern Zaire, into northwestern Rwanda and southwestern Uganda (Fig. 1). The species is listed in Appendix I of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (1973), in Class A of the African Convention on the Conservation of Nature and Natural Resources, and has been classified as *vulnerable* in the IUCN Red Data Book (1980).

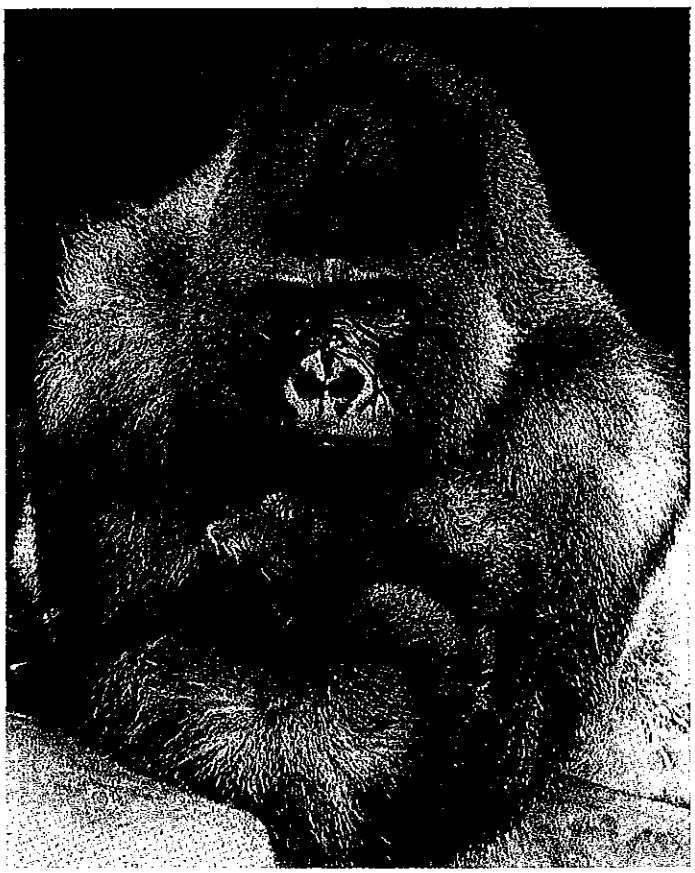

Fig. 2. A lowland gorilla (*G. g. gorilla*) (photo by the San Diego Zoological Society).

Three subspecies are currently recognized: *G. g. gorilla*, the western lowland gorilla (Fig. 2); *G. g. graueri*, the eastern lowland (or Grauer's) gorilla; and *G. g. beringei*, the mountain gorilla (Groves, 1970; Groves and Stott, 1979; Stott, 1981; Fig. 3). The status and distribution of each subspecies is detailed as follows.

G. g. gorilla. The western lowland gorilla is found in eastern Nigeria, west-central and southern Cameroon, southwestern Central African Republic, Equatorial Guinea, north-central and western Republic of the Congo (Brazzaville), Gabon, and Cabinda (an enclave of Angola). It is estimated that there are 40,000±9,000 individuals, the largest portion of which are located in Gabon (Harcourt, 1981a; Tutin and Fernandez, 1984a, 1984b). Surveys currently taking place, however, indicate the possibility of populations significantly higher than expected in northeastern Republic of the Congo (M. Fay, pers. comm.).

G. g. graueri. Grauer's gorilla is located entirely in eastern Zaire in a series of isolated populations. Its numbers have been estimated to be between 2,500 and 4,500 (Emlen and Schaller, 1960; Schaller, 1963), but have most certainly declined in recent years (Goodall, 1980).

G. g. beringei. The mountain gorilla is the least numerous of the three subspecies, and is listed as *endangered* in the Red Data Book (1980). Only two populations are thought to exist: the Virunga population which straddles the international boundaries of Zaire, Rwanda, and Uganda; and the Bwindi (or Impenetrable) Forest population of southwestern Uganda. The subspecific affiliation of the Bwindi population is problematical (Groves, 1970; Groves and Stott, 1979), but evidence points to a closer alliance with *Gorilla gorilla beringei*. Recent censuses show that mountain gorillas total between 370 and 440 individuals (Harcourt, 1981b; Butynski, 1985; Vedder and Aveling, 1986).

Fig. 3. Mountain gorillas (*G. g. beringei*) (photo by A. Vedder).

Common Threats to Survival

The greatest threat to gorillas is loss or degradation of suitable habitat. Gorillas inhabit African lowland and montane forests, which in general are being converted at an alarming rate (Myers, 1980). Although gorillas prefer areas of abundant herbaceous growth (secondary forests and edges, low-mid montane forests), they are also found at lower densities in primary tropical rain forest (Schaller, 1963; Goodall, 1977; Tutin and Fernandez, 1984; Vedder, 1984; Carroll, 1985). Permanent conversion of these forests for agriculture (cash and subsistence cropping and livestock grazing) is taking place throughout the range of the species, with *G. g. gorilla* and *G. g. graueri* each being greatly affected. Logging is another activity that is radically altering gorilla habitat, especially threatening *G. g. gorilla* (Gartlan, 1980). A serious potential threat to gorillas in coastal areas of west Africa is present and future petroleum exploitation.

Direct or indirect effects of hunting also imperil the species. *G. g. gorilla* and *G. g. graueri* are hunted both as sources of food for local human populations and in an effort to control crop destruction (Sabater Pi and Groves, 1972; Cousins, 1978; Goodall, 1980; Harcourt and Stewart, 1980). Organized trade is virtually non-existent, but Cameroon issued permits for the exportation of at least eight young gorillas in 1984. In addition, traps intended for the capture of other animals, particularly ungulates, frequently maim or kill gorillas throughout their range. The capture of infants (which normally requires the killing of several adult gorillas) and the taking of adult skulls for sale to expatriates are relatively recent practices that have taken a toll as well, most significantly on the small Virunga population of *G. g. beringei* (Weber and Vedder, 1983).

National parks and/or reserves have been established in several areas within the ranges of each of the subspecies. However, with the possible exception of Maiko National Park (Zaire), the individual gorilla populations located in these areas are generally small. In addition, legislation protecting the existing reserves is seldom fully enforced. Illegal hunting and forest conversion within the boundaries of these "protected areas" affect each of the subspecies. This situation results from multiple causes, including lack of popular support, necessary expertise, and/or financial resources for existing reserves.

Conservation

Efforts have been initiated for the conservation of each of the three subspecies of gorilla. These are discussed separately below and for each a brief summary is given regarding: (1) conservation-related research,

subdivided into (a) estimates of population sizes, (b) gorilla ecology and life-history parameters, and (c) analysis of human conflicts with attitudes towards gorilla conservation; and (2) applied projects undertaken, in progress, or being initiated.

G. g. gorilla — **Conservation-related Research**

1a) A nationwide census of gorilla populations in Gabon was conducted in 1980-1983 (Tutin and Fernandez, 1984a; 1984b). The census, based on nest counts from transect lines, produced a population estimate of 35,000±7,000 individuals. Numerical estimates of the gorilla populations in the other countries are very difficult because so few data are available. However, it is clear that the population in Gabon represents a significant portion of this subspecies. Numbers in Cameroon, Central African Republic and Equatorial Guinea are known to have decreased considerably within the past decade (Gartlan, 1980). Despite this, an unusually high density of gorillas exists in southwestern CAR and northeastern Congo (Carroll, 1986; M. Fay, pers. comm.) and although population estimates have not yet been made there are certainly more gorillas in the region than previously suspected. Details of the distribution of gorillas in Nigeria, Cameroon, and the Congo are vague and sometimes contradictory.

1b) Ecological research on general aspects of diet, group size and ranging patterns has been conducted in Equatorial Guinea (Jones and Sabater Pi, 1971), southern Cameroon (Calvert, 1985a; 1985b), Gabon (Tutin and Fernandez, 1985), and is commencing in the Central African Republic (Carroll, 1986; M. Fay, pers. comm.). No population of lowland gorillas has yet been the subject of detailed long-term field work but two programs are beginning. The first, initiated in October 1983 in the Lope-Okanda Reserve in central Gabon, aims to habituate social groups of gorillas to the presence of human observers and to carry out ecological and behavioral studies. A second program began in January 1987 in the Central African Republic, and includes extensive surveys to be followed by an intensive comparative ecological study of gorillas in two different habitats: primary and secondary (logged) lowland rain forest.

1c) Conflicts between humans and gorillas have been documented by Sabater Pi and Groves (1972), Cousins (1978), Goodall (1980), Harcourt and Stewart (1980), and Tutin and Fernandez (1985a, 1985b). Carroll and Fay (pers. comm.) have planned an examination of the traditions and attitudes of the BaBinga pygmies toward gorillas in the Central African Republic.

G. g. gorilla - **Applied Conservation Projects**

2a) Very few western lowland gorillas are protected under national park status. These few occur in the Monte del Frio National Park (100 km²) of Equatorial Guinea and the Odzala National Park (1,260 km²) of the Republic of the Congo. Several additional regions containing western gorillas are currently being considered for national park status: Dja Reserve (ca. 4,000 km²) in Cameroon, and the Dzanga-Sangha area of south-western Central African Republic (ca. 1,000 km² to be within a multiple-use reserve totaling 3,300 km²). Gorillas are present in the following reserves: the Lope-Okanda (5,000 km²), Moukalaba (1,000 km²), and Wonga-Wongue Reserves of Gabon; the Campo and Takamanda Reserves of Cameroon; the Monte Raices Wildlife Reserve (260 km²) of Equatorial Guinea. Currently no reserves protect gorillas in the Central African Republic, Cabinda, or Nigeria.

2b) No applied conservation projects are in progress. A program of habituating groups of gorillas has been proposed to the Gabonese authorities as part of a government project to develop tourism in the Lope-Okanda Reserve. Similarly, proposals have been made to World Wildlife Fund-France and the Peace Corps volunteer organization, to launch a conservation education program in Gabon. Both projects await approval and funding from these agencies. Survey work continuing in the Central African Republic is intended as the basis for reserve planning and management, and project personnel plan to development conservation educational materials for use in the country (M. Fay and R. Carroll, pers. comm.).

G. g. graueri — **Conservation-related Research**

1a) The only recent estimates for all but one of the populations of Grauer's gorillas were based on information collected in the late 1950's (Emlen and Schaller, 1960; Schaller, 1963). These estimates were derived from hiking transects in a limited number of sites, and extrapolating for the remaining habitat reported to harbor gorillas. More accurate information for the population found in the Parc National de Kahuzi-Biega is available from a census of night nests conducted in 1978-1979 by Murnyk (1981).

1b) Ecological research concerning ranging patterns, with respect to season and food availability, and diet composition has been completed by Casimir and Butenandt (1973), Casimir (1975), Goodall (1977), and Goodall (1978).

1c) Human activities which threaten the survival of Grauer's gorillas have been noted by Goodall and Groves (1977), Goodall (1980), and Aveling and Aveling (in press).

G. g. graueri - **Applied Conservation Projects**

2a) Zaire has established two national parks within the range of *G. g. graueri*. Parc National de Maiko is the larger of the two, at approximately 10,000 km², but reportedly contains gorillas at low density (IUCN Conservation Monitoring Centre, 1982). The Parc National de Kahuzi-Biega was enlarged in the mid-1970's from 600 km² to more than ten times that size. Murnyak (1981) censused the original area, and estimated approximately 250 gorillas. The gorilla population in the enlarged park is unlikely to be 10 times Murnyak's census count however, since the recent addition is largely lowland primary forest and therefore habitable at a lower density. It is encouraging that the park area has been increased recently, but a lack of enforcement of protective regulations remains a problem within these areas.

2b) A program of tourism was developed during the early 1970's in the Parc National de Kahuzi-Biega by A. Deschryver, then conservator of the park. The program exists to date, and though visitation practices and disturbance of gorillas have not always been well controlled, it has undoubtedly been the most important factor in the continued existence and enlargement of the park. In 1985, German bilateral assistance was made available for development of the park and tourism via a regional development project entitled Conservation Integrated in Development (von Richter, 1986). Emphasis has been placed on increasing public awareness, both governmental and local, via seminars, distribution of educational materials, and visitation to the park. Assistance is also designed to promote and improve control of the tourist program, while attempting to yield economic benefits for local people. Tourism, which has been part of the operation of the national park for many years and is managed by park personnel, is scheduled to receive German assistance through 1988. Educational activities have been initiated, and are intended to continue as well with German aid.

2c) The Zaire Gorilla Conservation Project was launched in March 1984 with funding from Frankfurt Zoological Society (FZS) and World Wildlife Fund (Aveling and Aveling, 1983). The project is operating in conjunction with the Institut Zairois pour la Conservation de la Nature (IZCN) and other Zairian government departments, as well as IUCN. Project personnel aim to clarify the distribution and status of the various gorilla populations in the Kivu province of eastern Zaire, and to initiate and develop conservation measures for representative populations of both *G. g. graueri* and *G. g. beringei*. As part of plans to improve the protection and long-term survival prospects of these representative populations, the project has begun the development of controlled tourism focused on the gorillas, and will initiate conservation education activities in 1987 on a regional basis. (It should be noted that this project encompasses most of the existing *G. g. graueri* range and that part of the Virunga population of *G. g. beringei* that is in Zaire.) The project is now in progress and core funding for personnel has been committed by FZS and WWF for three years. However, funds to implement the conservation measures recommended by the team and IZCN are necessary and will be sought from both FZS and WWF as well as other organizations con-

cerned with gorilla conservation. Funding is currently required for both personnel and equipment to help improve protection of the Virunga gorillas and to facilitate conservation education efforts in the region.

***G. g. beringei* — Conservation-related Research**

1a) The closest monitoring of a gorilla population has focused on the Virunga mountain gorillas. General estimates from 1959-1960 (Emlen and Schaller, 1960) have been succeeded by more accurate censuses (combined nest counts and sightings) done in 1971-1973 (Harcourt and Fossey, 1981), 1976-1978 (Weber and Vedder, 1983), 1981 (Harcourt *et al.*, 1983), and 1986 (Vedder and Aveling, 1986). This series of censuses indicates an approximate halving of the total population between 1959 and the early 1970's, followed by a trend of slight increases in the Rwandan sector being offset by a decline in Zaire and Uganda, and finally a likely increase throughout. A portion of the Bwindi Forest was censused in 1959, 1979 and 1984, and derived population estimates suggested little change (Schaller, 1963; Harcourt, 1981; Butynski, 1985).

1b) The ecology and life-history parameters of gorillas are also most fully detailed for the Virunga population. Early studies of gorilla ecology and behavior provide considerable background information (Schaller, 1963; Fossey, 1974). Life-history parameters have been investigated more recently by Harcourt, Stewart and Fossey (1976), Harcourt and Fossey (1981), and Weber and Vedder (1983). The most recent of these studies demonstrated a high potential population growth rate. Ecological work, particularly with respect to diet composition and ranging patterns, has produced a detailed data base for one subset of the Virunga population (Fossey, 1974; Fossey and Harcourt, 1977; Vedder, 1984; Watts, 1984; Harcourt and Stewart, 1984).

1c) Threats confronting the Virunga gorillas have changed, as noted by a series of authors (Groom, 1973; Weber and Vedder, 1983; Aveling and Harcourt, 1984). Somewhat different problems are encountered in the Bwindi Forest Reserve (Kingdon, 1973; Harcourt, 1981; Butynski, 1984a). The broader context of human/gorilla conservation conflicts has been analyzed, with an emphasis on local populations' attitudes towards wildlife and wild areas, by Weber (1981, 1986).

***G. g. beringei* - Applied Conservation Projects**

2a) The Virunga population of *G. g. beringei* was the reason for the establishment of the first national park of Africa (Parc National Albert) in 1925. Because this region is now divided by international boundaries, responsibility for the population is similarly divided among the three nations. Two of these (Rwanda and Zaire) have maintained national park status for the area, whereas the Ugandan portion is considered a reserve. The Rwandan Parc National des Volcans is ca. 160 km², the Kigezi Gorilla Sanctuary of Uganda measures less than 25 km², and the Zairian Parc National des Virunga-Sud contains a 240 km² sector inhabited by gorillas. The Bwindi Forest Reserve (Uganda), home of the second population of *G. g. beringei*, comprises 320 km². The Parc National des Virunga has not suffered serious encroachment since its creation. Despite continued reports of sufficient protection, it is clear that effective park security began to lapse significantly during the 1960's, undoubtedly due to civil strife, and remains inadequate to date. This is evidenced by the drastic decline in that sector's gorilla population over the past 25 years (Weber and Vedder, 1983). The Parc des Volcans was reduced in size by 40% during 1968-69, but has suffered no further significant loss of land. Cattle were forcibly excluded from the park in 1976, and guard forces have been augmented. Protection for the Kigezi Gorilla Sanctuary is almost entirely lacking and it has suffered from serious encroachment and degradation. Recent censuses have found no gorillas living permanently within the reserve. The Bwindi Forest Reserve has remained relatively stable in area, but much illegal logging, hunting and gold-mining takes place within its boundaries.

2b) In 1978, an 18-month project, entitled Gorilla Habitat Preservation in Rwanda, was initiated with support from the New York Zoological Society (Weber and Vedder, 1979). This project took place in and around the Parc National des Volcans, and was designed to investigate both the biological and sociological aspects of gorilla conservation. The study involved determination of the current status of the Virunga gorillas, their ecological requirements in terms of food species and vegetation zones, and the human land-use practices and attitudes in the environs of the park (as mentioned above under research). The study went on to recommend actions on the part of conservation organizations and the government of Rwanda that would help alleviate perceived conflicts between the local human population and the gorillas (the development of better park security, a tourism program, and a conservation education program). Pilot projects were begun in education, with local residents and students throughout the country as targets. Groundwork was laid for further collaboration with the Office Rwandais du Tourisme et des Parcs Nationaux (ORTPN) and the education ministries. This project evolved in part into the subsequent Mountain Gorilla Project.

2c) The Mountain Gorilla Project (MGP) has been in operation since 1979, funded by a consortium of conservation groups (African Wildlife Foundation, Digit Fund, Fauna and Flora Preservation Society, People's Trust for Endangered Species, World Wildlife Fund) and involving the work of a series of field representatives. Such work has been conducted in conjunction with ORTPN and the ministries of education, who have provided the project with Rwandan counterparts and personnel. The MGP was designed with three principal objectives: to improve park security by training and equipping park guards, and by strengthening enforcement of legal regulations; to develop a well-managed tourism program by habituating several gorilla groups to human presence, training guides, and establishing an orderly system of reservations and visitation; and to begin a program of education, aimed at school children and the local population, covering gorillas, wildlife, and general conservation issues (Fig. 4). The project is still in progress, and has shown success on all three fronts. Guards are far more effective and better equipped than previously, and poaching of gorillas has decreased. Tourism has brought significant profit to the park, served educational functions of its own, and was probably an important factor in the decision to abandon plans for further agricultural development in the park. The effects of education are clearly long-term, yet thousands of Rwandans have been exposed to information about conservation, and changes in attitudes are evolving (Weber, 1986). In addition, renewed interest on the part of bilateral aid groups is being shown; e.g. the Belgian cooperation has built guard and visitor lodgings at the park headquarters. Funding by conservation groups will be required into the future to assure continuation of the various branches of the MGP, some of which have been slowed by lack of adequate support.

2d) The Eastern Zaire Gorilla Conservation Project (described above under *G. g. graueri*), concerns both subspecies of eastern gorillas. The main focus of the project is on the Zaire portion of the Virunga population of *G. g. beringei.*

2e) Emphasis placed on the analysis and resolution of problems of human resource use in the vicinity of the Parc National des Volcans of Rwanda has resulted in the establishment of a development project which is intended in part to help alleviate human pressure on the park, and consequently the gorillas. The Ruhengeri Resource Analysis and Management Project, a three-year project which began in April 1985, is funded by the U.S. Agency for International Development. It is designed to inventory the natural resources of the province outlying and including the Parc National des Volcans, assess human demand on those resources, draw up management guidelines for ecologically sound development and help to initiate research, intervention and education activities which should relieve pressure on the regional resource base. This is being done in conjunction with the appropriate Rwandan institutions. The core program is in progress, and has produced informative resource maps of the region. Ancillary projects which are intended to develop as offshoots of the program may require additional funding.

2f) With regard to the Bwindi Forest population of *G. g. beringei*, a conservation project is now underway, funded by the World Wildlife Fund. Entitled "Conservation of the Impenetrable (Bwindi) Forest, with Particular Reference to the Mountain Gorilla" (Butynski, 1984b), it covers a three-year period which began in July, 1986. Project personnel will determine the current status of *G. g. beringei* and other species

of the forest, and the effects of human activity on gorillas. The development of a ten-year management plan is intended, which may include lobbying for a higher legal protection status for the forest. A conservation education program is planned for the environs, as well as encouragement of conservation-related development projects. Research done within the scope of the project has been designed to furnish a scientific basis for the development of a possible tourism program. All work is being done in cooperation with Ugandan authorities, and two counterparts will be trained. Funds are currently being sought to support the education program.

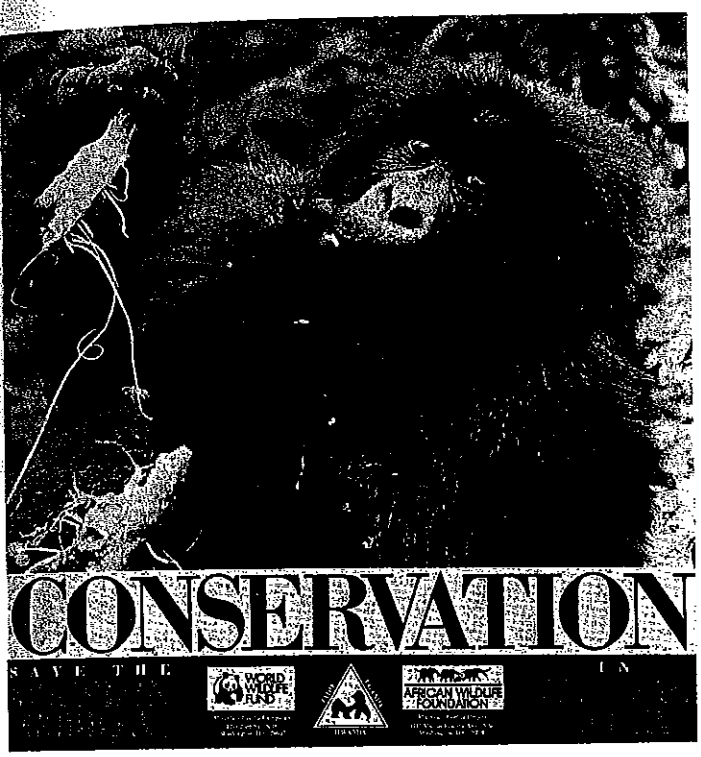

Fig. 4. A poster with accompanying test advocating the conservation of mountain gorillas (poster photo by R. Weyerhaeuser).

Conservation Priorities

The goal of the Gorilla Advisory Committee is to work toward the maintenance of biological diversity by focusing on the conservation of the three subspecies of gorilla. Because the subspecies *G. g. beringei* numbers less than 440, it requires and is receiving the most urgent attention. Very little is known, however, about the current status of either *G. g. graueri* or *G. g. gorilla* outside Gabon. Furthermore, populations within the subspecies *G. g. graueri* and *G. g. beringei*, as well as many of the populations of *G. g. gorilla*, are scattered and isolated from each other. Citation of total numbers of individual members of a subspecies, without reference to this fact, can therefore be misleading. Each subspecies requires the attention of conservationists.

The following activities are all considered to be necessary, and their order is not intended to imply rank in terms of importance or immediacy. Most are interrelated or even inseparable, but they are discussed individually for the sake of convenience. Some of these recommendations are already being implemented, as described above.

1) The current population sizes and distribution of *G. g. gorilla* (outside Gabon, where recent estimates are available) and *G. g. graueri* must be determined, along with threats to these populations. Consideration of both factors will allow evaluation of which individual populations are most important (those which are the largest but still protectable), and thus most deserving of attention at this time. Surveys are especially needed in the Republic of the Congo, Equatorial Guinea, Nigeria, and eastern Zaire. Since populations are normally isolated and relatively small, several of each subspecies must be targeted for immediate protection. In the case of *G. g. beringei*, it is clear that efforts must be focused on both of the two remaining populations. Important populations should subsequently be monitored on a regular basis, especially those of relatively small numbers and/or under substantial threat. Both populations of *G. g. beringei* should be censused every 3-4 years.

2) Conservation areas should be established as soon as possible for those populations determined to be of primary importance. This is particularly crucial for *G. g. gorilla*, which is currently not well-represented in any national park. Upgraded protective status should be lobbied for in cases where important populations are found in reserves where activities inconsistent with the survival of gorillas are allowed. This may be the case for selected reserves of west Africa (such as the Lope of central Gabon), the Kigezi Gorilla Sanctuary, and the Bwindi Forest Reserve of Uganda, although enforcement of current regulations may be sufficient in some cases.

3) Even within national parks, enforcement of protective regulations is often lacking. In both new and established parks assistance must be given to promote the training, equipping and compensation of competent and well-controlled guard forces, as well as their supervisors. Such activities are beginning in the Parc National des Virunga and the Parc National de Kahuzi-Biega (Zaire) and are continuing in the Parc National des Volcans (Rwanda).

4) A necessary step in management of gorilla populations is the determination of their ecological requirements. Group movement patterns and resources required vary from habitat to habitat, depending on resource availability and presence of competitors. Especially for confined or small populations, this type of information is essential in planning reserve size, shape and location. Such studies should be conducted in different ecosystems. This has been done in great detail for the western subset of the Virunga population, is in progress for *G. g. gorilla* groups of central Gabon and *G. g. beringei* of the Bwindi Forest, and is planned for two sites (primary and secondary lowland rain forest) containing *G. g. gorilla* in Central African Republic. At little expense, studies in the Virungas could be extended to include the remainder of the population which is found in a significantly different habitat. In addition, it is important that longer-term forest dynamics be taken into account: e.g. the effects of gorillas on their habitat, the recent reduction of elephant "damage" and its effect on secondary growth, the elimination or increase of other large mammals (potential competitors), the effects of selective logging, etc. The ecological study being initiated in Central African Republic will examine the relationships between elephants, habitat, and gorillas. More research along these lines should be encouraged. Finally, the effect of multiple-use management programs on gorillas should be tested, since it is suggested that gorillas may be able to coexist with controlled exploitation of their forest habitat. This type of research should be restricted to gorilla populations already determined to be incompletely protectable.

5. As human pressures on land resources increase, analysis and consideration of human needs in the environs of parks and reserves will prove increasingly important in their conservation. Again, this must largely be done on a case-by-case basis, since factors vary greatly across cultures, nations, and human ecological and economic systems. One of the most effective ways, and possibly the only way, to preserve protected areas in the long-run is to demonstrate benefits which accrue to those people living around them. Thus analysis of the threats to a gorilla population must include consideration of local people's needs, desires, and attitudes toward the wild ecosystem, including gorillas. Solutions intended to alleviate present and potential conflicts between people and conservation should be designed to inform residents of the less-obvious benefits gained from reserves (e.g. watershed maintenance, erosion control, microclimate stabilization, etc.) as well as to encourage development of new benefits (e.g. tourism). Conservation education and tourism programs have shown some success in and around the Parc National

des Volcans of Rwanda and the Parc National des Virunga of Zaire, yet the education work is far from completed. Programs are planned in eastern Zaire and for the Bwindi Forest Reserve, both of which are soliciting funds. Different and possibly more difficult problems await such work in western Africa, where gorillas are considered a food source and crop pests.

6) The conservation of a gorilla population is a long-term process. To increase effectiveness and efficiency of such an effort, it is necessary that long-range management plans be devised and incorporated in national conservation strategies. These should include a clear statement of goals, means of implementation, and evaluation procedures to be followed. Given that many projects are short-term or undergo changes in personnel, this becomes even more important. Such a management plan must focus strongly on the species *G. gorilla*, including regular monitoring of population size, actions for improving its security, ecological research, and the impact of human activities (from illegal activities to tourism). A management plan must also consider other components of the ecosystem of which gorillas are a part. The study of other selected species has already been mentioned as important to the understanding of the ecology of gorillas. Information on other species may well strengthen arguments to be made for conservation of the forest, especially if other endangered species are present. Furthermore, the attitudes of local people concerning conservation of a reserve are dependent on much more than the gorilla. Therefore, information on other aspects of the ecosystem can be crucial to gorilla conservation. The Parc National des Volcans has a management plan and annually reviews it, and one has been proposed for the Bwindi Forest Reserve.

7) Throughout all of these conservation efforts, emphasis should be placed on the involvement of host-country nationals and institutions. Cooperative planning and implementation are both important for the long-term success of any project. The host countries should be offered assistance in the form of information, expertise, and financial aid, but at the same time should commit personnel and support to the programs. Training should take place at all possible levels, from researchers to reserve managers to educators to government officials. The presence of competent counterparts at each of these levels would vastly improve long-term prospects for successful conservation across Africa.

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Fig. 5. Mountain gorillas in the Virungas (photo by A. Vedder).

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A Brief Survey of Human Attitudes to a Pest Species of Primate — *Cercopithecus aethiops*

by Fiona A. King and P. C. Lee

As the area under cultivation has expanded, conflicts between non-human primate populations and human communities have increased throughout Africa (see Else and Lee, 1986). Coexistence between monkeys and humans will only be possible with an understanding of the nature and degree of conflict, and of the attitudes of people towards the problems posed by primates. With knowledge of people's perceptions of the problem, ways of altering those perceptions can be attempted as part of a broadly based management program. Studies of attitudes to wildlife in general (Harcourt *et al.*, 1986), and some endangered primate species in particular (Harcourt, in press), have been made, but human attitudes to 'pest' primate species have rarely been assessed. A brief survey of such attitudes was carried out in a residential suburb of Blantyre, Malawi, where one group of 14 vervets (*Cercopithecus aethiops*) raided gardens. Vervets were recognized as a problem but no assessment of the magnitude of primate-human conflict had been made. It was in the interests both of the monkeys and those people whose gardens were being invaded to describe the problem in detail.

The Study Area

The group contained 2 adult males, 5 adult females, 3 juvenile females, and 4 young infants and occupied a home range of 8.4 ha (Fig. 1), bounded on three sides by roads and on the fourth by dense human settlement. In Fig. 1, the area covered by the group and the location of the houses surveyed within and outside the range are noted.

Householders in the suburb were both Malawians and expatriates, all of them professionals (with a secondary school education or more). Average families had 2-3 children (range 1-5). All households had at least one car; a few had swimming pools (Fig. 2). Most (80%) householders employed a gardener who lived on the premises. Gardeners had less education (few had attended secondary school) and larger families (average 4-5, range 1-7), most of whom lived in rural villages but visited frequently. Gardeners earned relatively low wages.

A small zoo within a kilometer of the area contains baboons, vervets, DeBrazza's monkeys, lions, jackals, various reptiles and birds. Low admission fees attract visitors of all wage levels and school visits are especially encouraged.

Vervets were either crop-raiding pests in gardens or captive curiosities. Hunting of vervets for sport or meat was very rare. They are typically portrayed as cunning, spiteful characters in Malawian stories (see Elliott, 1949).

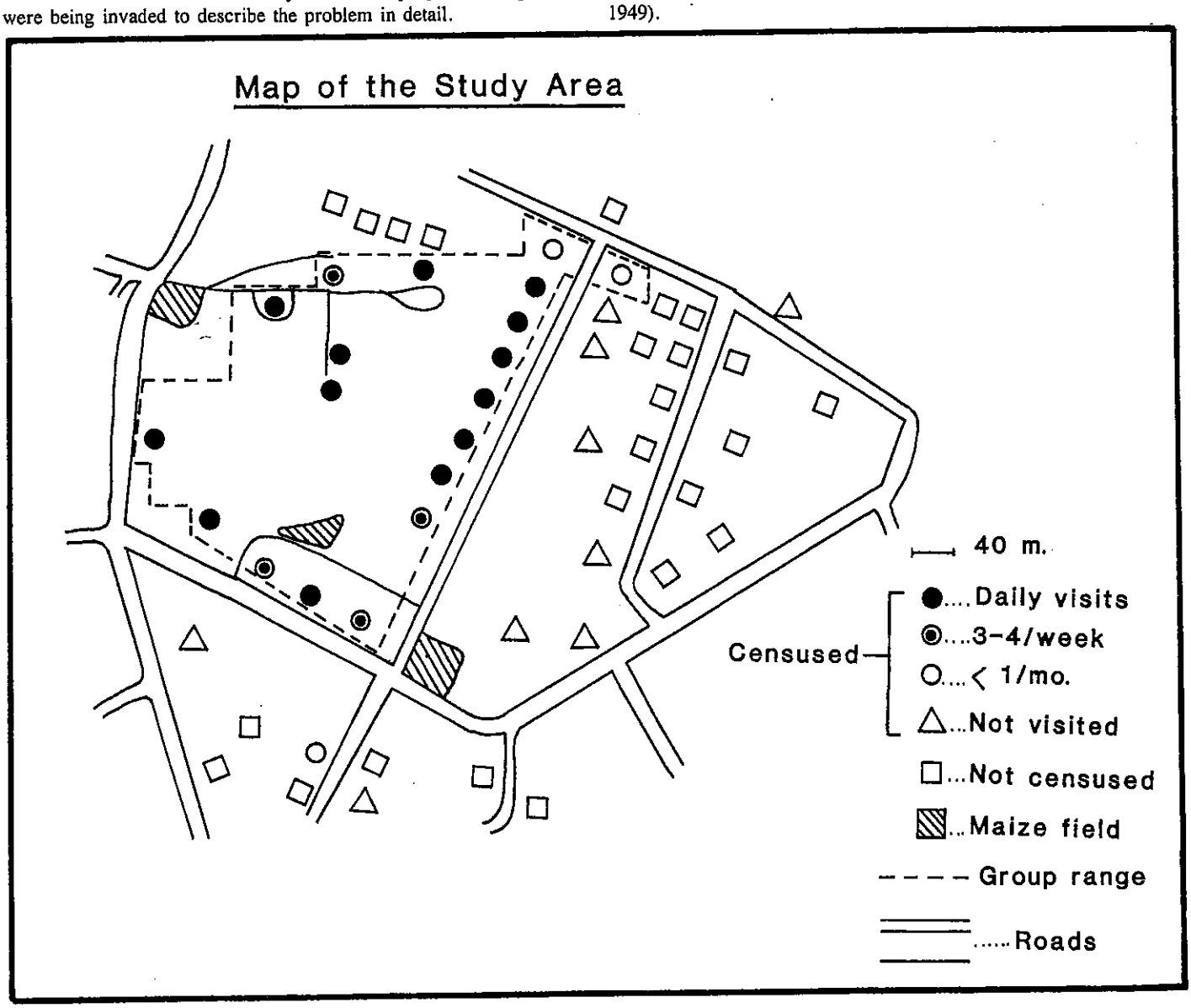

Fig. 1. A map of the study area, showing the houses visited by the vervets, their approximate home range, and the houses where residents were interviewed (map provided by authors).

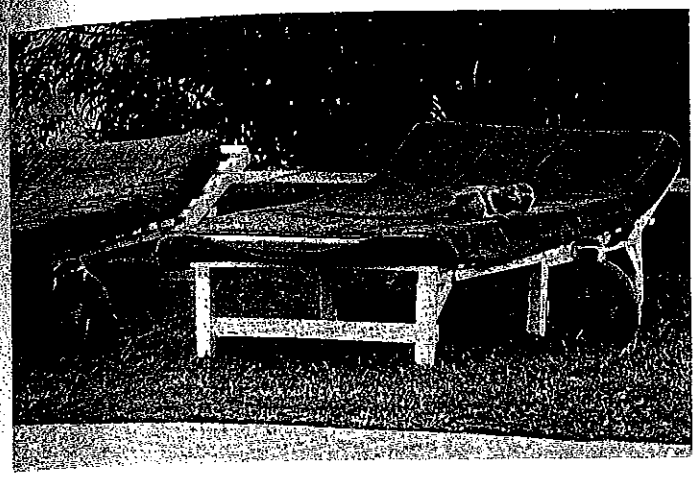

Fig. 2. Vervets lounging by a swimming pool (photo by P.C. Lee).

Questionnaires

Residents of 25 houses were interviewed (by FAK) in December 1985. Both householders and gardeners at each home were given a questionnaire on sightings and attitudes towards the vervets. Nine houses were outside the home range, and the attitude of these residents, with little negative contact with vervets, was assessed as a control. Information on cultivated crops and crop damage due to vervets was also gathered. Proportion of tree cover, presence of dogs, availability of permanent water in the garden, and methods of refuse disposal were assessed during house visits.

Three categories of frequency of visits to gardens by monkeys were determined: *high visit* ($n=13$) at least two or three visits each week, *low visit* ($n=3$) maximum frequency of visits was once per month, *no visit* ($n=9$) houses or gardens never visited by vervets.

Subjective assessments of crop damage caused by the vervets were made independently by householders and gardeners in reply to the question, "What do the monkeys do when they come into your garden?" Responses were categorized by the degree of crop damage. In the *High* category, vervets ate or damaged crops consistently. In the *Sporadic* category, vervets occasionally ate or destroyed seasonal garden fruits. When there was no apparent damage, this was rated as *None*. There were no reports of vervets biting humans.

Attitudes to the monkeys were examined through the questions, "What do you think about monkeys?" and "What do your children think about monkeys?" One child under 12-years-old was interviewed in each family whenever available. A total of 12 children were interviewed. Gardeners had more direct contact with the monkeys and crop damage. Their responses were considered especially important in rating human attitudes.

Crop Raiding

A brief survey of the vervets' diet found that 85% consisted of 'natural' foods while only 15% was cultivated foods. However, high frequency visits were significantly associated with the cultivation of maize and/or beans. ($P=0.04$, binomial exact, $n=21$). Tree cover had no effect on frequency of visits. The presence of maize and beans appeared to be the major influence on how frequently a house was visited (see Fig. 1). Houses not visited were across a broad road with uniformed security guards at the front. The lack of direct access to a garden, combined with the presence of a uniformed guard may have been a major deterrent to the vervets' use of this area.

The majority (78%, $n=23$) of householders and gardeners in the *high visit* category rated damage as *high*. In two such homes, cultivation of maize and beans was given up, and in another all crops (maize, beans, tomatoes, fruit, onions, etc.) were abandoned due to persistent raiding. Gardeners tended to rate vervet damage higher than householders, probably because gardeners had more direct exposure to monkey damage. Householders who did their own gardening also tended to give higher damage ratings than did householders who employed gardeners. Householders in *low visit* homes ($n=3$) scored either *none* or *sporadic* damage, while their gardeners' ratings were divided evenly among the three damage categories.

Human Attitudes

Responses to questions about attitudes to the vervets were categorized as *pest*, *like* or *indifferent*. All gardeners ($n=20$) perceived vervets as pests irrespective of the frequency of visits or amount of damage. Householders in *high visit* homes either perceived the monkeys as pests ($n=6$) or were indifferent ($n=5$), but seldom liked them ($n=2$). Those never visited tended to be indifferent ($n=5$, 2 *pest*, 2 *like*). *Low visit* householders did not see vervets as pests (*like* = 1, *indifferent* = 2).

Childrens' attitudes closely reflected those of their parents. All gardeners' and householders' children whose parents rated monkeys as pests ($n=7$) were also afraid of them. Only two householders' children liked monkeys; their parents either liked or were indifferent to them. The remaining three children were indifferent to vervets, as were their parents. Parental views of monkeys as pests, or direct experience with monkeys in threatening contexts, resulted in children being fearful of vervets. Educational programs aimed directly at children can potentially create a more positive feeling towards wildlife (Harcourt *et al.*, 1986).

Human attitudes towards vervets appeared to be influenced by the degree and nature of the contact between them. Those people with the most direct contact who had their essential food crops damaged had negative attitudes towards the vervets. Gardeners, in particular, were frustrated, foreseeing continued conflict. Human aggression towards the vervets caused the vervets to avoid human contact. As a result of the shooting of a female in 1985 by a uniformed game warden, all uniformed men were especially avoided.

Temporary contact with monkeys, such as that experienced by tourists, leads to the perception of vervets as attractive and entertaining (Brennan *et al.*, 1985). In Blantyre, householders and children with occasional sightings of vervets, but not suffering crop destruction, had more positive attitudes towards the monkeys. Brief contact with monkeys stimulated interest in them, and perhaps in wildlife in general. High contact or no contact tended to produce dislike or indifference.

Prevention of crop damage is obviously a management priority. Trapping or eliminating the raiding group would lead to a reinvasion by troops from surrounding areas, and typically proves expensive, ineffective in the long-term, and possibly destructive to the monkeys (Lee *et al.*, 1986). An inexpensive means of preventing monkeys from damaging crops would reduce contact between monkeys and humans, and encourage more positive human attitudes. Such a deterrent to crop-raiding is difficult to find. Small body size, intelligence, and behavioral flexibility reduces the effectiveness of fencing crops. Currently maize and beans are guarded by children or dogs (Fig. 3). Humans themselves appear to be the most effective deterrent against primates. A roving, uniformed scout from

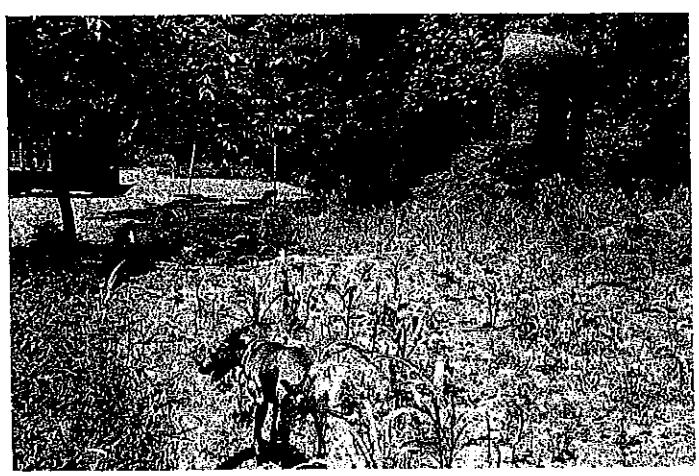

Fig. 3. Dog tethered in a field of young maize to protect it from vervet incursions (photo by F.A. King).

the game department who patrolled gardens at unpredictable intervals might deter vervets from crop-raiding. Loud noises are unlikely to be effective. The complex communication skills of vervets allow them to discriminate between real and false auditory threats. In our experience, slingshots, which are inexpensive, accurate, and non-lethal when used with small pellets, are excellent weapons against vervets. The mere sight of a familiar person armed with a slingshot is enough to make a group flee.

The willingness of people interviewed in Blantyre to discuss the vervets suggests that people's attitudes can be improved. Malawi has an active wildlife and conservation department as well as preservation societies involved in education. Encouraging educational visits to the local zoo and starting ecological studies aimed at finding alternative methods for deterring crop-raiding should improve the relationship between people and these primates.

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A Census and Study of *Hapalemur* and *Propithecus* in Southeastern Madagascar

by Patricia C. Wright, Patrick S. Daniels, David M. Meyers, Deborah J. Overdorff and Josef Rabesoa

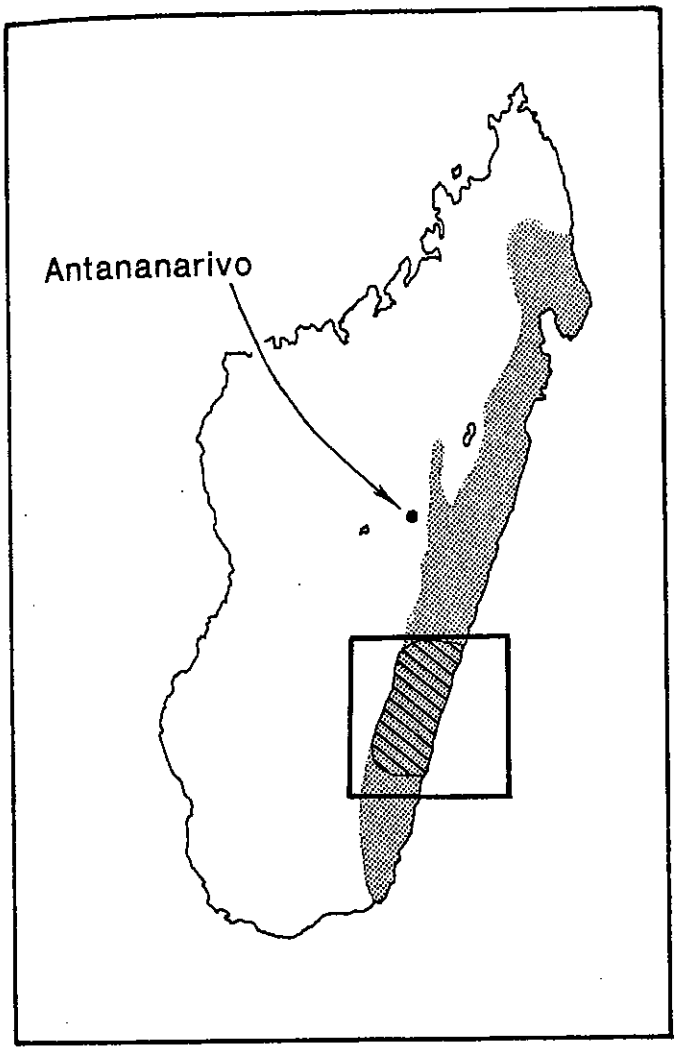
Introduction

The southeastern rain forest of Madagascar below the Mangoro River has a community of primates which differs in species composition from the northeastern rain forest. The indri (*Indri indri*), largest of all the Malagasy primates is not seen below the Mangoro River. The subspecies of *Propithecus diadema* changes from *P. d.diadema* in the north to *P. d. edwardsi* in the southeast (Tattersall, 1986). *Lemur fulvus fulvus* is replaced by *Lemur fulvus rufus* and farther south by *Lemur fulvus albocollaris* (Tattersall, 1982). There are also many species that occur in both communities, such as *Avahi laniger, Microcebus murinus, Cheirogaleus major, Lemur rubriventer, Hapalemur griseus.* There are several species for which information is not available, such as *Hapalemur simus, Allocebus trichotis, Daubentonia madagascarensis,* and *Lepilemur* spp. It had been suggested that the southeastern forests are the last refuge of the greater bamboo lemur (*Hapalemur simus*) (Godfrey and Vuillaume-Randriamanantena, 1986), yet this area contains no reserve and has not been surveyed for primate populations since the early 1970's. The objectives of the present study were to survey the remaining rain forest areas from the Mananara River (near the village of Vondrozo) north to the Namarone River (near Ranomafana, Fig. 2).

Fig. 1. A pair of golden bamboo lemurs now being described as a new species (photo by R. A. Mittermeier).

Methods

Surveys were carried out over a three-month period in 1986, interspersed with two weeks of behavioral observation. In June, four to five observers censused the Ranomafana area for two weeks. Two further weeks of searching were carried out in July in the inland forests from Vondrozo north to Karianga, and the coastal forest patches from Farafangana to Manakara. The final week-long survey was conducted in August near Kianjavato and the Ifanadiana region. Accessible forests were reached by road and were used as entries to more remote forest sites. Surveys were conducted by four or five observers walking slowly along 3-6 km of trail or by streams from the base camp area. Lemurs are quiet and secretive, and this spacing of observers was most effective in detecting groups. Group size and composition was recorded for each group of primate encountered and quantitative descriptions of habitat and forest composition were made. A Malagasy wildlife guide, Josef Rabesoa, accompanied us on all trips. As an additional method of surveying primate populations both past and present, we interviewed the elders of the villages about the species that they had seen recently and the species that had occurred in the area when they were young.



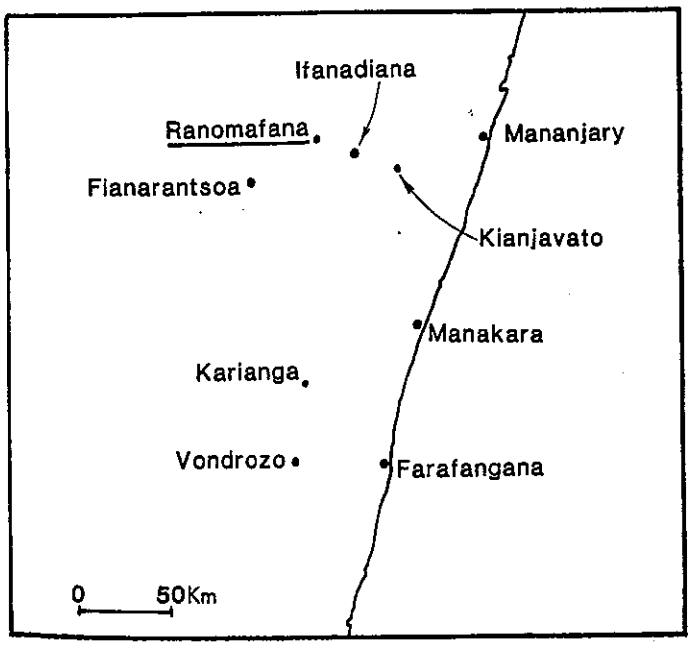


Fig. 2. Map of Madagascar showing the extent of the eastern rainforests (shaded), the area censused (hatched), and the location of the Ranomafana study area (underlined - figure by S. D. Nash).

A second objective of this project was to study the behavior and ecology of some rarer species of lemurs at one site. Diet, daily path length, home range size, sleeping tree information, and use of habitat were all documented. Plant parts eaten were identified to species with the help of Malagasy guides Emil Rajeriarison and Loret Rasabo, Mr. Armand Rakotozafy of the Herbarium at Parc Tzimbazaza, and Mr. Jean-Prosper Abraham of the Department of Water and Forests. For two of these species, the greater bamboo lemur (*Hapalemur simus*) and Milne-Edward's sifaka (*Propithecues diadema edwardsi*), previous information had been limited to anecdotes, and ours were the first quantatative data taken. At Ranomafana we discovered two species of bamboo lemurs sympatric: one a large, golden red is now called the golden bamboo lemur and is being described as a new species (Meier and Rumpler, in press; Fig. 1), the other is the greater bamboo lemur (*H. simus*). One group of golden bamboo lemurs was habituated and followed for eight half-days and four full-days at the Ranomafana site. In addition, all day samples on two groups of *Propithecus diadema edwardsii* were taken for 3-5 consecutive days for June through September at Ranomafana.

Survey Results - *Hapalemur simus*

Vondrozo region- In 1964 or 1965, A. Peyrieras bought a bamboo lemur in a market near Vondrozo, a town located 70 km west of the seaport of Farafangana. We drove to this region and found that only a thin strip of forest (7-16 km wide) exists today on the highest mountain peaks. This forest is not accessible by road but is only a day's walk from Vondrozo. Slash-and-burn agriculture has left only bare hills except on the steepest inclines. Areas of giant bamboo may have been all along the wider rivers, but these areas are heavily populated by people now. No bamboo lemurs were found in the forests near Vondrozo (Table 1). The elders mentioned that there was a red bamboo lemur in the past, but this species had disappeared about ten years ago. We asked local residents along the road to Karianga (north of Vondrozo) and they were familiar with a gray bamboo lemur (*H. griseus*), but did not know of another species.

Table I. Results of Survey of Southeastern Rain Forest Region in Madagascar

Species	*Grp Size*	*Vondrozo*	*Kianjavato*	*Ranomafana*
Hapalemur simus, greater bamboo lemur	4-12	E	S	S
Hapalemur sp. golden bamboo lemur	3-4	E	?	S
Propithecus diadema edwardsi, Milne-edward's sifaka	4-8	E	L	S
Lemur rubriventer, red-bellied lemur	2-3	—	S	S
Hapalemur griseus gentle lemur	3-4	L	S	S
Lemur fulvus rufus red-fronted brown lemur	7-20+	—	S	S
Lemur fulvus albocollaris white-collared brown lemur	4+	S	—	—
Avahi laniger, avahi	2-3	?	?	S
Microcebus murinus mouse lemur	1	?	L	S
Cheirogaleus major fat-tailed dwarf lemur	1	?	S	S
Varecia variegata black-and-white ruffed lemur	—	—	S	E
Lepilemur microdon weasel lemur	1	—	—	S

Key:
(S=species observed; L=local informants stated species exist in area; E=local elders stated species occurred in this region in the past, but not now, ?=unknown, —=never occurred in this location in the memory of elders)

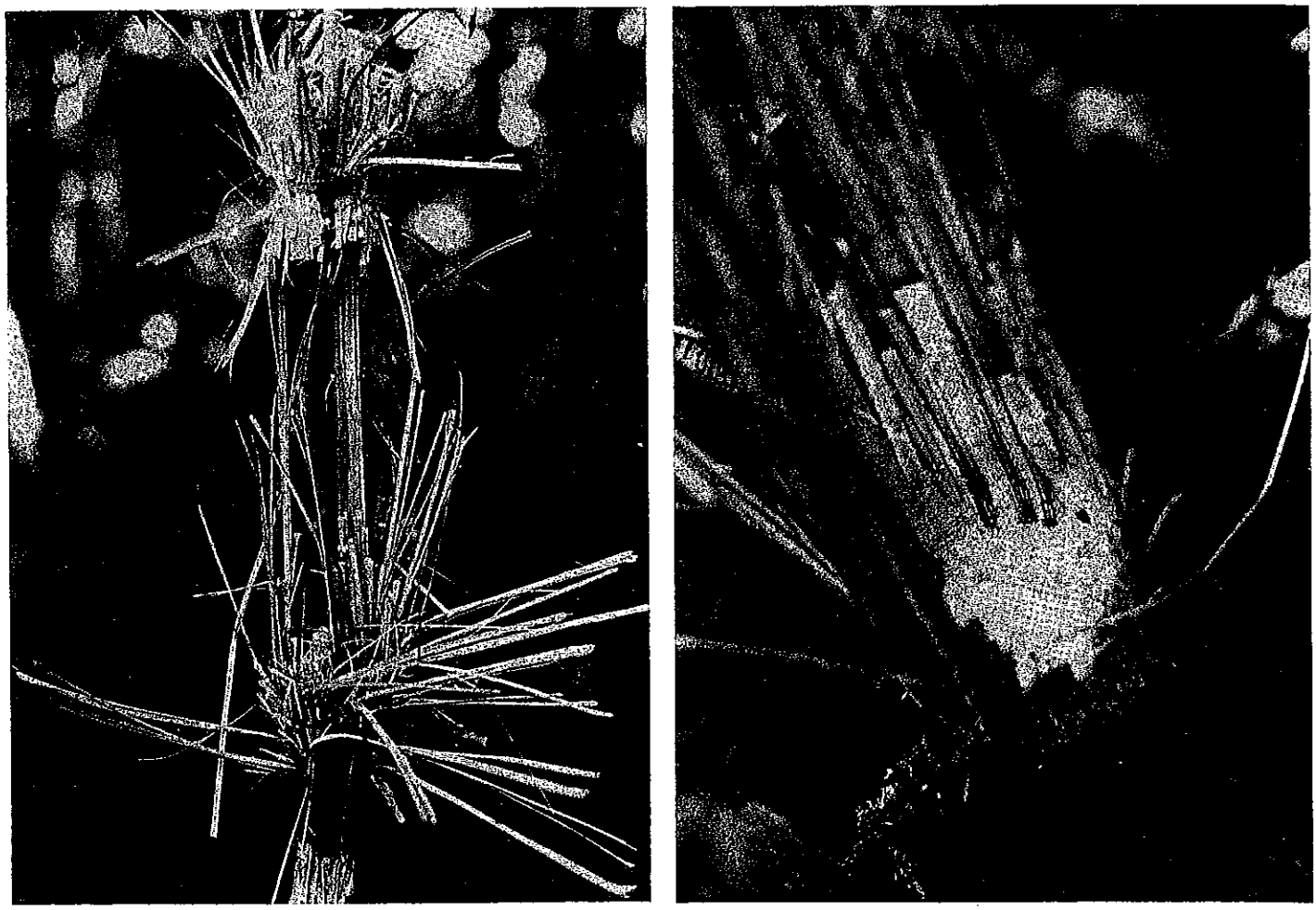


Fig. 3. Giant bamboo stems shredded by *Hapalemur* at Ranomafana (photos by P.S. Daniels and P. Wright).

Kianjavato region- In 1972, Petter and Peyrieras captured two individuals near a coffee plantation at Kianjavato (Godfrey and Vuillaume-Randramanantena, 1986), about 65 km inland from the Indian Ocean and east of Fianarantsoa. To follow up on this information, we gained permission to survey the site. This 20 ha, lowland rain forest still contains trees of 1 m diameter, and has remained uncut only because of the vigilance of the coffee plantation owners and managers. It is a forest island surrounded by grass-covered hills and large stands of traveller's palm, a native tree in the Musaceae family which does well on cleared hills. We visited this site three times and each time we observed a large group of greater bamboo lemurs. Over 12 animals were counted in one location. This could have been two groups. These greater bamboo lemurs seemed to be primarily nocturnal. We did not see them travel or feed after 9:00 and they began to feed again at about 17:30. The *H. simus* accompanied *Lemur fulvus* groups and were not seen eating giant bamboo. Surveys confirmed that giant bamboo (*Cephalostachyum viguieri*) no longer exists in the area.

Ranomafana region- There remain only forest patches from west of Kianjavato to Ranomafana. This watershed area of primary rain forest is now being selectively logged. Interspersed with the rain forest, there are large stands of giant bamboo on both sides of the white-water Namarone River. In this forest we censused an area of 20 km² during June. We sighted only two groups of golden bamboo lemurs (one group of four animals and a larger group of six). There are four ridge tops adjacent to the southern side of the Namarone River covered with the large bamboo (*Cephalostachyum viguieri*) as well as the thinner, viny species (*Cephalostachyum perrieri*). It appeared from survey results, feces and stripped bamboo, that each mountain slope contained a group of golden bamboo lemurs. It was difficult to obtain group size counts, but an estimate of about 30 animals living in these 20 km² was made. Most of the forest was rarely used by this species because giant bamboo only grew near the river.

Survey Results - *Propithecus diadema edwardsi*

Vondrozo region- During our week-long survey we did not see any sifakas. The elders of the villages explained that the *simpona* (the local name for *Propithecus diadema*) lived here long ago, but had not been seen for years.

not observe any *Propithecus diadema.* However, the manager of the coffee plantation reported seeing a group of black and white lemurs, but they were *Varecia variegata.* Elders in the Ifanadiana region also explained that *simpona* could be found in steep forests on the top of rock outcroppings.

Ranomafana region- In our censuses of the 20 km² of disturbed primary rain forest, we observed two groups (group size four and seven). From loud call vocalizations, we predicted that one or two more groups lived in about a 6 km² area. We estimate a population density of four individuals per km², the lowest population density reported for any lemur species. *Propithecus diadema edwardsi* groups range through all habitats, including river-edge areas with large stands of giant bamboo interspersed throughout the rain forest. Although the animals fed and traveled in valleys, slopes and ridge tops, they consistently slept about eight meters high in large trees located on various ridge tops.

Socioecology of *Hapalemur simus* and *Hapalemur* sp.

Diet- The diet of both *Hapalemur spp.* at Ranomafana was 98% bamboo at this time of year. The new species of bamboo lemurs ate the bases of leaves and all new growth (Fig. 3), while the *H. simus* ate the woody pith inside the main stem. The majority of the bamboo eaten was from one species, *Cephalostachyum viguieri,* although these animals occasionally ate the leaf bases of *C. perrieri.* The greater bamboo lemur was

seen to eat fruit on only two occasions.

Home Range and Group Composition- Although results presented here are preliminary, daily path length of *Hapalemur* sp. was short (mean = 365 m; n=6) and home range was small (16-18 ha). Because of its specialized diet, this species rarely ranged in areas that did not contain *C. viguieri*. Group size of the main study group of *Hapalemur* sp. was four: an adult male-female pair, a slightly smaller subadult and a large juvenile. The group count of the neighboring group of *H. simus* was more than six.

Socioecology of *Propithecus diadema edwardsi*

Diet-This species is highly folivorous, specializing on new leaves from trees. If the number of feeding minutes obtained for both groups for each five-day sample during June-September is totaled, 58% of the feeding minutes are on leaves, 28% on fruit and 14% on flowers (Table 2). The overall leaf diet consisted of 58% new leaves from trees, 26% mature and young vine leaves, 14% leaves from a mistletoe tree parasite, and 2% from herbs. Most of the flowers eaten were from the same species of mistletoe (*Bakerella sp.*) and the most eaten species of fruit was *Gambeya madagascariensis* (Sapotaceae). From 17 to 27 species of plants are eaten each day. This is about twice the number of species eaten daily by any other folivorous primate yet studied. Chemical analysis of the composition of the different species will help us understand whether it is the variety which is important or whether the animals are eating young leaves, regardless of species. The distinct difference between the dry forest sifaka's (*Propithecus verreauxi*) diet and the rain forest species' diet is that the former eats 70-86% mature leaves from trees (Richard, 1978) at the same time of year.

Table 2. Fifteen Plant Species Most Frequently Eaten by *Propithecus diadema edwardsi* in June-September at Ranomafana, Madagascar

Family	*Species*	*Malagasy Name*	*Type*	*Part Eaten*
Aquifoliaceae	*Ilox mitis*	Hazadrano	tree	young leaves
Araliaceae	*Polyscias sp.*	Manigny	tree	flowers, young leaves
	Cuphiocarpus sp.	Vatsilana	tree	young leaves
Asclepiadaceae	*Secamone sp.*	Vahiambanikondro	vine	leaves
Guttiferae	*Symphonia louvelii*	Kimba letika	tree	young leaves
Lauraceae	*Ocotea sp.*	Tavalopiana	tree	young leaves
Liliaceae	*Smilax kraussiana*	Roindambo	vine	leaves, young stems
Loranthaceae	*Bakerella sp.*	Tongolahy	parasite	leaves, flowers
Mimosaceae	*Albizia gumifera*	Vomboana	tree	leaves
Myrsinaceae	*Embellia sp.*	Kalamasina	vine	leaves
	Oncostemum sp.	Kalafana	tree	young leaves
Myrtaceae	*Eugenia sp.*	Rotra	tree	young leaves
Sapindaceae	*Crossonephelis pervillei*	Lanari special	tree	young leaves
Sapotaceae	*Gambeya madagascariensis*	Rahiaka	tree	fruits, young leaves
Urticaceae	*Pilea sp.*	Veladahy	herb	leaves

Home Range and Group Size- Census results from the Ranomafana area established that group size ranges from 4-8 (n=9). The two focal groups studied were at either end of that continuum. During the first week of July, the group of seven (Group II) had an infant. The group of four adults (Group I, two males and two females) did not have an infant. Home range size was large for both groups; Group I ranged over 1 km² (or 100 ha), while the home range of the neighboring Group II was 2.54 km² (or 254 ha). Group I had a mean daily path length of 670 m (n=18), while Group II ranged 1,265 m (n=8) each day. Simultaneous follows of neighboring groups suggest that each group has nearly exclusive use of its home range during these four months (June-September). The doubling of path length when group size doubles suggests that an increase in group membership requires more traveling in order that all individuals have enough to eat.

Conclusion

Hapalemur simus and the new species of bamboo lemur, both specialists on giant bamboo, and *Propithecus diadema edwardsii*, a specialist on new leaves and young shoots appear highly limited to specific habitats. There is no substantial tract of lowland rain forest in the southeast. On the top of the steepest mountains, primary forest does remain, but deforestation is occurring. There is more deforestation in the southeastern rain forest than previously documented. Although there are several species and subspecies of primate that occur exclusively in this rain forest, there are no rain forest reserves in the southeast. It is recommended that a reserve be established west of Ranomafana to preserve the community of eight sympatric species which occur here. This area (1,000 m elevation) is a watershed area critical for the well-being of human populations. It contains different habitat types, including the regions which contain the giant bamboo species on which *Hapalemur* spp. depend. It covers the variety of species on which the *Propithecus diadema edwardsi* depend for new leaves. We recommend that the reserve along the Namarone River contain at least 100 km² to protect these two lemur species. Immediate action to establish a special reserve is recommended since serious logging efforts have already begun to deteriorate this watershed area.

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Survey Work on Ruffed Lemurs *(Varecia variegata)* and Other Primates in the Northeastern Rain Forests of Madagascar

by Hilary J. Simons and N. B. D. Lindsay

Ruffed lemurs *(Varecia variegata)* are one of the large diurnal primates endemic to the tropical evergreen rain forests of eastern Madagascar. As with many other primates of this region, they are listed as vulnerable or endangered in the IUCN Red Data Book, and are included in Appendix I of CITES. Their present distribution limits are poorly known and their taxonomy confusing (Tattersall, 1982). In this paper we report on the results of an August-October, 1986 survey of the Masoala Peninsula and the region of the Bay of Antongil (Fig. 1) to investigate these aspects of ruffed lemur biology and also to assess the conservation status of the species.

The Masoala Peninsula

The Masoala Peninsula contains many locally restricted plants and animals, including the rarer of the two ruffed lemur subspecies, the red-ruffed lemur (*Varecia variegata rubra*, Fig. 2). The Masoala was included in Madagascar's natural reserve system until 1964, when Reserve No. 2 on the eastern side of the peninsula was degazetted to permit timbering (Andriamampianina, 1984). Although the eastern sector of the Masoala is now heavily degraded, forests in the western sector are still largely intact (Richard and Sussman, 1986). A new natural reserve is urgently needed, and surveys must be conducted to target potential areas for reclassification. Toward this end, we spent one week camped at a settlement by the Hiaraka River (15° 28'S, 49° 54'E) and one week at the village of Ambanizana (15° 38'S, 49° 58'E) on the western coast of the Masoala Peninsula.

The Hiaraka settlement, situated below the massive "sacred rock of Hiaraka", comprises about 60 people. They practice swidden agriculture, known as *tavy* in Madagascar, and cultivate cash crops (e.g. coffee and cloves) at low elevations on slopes within a few miles of the coast. Several miles south of Hiaraka, intact coastal forest is interspersed with scattered dwellings and *tavy* plots. A few footpaths penetrate the steep forest slopes, but are not used frequently. Although we met one family practicing *tavy* about three miles from the coast, human habitation inland is sparse, and forest disturbance is minimal.

Ambanizana, situated on the southern bank of the Ambanizana River, is one of the most densely populated villages on the western side of the Masoala Peninsula. There are small settlements along the coast several miles north of the Ambanizana River. The village of Ambanizana is surrounded by a mosaic of secondary vegetation, riziculture, and *tavy*. Many footpaths used by woodsmen penetrate the forest slopes around the village, and we observed small-scale timber production along the coast. On some forested slopes above the village all the large trees have been removed, and it is likely that selective logging was done about 30 years ago (Gerard-Jean, pers. comm.). No animals were seen and few ruffed lemur calls were heard in these areas. Small ground traps were observed along one forest trail, and two abandoned pole-and-noose traps for lemurs were found along other trails (see Constable *et al.*, 1985). Shotgun cartridges were discovered along two different trails and a resident of Ambanizana reportedly hunts lemurs with a shotgun (A. Jolly, pers. comm.; A. Peyrieras, pers. comm.).

During the survey, census walks were made along existing trails: we did four day-walks (32 h) and one night-walk (2 h) at Hiaraka, and five day-walks (26 h) and one night-walk (1 h) at Ambanizana. During day-walks, we saw red-ruffed lemurs three times: twice at Hiaraka, and once at Ambanizana (Fig. 1). One group contained at least five animals, and two groups contained at least three animals. The group of five was found in a *Carissa edulis* (Apocynaceae) tree near *tavy* plots (Hiaraka), while the other groups were found in apparently undisturbed forest. A total of 63 ruffed lemur loud calls was heard during day-walks (an average of 1.1/h).

In addition to red-ruffed lemurs, we saw a group of at least three white-fronted lemurs (*Lemur fulvus albifrons*) at Hiaraka, and a group of at least five at Ambanizana. During the night-walk at Hiaraka on 12 October, *Avahi laniger* with infants carried transversely across the ventrum was encountered twice (an individual, and a pair), indicating a late winter/early summer birth season. One *Cheirogaleus major* was found. During the night-walk at Ambanizana, a plain mongoose (*Salanoia concolor*), one of the rare eastern carnivores, was seen in coastal forest.

Antainambalana River Valley

The northeastern region of Madagascar still contains large tracts of primary low-mid altitude rain forest (M. Nicoll, unpub). Little ground survey work has been done recently in this region, and reports of remaining forest cover and lemur distribution and abundance should be updated.

The Antainambalana River is one of the primary river systems in the northeastern region. It marks the geographical boundary for a few primate subspecies, *Propithecus diadema* subsp. and *Varecia variegata* subsp. (Tattersall, 1982). Petter *et al.* (1977) reported that the Antainambalana River separates the ruffed lemur subspecies: the red-ruffed lemur is restricted to the Masoala Peninsula east of the river, and the black-and-white ruffed lemur (*Varecia variegata variegata)* is found south of it. There is evidence that subspecies hybridization has occurred in the northeast region (Hill, 1953; Petter *et al.*, 1977; Tattersall, 1982). For example, the Archbold expedition collected a specimen from a locality 40 km northwest of Maroantsetra that looks exactly like *V. v. rubra* x *V. v. variegata* hybrids bred in captivity (Buettner-Janusch and Tattersall, 1985).

To update information on the current geographical limits of the ruffed lemur subspecies, we made a two-week survey near the small village of Andaparaty, located about 42 km north-northwest of Maroantsetra, in the Antainambalana river valley (15° 12'S, 49° 37'E).

The Antainambalana river valley is well populated, and extensively cultivated with irrigated rice and cash crops (e.g., cloves, vanilla, and coffee). Swidden is also practiced, and fallow plots were visible low on most of the slopes bordering the river valley. Villagers use the many narrow footpaths on the forest slopes for collecting palm and wood products for their food and housing. They also practice trapping: an abandoned trap for wild boar and several lemur traps were observed.

On the western bank of the Antainambalana River, we did three day-walks (14 h) in a block of disturbed forest about 2 km southwest of Andaparaty. On three successive mornings, we found two black-and-white ruffed lemurs in a large blossom-bearing *mampay* tree at the edge of a fallow clearing. The ruffed lemurs showed no reaction to our presence, and we observed them eating blossoms and engaging in self-grooming and reciprocal allogrooming. A total of 52 ruffed lemur group loud calls were recorded during day-walks and from our camp (an average of 1.7/h or 17/day). Two groups of *Lemur fulvus albifrons* were encountered; one group had at least four animals and the other at least five. We also heard vocalizations of *Indri indri* (eight calls) and *Hapalemur griseus*

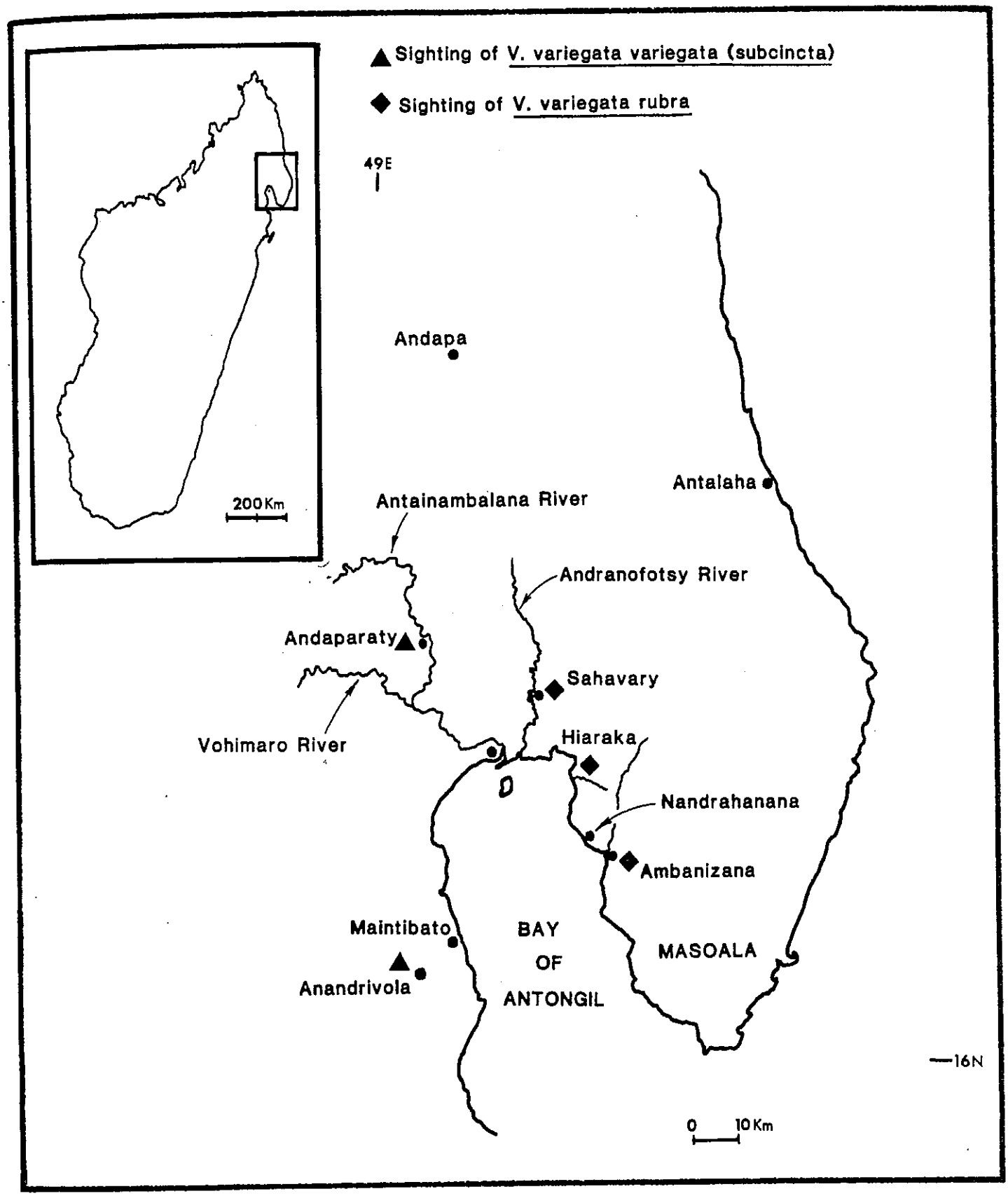

Fig. 1. Sightings of *V. variegata variegata (subcincta)* and *V. variegata rubra* in the Bay of Antongil region of northeastern Madagascar (map by S.D. Nash).

(one alarm call). Three rare helmet birds (*Euryceros prevostii*) were seen as well.

On the eastern bank of the Antainambalana River, we spent six days in relatively intact forests at two locations, about 2 km east and 7 km southeast of Andaparaty. We heard *Lemur fulvus albifrons* calling in the evening and early morning (1:30), and we saw two *Hapalemur griseus* in the evening. Two helmet birds were seen. Although local villagers told us they often saw and heard red-ruffed lemurs near our camps, we could not confirm their presence.

Andranofotsy River Valley

The Andranofotsy River valley extends northeast of Maroantsetra, and like the Antainambalana River valley, it is heavily populated by agriculturists. We made a brief survey near the village of Sahavary, on the eastern bank of the Andranofotsy River; less than 15 km north-northeast of Maroantsetra (15° 19'S, 49° 50'E). During two day-walks (11 h), we saw one group of red-ruffed lemurs (1 or 2 animals) and heard 10 group loud calls. A group of at least three *Lemur fulvus albifrons* was observed within an hour's walk of the village. We also disturbed a helmet bird on its nest, causing it to "mob" our group by flying rapidly back and forth over our heads and at eye level.

Anandrivola Forest

We spent one week at the Anandrivola forest, about 40 km southwest of Maroantsetra (15° 45'S, 49° 36'E) on the western side of the Bay of Antongil. Most of the land along the coast and up to 7-10 km inland on the western side of the Bay of Antongil has been cleared for swidden agriculture. The Anandrivola forest is on the edge of a large tract of primary forest about 10 km southwest of the village of Maintimbato (Stephenson *et al.*, 1986). During six day-walks, we saw *V. v. variegata* (one group of two animals), *Lemur fulvus albifrons* (one group of six), and *Indri indri* (once). During four night-walks (13 h), we saw *Avahi laniger* (two animals) and *Lepilemur mustelinus* (three animals). Two of the *L. fulvus albifrons* males showed the less common color phase (Tattersall, 1982): instead of a white ruff around the face, they had short white fur on the cheeks with a black stripe across the crown between the ears and down the muzzle. It is interesting to note that the Archbold expedition collected a juvenile male *L. fulvus albifrons* with an entirely brown head from a locality 20 km southwest of Maroantsetra (Rand, 1936).

***Varecia variegata* Distribution**

The results of our survey support earlier reports that the Antainambalana River separates the two ruffed lemur subspecies (Petter *et al.*, 1977; Tattersall, 1982). *V. v. variegata* is present south and west of the Antainambalana River. *V. v. rubra* was present on the Masoala Peninsula and to the east of the Andranofotsy River, however, we did not see red-ruffed lemurs near the Antainambalana River and could not confirm earlier reports that this is their western limit of distribution (Petter *et al.*, 1977; Tattersall, 1982). Tattersall (1985) suggests that red-ruffed lemurs are rare throughout their range. Our surveys covered only a limited area, but we suspect that this subspecies either occurs at very low densities or is now locally extinct between the heavily disturbed Andranofotsy and Antainambalana river valleys.

***Varecia variegata* Taxonomy**

Varecia variegata exhibits considerable variation in pelage pattern, and at least six distinctive color variants have been described (Hill, 1953; Petter *et al.*, 1977; Tattersall, 1982). As Tattersall (1985) has clearly stated, we do not have enough information to understand the geographical distribution or taxonomic status of these color variations. In the absence of good survey data, lemur systematics remain confused and perplexing.

The black-and-white ruffed lemurs seen during this survey in the Bay of Antongil region and on Nosy Mangabe conformed to the *subcincta* or type c color pattern as described by Tattersall (1985): uniformly black except for white cheeks, ears, and throat, and white transverse stripes across the back and sides just behind the shoulders and across the rump. Our sightings support previous reports that the *subcincta* (A. Smith, 1833) color pattern occurs north and west of Maroantsetra (Hill, 1953; Petter *et al.*, 1977; Tattersall, 1982). Unfortunately, we saw only four black-and-white ruffed lemurs on the mainland; with such a small sample size, we cannot conclude that no other color forms are sympatric with *subcincta*.

Fig. 2. A red ruffed lemur, *Varecia variegata rubra* (photo © by the Zoological Society of San Diego).

Clearly, more extensive survey work is required to better document the geographical distributions of the ruffed lemur pelage variants, and to update knowledge of the distribution of the subspecies. This presents a real challenge since the northeast region is remote, and surveys for lemurs must be conducted primarily on foot at great distances from villages. Unfortunately, since ruffed lemurs are rare or perhaps locally extinct in many parts of their range in the northeast, it is unlikely that we will ever achieve a complete picture of their distribution.

Conservation Status

The major threats posed by humans to lemur populations on the Masoala Peninsula and around the Bay of Antongil are forest destruction for small-scale subsistence agriculture, cash crops and firewood, and trapping animals for food. Deforestation for agriculture is particularly severe in major river valleys and in coastal areas south and west of Maroantsetra. These practices are widespread throughout the eastern forests (Pollock, 1986).

Our survey found that ruffed lemurs and other primarily diurnal primates are present in highly disturbed forests. We saw and heard ruffed lemurs and white-fronted lemurs near villages in the vicinity of fallow clearings and lemur traps, but we suspect they are more abundant in areas with few human inhabitants (e.g., Hiaraka on the Masoala Peninsula). There is evidence suggesting that ruffed lemurs occur at low densities in all of the mainland forests we surveyed. On the small island reserve of Nosy Mangabe, where there is virtually no human disturbance, encounter rates and calling frequencies of ruffed lemurs were much

higher than on the mainland. Encounter rates and group sizes of white-fronted lemurs also were greater on Nosy Mangabe than on the mainland (HJS, pers. obs.).

It is important to stress that our results are preliminary, and our comparisons between locations may be biased, because our data were collected over a short period of time. We were not able to use the line transect technique often employed to census anthropoid primates because sightings of lemurs were so infrequent during our surveys. Lemurs are cryptic, small-bodied animals that live in small groups in dense vegetation, and they usually flee rapidly and quietly when humans approach. Moreover, census data obtained in disturbed forests may be biased. Johns (1985) suggests that behavioral changes adopted by primates in Malaysian rain forest after selective logging resulted in lower encounter rates and calling frequencies during censuses and this may be true in Madagascar as well.

Density estimates are unavailable for many eastern rain forest primate species, but without these data or long-term monitoring of local populations, it is difficult to judge the impact of human activities on lemur abundance. We do not know if, or to what extent, lemur population levels are declining as a result of human disturbances. Primate species in the eastern forests may occur at low densities even without human interference: Pollock (1986a) notes that although primate species diversity is higher in the east than in the west and south of Madagascar, eastern primate abundance and biomass are lower. Thus, conservation efforts are particularly critical in Madagascar's eastern rain forests.

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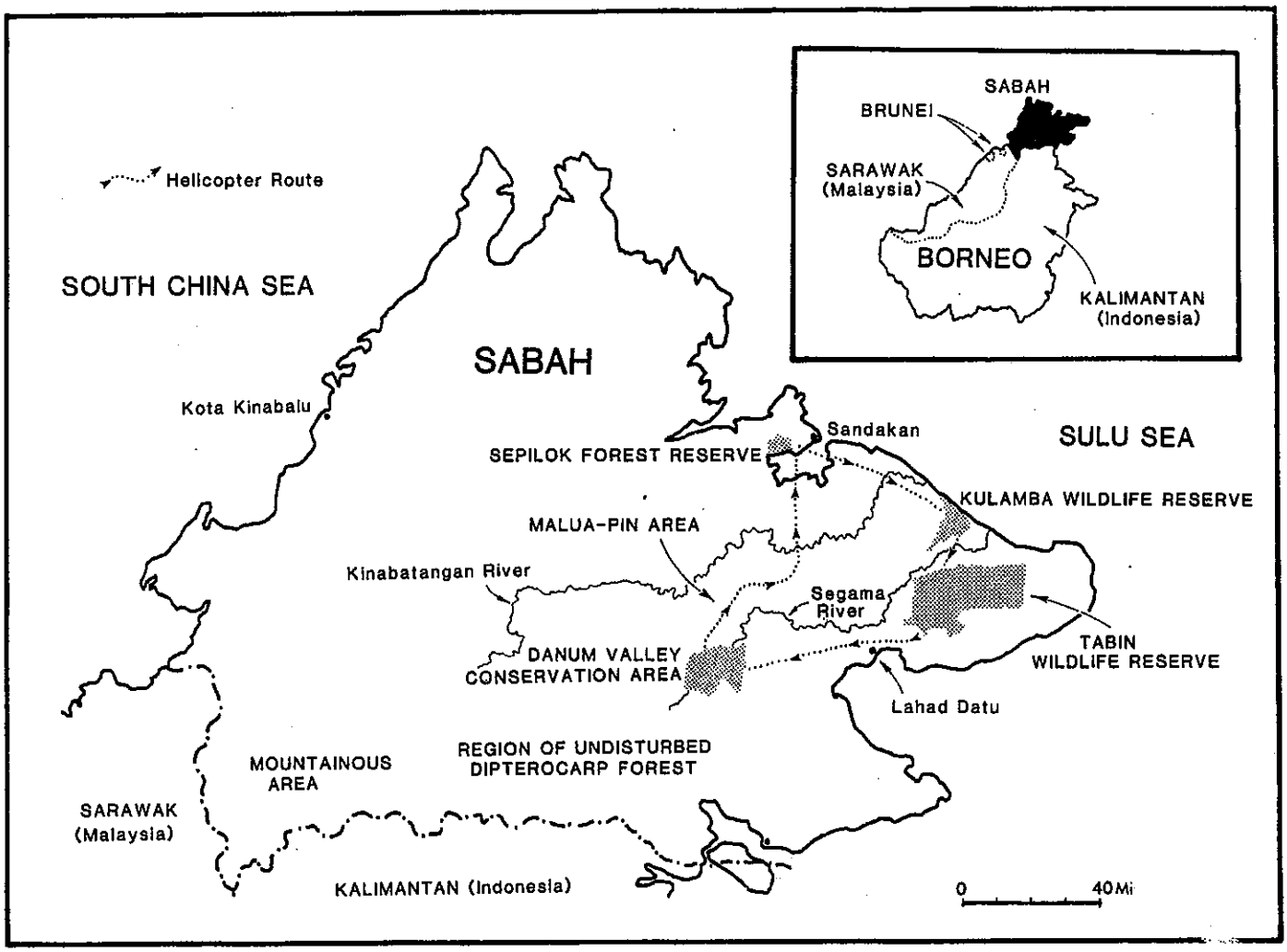

Fig. 1. A map of Sabah showing the areas surveyed for orang-utan nests by helicopter (map by S. D. Nash based on author's original).

Surveying Orang-utan Populations by Counting Nests from a Helicopter: A Pilot Survey in Sabah

compiled by Junaidi Payne

Introduction

Surveys aimed at estimating the distribution or density of vertebrate animal populations in evergreen forests always incur problems. Direct counts are usually impossible because there are too many plants in the way. Line transects similarly involve problems of highly limited visibility. Mapping of calls provides a convenient survey technique only for a few territorial species such as gibbons. Trapping is usually impractical except for common terrestrial species. Of all mammal taxa, diurnal primates tend to be relatively easy to survey or census. Most are large, noisy and gregarious. Orang-utans are something of an exception: they are solitary and usually quiet. Coupled with their relatively low abundance, these factors make surveying for orang-utans an almost impossibly time-consuming business. Orang-utans do help their surveyors in one way, however, by making nests which can be seen long after the maker has gone elsewhere. This point has been noted by several field workers, but the value of nests as a survey technique has been neglected because looking for nests from the ground is nearly as time-consuming as looking for orang-utans themselves when large areas of forest need to be investigated. This paper examines the value of surveying orang-utan nests from a helicopter and suggests how future surveys might be done.

Background

While conducting a management survey of the Lanjak-Entimau Wildlife Sanctuary in Sarawak during September 1981, Banggan Empulu, D. Labang and other staff of the National Parks and Wildlife Office (NPWO) of the Sarawak Forest Department found that they could readily and reliably identify the nests of orang-utans *(Pongo pygmaeus)* from a helicopter flying over the forest canopy. Fortunately, this unexpected discovery of a novel survey technique could be tested in Lanjak-Entimau, because the Tentera Udara DiRaja Malaysia (TUDM = Royal Malaysian Air Force) based at Kuching not only ferried personnel and supplies into the remote survey area, but also provided helicopter flying time to survey a large portion of the sanctuary specifically for orang-utan nests (WWFM, 1982a). As a result, it was confirmed within one day that orang-utans occur through many parts of the sanctuary, where ground surveys would have taken many weeks to come up with the same result. Since then, NPWO has used the technique on several occasions over various types of forest (NPWO/WWFM, 1983a, 1984) and has been able to obtain preliminary confirmation of the validity of this survey technique by some opportunistic ground checking (NPWO/WWFM, 1983b). NPWO had not, however, been able to attempt a quantitative ground assessment.

In 1985, M. Kavanagh with Lt. Col. (U) Sharkawi Hj. Hasbie (TUDM), P. Chai (NPWO) and J. Payne arranged to try the helicopter technique in Sabah (Fig. 1). TUDM kindly provided one whole day of helicopter flying time, while the Sarawak Forest Department permitted one of its skilled orang-utan nest-spotters to participate. The Sabah survey permitted a quantitative ground check to be added to the data, because the areas covered included Sepilok, an accessible site which allowed a ground survey to be made for comparison with the results of the helicopter survey. Five months later, Sabah Foundation kindly made available three hours of flying time in a smaller helicopter owned by Sabah Air Sdn Bhd, and Sepilok was surveyed again, taking different routes and different staff, thus permitting an additional assessment of comparability of data from helicopter surveys for nests.

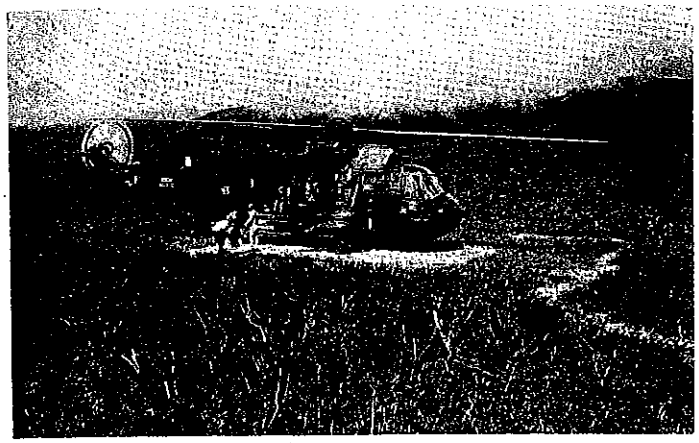

Fig. 2. The Nuri helicopter in which one team of spotters stood by the waist-height front door, and a second team sat by the open rear door (illustrated) on the opposite side of the aircraft (photo by M. Kavanagh).

First Helicopter Survey

The first aerial survey for orang-utan nests was done on 24 May 1985, from a TUDM Nuri helicopter (Fig. 2) flying at approximately 132 m altitude and 110 km/hour. Altitude and speed varied with topography, however, being more variable over rough terrain. Nuri helicopters can take about 14 people comfortably, thus allowing participants to take turns spotting.

Survey routes were planned in advance of the flight in consultation with the air-crew and other personnel at a detailed briefing session. This was considered essential to clarify to the pilots the route to be followed, and to other personnel their role during the flight, when accurate communication is difficult. In addition to the helicopter crew, recording data required at least three people: a Navigator, one or more Observers and one or more Recorders.

All personnel involved in data collection for the nest survey synchronized watches before commencing the flight, this being essential to plot nest data on a map after the flight. The Navigator stood behind the pilot, in contact via helmet telephone, guiding him along the route to be taken and mapping the route by a series of dots at one-minute time intervals on a 1:250,000 topographical map (Joint Operations Graphic-Ground, Series 1501). The sole task of the Observer was to look continuously for nests from the side of the helicopter. Field of view was normally concentrated in the range from below the side of the helicopter out to a distance of about 100 m. The width of the transect within which nests are spotted varied with altitude, topography and tree canopy structure, and no attempts were made to convert observations to density of nests per unit area of forest. In the Nuri helicopter, doors are arranged such that two people can watch for nests, one from the front left side and one from the rear right. Ideally, slightly-tinted spectacles are used to reduce the adverse effects of strong air currents and glare. Each time a nest was spotted, irrespective of its age, the Observer tapped the Recorder who wrote down the number of nests counted at one-minute intervals.

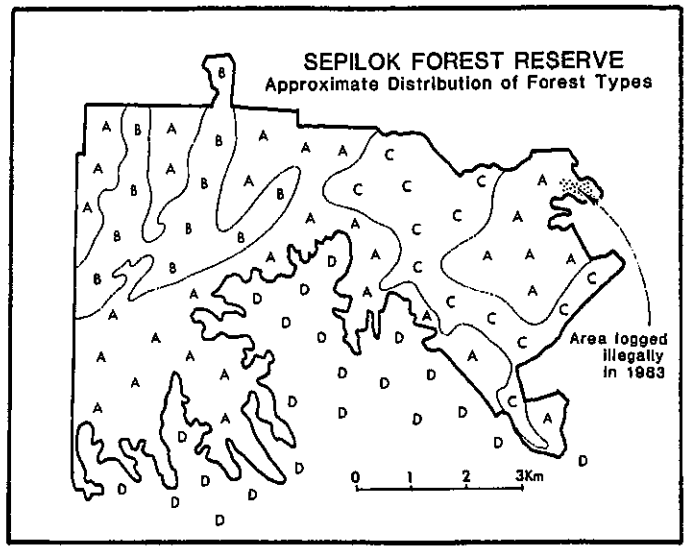

Fig. 3. The approximate distribution of forest types in the Sepilok Forest Reserve (map by S. D. Nash based on author's original).
Key:
A Tall diptercarp forest, on flat land and hills; canopy often broken.
B Dipterocarp forest on steep hills; lower, less broken canopy.
C Heath forest on steep terrain; low, unbroken canopy.
D Mangrove.

The following areas were surveyed (Fig. 1):

1. Sepilok Forest Reserve

This area of lowland forest (4,300 ha; 0-170 m) lies about 15 km west of Sandakan town and consists primarily of tall dipterocarp forest, parts of which were selectively logged up to the 1950's, and again illegally in 1983 (Fig. 3). The areas on the flat and gently-sloping terrain in the east and southeast of the reserve have regenerated well except for the small part logged more recently. Undisturbed tall dipterocarp forest on the lower and flatter parts of Sepilok tends to have a rather broken canopy with scattered, very large trees, while dipterocarp forest on the higher, steeper ridges tends to have a somewhat lower and more even canopy. The steep hills in the eastern part of Sepilok Forest Reserve are characterized mainly by *kerangas* or heath forest of much lower, more even stature, containing few trees of the family Dipterocarpaceae. This forest is poor in known orang-utan food trees.

Since 1964, nearly 200 orang-utans have been brought to the Sepilok Orang-utan Rehabilitation Center for reintroduction (Figs. 4,5). There is inadequate information to assess the success of this program, but certainly only a small proportion of introduced orang-utans fully adapt to life in the wild. Information on orang-utan population densities from elsewhere in Sabah (WWFM, 1982b) suggests that Sepilok Forest Reserve, now nearly isolated from other forest by agriculture and the sea, can support a maximum of about 80 wild orang-utans.

Fig. 4. Rehabilitant orang-utan at Sepilok Reserve, Sabah (photo by M. Kavanagh).

Fig. 5. Tall dipterocarp forest in Sepilok Forest Reserve surrounds the orang-utan rehabilitation center (photo by M. Kavanagh).

2. Kulamba Wildlife Reserve

This area of undisturbed coastal, mainly freshwater swamp forest (20,682 ha) was gazetted in March 1984 (Fig. 6). The original purpose of the reserve was primarily for conservation of tembadau or banteng *(Bos javanicus)* and the estuarine crocodile *(Crocodylus porosus)*. Unexpectedly a ground survey in May 1984, found evidence to suggest that orang-utans may be widespread throughout the reserve.

The aerial transect primarily covered the middle of the reserve; the coastal region was avoided because of heavy rain at the time of the survey.

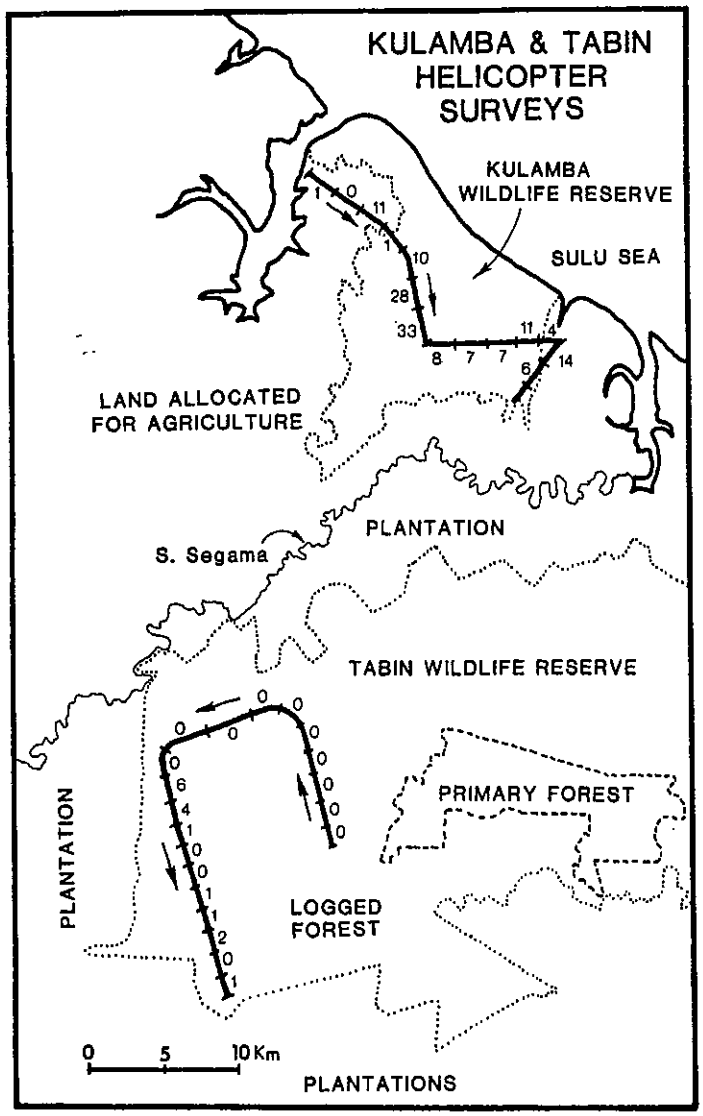

Fig. 6. Helicopter survey routes over Kulamba and Tabin Wildlife Reserves marked with numbers of nests spotted in one-minute intervals (map by S. D. Nash based on author's original).

3. Tabin Wildlife Reserve

An area of dipterocarp forest (120,521 ha; 0-570 m), most of this reserve has been or will be selectively logged (Fig. 6). The reserve was gazetted in March 1984, for protection of Asian breeding populations of the Asian two-horned rhinoceros *(Dicerorhinus sumatrensis)* and the Asian elephant *(Elephas maximus)*. Extensive ground surveys, both in primary and logged forest, have indicated that very few orang-utans live in the reserve; none have been sighted at all by Forest Department staff in the western half, and the few sightings in the eastern half suggest a population density somewhat lower than typical for similar forest elsewhere. The flora of the area is the same as elsewhere in eastern Sabah, and the region has not been inhabited by hunting peoples in recent historical times. The reason for this apparent, unusually low population density remains unknown.

The intention was to fly an east-west transect across the entire reserve, encompassing a core area of unexploited forest in the middle. Heavy rain prevented this plan from being carried out and instead only logged forest on the western side of the reserve was covered.

4. Danum Valley Conservation Area

This area of predominantly dipterocarp forest (42,755 ha; about 150-1,000 m) is within the Ulu Segama Forest Reserve, and part of Sabah Foundation's 100-year logging concession designated for conservation (Fig. 7). A field studies center has been constructed within the area as a base for research and training activities. Ground surveys have revealed fairly high population densities of orang-utans immediately to the northeast of Danum Valley, and signs of the species are often found within the Conservation Area near to the field studies center. It has been assumed, but not confirmed, that Danum Valley is an important refuge for the species.

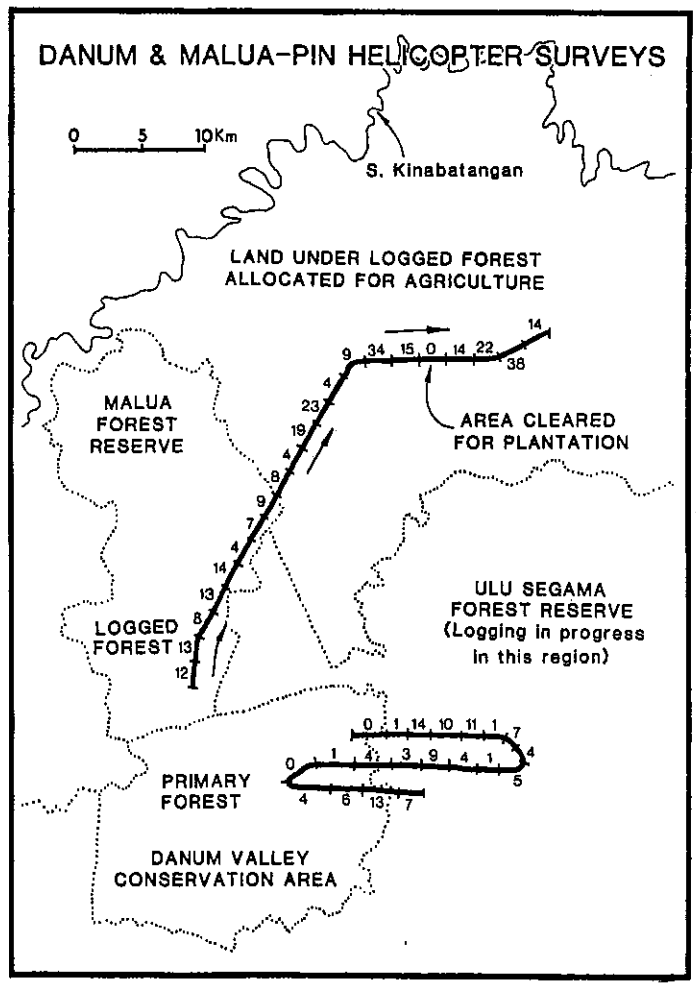

Fig. 7. Helicopter survey routes over Malua-Pin Area and Danum Valley marked with numbers of nests spotted in one-minute intervals (map by S. D. Nash based on author's original).

Heavy rain at the time of the survey permitted only a short transect to be flown over the eastern side of the Conservation Area.

5. Malua-Pin

This region of logged dipterocarp forest (mostly 50-150 m) was surveyed because it fell conveniently on the route taken to return to Sandakan from Danum Valley (Fig. 7). Part of the area consists of Malua Forest Reserve, but the remainder (over 60%) is scheduled for permanent conversion to agriculture. Most has been heavily logged from the 1960's up to the present, and few large trees remain.

Ground Survey

The ground survey for orang-utan nests was done between 31 May – 24 June 1985, at Sepilok Forest Reserve (Fig. 8). Both helicopter and ground survey routes had been planned to follow three east-west transects spaced at 1 km apart. In practice, the aerial transects were about 1.3 km apart (Fig. 9), while several problems were experienced in adhering to this plan during the ground surveys. Much of Sepilok is characterized by highly broken topography, locally very steep, so that straight-line rentises are difficult and time-consuming to follow, and in some places impossible. Also, rentises thought to have been cut in the eastern side of Sepilok were either overgrown or had not been cut. Consequently, the ground survey only approximately followed the helicopter routes.

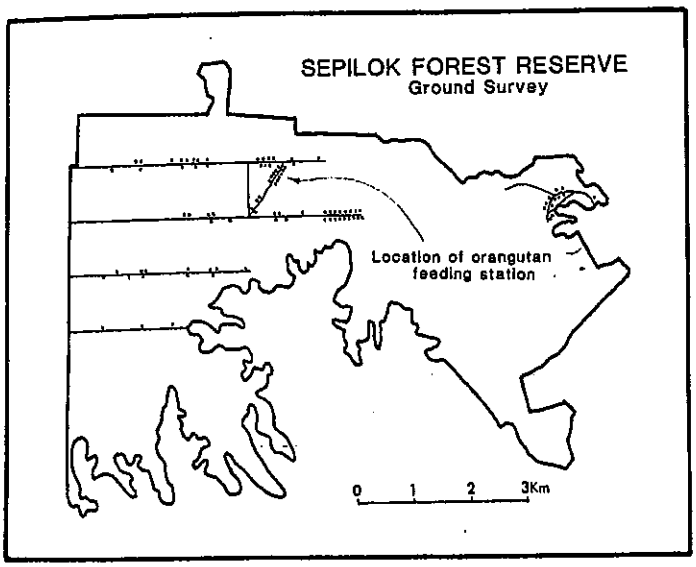

Fig. 8. Ground surveys of Sepilok by J.P., H. M. and S. O. (map by S. D. Nash based on author's original).

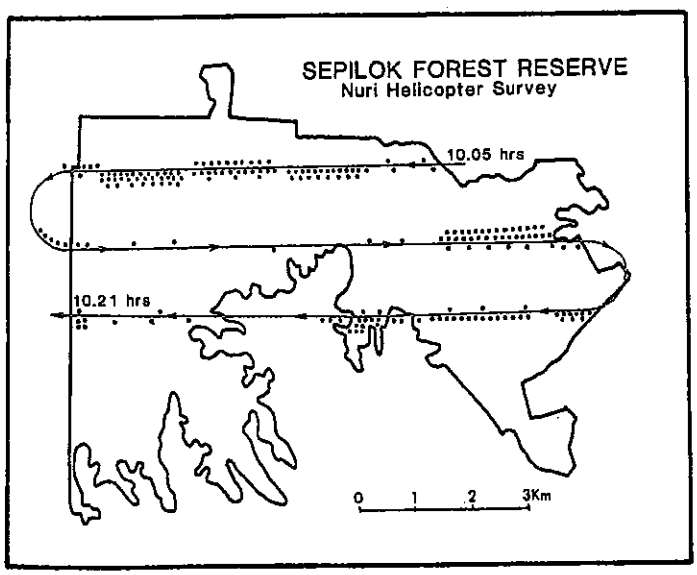

Fig. 9. Nuri helicopter survey of Sepilok, 24 May 1985 (map by S. D. Nash based on author's original).

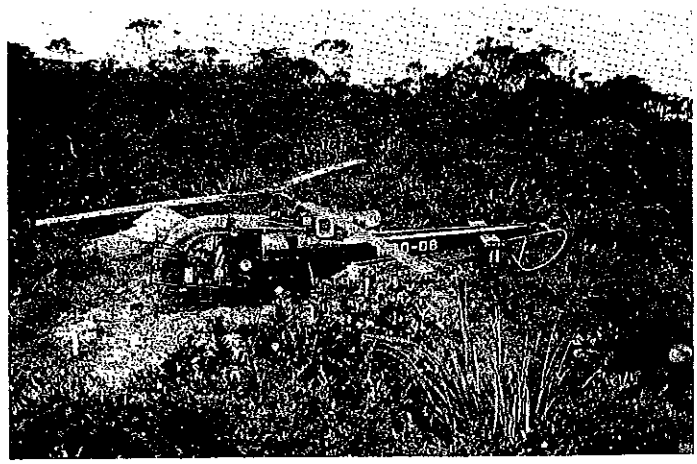

Fig. 10. The Royal Malaysian Air Force Alouette which was used for most of the survey work in Sarawak. The rear door can be kept open in flight to facilitate nest spotting (photo by M. Kavanagh).

Ground survey observers recorded the location of all orang-utans and nests seen, irrespective of the age of the latter, directly on to a 1:25,000 scale map. Walking speeds varied from about 2 km/hour to 0.5 km/hour or less on difficult terrain.

Second Helicopter Survey at Sepilok

The second aerial survey was done on 31 October 1985, from a Bell 206 Jet Ranger helicopter owned and flown by Sabah Air Sdn Bhd (Fig. 10), at approximately 150 ft altitude and about 70 km/hour (Fig. 11). Altitude and speed varied, as with the Nuri, but on average the flight was significantly lower and slower. The Bell helicopter can take a maximum of four passengers with one pilot, and movement between seats is not possible during flight. The Navigator sat on the left of the pilot and plotted the route taken on the map. He also recorded additional notes on a tape recorder. Two Observers sat behind with one Recorder in the middle who was able to record data without difficulty for both Observers.

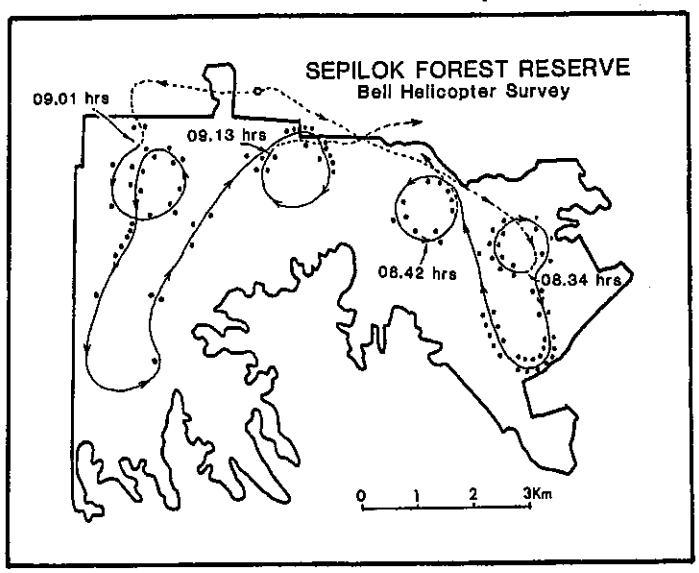

Fig. 11. Bell helicopter survey of Sepilok, 31 October 1985 (map by S. D. Nash based on author's original).

While the Nuri flight was found excellent for long-distance nest surveys over large tracts of forest, problems had been experienced during the Sepilok survey where more precise locations of nests were desired. This was because during straight-line flights over the generally low but very broken topography of Sepilok, it was often difficult to know exactly where the helicopter was at any particular time. This problem was compounded because patches of heath forest were interspersed with tall dipterocarp forest, and when plotting the nest counts on to a map after the flight,

it was not possible to distinguish whether those nests had been spotted in dipterocarp or heath forest. In an attempt to overcome these problems, the first flight in the Bell helicopter was arranged so as to follow ridge tops and river courses. It was found, however, that the same problems arose, because the topography of Sepilok is so broken. This practice flight was valuable in two respects. First, it was found that Observers obtained a good view of the forest canopy without having to remove the doors. Second, rather than continue with either straight-line flights or attempt to follow topographical features, it was decided to choose six separate parts of the reserve based on geographical spacing and forest type, and to circle over each. It was hoped in this way to be able to detect variation in orang-utan nest density between different regions of Sepilok or between different forest types.

Discussion

No statistical comparison of helicopter nest counts is attempted because limits for sampling units cannot be drawn. Apart from some young rehabilitant orang-utans, no animals were seen during the ground survey at Sepilok. Three individuals were seen from the Nuri helicopter at Sepilok, and none from the Bell helicopter, but these observations are fortuitous, and are not considered to be of any importance in terms of survey technique.

Nest surveys, whether from the ground or from a helicopter, can provide a convenient method of plotting the definite presence or probable absence of orang-utans in a particular area of forest. Questions which arise center on whether it is valid to compare data from different areas, and on choice of survey technique so as to maximize amount of useful data collected while minimizing costs.

1) Factors Influencing Comparability of Data

Helicopter Surveys

The ability of different Observers to spot nests from a helicopter varies significantly. Not only the number of nests spotted varied between Observers covering the same survey route, but the recorded distribution of nests differed along the same route (Tables 1 and 2). This is surprising, since it was expected that the recorded pattern of nest distribution, even if not the absolute number of nests, would be similar. A partial explanation possibly lies in the fact that, except for Banggan Empulu, this was the first helicopter survey for all Observers. However, there was no obvious improvement with time in the number of nests seen by new Observers as compared with the number spotted by Banggan Empulu. It may also be that some Observers are less able to keep up a sustained watch for nests, intensive watching for nests from a helicopter is tiring, and adequate rest periods are needed.

Helicopter altitude and speed affect the number of nests spotted and it is essential that both are kept as constant as possible for comparative surveys. Variation increases in steep areas and with broken topography, and if flight paths are not straight.

Fig. 12. An old, decaying nest (center foreground) in the Sungai Jingin area of Sarawak (photo by M. Kavanagh).

Nests are spotted from helicopters by watching for a combination of color (nests more than a few days old being dark brown) and form (a localized, thick concentration of vegetation, normally in a branch fork) (Fig. 12). Observers who are red-green-brown color-blind have more difficulty spotting nests, and may see fewer than those with good color vision. (From the ground, color may be less important, as nests appear as dark forms against a light sky). Our experience also suggests that short-sighted Observers, even when wearing corrective spectacles, may spot fewer nests than Observers with good vision. It was noted in Sarawak that those Observers skilled at spotting nests from the ground tend to be the best at spotting them from helicopters.

Ground Surveys

Numerous and significant other problems are encountered with ground surveys of nests. Undoubtedly, there are differences between Observers in terms of ability to spot nests even under identical conditions, but under differing conditions the problems are compounded. For example, one Observer walking along a 600 m stretch of trail in Sepilok on 31 May 1985 spotted 7 nests within 30 minutes. A different Observer walking along the same stretch four days later in twice the time spotted 13 nests, none of which was new. Probably a combination of both inter-observer ability and time spent looking for nests contributed to the different result. Other points probably contributing to differences in results include:

(1) decreasing degree of concentration with time spent looking (after about three hours, and especially during the hot middle part of the day, relatively fewer nests were spotted);
(2) weather (concentration goes down as temperature rises. Also, from the ground, nests seem more difficult to spot on very dull and very bright days, the latter because of contrast between dark vegetation and intense light from above);
(3) topography of the ground (watching for nests on steep and rough terrain is difficult as much time is spent looking down).

There is one significant problem relating to comparability of data, which affects both aerial and ground surveys: structure of the forest cover. Visibility of nests varies enormously mainly because of variation in the density of vegetation in the lower to middle levels of the canopy. Visibility in forests with a low, open or even tree canopy (such as swamp forests and old secondary forests on dry land) is greater than in most dipterocarp forests. Visibility is also greater in dipterocarp forests which have been logged; the more heavily logged the forest, the greater the visibility. Furthermore, it seems that orang-utans tend to build nests in the few taller trees in logged and secondary forests, where they are particularly easy to spot. Because of this, it is not valid to make comparisons between results from different forest formations, or from forests which have undergone different levels of exploitation or disturbance.

If efforts are made to ensure the conditions listed below, then quantitative comparisons may be made between different areas.

a) Surveys should be done by one person or by people with proven similar nest-spotting ability.
b) Comparisons should be made only between similar forest types, or between regions with a similar mix of forest types.
c) Weather conditions should be similar.
d) Adequate allowance should be made for rest periods.
e) Survey paths should follow the same pattern (preferably straight lines, except for ground surveys on steep terrain).
f) Altitude and speed should be as constant as possible for all helicopter surveys.
g) Caution should be exercised in comparing data from areas with different topography, even though all other factors are similar.

2) Selection of Helicopter Survey Techniques and Routes

Although the Nuri helicopter flew higher and faster than the Bell, there is a wider and clearer field of view of the forest canopy from the Nuri. At Sepilok, the "Typical Observer" counted 33 nests in 17 minutes of flying time in the Nuri, equivalent to a mean of about 1.4 nests/km. From the Bell, the "Typical Observers" together counted 45 nests in 32 minutes of flying time on the first run, equivalent to about 1.2

nests/km. On the second run, they counted 95 nests in 42 minutes, or 1.9 nests/km. The two types of helicopter appear, therefore, to yield similar results.

The use of at least three people for recording data (Navigator, Observer and Recorder) may not always be practical or economical if a major survey program is intended. If a large region is to be covered with the pilot following a predetermined straight-line flight path, and there is no intention to record the route precisely, it should be possible to conduct nest surveys with only one surveyor by using a tape recorder. Each nest could be recorded with one word, habitat type with another code and time when appropriate. A second person is needed if the route is to be mapped.

Three types of flight paths were tried during the surveys reported here. The Nuri flew essentially straight line paths. This is the easiest method for all survey participants. A flight path following natural features was attempted in the Bell in an effort to locate nest positions more precisely and to relate distribution to forest type. This method was more difficult because most topographical features are not as clear from a helicopter as they are on a map, and the Navigator was continually distracted by having to instruct the Pilot where to go. This method is not recommended. The third method of circling over predetermined, separate areas in an attempt to define sampling units for a quantitative comparison, also failed for several reasons: the pilot required continuous instruction, making route-recording difficult; each "circle" was joined by a straight-line route and was thus not a discrete sampling unit; the same nests may be counted twice; the Observer must always be either on the inside or the outside of the circle if comparisons are to be valid. For future helicopter nest surveys, it is recommended that a few, long-distance straight-line routes be followed.

3) Comparison of Helicopter and Ground Results

Results of the helicopter and ground survey at Sepilok can be compared subjectively by referring to Figures 8,9,11. A precise quantitative comparison is not valid because many aspects of each survey method are different (for example, helicopter counts were recorded as nests per minute, while ground counts were plotted directly on to the map).

Within the 24 km (approx.) transect covered by Nuri helicopter over Sepilok, 163 nests were spotted by the "Skilled Observer" (B. E.) and 33 nests by the "Typical Observer" (S. A.). This corresponds to a rate of 6.8 nests/km and 1.4 nests/km respectively. The rate of nests spotted from the Bell helicopter was also 1 - 2 nests/km. Within the 17.7 km (approx.) of transects covered on the ground, approximately 84 nests were recorded by "Typical Observers", equivalent to a rate of 4.7 nests/km. In terms of nests counted/unit distance covered, therefore, ground surveys seem to yield more data than helicopter surveys at least in tall dipterocarp forest, with "Typical Observers".

A number of points emerge from inspection of Figure 3.

1) There is no consistent correspondence between results from the air and the ground. Most notably, the high concentration of nests towards the west end of the most northerly Nuri transect (Fig. 9) seen by B. E. was not found on the ground, even though the helicopter and ground transects covered almost exactly the same route later.
2) Both air and ground surveys showed generally higher concentrations of nests in the north and east compared to the southwest of Sepilok, but a notably patchy distribution of nests throughout, with regions of low and high nest density separated by distances of 0.5 km or less.
3) The high concentration of nests in the region around the rehabilitant orang-utan feeding station (Fig. 8), evident from the ground, was not prominent from the helicopter. Possibly, this is because many of these nests, built by inexperienced immature orang-utans, are lower in the canopy.
4) There is no obvious correlation of nest concentration with habitat. There appears to be a greater difference between tall dipterocarp forest in the northwest and southwest, than between tall dipterocarp forest and heath forest. Both during this ground survey and the Faunal Survey of Sabah (WWFM, 1982b), population density of orang-utans generally appeared to be higher on flat land than on steep slopes bearing similar forest structure. Furthermore, the limited data available and distribution of orang-utan food trees, suggest that orang-utan population density would be lower in heath forest and heavily logged forest, than in unexploited dipterocarp forest.

Figure 3 shows the approximate distribution of low flat land and higher steep land in Sepilok, based on a 1:50,000 topographical map. Although this accurately reflects the overall physiography of Sepilok, the ground survey showed this to be too general in the context of analyzing orang-utan nest count data. Large portions of land classed as "flat" contain numerous low but very steep ridges, while the "steep" category contains some higher but gentler slopes. The area shown as heath forest, however, is truly dominated by heath forest, especially in the northern section, where there are no tall trees whatsoever. The relatively high concentrations of nests that were seen in heath forest in May and October, suggest that orang-utans had not entered the area in response to fruit resources (the main fruiting season at Sepilok is usually around September). Instead, it is likely that the relatively high concentrations of nests seen in the heath forest reflect better visibility rather than a real abundance of orang-utans in this habitat.

4) The Orang-utan Population in Other Areas Surveyed

a) Kulamba Wildlife Reserve

The helicopter survey results support those of a previous ground survey, where evidence of the presence of orang-utans in the form of nests and calls was found in all regions of the reserve. Nests were also seen from the helicopter in the predominantly mangrove/nipah area to the west of the reserve, confirming reports of sightings there by local residents (Fig. 6). During the helicopter survey, nests were recorded as most abundant around the middle of the transect (i.e., somewhat to the west of the center of the reserve). It is quite plausible that orang-utans might be most abundant in this region since it is here that there are tracts of dry land, with a somewhat taller and more diverse tree flora.

b) Tabin Wildlife Reserve

The helicopter survey results again support those of previous ground surveys, indicating the presence of orang-utans, but at extremely low densities. The "Skilled Observer" noted nests only along that part of the transect covering the western edge of the reserve, with no nests at all in the first 18 km or so of the helicopter transect. The "Typical Observer", however, did note a few nests within the first 18 km.

c) Danum Valley and Adjacent Area

The limited data for this area resulting from the helicopter survey must be treated with caution as only a small portion of the Danum Valley Conservation Area was covered and in poor weather. The "Skilled Observer" counted 28 nests in 7 minutes (= 13 km) over the Conservation Area, as compared to 65 nests in 11 minutes (= 20 km) in unlogged forest to the east of the Conservation Area. This corresponds to a rate of 2.2 nests/km in the Danum Valley Conservation Area and 3.3 nests/km to the east, as compared to a rate of 6.8 nests/km at Sepilok, where habitat structure is fairly similar (although orang-utan population density is abnormally high in some parts). In the Danum Valley Area, localities with the fewest nests tended to correspond with the steepest topography (Table 1d). About 80% of the area consists of such steep terrain (WWFM, undated), but 20% (still twice the size of Sepilok), has flatter terrain.

d) Malua-Pin

Although not originally intended as a survey area, this transect was one of the most instructive. The results indicate that even heavily logged forest can support a high population density of

orang-utans. Omitting the parts of the transect over unlogged forest, burned and totally cleared areas, 83 nests were counted in roughly 15 km, equivalent to a rate of 5.5 nests/km. This may be compared to a rate of 0.3 nest/km over forest of similar structure in Tabin. On the other hand, the apparently high density of nests at Malua-Pin seems less remarkable when compared to rates of 2.2 and 3.3 nests/km at Danum and 6.8 nests/km at Sepilok, regions where nest visibility is considerably worse.

Especially obvious during this survey was the difference in visibility of nests between different forest structures. Banggan Empulu reported that in heavily disturbed parts of the forest on this transect, not all nests visible could be counted in the time permitted by the speed of the helicopter. It is not possible to calculate whether this was entirely because nest visibility was very good, or because nest density was very high.

5) Prospects for Estimating Orang-utan Population Density from Nest Counts

There is some indication that the number of nests spotted per minute in tall dipterocarp forest does reflect the population density of orang-utans. The twenty 1-minute observations from Danum Valley were divided into those over terrain which was either gentle (9 obs.), mixed (7 obs.) or steep (4 obs.). The median number of nests spotted was respectively 6 (range 0-13), 4 (range 1-10) and 1 (range 0-14). This result corresponds to independent findings during the Faunal Survey of Sabah (WWFM, 1982b) that orang-utan population density tends to decrease with steepness and altitude. Ground surveys in 1980 in undisturbed dipterocarp forest in the upper Segama valley, some 20 km north of this Danum survey, found evidence of over 2 orang-utans/km^2 on gentle terrain at 100 m, and about 1 orang-utan/km^2 on steeper terrain at 400 m. Without further survey work, little more can be said on the relationship between the number of nests spotted from a helicopter and the population density of orang-utans.

It should be appreciated that counts of orang-utans, based on ground sightings from transects of known length, require a very substantial amount of work. During a Faunal Survey of Sabah (WWFM, 1982b), the mean rate of sightings of orang-utans in 11 localities of dipterocarp forest sampled throughout Sabah, was 1 orang-utan in 19.3 km. At only 3 of the 11 localities were orang-utans actually seen and at 2 their presence was detected by nests and calls. At the remaining 6, orang-utans were either absent or so rare as to be undetected within the area sampled. At this rate, to obtain 15 sightings at 5 localities, 290 km would have to be surveyed.

In view of the large amount of ground work that would be required to obtain data for estimates of orang-utan population density in different areas, it would seem wise to consider any possible alternatives. Surveying from a helicopter, however, presents several major problems.

The first major unknown is what proportion of nests present are actually seen from the helicopter. Some inferences can be made from this survey. In heavily disturbed parts of the Malua-Pin area, where probably most nests are visible, over 20 nests were counted per minute, a rate at which not all nests could be recorded because of the speed of the helicopter. In comparison, the mean rate of nests counted in unlogged forest, for example at Danum Valley, was 5 per minute. If we assume that the orang-utan population density is at least as high at Danum Valley as at Malua-Pin, then well under 25% of the nests were spotted over unlogged dipterocarp forest, even by a "Skilled Observer".

The second difficulty concerns the fact that nests of various ages are seen, and unless only very fresh nests are counted, ground work would still be needed to derive a relationship between total nest numbers and orang-utan numbers. In practice, only a very small proportion of nests seen are fresh, and so all nests must be recorded to give adequate data. If all nests counted are used in calculations, it must be assumed that rate of nest disintegration is the same in all areas surveyed.

If ground surveys were done to estimate population densities from counts of orang-utans, together with helicopter nest counts over the same survey sites, a relationship could be derived but would be valid only if an Observer of the same ability conducted all helicopter surveys. This approach assumes that the same proportions of nests of all ages are seen at all survey localities, irrespective of the absolute number of nests counted, and thus does not require any knowledge of the age of nests. It is possible that the rate at which nests disintegrate varies to a significant extent with weather, but this factor could be avoided by not doing surveys during, or for some time after, long rainy periods. There is a possibility that nest disintegration rate also varies with soil and forest type (according to tannin and fibre levels in leaves and twigs), this would require a long and detailed investigation. Even if all factors are identical, the number of nests counted may not reflect the exact number of orang-utans in any particular locality. Some individuals may habitually build nests either high or low in the canopy; others may build more than one nest in a day. Large samples should overcome this possibility.

It should be emphasized that different relationships will hold for different forest types. For practical purposes, we suggest that if surveys are done to derive a relationship between nest counts and orang-utan population density, one set of surveys should be done in undisturbed dipterocarp forest, and another set in recently-logged dipterocarp forest. Both forest types are represented over most regions of Sabah.

6) The Efficiency of Helicopter and Ground Surveys

A total of 1 hour 30 minutes was spent actually surveying for orang-utan nests from the Nuri helicopter, and during that period a transect of approximately 170 km was surveyed. The most skilled nest-surveyor spotted 656 orang-utan nests during that period, while the other observers recorded a total of 220 nests.

Using a Bell 206 Jet Ranger helicopter, this survey of five regions could have been done within three hours of flying time (1 hr 30 mins (transects) + 1 hr 30 mins (routes between transects, at about 180 km/hour) = 3 hrs. Note that stops are needed for rest; this calculation is for purposes of estimating costs). The total cost for 170 km of transects or three hours of flying time would be U.S. $1,750. (U.S. $580. per hour is the current rate charged by Sabah Air Sdn Bhd, which has a monopoly on helicopter hire in Sabah.)

In comparison, if ground surveys were done for orang-utan nests along the same transects, the estimated amount of time required would be at least 98 days and the minimum cost U.S. $4,884. for a survey team of three people.

Additional Survey of Danum Valley

Since the main body of this report was written, an additional survey in a Bell 206 Jet Ranger was made on 19 December 1985, over the Danum Valley Conservation Area. The methods were the same as in the earlier survey in a helicopter of this type, and both Observers (JG and JP) were experienced. The flight path followed four parallel transects designed to give approximately equal coverage of primary and logged forest of otherwise similar type and over gently rolling terrain (Fig. 13). In this way it was hoped to make a more formal comparison of nest frequencies in logged and primary forest incorporating all our earlier experience.

Nest counts were made during 29 min. of flying over primary forest (34 km) and 35 min. (41 km) over logged forest. The results are given in Table 3. The mean number of nests counted was 4.95/km over primary forest and 3.31/km over logged forest. A Mann-Whitney U-test applied to the number of nests sighted each minute in the two habitat types shows a statistically significant difference between them ($U = 265$, $Z = 3.26$, $p \ll .01$ two tailed, $n_1 = 29$, $n_2 = 34$) i.e. significantly more nests were seen in primary forest. Since visibility is better in logged forests, it is safe to conclude that fewer orang-utan nests occur there and that the true difference in density is probably greater than that shown by the data.

These results are consistent with field observations of the relative scarcity of orang-utans in logged forest compared to adjacent unlogged areas (Mackinnon, 1974). However, they do not contradict the findings in the earlier surveys of great regional variation in orang-utan nest densities. This fact, together with the better visibility in logged forest may explain why on some occasions more nests were seen in logged forest than

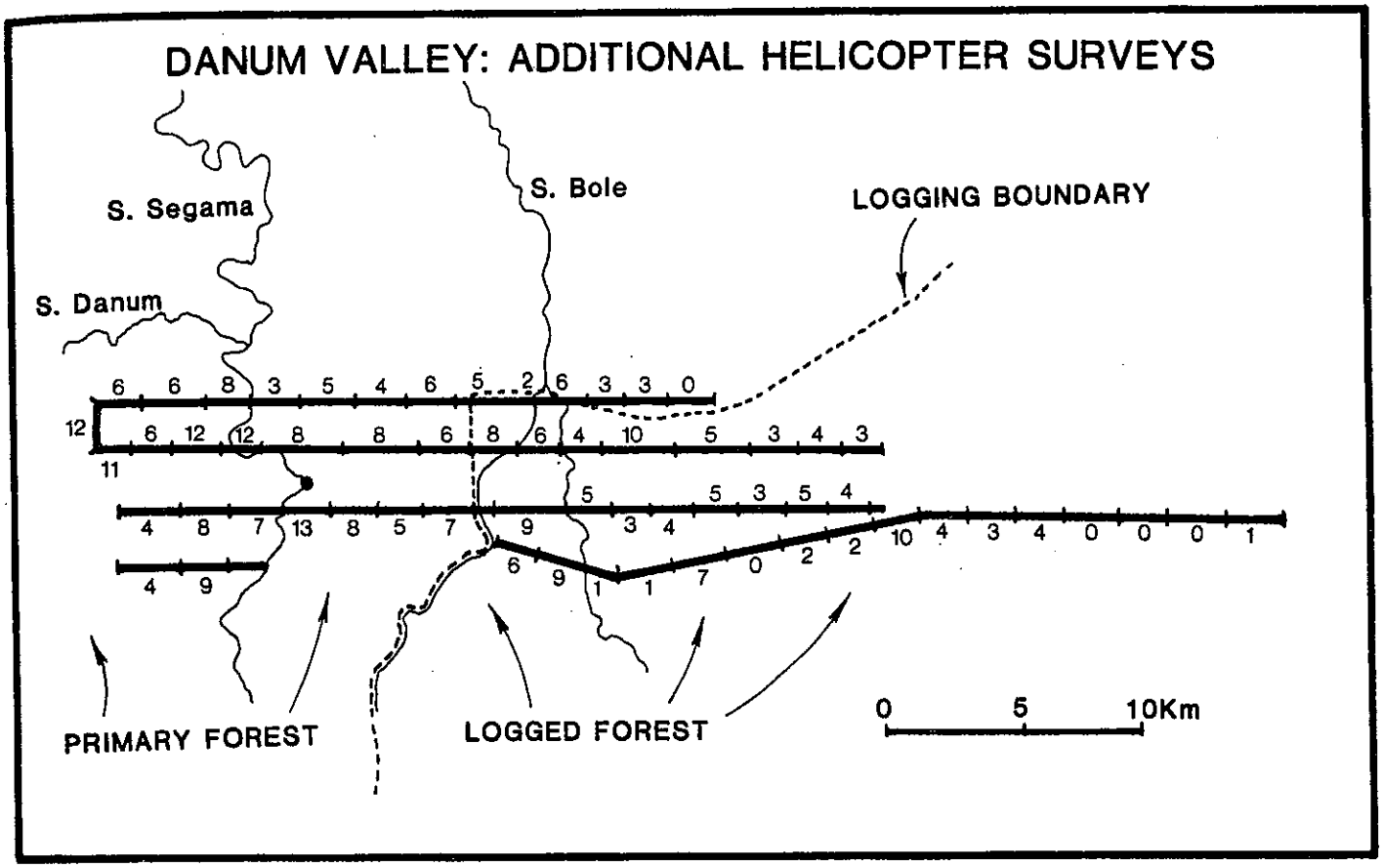

Fig. 13. Additional helicopter survey routes over Danum Valley marked with numbers of nests spotted in one-minute intervals (map by S. D. Nash based on author's original).

in primary forest. The firmest comparisons are probably those between forest types with similar visibility characteristics and on similar terrain.

Conclusions

1) Helicopter surveys provide a reliable and convenient means of detecting the presence of orang-utans by their nests. For areas where access is moderately easy, the helicopter method is estimated to be nearly 100 times more efficient than ground surveys in terms of time required, and nearly three times cheaper for the same area covered. The helicopter method would be particularly suitable for remote areas where ground access is even more difficult and time-consuming.
2) Helicopter surveys of nests give very large sample sizes, as compared to ground surveys, which permit greater confidence that survey results reflect the actual situation.
3) Different observers vary significantly in their ability to spot nests from a helicopter, as well as from the ground. Thus, comparison of nest counts between two or more areas, as a basis for estimating relative density, is only valid if the counts are made by the same person or by people who have proven similar ability.
4) In addition to having the same or equivalent observers conduct all helicopter surveys, comparable results can only be achieved if other conditions (notably, weather, altitude and speed) are fairly constant.
5) There is evidence that visibility of nests, even to the same observer, varies significantly between different forest types. It seems that the more heavily disturbed the forest, the easier it is to see nests, giving the false impression that orang-utans are more abundant in logged forests. It is not valid to compare between nest counts from different forest types. In practice, however, this factor does not restrict the value of helicopter surveys because most parts of Sabah contain extensive tracts of logged dipterocarp forest with similar structure, together with smaller patches of unlogged forest.
6) Nests are generally clumped (concentrated into small areas of forest), and not distributed randomly or evenly. Comparisons between two or more areas of the same forest type may be considered valid only if adequately large areas are sampled. This presents a significant problem for ground surveys, but not for helicopter surveys.
7) It is possible to derive a rough relationship between nests counted from a helicopter and population density of orang-utans with adequate ground work. Even if this is not possible, the helicopter technique is valuable in giving quick, relatively cheap coverage of large and remote areas, to plot variation in relative density.
8) During this survey, many nests were recorded in four areas: Sepilok Forest Reserve, Kulamba Wildlife Reserve, the upper Segama River including Danum Valley Conservation Area, and Malua-Pin, and very few nests were recorded in one area: Tabin Wildlife Reserve. The reason for the very low density of orang-utans in Tabin (confirmed from previous ground surveys in the same region) is unknown. At Sepilok, many nests were counted in the north and east of the reserve, but few in apparently similar habitat in the southwest.
9) Nests were recorded in unexploited, recently logged and old logged dipterocarp forest, on flat land and slopes, in forest with strong heath or *kerangas* elements, in freshwater swamp forest, and in mangrove/nipah areas. Orang-utans appear to be distributed throughout much, but not all, of eastern Sabah in all types of forest formations.
10) The generalization reported by *A Faunal Survey of Sabah* (WWFM, 1982b), that in unexploited dipterocarp forest, orang-utan population density decreases with increasing altitude and steepness, is not invalidated by the surveys reported here. It is apparent, however, that the distribution of the species in Sabah is patchy, and that it is rare or absent in some areas of seemingly suitable habitat. Areas reported as having many orang-utans before logging (between the Kinabatangan and Segama Rivers), appear still to support relatively high densities after heavy logging. In parts of Tabin, both unexploited and logged forests contain very few orang-utans.

Suggestions for Further Surveys

1) It is suggested that further helicopter surveys are done to assess distribution of orang-utans in all extensive regions of permanent forest.
2) If resources are available to conduct ground surveys to estimate absolute population densities, with a view to deriving a relationship between number of nests counted and orang-utan numbers, one series of surveys should be done in unexploited dipterocarp forest and another in recently logged forest. One or both habitat types occur in all areas of Sabah where surveys are required.
3) Surveys related to distribution and abundance should be extended to investigate the response of orang-utan populations to logging because in the future most orang-utans will occur in logged forest.
4) Data collection on future helicopter nest surveys would be made easier, more complete and more accurate by recording directly on to a tape-recorder. This would remove the need for both a nest Observer and a Recorder, and would permit habitat data to be recorded with each nest spotted. It would also allow incidental information on nests and other wildlife to be made without distracting attention from the main role of simple nest-counting. A Navigator is still needed to liaise with the pilot and to record routes taken.
5) Data recording on future surveys should be done either by one person at all times, or by more than one person with similar nest-spotting ability, each covering either a particular forest type or a separate geographical sub-region.
6) Briefing and debriefing sessions should be held before and after every helicopter survey. The pilot should be briefed on the aims and methods of the survey before the flight.

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WWFM. 1982b. *A Faunal Survey of Sabah.* Compiled by G. Davies and J. Payne. World Wildlife Fund Malaysia, Kuala Lumpur.

WWFM. Undated. A survey of the proposed Sungai Danum National Park, Sabah. Compiled by B.H. Kiew. World Wildlife Fund Malaysia, Kuala Lumpur.

Table 1a-e. Nuri Helicopter Nest Survey Results, 24 May 1985

Key
Personnel Spotting Nests:

BE Banggan Empulu	CJ Chani Jaikim	CM Clive Marsh
JP Junaidi Payne	SA Saimon Ambi	SS Stephen Sira

Forest Types Recognized During Survey:

Burned:	Logged dipterocarp forest which was burned during the long drought of January-June 1983, resulting in the death of many smaller trees.
Dipt.:	Unexploited dipterocarp forest.
FWSF:	Fresh-water swamp forest, unexploited, with few dipterocarp trees and a lower, more open and homogeneous tree canopy.
Heath:	Low stature forest, characteristic of sandy soils of low fertility, with low tree species diversity and poor in orang-utan food sources.
Logged:	Logged dipterocarp forest, from which most large dipterocarp trees have been removed.
Mangrove:	Mangrove forest.
Nipah:	Nearly-pure stands of nipah.
Old Logged:	Dipterocarp forest which was selectively logged many years ago and has regenerated to form a tall tree canopy.

Table 1a. Area: Sepilok
Weather fine

Time	# Nests BE	SA	Forest Type
10.05	2	2	Heath
.06	21	0	Dipt./Heath
Feeding area for rehabilitant orang-utans			
.07	15	10	Dipt.
.08	32	0	Dipt.
.09	1	4	Dipt./Logged
.10	7	0	Logged/Dipt.
.11	2	0	Dipt.
.12	0	1	Dipt.
.13	2	0	Dipt./Heath
.14	29	5	Dipt./Logged/Heath
.15	1	3	Near Mangrove
.16	9	0	Mangrove/Heath/Logged
.17	14	3	Dipt./Old Logged/Heath
.18	18	3	Dipt./Old Logged/Mangrove
.19	1	0	Mangrove
.20	3	1	Dipt.
.21	6	1	Dipt.
Total Nests	163	33	

Table 1b. Area: Kulamba
Rain from 10.49 - 10.51

Time	# Nests BE	JP	Forest Type
10.45	1	-	Mangrove
.46	0	0	Mostly Nipah
.47	11	0	Mostly Nipah
.48	1	0	Mostly Nipah
.49	10	1	Mostly FWSF
.50	28	2	Mostly FWSF
.51	33	0	Mostly FWSF
.52	8	6	Mostly FWSF/Dipt. nearby
.53	7	0	Mostly FWSF
.54	7	2	Mostly FWSF
.55	11	6	Mostly FWSF
.56	4	9	Mostly FWSF
.57	14	14	Mostly FWSF/Mangrove nearby
.58	6	1	Mostly FWSF
Total Nests	141	41	

Table 1c. Area: Tabin
Occasional rain 11:14 - 11:19, and 11:27

Time	# Nests BE	CM	Forest Type
11.14	0	1	Logged
.15	0	1	Logged
.16	0	0	Old Logged
.17	0	3	Old Logged
.18	0	0	Logged
.19	0	0	Logged
.20	0	0	Logged
.21	0	2	Heavily Logged
.22	0	0	Logged
.23	0	1	Logged
.24	6	0	Active Logging
.25	4	0	Active Logging
.26	1	0	Logged (existing logging camp area)
.27	0	1	Active Logging
.28	0	0	Logged (existing logging camp area)
.29	1	0	Logged
.30	1	0	Logged
.31	2	2	Logged (abandoned camp area)
.32	0	0	Logged
.33	1	-	Logged (near boundary with plantation)
Total Nests	16	11	

Table 1d. Area: Danum
Rain for last two minutes

(Note: the watches of the two data Recorders for this transect were out of synchrony by 1-2 minutes)

Time	# Nests BE	CJ	Forest Type	Topography
13.43	7	-	Dipt.	Gentle
.44	13	-	Dipt.	Gentle
.45	6	2	Dipt.	Gentle
.46	4	3	Dipt.	Gentle/steep
.47	0	2	Dipt.	Steep
.48	1	4	Dipt.	Steep
.49	4	0	Dipt.	Gentle/steep
.50	3	7	Dipt.	Gentle/steep
.51	9	1	Dipt.	Gentle
.52	4	1	Dipt.	Gentle
.53	1	0	Dipt.	Gentle
.54	5	2	Logged	Gentle
.55	4	0	Dipt.	Gentle/steep
.56	7	0	Dipt.	Gentle/steep
.57	1	2	Dipt.	Gentle/steep
.58	11	1	Dipt.	Gentle
.59	10	1	Dipt.	Gentle/steep
14.00	14	0	Dipt.	Steep
.01	1	2	Dipt.	Steep
.02	0	5	Dipt.	Gentle
.03	-	0	Dipt.	
.04	-	1	Dipt.	
Total Nests	105	34		

Table 1e. Area: Malua-Pin
Weather dull

(Note: so many nests were spotted on this transect by BE that not all could be counted)

Time	# Nests BE	SS	Forest Type
14.09	12	3	Dipt.
.10	13	1	Dipt.
.11	8	2	Dipt.
.12	13	0	Old Logged
.13	14	3	Logged
.14	4	5	Logged
.15	7	9	Logged/Active logging
.16	9	3	Active logging
.17	8	3	Active logging
.18	4	1	Logged/Burned
.19	19	10	Old Logged
.20	23	8	Logged/Slightly Burned
.21	4	3	Logged/Burned
.22	9	0	Old Logged
.23	34	9	Old Logged/Some Burned (about one third of nests in burned areas)
.24	15	8	Logged/partly cleared for plantation
.25	0	0	Cleared for plantation
.26	14	3	Logged/partly cleared for plantation
.27	22	13	Logged/Burned
.28	38	11	Logged/Burned
.29	14	6	Logged/Burned
Total Nests	284	101	

Table 2a-b. Bell Helicopter Nest Survey Results, Sepilok, 31 October 1985

Key:
Personnel Spotting Nests —

JG Joseph Gasis SP Sampoladon Pilik SS Sundang Sarim

Forest Types Recognized During Survey —

Dipt.: Tall dipterocarp forest. Variable, but generally with tall trees and rather broken canopy. Somewhat lower and even stature on the north-south ridges in the western half of Sepilok Forest Reserve. Old logged forest was not distinguished separately on this survey, as it does not differ significantly from unlogged forest.
Heath: Low stature forest with generally unbroken canopy. Few or no dipterocarps.

Left column indicates Observer on port side of helicopter, right column indicates starboard Observer.

Table 2a. First Sortie

Time	# Nests SP	SS	Forest Type	Notes
Start practice flight				
07.46	0	0	Dipt.	Straight-line flight
.47	0	0	Dipt.	Straight-line flight
.48	0	0	Dipt.	Straight-line flight
.49	0	0	Dipt.	Helicopter turning
.50	3	0	Dipt.	Straight-line flight
.51	5	2	Dipt.	Straight-line flight
.52	3	0	Dipt.	Helicopter turning
.53	0	0	Dipt./Heath	Straight-line flight
.54	0	2	Heath	Straight-line flight
.55	4	3	Heath/Dipt.	Straight-line flight
.56	3	3	Heath/Dipt.	Straight-line flight
.57	2	3	Heath	Helicopter turning
.58	3	1	Dipt.	Straight-line flight
.59	2	4	Dipt.	Straight-line flight
08.00	1	0	Dipt.	Straight-line flight
.01	1	0	Dipt./gardens	reserve boundary
End practice flight				
08.34	6	4	Dipt.	Circling
.35	3	2	Dipt.	Circling
.36	2	2	Dipt.	Straight-line flight
.37	7	6	Dipt./Heath	Circling
.38	5	3	Dipt./Heath	Straight-line flight
.39	0	1	Dipt./Heath	Straight-line flight
.40	5	0	Heath	Circling
.41	3	1	Heath	Circling
.42	1	1	Heath	Incomplete minute

Table 2b: Second Sortie

Time	# Nests SS	JG	Forest Type	Notes
09.01	0	2	Dipt.	Circling
.02	3	1	Dipt.	Circling
.03	4	5	Dipt.	Circling
.04	0	5	Dipt.	Straight-line flight
.05	0	1	Dipt.	Straight-line flight
.06	0	0	Dipt.	Circling
.07	1	0	Dipt.	Circling
.08	1	1	Dipt.	Straight-line flight
.09	1	2	Dipt.	Straight-line flight
.10	1	0	Dipt.	Straight-line flight
.11	9	2	Dipt.	Circling
.12	0	0	Dipt.	Circling
.13	2	2	Dipt.	Incomplete minute

Table 3a-b. Bell Helicopter Nest Survey in and Near Danum Valley Conservation Area, 19 December 1985

Key:
Personnel Spotting Nests —

JG Joseph Gasis JP Junaidi Payne

Forest Types —

Primary: Lowland dipterocarp forest
Logged: Similar forest type logged between 1970 and 1981

Table 3a: First Sortie

Time	# Nests JP	JG	Total	Forest Type
11.08	6	3	9	Primary
.09	1	4	5	Primary
.10	-	-	-	(Turning)
.11	2	2	4	Primary
.12	5	3	8	Primary
.13	4	3	7	Primary
.14	3	10	13	Primary
.15	2	6	8	Primary
.16	4	1	5	Primary
.17	3	4	7	Primary
.18	1	0	1	Logged
.19	2	7	9	Logged
.20	2	5	7	Logged
.21	2	0	2	Logged
.22	2	2	4	Logged
.23	0	5	5	Logged
.24	1	2	3	Logged
.25	5	0	5	Primary
.26	2	2	4	Primary
.27	-	-	-	(Turning)
.28	3	0	3	Logged
.29	0	4	4	Logged
.30	3	0	3	Logged
.31	2	3	5	Logged
.32	0	1	1	Logged
.33	7	3	10	Logged
.34	2	2	4	Logged
.35	0	6	6	Logged
.36	3	5	8	Logged
.37	5	1	6	Primary
.38	3	4	7	Primary
.39	1	0	1	Primary
.40	3	5	8	Primary
.41	2	10	12	Primary
.42	4	8	12	Primary
.43	4	2	6	Primary
.44	6	5	11	Primary
.45	6	6	12	Primary
.46	3	3	6	Primary
.47	1	5	6	Primary
.48	5	3	8	Primary
.49	2	1	3	Primary
.50	2	3	5	Primary
.51	4	0	4	Primary
.52	2	4	6	Primary
.53	3	2	5	Logged
.54	0	2	2	Logged
.55	2	4	6	Logged
.56	3	0	3	Primary
.57	1	2	3	Primary
Total Nests	129	153	282	

Table 3b: Second Sortie

Time	# Nests JP	JG	Total	Forest Type
14.59	1	0	1	Logged
15.00	0	0	0	Logged
.01	0	0	0	Logged
.02	0	0	0	Logged
.03	0	4	4	Logged
.04	0	3	3	Logged
.05	0	4	4	Logged
.06	3	7	10	Logged
.07	0	2	2	Logged
.08	0	2	2	Logged
.09	0	0	0	Logged
.10	4	3	7	Logged
.11	1	0	1	Logged
.12	0	1	1	Logged
.13	7	2	9	Logged
.14	1	5	6	Logged
Total Nests	17	33	50	
Combined totals from both sorties	146	186	332	

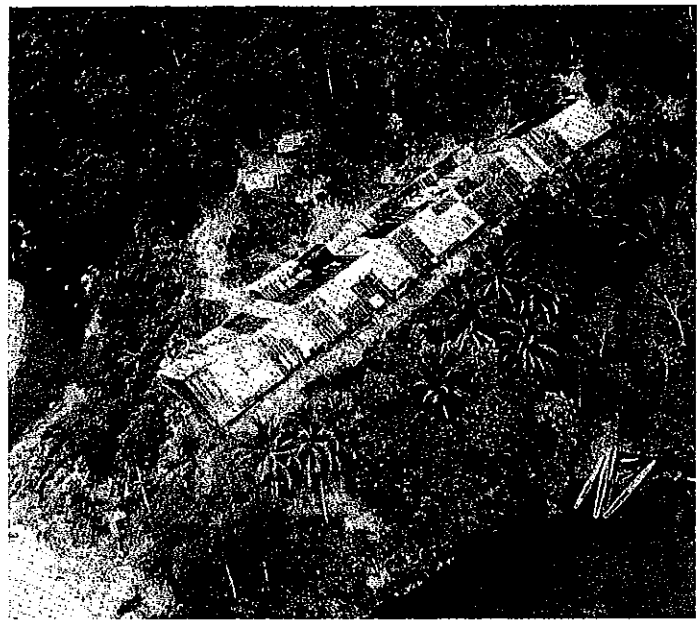


Fig. 14. An Iban longhouse in Batang Ai, Sarawak, where orang-utan are locally abundant and will venture into secondary forest within sight of the longhouse because the people have a taboo against disturbing them (photo by M. Kavanagh).

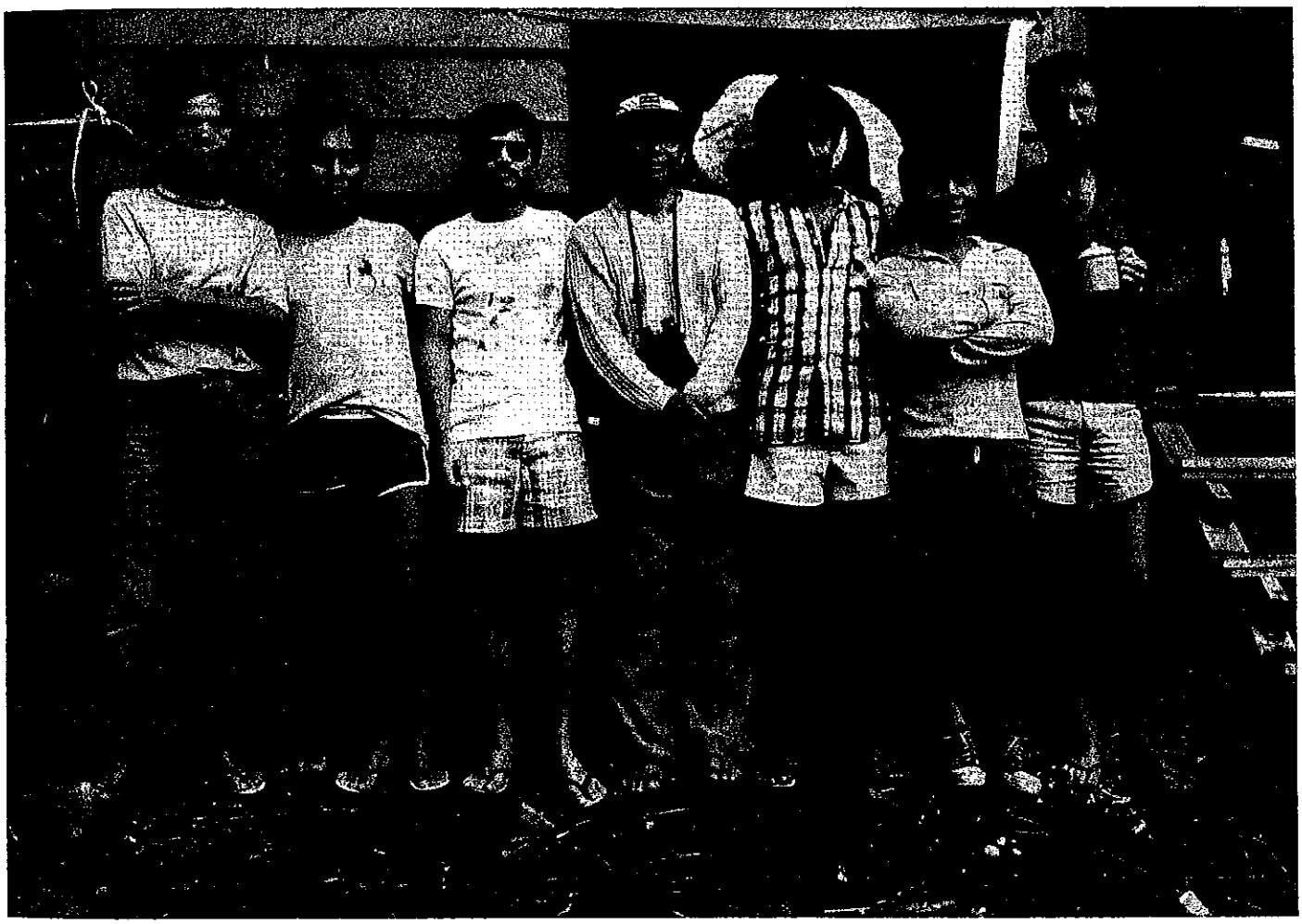


Fig. 15. Sarawak Forest Department personnel in Lanjak-Entimau Wildlife Sanctuary in 1981, during a joint management survey with World Wildlife Fund Malaysia. It was during this survey that Forest Guard Banggan Empulu (second left) and Senior Forest Officer David Labang (center) discovered that orang-utan nests could be counted from the air (photo by M. Kavanagh).

The Status of Primates and their Habitats in the Pagai Islands, Indonesia

by Richard Tenaza

Introduction

From 5 June to 14 July 1986, I visited the islands of North and South Pagai and some islets off South Pagai (Fig. 1), to elevuate the status of the native primate species: Kloss's gibbon *Hylobates klossii* (Fig. 2), the pig-tailed langur *Simias concolor* (Fig. 3), the Mentawai langur *Presbytis potenziani*, and the Mentawai pig-tailed macaque *Macaca pagensis* (Chasen and Kloss, 1927; Miller, 1903, 1906; Thomas, 1894). All four species are endemic to the Mentawais, and all occur on each of the four major islands.

Prior to my first visit to Mentawai in 1970 (Tenaza and Hamilton, 1971), the native primates were known only from museum specimens obtained by the early collectors. Since then more intensive field work on Mentawaian primates has been done only in Siberut (Marler and Tenaza, 1977; Tenaza, 1974, 1975a, 1975b, 1976; Tenaza and Mitchell, 1985; Tenaza and Tilson, 1977, 1985; Tilson and Tenaza 1976, 1982; Tilson, 1976, 1977, 1981; Watanabe, 1981; Whitten, 1982a, 1982b, 1982c, 1982d, 1982e; Whitten and Whitten, 1982; World Wildlife Fund, 1980, 1982).

Due to the focus on Siberut, the southern Mentawais have been totally overlooked in Mentawai conservation efforts (World Wildlife Fund, 1980, 1982). The Sumatran section of the recent conservation plan for Indonesia (MacKinnon and Artha, 1982) includes Siberut but ignores the southern Mentawais except to present a map erroneously showing South Pagai Island to be devoid of rainforest and, by implication, devoid of primates. Indonesian wildlife officials often believe that the endemic Mentawaian primates occur only on Siberut. The vernacular names for primates in the two regions are quite distinct and have added to the confusion (Table 1).

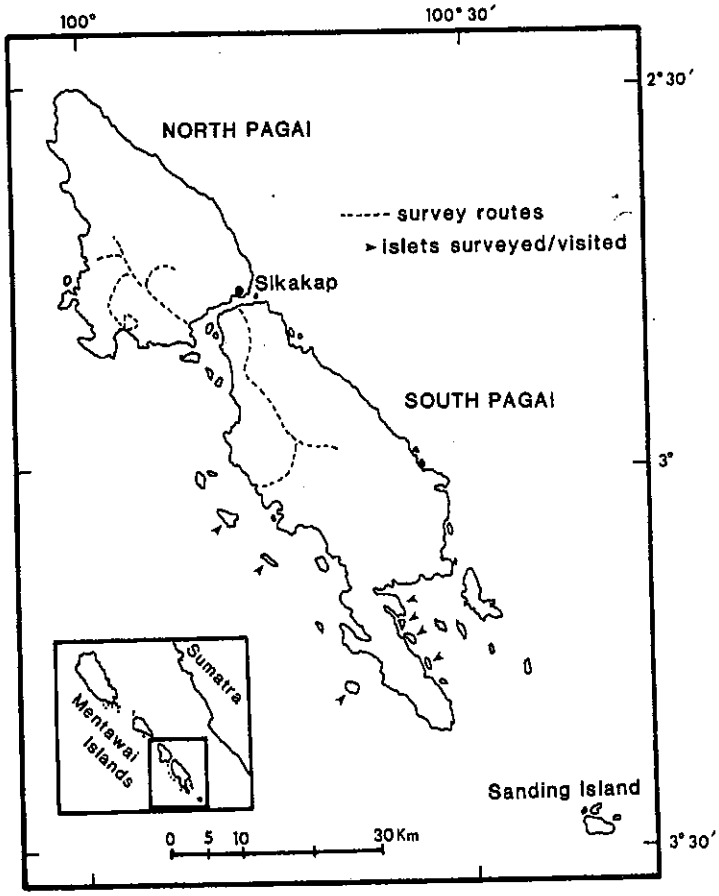


Fig. 1. Map of the Pagai Islands showing the survey routes and areas visited in the present study. Primates were present in all primary and selectively logged forests that were visited. As shown in the insert, the Pagais are the two southernmost Mentawai Islands. In addition to the four main islands, the Mentawai archipeligo includes about 50 offshore islets (map by S.D. Nash based on author's original).

Table 1. Different Vernacular Names for the Mentawaian Primates

	Siberut	North Pagai, South Pagai, and Sipora
Hylobates klossii	Bilou	Bilou
Macaca pagensis	Bokkoi	Siteut
Simias concolor	Simakobu	Masepsep
Presbytis potenziani	Joja	Atapaipai

Travel to the Pagai Islands

Travel to the Pagai Islands usually is by ship from Padang, west Sumatra. A government ship leaving from Teluk Bayur goes to Sikakap approximately twice a month on an irregular schedule. More frequently, small copra trading boats and fishing boats leave for Sikakap from Padang's river port, Muara Padang. The government discourages passenger travel on these smaller vessels because in recent years several of them have been lost at sea. Anyone wishing to book passage on one of these vessels is required to first obtain a permit from the Muara Padang Harbor Master.

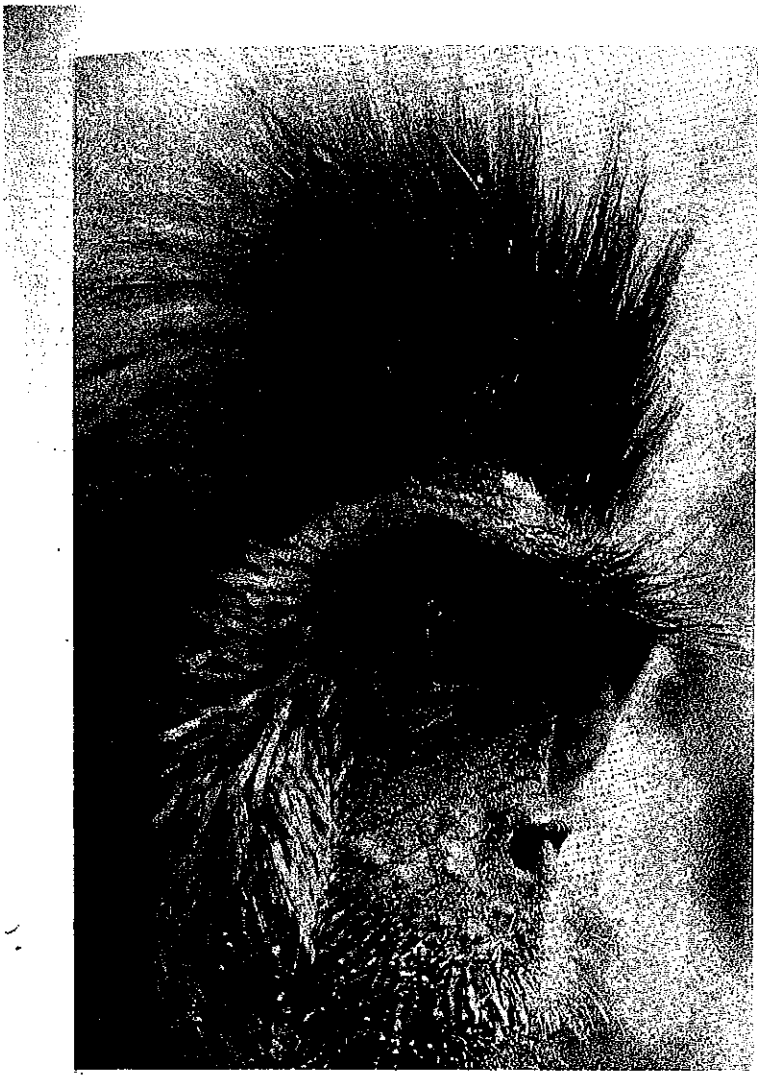
Minas Lumber Company charters a four-passenger twin engine plane that regularly flies between Padang and South Pagai. However, space on this plane generally is available only to certain Minas personnel. Minas has leased the entire 90,000 ha North and South Pagai logging concession, and theirs is the only airstrip in the Pagai Islands. To Sipora, however, there was a commercial flight twice a week from Padang.

Fig. 2. A juvenile Kloss's gibbon endemic to the Mentawai Islands of Indonesia (photo by R. Tenaza).

Habitats

The following is a cursory introduction to the habitats of the Pagai Islands based on my observations. Much of the east coast of the islands and the shores of Sikakap Strait (between North and South Pagai) are fringed with mangrove formations dominated by *Rhizophora* spp. This is in sharp contrast to the west coasts, which are more exposed to wave action. Although some mangrove occurs on the west coasts, the predominant intertidal habitats are sand and coral rock beaches.

Soggy coastal flatlands behind the intertidal zone are characteristically covered with swamp forest. On some of South Pagai's offshore islets, *pandan* (Pandanacae) and *nibung* palms are among dominant elements of the swamp forests. On the NW coast of Simalegu Islet are several hectares of the mangrove fern *Acrostichum* sp. This was the only place I noted *Acrostichum*.



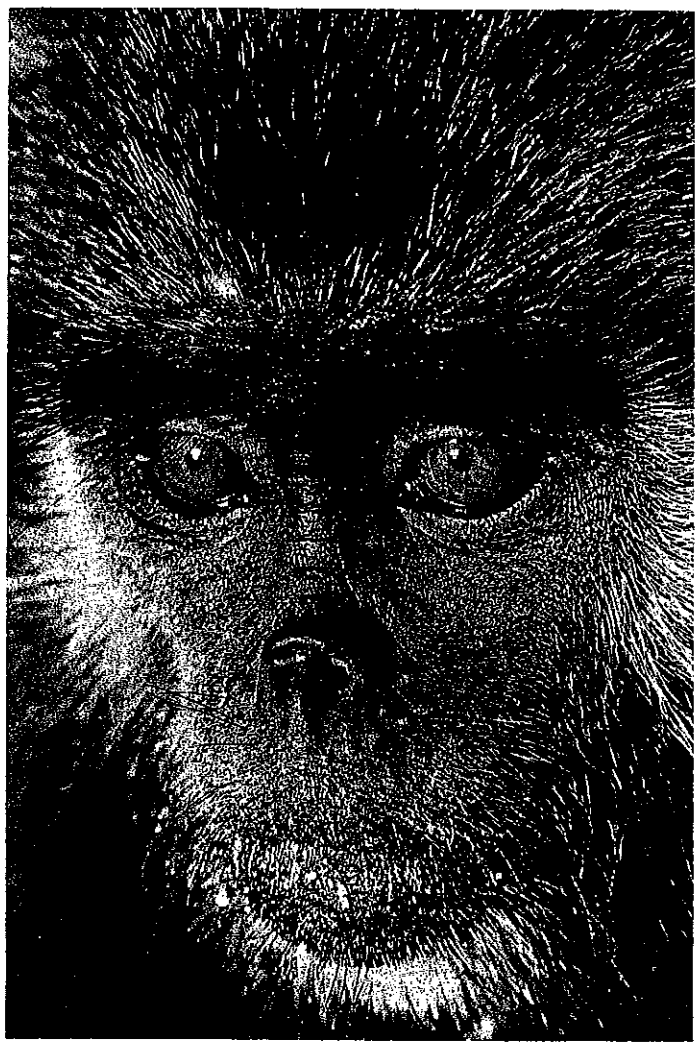


Fig. 3. Pig-tailed langurs from the Mentawai Islands (photos by R. Tenaza).

Behind the swamp forest on more elevated ground with better drained soil, lowland rainforest becomes the dominant vegetation. Where conditions are appropriate, lowland rainforest may begin just behind the intertidal zone. This rainforest, when undisturbed, has a relatively open understory and closed upper canopy with many emergent dipterocarps.

Commercial selective logging has converted ca. 30,000 ha of virgin lowland rainforest in the Pagai Islands to forest dominated by thick secondary growth. Small and inconspicuous by comparison is disturbance that has resulted from the collection of rattan palm for traditional and commercial uses, and the removal of trees by natives and settlers to make canoes, boats, and boards. Deforested areas include villages, lumber camps, logging roads, native subsistence gardens, and cash-crop clove gardens.

Areas Surveyed

The areas I surveyed are shown in Fig. 4. All four species of Mentawai primates still are present on both North and South Pagai Islands. In addition, two small uninhabited islands off the southeast coast of South Pagai were found to have primates on them: Sinaka Island, which has populations of all four species; and Simalegu, which I estimate has at least 60 to 100 *Simias* on it. Although nearby Berikopek Island and Simatapi Island were reported by local residents to have *Simias* populations, I searched both islands and could not verify their presence. It is likely that *Simias* has been hunted to near or total extinction in the past few years on these islands, both of which are inhabited. A former resident of Simatapi, who now lives in northwestern South Pagai, told me that as recently as five years ago he still hunted *Simias* on both Simatapi and Berikopek.

On coastal South Pagai, across from the islands of Sinaka, Simatapi, Simalegu, and Berikopek, *Hylobates* and *Presbytis* were abundant, and

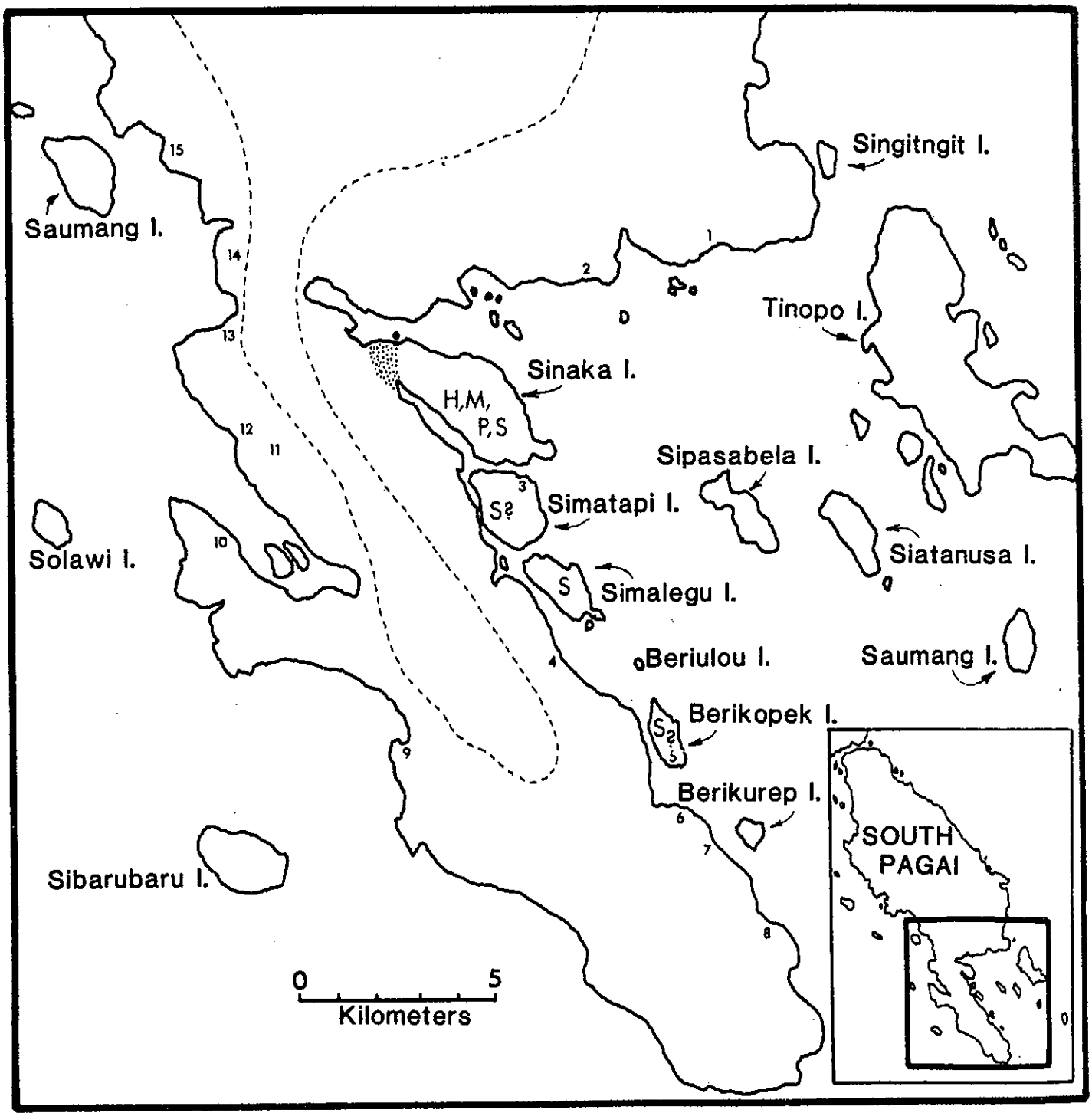


Fig. 4. Islets off South Pagai that were inhabited by primates. H = *Hylobates*, M = *Macaca*, P = *Presbytis*, S = *Simias*. S? means *Simias* was reported by natives to be present but was not found during searches by Tenaza. Although Sinaka Island appears on most maps as a peninsula, the mangrove forest between Sinaka and South Pagai (stippled) is permanently inundated and navigable by canoe. Logging is presently allowed only within the area marked by a broken line (map by S. D. Nash). Key: LOCATION OF VILLAGES: 1. Buriai Baru, 2. Kosai, 3. Simatapi, 4. Matotonan, 5. Berikopek, 6. Mangkaulu, 7. Ganjo, 8. Mabola, 9. Surataban, 10. Limosua, 11. Lakau, 12. Maonai, 13. Mapinang, 14. Limu, 15. Saumang Kakapi

Macaca and *Simias* were present in unknown densities (based on my hearing their vocalizations from the islets just mentioned).

Primates were observed in close proximity to human settlements. *Presbytis* groups were seen within 100 m of the village of Purourougat (South Pagai), the Minas Lumber Co. town (South Pagai across from Sikakap), and the Minas Lumber Co. camp (North Pagai ca. 7 km east of Sikakap). *Simias* also was seen or heard within 100 m of both lumber company settlements. *Hylobates* was seen or heard within 1 km of all three settlements but were no closer to any of them than 500 m. Local residents told me it is common for *Presbytis* to occur in swamp forest adjacent to native villages but that the other species usually do not venture so close. *Simias* reportedly avoids villages because it is hunted, *Macaca* does not occur (or is extremely wary) near villages because it is harrassed and poisoned, and *Hylobates* is uncommon near villages because it tends to avoid swamp forest, which is the predominant natural habitat around most Pagai villages (all Pagai villages are located coastally or a short distance upstream from the coast). I did, however, hear one adult male gibbon singing in coastal swamp forest near the South Pagai village of Purourougat.

Threats

Poisoning Macaques as Crop Pests

According to residents of Simatapi and Berikopek, Berikopek Island had macaques on it until 1981. In 1981, residents of Simatapi poisoned the thirty-odd macaques with the Union Carbide pesticide *Aldicarb* sprinkled in split coconuts because they were eating coconuts from native gardens. This practice I learned is widespread, and has resulted in the local reduction or elimination of macaques near other villages in the Pagai Islands.

Aldicarb is sold in Sikakap specifically to poison monitor lizards (*Varanus* spp.) and macaques. The monitors are poisoned to obtain their skins, which are exported to Padang. To capture monitors, *Aldicarb* is applied to baits of meat or fish. The poison is said to act so quickly that the lizards die by the bait.

Commercial Logging

From 1971-1986, about 8,000 ha on North Pagai and 19,000 ha on South Pagai were selectively logged. The company, Minas Lumber, was started by Americans, who sold out in 1979 to a Malaysian-owned company based in Singapore. From 1971 to 1973, Minas operated only in northern North Pagai. In 1973, the operation moved to South Pagai, and established headquarters by Sikakap Strait. Minas has a 20-year lease (1971-1991) on the Pagai concession, but Minas officials estimate it will take 35 years to cut the entire concession. The concession comprises 90,000 ha, of which ca. 40,000 are on North Pagai and ca. 50,000 on South Pagai. From 1973 to 1983, Minas logged the northernmost 19,000 ha of the South Pagai concession. In July 1983, they stopped cutting on South Pagai and began in southwestern North Pagai. They plan to finish logging the entire 40,000 ha on North Pagai before starting to log South Pagai again. All logs harvested on North Pagai are currently sawn and kiln-dried at facilities on South Pagai by Sikakap Strait. Minas officials anticipate, however, that to decrease transport costs they will have to construct new processing facilities in southern South Pagai when they begin to log that area.

The sawmill output is approximately 100 tons of cut wood per day. More than 90% of the wood exported from Pagai by Minas goes directly to ports in Holland and England as sawn timber. The wood is purchased from Minas by a consortium that wholesales it in England and Holland.

The commercially valuable trees, mainly dipterocarps of the genera *Shorea* and *Dipterocarpus*, are lowland rainforest species. The minimum size of trees taken by the loggers is 55 cm dbh for unbuttressed trees, and 55 cm diameter 20-30 cm above the top of the buttresses for buttressed trees.

According to a Minas Lumber Company official, Minas has taken 10-12 trees per ha in the areas so far cut. This does not include trees destroyed incidental to logging operations. Incidental damage includes (1) trees knocked down when desired trees are felled, (2) clearing of forest to construct logging roads and camps, (3) digging of gravel pits for materials to pave logging roads, and (4) tractor trails through the forest to drag out logs. Logging is not allowed in a zone 1-7 km wide around the perimeter of both North and South Pagai (Fig. 4).

On South Pagai, I spent three nights and two days in an area called Camp Jaya that was selectively logged in 1981, then abandoned. I saw gibbons and heard both male and female gibbon choruses. Although I did not see any of the other species in the area, I heard loud male vocalizations of all three species. It is clear that commercial logging at Camp Jaya did not permanently eliminate any primate species. Effects of logging on carrying capacity, population densities, productivity, social behavior, and other parameters remain to be determined. Studies comparing primates in logged areas like Camp Jaya with virgin forest would be helpful in this regard.

Hunting

In Siberut, all four species of Mentawai primates are intensively hunted for food with bow and poisoned arrows (Tenaza and Tilson, 1985). I found in the Pagai Islands, however, that only *Simias* is heavily hunted, whereas *Presbytis*, *Hylobates*, and *Macaca* are hunted only occasionally. *Simias* is hunted not because the people need the meat. Unlike in Siberut where protein is in short supply and death from malnutrition is common among children, in the Pagai Islands marine fish and shellfish provide superabundant protein sources. People hunt *Simias* in the Pagais because it is their favorite food.

When hunters shoot gibbons or macaques it is usually to kill mothers to obtain infants, which can be sold as pets. A hunter after *Simias* generally tries to avoid gibbons because the gibbon's loud alarm calls alert all other primates in the vicinity to the hunter's presence, and thus reduce his chances of shooting a *Simias*.

In the Pagais, as in Siberut, the traditional hunting weapon was the bow and poisoned arrows. Bows still are used, but .22 caliber hand-pumped air rifles are now favored by those who can afford them. Air rifles sell in Sikakap for approximately 40,000 rupiah (U.S. $36). Hunters coat air rifle pellets with the traditional arrow poison, so that any pellet which penetrates the skin is deadly. The poison is a mixture of toxic latex from the *upas* tree (*Antiaris toxicaria*) and toxic extracts of rotenone roots (*Derris elliptica*). It is made more piquant by adding chile peppers and ginger root juices. All four ingredients are grown in native gardens throughout Mentawai.

Most Pagai islanders do not know that the Mentawai primates are protected by Indonesian law and those that do disregard the law. Islanders make no attempt to conceal their hunting or poisoning of primates. Neither the police nor the Forestry Department rangers stationed in Sikakap enforce wildlife protection laws.

The hunting pressures have increased because of logging activities. Since all Pagai villages are near the coast, until recently men wanting to hunt had to make long, overnight treks into the interior. Consequently, the central forests of North and South Pagai were subject to very mild hunting pressure. This has changed with the construction of logging roads into the interior. Not only is walking on the roads easier and faster than walking in the forest, but lumber company vehicles that travel the roads provide transport for hunters. Hunters can board a logging vehicle near Sikakap Strait at sunrise, ride to the end of the logging roads (currently only on North Pagai) enter virgin forest to hunt *Simias*, and return home by logging vehicle in the afternoon.

Hunting pressure on *Simias* can be eased if the logging company is prohibited from carrying people with hunting weapons or captured primates in their vehicles. Logging company officials are reluctant to establish such a policy themselves because it will antagonize the locals. The rule will have to be imposed on the logging company by the Forestry Department or the police.

In traditional Pagai religion, there were periodic sacral ceremonies called *punen* during which people refrained from sexual intercourse and certain other activities, and men hunted monkeys for feasts (Nooy-Palm, 1968). Now more than 99% of the Pagai population is Christian (Nooy-Palm, 1968), and traditional *punens* have been abolished. The term *punen* has been retained to refer to the Sunday Christian ceremonies. In many villages, I found a prevalent tradition of hunting *Simias* every Saturday to provide meat for this Sunday *punen*. A few years ago, Minas, in an effort to improve relations with the islanders, sent trucks out every Saturday specifically to carry hunters to the interior of South Pagai in search of *Simias*.

A side-effect of Christianization has been increased hunting pressure on *Simias*. Indonesia's national religion, Islam, prohibits eating of primates. Unfortunately for the primates, however, less than 1% of the Pagai islanders are Moslem. Resident Catholic missionaries and native Protestant ministers could be influential in convincing Pagai Islanders to stop hunting primates.

The Pet Trade

During the summer of 1986, I saw three *Hylobates klossii*, one *Simias concolor*, and two *Macaca pagensis* for sale by Minangkabau shopkeepers in Sikakap. The shopkeepers had bought the primates from native

hunters and were reselling them. The price in Sikakap was 30,000 rupiah (U.S. $27) per primate regardless of species. Few *Simias* are sold because they are difficult to care for and rarely live longer than a few weeks in captive conditions. Gibbons and macaques are hardier.

I was told that some primates are sent to Padang, where they may fetch 75,000 rupiah (U.S. $68) each. The best prices are paid by personnel on foreign ships that visit Pagai to pick up lumber for transport to Holland and England. Such crew members commonly pay 100,000–300,000 rupiah (U.S. $90–$270) per primate. Residents of Sikakap reported that almost every foreign lumber ship leaves carrying Pagai primates purchased as pets by crew members. This may be a source of the Mentawai primates that have inexplicably turned up in European zoos.

Human Population Growth

The Pagai Islands were first populated by emigrants from Siberut about 350 years ago (Nooy-Palm, 1968; Loeb, 1935). The population of North and South Pagai grew from about 1,400 in the 1790's to 2,550 in 1855; 4,940 in 1930; and 7,523 in 1966 (Nooy-Palm, 1968). According to the office of the district civilian administrator in Sikakap, by 1978 the population of North and South Pagai had risen to 12,377, and by 1981 it was 15,090. The growth rate of the population from 1978 to 1981 was 7.3% per annum, giving a population doubling time of less than ten years. This rapidly growing human population will increase the rate at which primates are hunted, poisoned, and diminished by habitat destruction.

The Pagai islanders have traditionally cut small numbers of trees to make canoes, houses, and other items, and have cleared patches of forest for subsistence gardens. More land is now being cleared to plant clove trees to generate a cash income. Although the people produce more than adequate food, their sources of cash to purchase clothing, utensils, outboard motors, and other manufactured goods are severely limited. Sale of large rattan (*manau*) was a major source of cash for several years, but between 1984 and 1986 the price of rattan dropped more than 80%. Consequently, the islanders have virtually stopped harvesting rattan except for their own use. Although the price of fire-dried copra has declined (to 80 rupiah, or U.S. 7¢ per kg), sale of copra currently is the major source of cash for the islanders. Dried cloves also sell for less, 30,000 rupiah per kg in 1975 compared to 4,000 per kg in 1986, but most islanders still consider cloves to be their potentially most profitable cash crop. Consequently, they are clearing lowland rainforest at a rapidly accelerating rate to plant clove trees. Clove is planted principally on well-drained hill slopes.

People are motivated to convert virgin forest to garden within the logging concession because the logging company is required by law to compensate them for damage to gardens. In North Pagai, islanders are planting gardens along logging roads to the interior because the roads and logging vehicles provide access and transportation.

Primate Observations

In Siberut, Kloss's gibbons live in monogamous families (Tenaza, 1975) and sing in sex specific choruses, males chorusing mainly before sunrise and females later in the morning (Tenaza, 1976). I observed the same behavior among Kloss's gibbons in Pagai.

My best observations of *Simias* were on Simalegu and Sinaka Islands. These groups contained one adult male and from 1-5 adult females and their offspring. The largest group I saw was on Sinaka Island; it contained one adult male, five adult females, and three infants. From the captive management standpoint, *Simias's* polygynous mating system means that several females can be kept together with a single male for breeding.

I observed *Simias* in virgin and selectively logged lowland rainforest, swamp forests, and secondary forest near gardens. The highest density I encountered was on Simalegu Island where it is the only primate species present. On Simalegu, the habitat is predominantly flat swampy forest dominated by *pandan* (Pandanaceae) thickets and *nibung* palm. I observed *Simias* eating most frequently *nibung* inflorescences, but I also saw them eat leaves of a variety of unidentified broadleaf trees. There are no streams or freshwater ponds on Simalegu, and *Simias* must obtain all its water from rain, drew, and the moisture in its food.

Sinaka Island, less than 5 km from Simalegu, is a very different *Simias* habitat. Except for the mangroves encircling the entire island, and a small swampy peninsula jutting southeast (Fig. 4), Sinaka is dominated by lowland rainforest and inhabited by all four species of Mentawai primates. *Nibung* is present, but is not a dominant component of Sinaka's forest as on Simalegu. During one hour that I watched six adult *Simias* on Sinaka Island feeding, they ate leaves of several unidentified species of broadleaf trees.

The mean size of the six *Presbytis* groups (two on South Pagai, four on North Pagai) I was able to count with confidence was 3.3 (R=2-4). As in Siberut (Tilson and Tenaza, 1976), *Presbytis* were monogamous, each group consisting of an adult pair and 0-2 offspring. Males made loud, stereotyped calls spontaneously or in choruses. Call structure and chorusing were similar to those exhibited by *Presbytis* in Siberut (Tilson and Tenaza, 1976). Despite the same unmistakable structure, however, subjectively I believe I perceived an audible difference between calls of North Pagai males compared to those of South Pagai, and between Pagai animals and those in Siberut. This hypothesis requires testing by comparative physical analyses of calls from the three islands.

While I heard macaques several times, I saw only two groups. One contained one adult male, and one adult female, and two smaller animals. The other contained one adult male and three or four smaller animals. Macaque males in the Pagai Islands make distinctive loud calls. Unlike the songs of gibbons and loud calls of male *Simias* and *Presbytis*, spontaneous calls by male macaques did not stimulate other males to call. In addition to the loud and apparently spontaneous call of the male, an adult female with pink pendulous nipples began vocalizing loudly when she detected me. She continued vocalizing for about 30 min. until I withdrew from the area. The male watched me and made one typical male call, but did not produce calls like the female's. I believe I could have located more macaque groups had I devoted more effort to it. I elected instead to focus on *Simias*.

I found that the Siberut and Pagai macaques differ from one another in tail form, facial markings, and coloration. Wilson and Wilson (1976) saw macaques in Siberut and pointed out that the Siberut form differs in appearance from Miller's (1903) original description of the type (an adult female) and another specimen collected in Pagai Islands. This led Whitten and Whitten (1981) to suggest that the Siberut macaques might be subspecifically distinct from those in the Pagais. My observations bear this out.

Other Mentawai primates also are thought to have differentiated at the subspecific level. Chasen and Kloss (1972) considered *Simias concolor* and *Presbytis potenziani* in Siberut (*S. c. siberu* and *P. p. siberu*) to be subspecifically distinct from their conspecifics (*S. c. concolor* and *P. p. potenziani*) in the southern Mentawais.

Reports of Kloss's gibbons on Sanding Island

About 20 km south of South Pagai is an island called Pulau Sanding (Sanding Island), inhabited by a Chinese-Indonesian who has a concession to harvest and export copra from the island. Many Pagai Islanders visit it periodically to gather sea turtle eggs and to capture adult sea turtles. In questioning Pagai people about Pulau Sanding, I found that superstitions prevent most of them from entering Sanding's forest. All the islanders I interviewed who had been to Sanding, told me they had heard Kloss's gibbons (bilou) singing but no one had seen a gibbon. They attributed the singing to spirits, and claim there are no primates on Sanding. It is important to survey the island and determine whether gibbons are present.

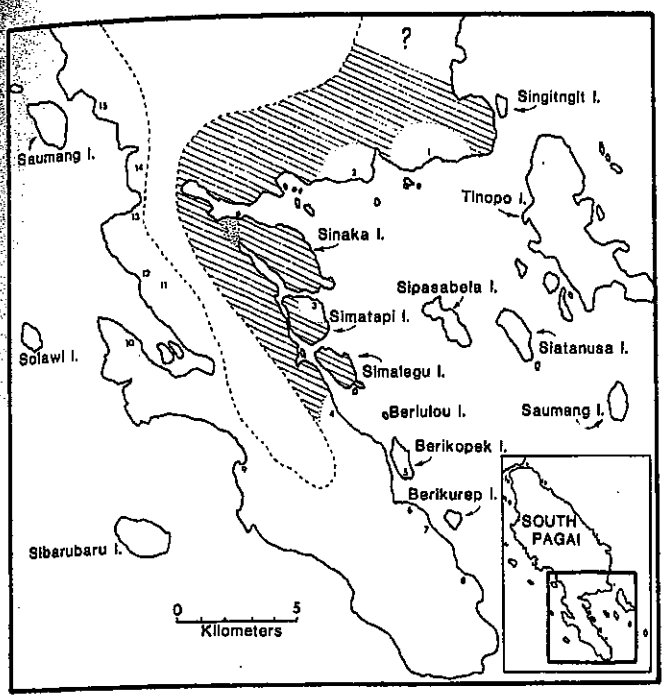


Fig. 5. The area recommended to be included in a South Pagai conservation area is hatched. The habitat is mostly virgin lowland rainforest fringed on the sea side by mangrove. Simalegu, however, is mainly swamp forest with *pandan* and *nibung* palm among the dominant vegetational components. The buffer zones around villages were drawn in arbitrarily (map by S.D. Nash based on author's original).

Recommendations

I recommend as a first step establishing protected areas in the southern Mentawais and making Sinaka and Simalegu Islands and adjacent portions of South Pagai a reserve (Fig. 5). If agreeable to the Indonesian Government, the narrow strip of forest in South Pagai's southern peninsula that is currently part of the logging concession should be removed from the concession and placed in the reserve.

The most endangered primate in the Pagai Islands is *Simias concolor*. To my knowledge, this species has never been kept in any zoo or laboratory, and Pagai natives say it is the most difficult of the four species to keep alive in captivity.

With the rapid rate of forest removal to make gardens, many *Simias* and other species are bound to be displaced. I therefore recommend that *Simias* be rescued from forests that are destined to be clearcut, and that a facility be established to maintain and attempt to breed captured animals in Pagai. Berikopek Island, which until recently had a natural population of *Simias* on it, might be a suitable site for such a facility. There are, however, many other islets to choose from. *Simias* acclimated to captivity and artificial diets in Pagai might then be moved to zoos or other breeding facilities outside of the Mentawai Islands. The same procedure could apply to other species.

The strict enforcement of hunting laws by government officials, combined with a public relations campaign aimed at convincing the people to voluntarily give up hunting, might succeed in breaking the tradition of hunting *Simias*. In my experience the Pagai islanders are sensitive to opinions of outsiders. If they can be convinced that the outside world knows and cares about conserving their primates, I think the majority of hunters will give up hunting and poisoning primates.

Specifically, I recommend a program that would include the following activities.

1. Enlist the aid of missionaries, native ministers, village heads, and other people in positions of respect and/or authority to ask people to stop hunting and poisoning primates.
2. Produce a video about Mentawai primates and the importance of conserving them. The video should be narrated in the Pagai dialect, and should include testimony from Indonesian Government officials and foreign scientists and conservationists. Once produced, the video should be taken from village to village and shown. Though there is no electricity in the villages, a small electric generator could be carried to run the equipment. An entepreneur in Sikakap already has started taking such equipment from village to village by outboard motorized canoe to show commercial videos.
3. Produce posters urging conservation of Pagai primates. Poster captions should be in Pagai dialect, and posters should be hung in all villages. They would need protection from the constant high humidity in Pagai.
4. Initiate a conservation education program in the schools. The majority of Pagai children now attend school. If their own village does not have a school, they generally walk or go by canoe to the nearest village that does. This would require providing materials and training to the school teachers.
5. As frequently as possible bring groups of tourists or other outsiders to Pagai villages to express appreciation of Pagai wildlife and culture. Such visits could include forays into the forest to observe primates.
6. Impose a ban on lumber company vehicles transporting people with hunting weapons or captured primates.
7. Possibly establish a system to reimburse people for damage done to their coconuts by macaques.
8. If further investigation shows *Aldicarb* and similar poisons have no legitimate uses in Pagai, ban their sale. At least impose a legal ban on using them to capture or eradicate wildlife.

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Options for Unwanted or Confiscated Primates

compiled by A. H. Harcourt

Note from the Editors

The fate of animals confiscated from trade or otherwise displaced from their natural habitat is a very controversial one that almost constantly faces primate conservationists around the world. PSG member A. H. Harcourt has compiled the following statement on behalf of the IUCN/SSC Primate Specialist Group and the Primate Society of Great Britain, with the help of the members of these two organizations. The IUCN/SSC Captive Breeding Specialist Group (CBSG) is now in the process of reviewing this document as well. Although the CBSG has not yet formally endorsed this document, Chairman U. S. Seal states that the group agrees that such a statement is necessary, that it is in general accord with the current version, and that it would like to issue a joint statement with the PSG after the September meeting. Further details will be included in the next issue of *Primate Conservation*. Once the document is accepted by both the PSG and the CBSG, it will be submitted to the entire SSC for approval and then to IUCN for final acceptance as an official IUCN document.

Introduction

This report discusses the range of possible options available to people faced with the problem of unwanted or confiscated primates. It is not a policy statement: no one option is recommended above any other because conditions vary so much between species and regions. Rather, the aim is to enable full and efficient discussion of the choices. Although the document was prepared with primates in mind, the discussion should be relevant to most orders of animals. The report is mainly concerned with "displaced animals" (an abbreviation we use for animals displaced from their natural habitat) in their country of origin, and threatened species. To help decide what to do with these animals, we will outline the five options available, list their advantages and disadvantages, and make recommendations for each. The options are: 1) euthanasia, 2) use of the body or its parts, 3) export to captivity abroad, 4) continued captivity in the country of origin, and 5) release to the wild.

In presenting the options, and especially the recommendations, we assume that the goal of conservation is protection of wild populations in their natural habitat. Three populations of animals are involved: the wild population, the captive population, and the displaced animals. Decisions about which option to choose must consider the welfare of the individual animal and the conservation of the species. A major problem is when these two considerations conflict. For example, export to a good zoo might be the best option for the displaced individual, but if export encourages trade, this option might endanger the wild population. Humanitarian considerations in this instance appear to conflict with conservation; however, if the wild population suffers, several individuals suffer. An assumption behind this report , therefore, is that both on humanitarian grounds and on conservation grounds, the welfare of the wild population over the long-term should take precedence over the short-term welfare of the individual animal.

GENERAL CONSIDERATIONS:

1. Encouragement of the Trade

All options, but perhaps particularly export, carry with them the danger of either directly or indirectly encouraging trade. If animals are exported or kept in captivity, money is spent and jobs become available. As a consequence, the animals are perceived as valuable and a potential market is created. If a market exists, or is even suspected to exist, animals will be taken from the wild in the hope or knowledge of profit. Trade, or suspicion of it, thus endangers the wild population. Displaced animals form only a small part of the market. Nevertheless, many zoos and private individuals directly create a market by buying displaced individuals. Even if a purchase is for laudable humanitarian reasons and payment is far less than the normal market price, trade is encouraged. The major mistake western buyers make is to forget the comparatively extremely low wages of people in non-industrialized countries. For example, less than 0.1% of a gorilla's market value can be equivalent to the minimum monthly wage in the country of origin. It cannot be stressed too strongly that any payment, especially if it is not offically to the conservation authority of the country, is likely to encourage trade, while payments to conservation authorities may lead to suspicions of profit from trade and erode public support. Yet in particular cases, very tightly controlled trade can be an effective tool in conservation management. Existing cropping programs for wild ungulates and captive breeding of crocodiles and butterflies are examples. The advantages of controlled trade, especially in very valuable animals or their parts, are that the conservation authorities can benefit from the revenue generated, and illegal dealers can be forced out of the market.

Recommendations: At present the dangers of trade seem to outweigh the benefits in most situations: it is too easy for the trade to run out of control. However, a solution might be to exchange non-salable materials such as expertise, rather than money, for animals or their parts. Another, might be for the foreign receiving facility to become directly involved in conservation in the country of origin. In either case, an independent body should probably be chosen to oversee the transactions.

2. Financial Costs

Costs differ greatly among countries, species, and the number of individuals involved. However, in general, the options of euthanasia and export cost the country of origin comparatively little. A well-run, long-term captive facility can be very expensive. For ten medium-sized primates, capital costs of a new facility might be U.S.$20,000; for great apes as much as U.S.$100,000. Maintenance costs could be more than U.S.$10,000 per year and a well-run conservation awareness program is at least as much. Of course, costs can be far lower; but in general establishing a good facility is an expensive option.

Recommendations: On a facility by facility basis, it might occasionally be possible for a few international conservation organizations to raise the initial capital required for a very threatened or attractive or useful species. In effect, the in-country facility is twinned with one or more reputable, established overseas organizations, to the benefit of all parties. The Bohorok Orangutan Rehabilitation Center's relationship with the Frankfurt Zoological Society over its initial years (Aveling, 1982), the Malaysian Primates Research Program (Chivers, 1981), and the Golden Lion Tamarin Project (Kleiman *et al.*, 1986) are examples. However, it has to be accepted that new captive facilities are usually going to be extremely hard to fund.

3. Conservation Awareness Programs

For most people, the main priority for conservation action is preservation of natural habitat. If poorly explained and publicized, the described options can become detrimental to conservation. However, options 3-5 which involve captivity can be beneficial to conservation when associated with a well-run education program, especially when conducted in the country of origin. This has been done successfully with the orang-utan rehabiliation centers. In the late 1970's, the Bohorok Center received 5,000 visitors per year, 80% of them Indonesians, and the center at

Sepilok more than 17,000, perhaps as much as 90% of them Malaysian (Aveling, 1982: Aveling and Mitchell, 1982). Less than ten years later, between 1984-1985, visitors to Sepilok rose to 50,000, still 90% of them being local Malaysian.

Recommendations: All options should be associated with conservation awareness programs. Indeed if captivity in the country of origin is necessary, the facility should form the basis for a conservation awareness program.

THE OPTIONS

The options are not given in any order of priority; there is no such order. Where possible, however, the advantages and disadvantages of each option are listed in rough order of priority based on the assumption that safeguarding the wild population in its natural habitat is the goal of conservation. The first two options involve killing the displaced individual. For many people, killing will be ethically wrong, perhaps especially if the animal is an ape or the species is highly threatened. The last three options involve keeping the individuals alive and healthy. Even so, ethical problems arise; for example, should money be spent on animals when it might better be spent on people? A document such as this cannot resolve what are essentially matters of personal opinion. Nevertheless, it should be borne in mind that both killing and captivity could be seen by some as contrary to the conservation ethic. The necessity for good conservation awareness programs to be associated with all the options is therefore again emphasizied.

1. Euthanasia

Humane societies kill thousands of animals per year to prevent suffering and because of lack of space to keep them. Euthanasia of displaced primates is thus a logical option. It is distinguished from the next option by the fact that no use is make of the body or its parts.

Advantages: a) There should be no possiblity of suspicions of profit and therefore trade is not encouraged. b) Costs are very low. c) With confiscated animals, this option emphasizes strict enforcement of the country's conservation laws.

Disadvantages: a) A potential breeder is wasted, as is the chance of using the individual in conservation awareness programs. b) For some, this option more than any of the others might conflict with the message of conservation, and therefore could jeopardize the wild population.

Recommendations: Euthanasia should probably not be chosen except to prevent suffering, or to prevent illegal trade that could seriously endanger the wild population.

2. Use of the Body or its Parts

This option's aim is to prevent waste of a potential specimen, rather than to promote conservation. Possible uses are medical research, for example, or museum and classroom displays. The pet trade might appropriately be included here, since pets tend to be non-breeding solitary animals.

Advantages: a) Costs should be very low for the conservation authorities in the country of origin. b) Availability of specimens for schools and museums could be a positive benefit to conservation if linked with education. c) Although it is possible that the inclusion of already displaced animals into any existing trade might prevent further capture from the wild, the irregularity of supply makes this unlikely.

Disadvantages: a) A trade might be created or suspicion of profit from trade might be hard to deny, and therefore the wild population could be threatened. b) Potential breeders might be wasted.

Recommendations: a)This should be an option probably only if it is clear that such use of the animals would diminish demand from wild populations, especially of threatened species. b) With regard to trade, see General Considerations. c) With regard to conservation awareness programs, see General Considerations.

3. Export to Captivity Abroad

The emphasis in this section is on export to a situation where the animal is kept alive. Zoos, research institutes, and the pet trade are the three main possible destinations for exported live displaced animals. However, the advantages and disadvantages vary, with the pet trade probably producing the fewest advantages and the most disadvantages.

Advantages: a) The animals can help conservation awareness and education programs in the receiving country. b) Not only should costs to the country of origin be minimal, but the conservation authorities could benefit materially from the transaction as discussed in General Considerations. c) Findings from research on the living animal in captivity, on its breeding behavior for example, could help conservation management practice, especially in captivity. d) An addition to the captive breeding population is acquired and the displaced individual is saved: the smaller the wild population, the more crucial this advantage becomes. Indeed some species have been saved and then reintroduced to the wild, only because of captive breeding programs. The number saved by captive breeding is small at present: among primates, the golden lion tamarin (*Leontopithecus rosalia*) is an example (Kleiman *et al.*, 1986). However, the number will undoubtedly increase for all orders of plants and animals.

Disadvantages: a) Export is particularly likely to encourage trade, because of the fact, or assumption, that if the animal or its parts are exported, they must be very valuable. b) The chance is lost of using the individual for education and conservation awareness programs in the country of origin. c) Export could promote resentment in the country of origin against the conservation authorities, or indeed the species, in two ways: the export might be perceived as theft or loss of the country's heritage, or it might be perceived as allowing foreigners, but not citizens, to use the protected species.

Recommendations: a) An independent body, perhaps composed of a group of interested organizations, should choose the receivers. Examples of appropriate independent bodies might be the IUCN Captive Breeding Specialist Group or the various IUCN Specialist Groups for particular taxa. The Golden Lion Tamarin Project (Kleiman *et al.*, 1986) is a good example of how such a consortium can operate. b) Consideration should be given to the suggestion that the same body or consortium not only advises on placement of the displaced individuals, but monitors and maybe even controls their management. Again the Golden Lion Tamarin Project provides a good example of such a scheme. In this case, the exported individuals remained the property of the country of origin and hence, instead of being sold, were loaned at no cost to the participating overseas institutions. c) With regard to trade, see General Considerations. d) With regard to conservation awareness programs, see General Considerations.

4. Captivity in the Country of Origin

Captive facilities vary from a concerned individual looking after one or two confiscated animals to a large-scale breeding institution. The need to advertize the aims of the facility, produce conservation awareness programs, hire expert technical assistance and so on increases proportionately with the size of the facility. Where captive facilities are accepted as part of a country's conservation program, four main aims appear possible, none of them mutually exclusive: to create a captive population to guard against extinction in the wild, to create an education facility, to eventually release to the wild, to save the confiscated or unwanted individual.

Advantages: a) A well-managed facility can be a valuable educational resource and a basis for conservation awareness programs. b) If the captive population breeds well, then an avenue of rescue additional to preservation of the natural habitat is provided. c) Captive facilities can be valuable tourist attractions, providing revenue for the conservation authorities and the government.

Disadvantages: a) If the facility and its associated publicity and conservation awareness programs are not properly managed, the wild population can suffer through encouragement of trade, and reinforcement of the perception of wild animals as playthings for people. b) Captive facilities can be seen as alternatives to conservation in the wild. c) A well-managed facility can be extremely expensive.

Recommendations: a) The main recommendation must be that the cap-

tive facility and the conservation awareness program that should be conducted with it are well-managed. This is self-evident, but is stressed because both the benefits and the costs of keeping animals in captivity might have effect more immediately and more intensively in-country. b) One of the main disadvantages is cost, which might in rare cases be solved by twinning with one or more conservation organizations. c) The captive facility must never acquire the animals by purchase. d) It might be useful if the captive facility were adjacent to natural habitat: the conservation awareness program would then be more effective and the option of releasing animals to the wild from the captive facility would be easily available.

5. Release to the Wild

This option has already been considered in detail (Caldecott and Kavanagh, 1983; IUCN, 1984; Konstant and Mittermeier, 1982), but a summary is presented here. The benefits of release programs have so far arisen from the public awareness of conservation and wildlife that they stimulated. As yet, no wild population of primates has been significantly augmented by additions from captivity. Thus one of the most successful centers, Bohorok in Sumatra, released 25 orangutans over three years (Aveling, 1982). This number is probably less than 5% of the yearly surviving recruitment in the wild Sumatran population, in other words a negligible effect. Moreover, it is often difficult to follow a liberated animal, meaning that the option as a conservation measure in itself is difficult to evaluate. For example, of 25 orangutans liberated at Bohorok, only seven were again seen for certain. If the released individuals usually die (see Kleiman and Beck, 1986; Konstant and Mittermeier, 1982), this option is then equivalent to killing them. However, as long as death is not certain, release will probably be more politically and ethically acceptable than euthanasia, because the individuals have been given at least a chance of survival. The releases that have occurred show that this option is a feasible way to combine saving of the displaced individual with promotion of conservation of the wild population (Aveling, 1982; Aveling and Mitchell, 1982; Borner, 1985; Kleiman and Beck, 1986; Konstant and Mittermeier, 1982; Strum, 1986).

Advantages: a) Of all the options, release most strongly emphasizes that the place for conservation of wild animals is in their natural habitat. b) If the release is not performed immediately after capture, a captive facility in the country of origin needs to be established. All that was said about the Option 4 then applies to this one. c) Because the animal is returned to the wild, it is unlikely that there will be suspicions of financial gain, especially in the case of immediate release of rescued animals. d) A successful release into an area not presently inhabited by the species, provides an additional safeguard against extinction. d) A successful release into an existing population might augment its size. Such a result will occur only where the number of released animals survive and breed better than do the residents, which is unlikely. In nearly all situations, therefore, adequate protection of existing populations to promote internal recruitment will be the best way to increase the wild population.

Disadvantages: a) Whether the release is into an existing population or into a new area, severe disruption of the native fauna and flora might result. Thus diseases can be introduced, local densities increased beyond carrying capacity, and normal behavior or vegetation be detrimentally altered (Laycock, 1966; and references cited at start of this section). b) Where captivity is involved, all the disadvantages discussed in Option 4 are applicable.

Recommendations: a) Release can directly endanger wild populations in ways that the other options do not. Particular care needs to be taken to ensure that the wild habitat and its fauna are not detrimentally affected, that the released individuals are healthy both for their own sake but especially to prevent transmission of disease, that the released individuals are monitored, and that subspecies are not mixed. These last three recommendations also apply to captivity; they are given special mention here because of the difficulty of remedying the problems that might arise if they are not followed. b)Unless the release is going to be immediately after capture, then a captive phase follows, where the recommendations of Option 4 apply.

CONCLUSIONS

Two of these options, euthanasia and use of the animal's body or its parts, are in most contexts inappropriate for threatened species. However, for non-threatened species, or where availability of the displaced individuals might diminish demand from the wild population, use of their bodies in research or education might be acceptable. Of the other three options, namely captivity in a foreign country, captivity in the country of origin, and release to the wild, each is appropriate under different circumstances. No one option is preferable to all others under all conditions. The greatest danger is encouragement of trade and the greatest potential benefit is creation of an interest in wildlife conservation. Whatever the choice of option, it is emphasized that it should be made as part of a long-term management plan for the welfare of the population, particularly the wild population, and not be a short-term measure for the welfare of the displaced individual. This is not to say that conservation is more important than humanitarian concerns. Rather, on both humanitarian and conservation grounds, the survival of many animals in the long-term is more important than the comfort of a few individuals in the short-term.

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SPECIAL SECTION

Proceedings of the Conservation Symposium, XIth Congress of the International Primatological Society

The following papers were presented at the Conservation Symposium (July 24-25, 1986) held at the XIth Congress of the International Primatological Society in Göttingen, West Germany. We would like to thank the authors for their contributions and for making this Symposium a success.

Central and South America

Primate Conservation in Mexico

by Ernesto Rodriguez Luna,
John E. Fa, Francisco Garcia Orduña,
Gilberto Silva Lopez and Domingo Canales Espinoza

Introduction

Mexico exemplifies a country with a variety of pressing socioeconomic and political conditions that greatly influence the conservation of its natural habitats. In this paper, we briefly review the present condition of primate habitats in Mexico, the status of the three native primate species (*Ateles geoffroyi vellerosus* and *A. g. yucatanensis*, *Alouatta palliata* and *Alouatta villosa*). We also attempt to explain the effect of habitat destruction and modification on primate populations in a sample area: the Santa Martha Mountains in Veracruz State. This example will illustrate the interplay of social, economic and ecological variables that typically affect most tropical forests in Mexico. Recommendations for the protection of Mexican primates and their habitats are also given.

Current Condition of Primate Habitats

As a direct consequence of the varied physiography of Mexico, the tropical regions in the country are covered by a complex mosaic of vegetation types. Latitude, climate and soils play important roles in producing an even more diverse tangle of environmental conditions. The prevailing humid winds over the Gulf of Mexico coastal plain have helped to produce a lush tropical rain forest. The lack of these winds over the Pacific lowlands have resulted in dry forest types. However, the Yucatan Peninsula, despite its lower rainfall, has an abundant cover of a lower, deciduous tropical rain forest.

All three Mexican primate species are restricted to tropical rain forest. This vegetation type in Mexico consists of trees > 25 m tall, and is found in areas with an annual rainfall > 1,500-2,000 mm, and average annual temperatures 20-26 °C. Commonly, these forests grow in different types of well-drained soils, such as red and yellow laterites, brown soils derived from volcanic ash or limestone, and alluvium (Toledo, 1980). The situation of the Mexican tropical rain forest has already been summarized by a number of authors (see for example: Gomez-Pompa, Vasquez-Yanez and Guevara, 1972). All concur that what is found at present is only a poor reflection of what originally existed. A comparison of the "potential" rain forest cover, derived from vegetation maps from Rzedowski (1978), with its actual extent, as given by the *Atlas Nacional del Medio Fisico* (SPP, 1981; data from Toledo, in press) (Fig. 1), shows that there has been an overall loss of more than 55%. More specifically, Toledo (in press) argues that there are only 12.33 million ha of "undisturbed"

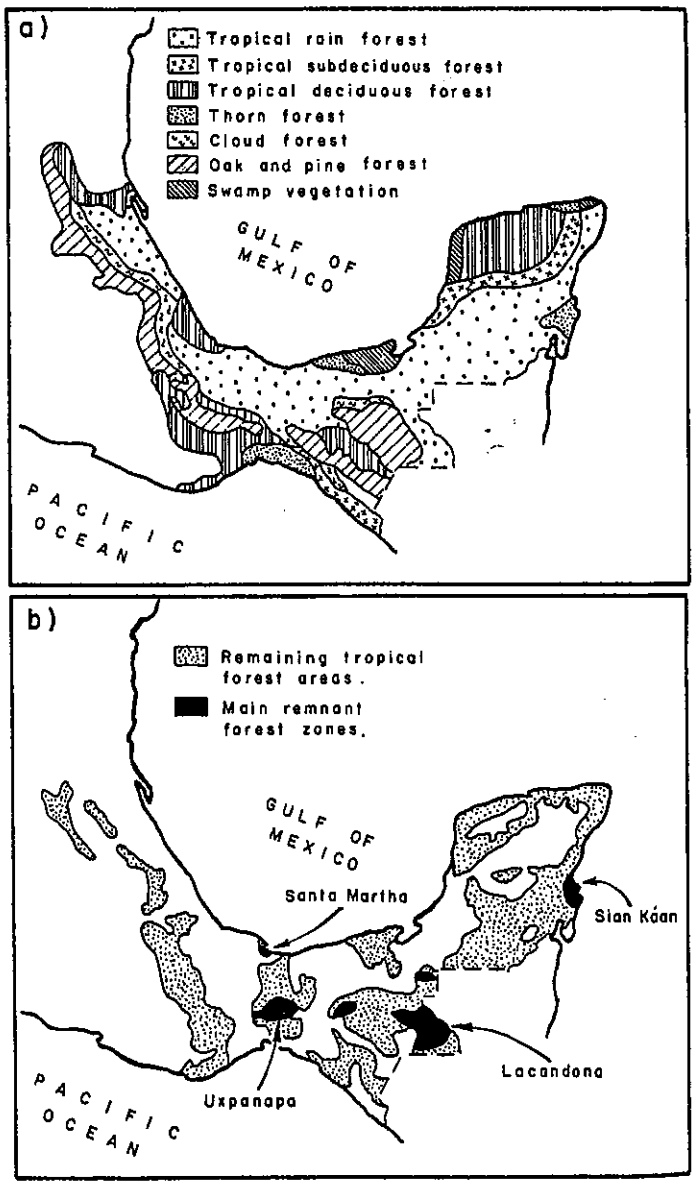

Fig. 1. a) The original distribution of vegetation types in tropical Mexico (modified from Rzedowski, 1978), and b) the existing undisturbed vegetation in tropical Mexico (Toledo, in press) and main remnant forest zones (Guevara, 1986; figures by authors).

tropical forest left in Mexico. This figure may be an overestimate since the criterion for "undisturbed" is based on a cartographic interpretation of main vegetation stands and not on ground surveys. If the extent of the remaining forest areas is compared with the remnant forest zones as derived by Guevara (1986), Toledo's figures exceed Guevara's more realistic estimates by an order of magnitude. There is no doubt that the tropical forest in Mexico is being increasingly fragmented and impoverished.

Present Status of Primate Populations

There are still no adequate surveys on the situation of the three primate species in the seven states (Campeche, Chiapas, Oaxaca, Quintana Roo, Tabasco, Veracruz and Yucatan) where they are known to occur. The general conservation status (Thornback and Jenkins, 1982), "vulnerable" for *Ateles* and "indeterminate" for the two *Alouatta*, is based on scanty data collected by Leopold (1959). Estrada and Coates-Estrada (1984) and Horwich and Johnson (1984), have recently reiterated the growing pressures on the country's tropical forest habitats and primates. Yet, there are no significant data that could support these realistic contentions. It is not enough to mention habitat destruction, hunting and capture for the pet trade as problems facing Mexican primate populations when these are the primary causes of the demise of primates throughout the world. In order to judge the potential Mexico's primate populations have for recovery, it is necessary to calculate each threat's rate and relative contribution to primate losses. Under certain circumstances, each of these threats may be tolerable. Hunting and capture for the pet trade, for example, may be more significant in small forest pockets where these activities provide an extra source of income or protein for the local residents, than in large forest zones, where the major threat is usually mass habitat modification for ranching (Toledo, in press) or outright destruction by timbering operations and oil exploitation concerns.

Example of the Interplay of Socioeconomic Factors and Primate Conservation

Conservation of primate species in Mexico requires the resolution of problems related essentially to man's use of the land. With the Agrarian Reform of 1910, *ejidos* or small peasant communities with lands awarded by the central government for exploitation, have sprung up throughout the country. According to the most recently published figures (Eckstein, 1969), there were 23,000 *ejidos* with two and a half million people exploiting 55 million ha in the late 1960s. This figure may now be a gross underestimate since it is certain that more *ejidos* have been created since. Using Baez-Jorge's (1973) figures for the Soteapan area, in 39 years 25,563 ha were turned over to *ejidos*; an average of 655 ha a year. This land tenure system provides perpetual use rights to the individuals who clear a piece of forested land. However, no part of the land in the *ejido* can be sold, rented or mortgaged since the land is considered communal property. Stuart (1978) comments that the official government rule concerning the use of the *ejido* property is similar to the customary system of land tenure, the only modification being that only official *ejido* members may clear *ejido* lands and a maximum of 20 ha may be cleared by any single *ejidatario*. Despite this superficial similarity of the *ejido* system to traditional land tenure modalities, the *ejido* is largely, as Toledo (1976) calls it, a social and ecological contradiction. The *ejido* pretends to be a closed economic system but is actually an open one and does not provide an effective economic development framework for the Mexican countryside. Besides bureaucratic problems concerning the allocation of land rights to *ejidatarios* (land redistribution can take up to 30 years with a mean of more than 18 years; Baez-Jorge, 1973), there have not been any integrated or long-term agricultural programs implemented with credits, investment channels or technical support given to peasants (Baez-Jorge, 1973). The result has been the gradual, or not so gradual, conversion of a slash-and-burn small garden society which could maintain small Indian communities, to a monoculture system which is becoming dependent on external sources of income. Perhaps initially, most *ejidos* had sufficient land to support their human populations, but with a population increase of 1.5 times and an incessant influx of new landless peasants (according to Toledo, 1976; more than 50% of the rural population in Mexico is landless), land productivity is no longer adequate. The inevitable result is the progressive enlargement of a community living at below-subsistence levels (in 1960, 50% of the peasant properties produced no more than U.S. $60.00 a year; Toledo, 1976).

Table 1. Land Use in the Four Study Ejidos

	Mirador Pilapa	Magallanes	Fernando Lopez Arias	Guadalupe Victoria
Year founded	1965	1964	1969	1973
Total area (ha)	970	808	846	700
Pasture (ha)	362.5	371.0	408.0	300.0
% total area	37.37	45.91	48.22	42.85
Agriculture (ha)	202.5	148.0	50.0	200.0
% total area	20.88	18.32	5.91	28.75
Secondary forest	241.0	128.0	170.0	10.0
% total area	24.85	15.84	20.09	1.42
Natural forest	124.0	121.0	102.0	100.0
% total area	12.78	14.98	12.05	14.27

In the San Pedro Soteapan/Santa Martha area, four *ejidos*, which conform to a natural transect from the coast to the Santa Martha volcano, were selected for study. In each of these, data were recorded on the principal human activities engaged in and the land area devoted to agriculture, pasture and natural or secondary forest (Table 1). Typical of all four *ejidos*, a large percentage of the land was maintained for pasture (a mean of around 44%), and a relatively small area (mean 18%) for crops (mainly maize for home consumption). The rest of the land was left to secondary vegetation (15%) and small patches of natural forest (14%). These data indicate that since the start of each ejido, more than 86% of the natural forest has been completely removed at rates ranging from 3.86% per year (Magallanes) to 6.59% per year (Guadalupe Victoria), with an overall annual average of 4.94%. The impact of this can be seen in the vegetation profiles shown in Figure 2. The calculated actual rate of deforestation is around 12 ha per season, a level of destruction which will lead to the total disappearance of natural forest within a decade.

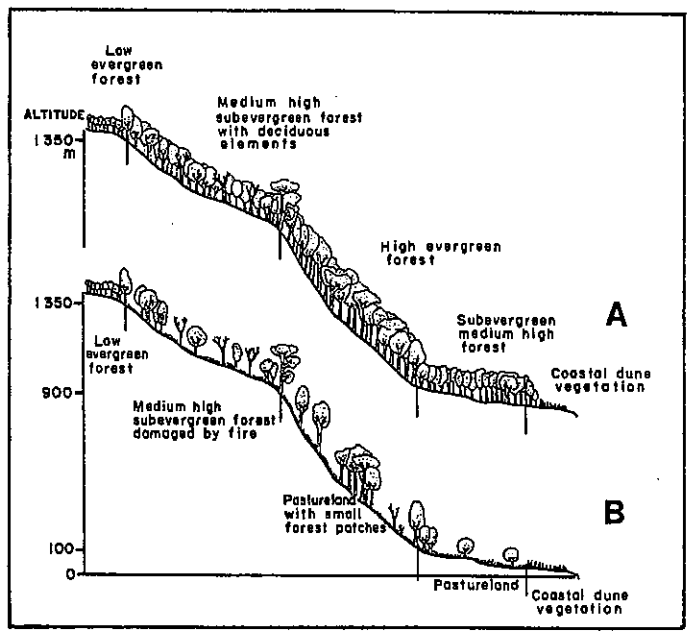

Fig. 2. Vegetation profiles of the Santa Martha Mountains region showing original (A) and present (B) vegetation (figure provided by the authors).

Table 2. Censuses of Primate Groups in the Remaining Forest Patches of the Four Study Ejidos

Locality	Map no. in Fig. 3	Forest size (ha)	Primate species*	Group size	Group composition: adult M	adult F	subadult	juvenile	infant
Mirador Pilapa	1	5	*Ateles*	3	-	-	-	-	-
	2	6	*Alouatta*	3	1	2	-	-	-
	3	20	*Ateles*	12	-	-	-	-	-
			Alouatta	6	2	2	0	1	1
	4	2	*Ateles*	7	2	3	0	1	1
	5	4	*Alouatta*	7	2	3	0	0	2
	6	6	*Ateles*	2	0	1	0	0	1
			Alouatta	7	2	3	0	1	1
Magallanes	7	3	*Ateles*	3	1	1	0	0	1
	8	5	*Alouatta*	9	1	3	0	4	1
	9	9	*Ateles*	16	3	6	2	4	1
F. Lopez Arias	10	4	*Ateles*	8	1	4	0	2	1
	11	4	*Ateles*	4	1	1	1	0	1
			Alouatta	4	1	3	0	0	0
Guadalupe Victoria	12	10	*Alouatta*	4	1	2	0	1	0
	13	5	*Ateles*	5	1	3	0	0	1
	14	12	*Ateles*	7	1	2	0	3	1
Total		95	*Ateles*	67	10	21	3	10	8
			Alouatta	40	10	18	0	7	5

**Ateles* is *Ateles geoffroyi*, *Alouatta* is *Alouatta palliata*

Of the 447 ha of natural forest still left in the study area, only 95 ha (21%) contain primates. These patches, 14 in all, range from 2-20 ha (Fig. 3) and contain both *Alouatta palliata* and *Ateles geoffroyi* at varing densities (Table 2). Censuses conducted indicate that the largest groups counted were of *Ateles* (n=10, m±S.D. 6.70 ± 4.42 monkeys per troop); *Alouatta* always being poorly represented (n=7, m±S.D. 5.71±2.14 monkeys per troop). Although the largest forest patch did contain as expected more animals, there is no significant positive correlation between the size of the populations and patch size (Spearman rank correlation test, r=0.299, n.s.). This could be because given their small size these patches are probably unstable habitats still subject to pressures of hunting and burning. Interestingly, *Ateles* was the better represented species. This sheds some doubt on the assertions made by Estrada and Coates-Estrada (1984) that *Ateles* in Mexico is likely to suffer more than *Alouatta* as a consequence of its larger home range requirements. The higher numbers of *Ateles* in small forest patches may be due to the fact that this species is better able to escape from logged or burnt areas. It may also be that this species has a higher tolerance for disturbance and the probable reduction of food resources. On the other hand, populations in such small habitat patches may be in a disequilibrium phase, and the groups may be temporarily artificially large and likely to drop in numbers because of food or space limitations.

The situation of the study *ejidos* presents a picture of a rapidly depleting resource, affecting not only the natural forest and its fauna but also the human populations. In three of the four *ejidos*, over half of the income comes from cattle and derived products. This is a recent phenomenon, typical of most *ejido* lands in Mexico, which has toppled the swidden agricultural economy with its less drastic impact on the forest. *Ejido* families are no longer able to survive on the extensive/intensive cultivation of primary crops, maize in particular (Andrle, 1964, has estimated that in the more fertile soils of the region, the land can be used uninterruptedly for only 10 years, in the commoner poorer soils, no more than 3-4 years). The decline in maize production reported by Toledo (1976), has forced *ejidos* to seek other means of income. The most convenient has been the renting of land (*sistema piso*) for calf-rearing to large meat producers. These producers need land to rear livestock for export to the U.S. (2 million calves were exported in 1985; R. Garcia, pers. comm.) They provide the *ejidatario* with the animals (6-7 animals are usually given for a year) and the essential veterinary requirements. This

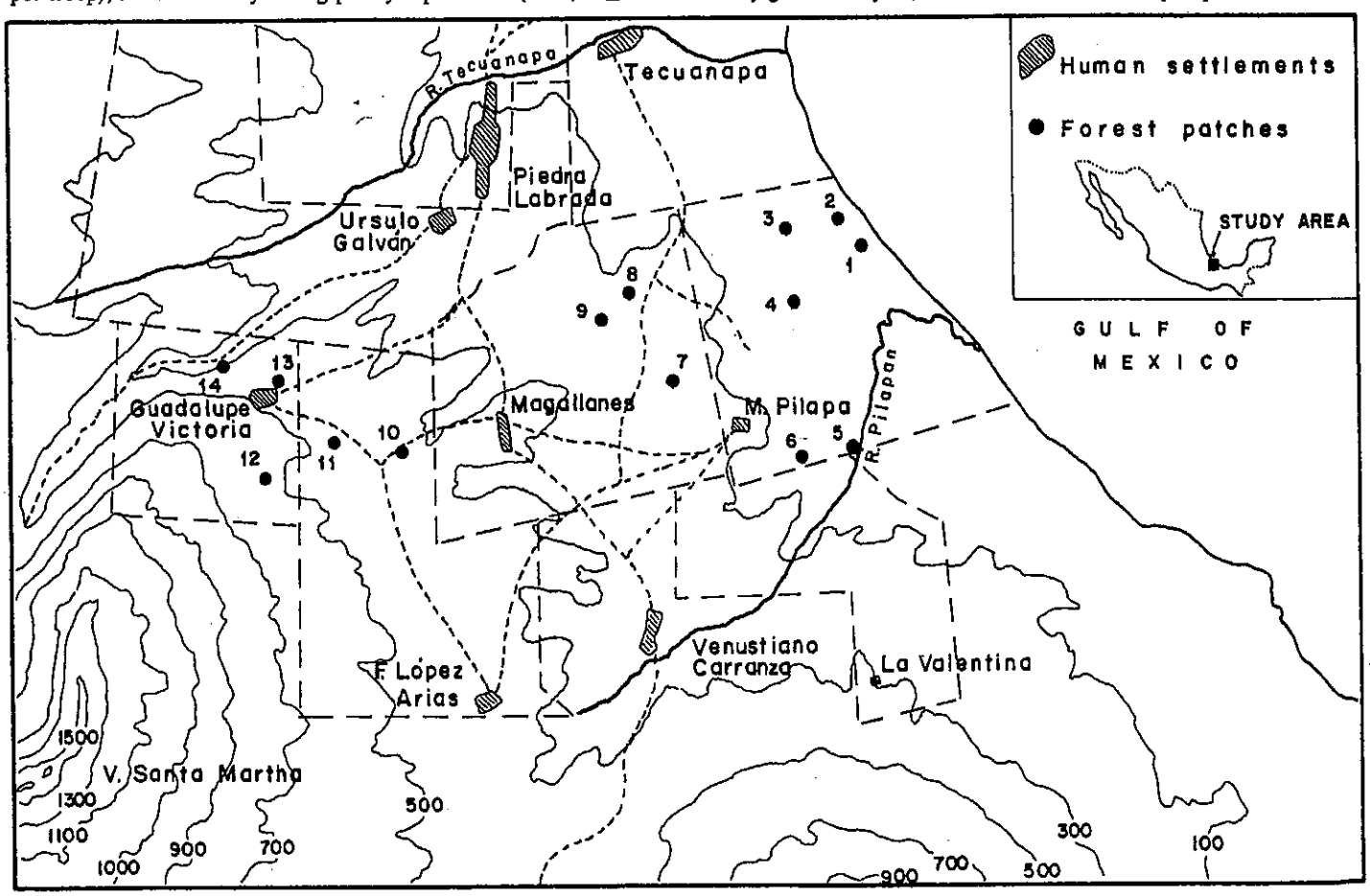

Fig. 3. Map showing the four study *ejidos*, and the location of the 14 forest patches surveyed (map provided by authors).

system which aims to keep production costs low can represent up to a 300% profit for the large producers (Garcia, 1986), and considerable returns for the *ejidatario* with no investment. It also results in progressively more land being devoted to cattle ranching (see Toledo, in press), and only small patches of unusable ground remaining forested. Figure 4 illustrates this situation in the Santa Martha Mountains. Here, the encroachment by *eijdos* and small holdings has left the two higher areas in the region, the Santa Martha and the San Martin Pajapan Volcanoes, as the only potentially conservable areas. These are *Territorios Nacionales* (National Territories) but have little protection.

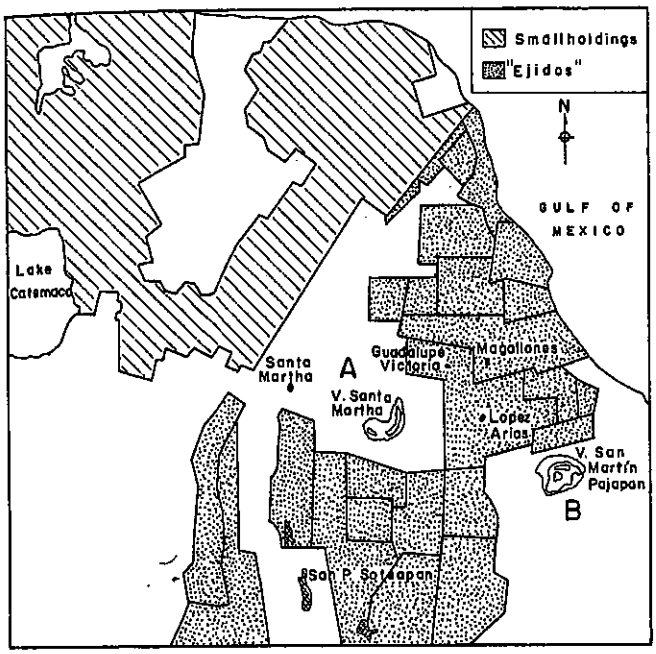

Fig. 4. Distribution of *ejido* land and smallholdings in the Santa Martha region. Areas A (Santa Martha Volcano) and B (San Martin Volcano) are relatively undisturbed forest zones (map provided by authors).

Future of Primate Populations in Protected Areas

Given the problems that confront most of the primate habitat in Mexico, the only hope of conserving representative populations of these animals may be in protected areas such as national parks and biological reserves, and the restoration of other zones outside these. Within Mexico's tropical region, there are 26 areas designated as protected (SEDUE, 1983; Fig. 5). Out of these, only 17 have legal status at present and 18 could contain viable monkey populations. Most of the parks and reserves with primates have varying degrees of problems with illegal settlers, poaching of animals and wood, and lack of proper management and vigilance (see Vargas Marquez, 1984, for a review of the current status of Mexican national parks and biological reserves). The Montes Azules Biosphere Reserve established in 1978 and containing 331,200 ha, and the recently established Sian Ka'an Biosphere Reserve of 500,000 ha, contain the largest stretches of tropical forest and have large representative primate populations. Montes Azules is a protected area for *Alouatta palliata mexicana* and *Ateles geoffroyi vellerosus*, while Sian Ka'an is important for the conservation of *Alouatta villosa* and *Ateles geoffroyi yucatanensis*. Despite all this, little has been done in relation to conservation work in Montes Azules (Lobato, 1981) and indeed controlled human settlements, supposedly a forte of Biosphere Reserves, are growing unchecked according to Vargas Marquez (1984). The 12 original communities in the area, with a population of 4,000 inhabitants, have increased to 14 communities with an approximate population of 6,000.

The prospects for the Sian Ka'an Biosphere Reserve are better because it is not subjected to internal pressures, and has the support of a scientific body, the CIQRO (*Centro de Investigaciones de Quintana Roo*), and the newly formed organization of friends, *Amigos de Sian Ka'an*.

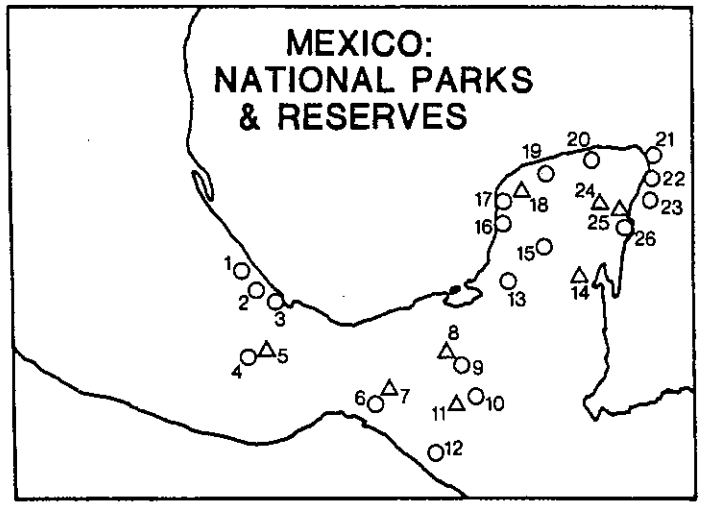

Fig. 5. National parks (circles) and biological reserves (triangles) within the tropical region of Mexico (map by S. D. Nash based on authors' original).

1. Cuenca del Rio Carbonera
2. Sierra de Santa Martha
3. Volcan de San Martin
4. Sierra de Juarez
5. Benito Juarez National Park
6. Selva del Ocote
7. Palenque
8. Cañon del Sumidero
9. Cascada de Agua Azul
10. Montes Azules Biosphere Reserve
11. Lagunas de Montebello
12. El Triunfo
13. Calakmul
14. Kohunlich
15. Sierra Chincua
16. Los Petenes
17. Ria Celestum
18. Dzibilchaltum
19. Dzilam de Bravo
20. Ria Lagartos
21. Isla Contoy
22. Isla Mujeres
23. Cozumel Reef
24. Coba
25. Tulum
26. Sian Ka'an Biosphere Reserve

For any protected area in Mexico to succeed in its aims, it may have to follow a path similar to that of Sian Ka'an, combining lay interests with institutional support. Such an association will hopefully serve as a buffer against the vicissitudes of central government policies.

Recommendations

Recommendations for action on behalf of primate conservation in Mexico have been divided into two categories: basic research and direct conservation action.

Basic research recommended is: (1) analysis of the current status of all three primates in terms of population numbers, distribution and use of different habitats; (2) behavioral and ecological studies that can contribute to their conservation; (3) research on relevant aspects of human ecology, especially with a view to finding alternative uses of the tropical forest compatible with its conservation.

Direct conservation actions recommended are: (1) promote better links between universities, research institutes and official governmental bodies in order to formulate concrete action plans for primate protection in the states where they occur; (2) provide the *Subdelegaciones Estatales* belonging to SEDUE (the main official conservation body in Mexico),

with incentives to carry out recurrent inventories of the primates and other fauna, and to perform its function of guarding against hunting and the pet trade; (3) provide help for the protection of national parks, biological reserves and biosphere reserves, and more importantly for the initiation of conservation education within and outside these areas; (4) wherever possible, provide assistance for translocation programs to help primates in imminent danger in disappearing forest patches; (5) make use of the existing concern and pride expressed by country people in Mexico, to promote the creation of "home nature reserves" under their custody.

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Conservation of Primates in Belize, Central America

by Jeremy F. Dahl

Introduction

The newly-independent country of Belize is located to the north of the Intertropical Convergence Zone between latitudes 18°30′ and 15°55′ N in the southeastern part of the Yucatan Peninsula, Central America (Fig. 1). It has a surface area of approximately 23,000 km² and a relatively sparse human population density of 7-8/km². Much of the region is below 100 m, but the Vaca Plateau and Mayan Divide, which dominate the southern half, rise to a ridge between 850 and 1,100 m. Most of the areas above 100 m have a broadleaf forest biome, including tropical-dry, tropical-moist and subtropical-moist life zones from which three species of cebids have been reported (Hill, 1960, 1972; McCarthy, 1982): a howler monkey (*Alouatta pigra luctuosa* Lawrence, 1933), a spider monkey (*Ateles geoffroyi yucatanensis* Kellog and Goldman, 1944), and a capuchin monkey (*Cebus capucinus limitaneus* Hollister, 1913). These populations represent some of the most northerly-distributed cebids (see Estrada and Coates-Estrada, 1984; Watts *et al.*, 1986) and monkeys inhabiting the Mayan Divide may experience some of the more extreme climatic fluctuations of all the Ceboidea. Walker (1972) reported a lowest monthly minimum temperature of 6°C from Augustine, near the Chiquebul Forest, at about 500 m; some monkeys may inhabit areas at even higher elevations and, hence, experience even lower temperatures. With an awareness of the need to conserve the greatest variety of monkey habitats, and an awareness of the sensitivity to disturbance of *Ateles*, work was begun during the dry seasons of 1982 and 1983 to survey monkey populations around the Mayan Divide and to evaluate the prospects for a productive conservation effort (Dahl, 1984). Additional work was carried out during the wet season of 1984, and R. Hubrecht conducted a survey in 1985 (Hubrecht, 1986). The present report summarizes the findings of the 1982-84 surveys and pinpoints the issues which appear have greatest relevance for the formulation of what could be a productive conservation policy for Belize and for other regions.

Table 1: Principal Survey Areas

Map Reference Number	Area (km²)	Elevation (meters)	Location
1	8	60-100	Macal river north of Charr Creek
2	7	220-440	Area around Rio On to the west of the Mountain Pine Ridge
3	8	380-620	Ballerina: area between Macal and Raspaculo
4	22	480-620	Type Locality of *A. p. luctuosa*, Cohune Ridge/Tziminkax (Mountain Cow)
5	22	540-600	Arabato, Puente Naturalle, Bordel Camp, Grano, Engineers Camp
6	5	600-700	Mollejon: Upper Chiquebul River
7	9	700-920	Mayan Divide, Howe's Pass
8	11	50-200	Trio River - Middle Range
9	10	20-50	Trio River - Lower Range
10	18	40-200	Bladen River (Fosse Hill to Quebrada)
11	12	15-(90*)	Confluence of the Bladen and Trio Rivers (*Nelson Hill)
12	9	10-25	Bladen Bridge (and local vicinity)
1-12	141	15-920	TOTAL FROM NORTH AND SOUTH OF THE DIVIDE

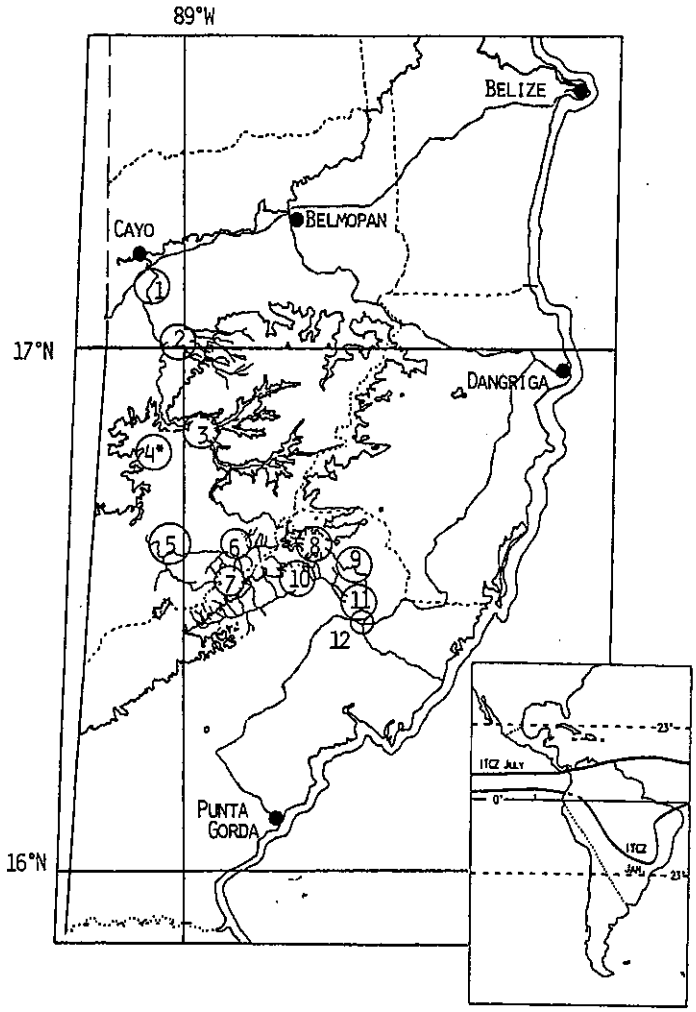

Fig. 1. Map of the southern half of Belize showing areas surveyed (numbered circles), principal towns, district boundaries (small broken lines), roads (lines with bars), the 500 m contour line and some important rivers; see text and Table 1 for additional details. Inset shows the location of Belize in relation to the broad range of the Ceboidea (dotted line) and the approximate limits of the Intertropical Convergence Zone (ITCZ). *N.B.* Quebrada de Oro is just to the west of the circle (#10) and is not in the area indicated on the map shown in Hubrecht, 1986 (map provided by author).

Results

A total of 12 areas were surveyed in 1982-1984 (Fig. 1, Table 1). In Area 1, farming was conducted on both sides of the River Macal and the remaining wooded areas were limited. No evidence of monkeys was found in this area either directly or indirectly from interviews with local inhabitants.

Contact was made with a single group of howler monkeys in Area 2 in 1982, and two groups were evident in 1983. This area is located within the Mountain Pine Ridge Forest Reserve in which logging activities were discontinued over 20 years ago.

The well-developed high forest (High Ridge) in Area 3 was hit by Hurricane Hattie in 1961 and logged in 1965, but the steepness and orientation of the area protected the forest from the most damaging effects of both the storm and logging activities. A group of *A. p. yucatanensis* was located in Area 3 at an elevation of approximately 550-600 m, and tracks of tapir were numerous.

Area 4, the Type Locality for *A. p. luctuosa*, was surveyed in 1982 when an active logging camp was in operation. Some of the area was covered by a relatively low, secondary thicket, but there was also some considerably taller forest with a well-developed "C" layer. Many fresh logging trails, clearings and canopy gaps were present, and the only evidence of monkeys was a sighting by loggers of howler monkeys to the south. Tapir tracks were occasionally observed.

Area 5 included an active logging camp at Grano del Oro in 1983, and Engineers Camp where there had been a forest fire several years earlier, now marked by a large area of low regrowth extending from the camp to within 1 km of the Chiquebul River. Bordel Camp had recently been used as a military training camp, and evidence of military activity extended to the Smokey Branch of the Chiquebul and to the Puente Naturelle. Although howler and spider monkeys were previously seen in these areas by N. Howe, not one was recorded during the survey. Jaguar and tapir tracks were noted frequently, and a very large raptor (possibly a harpy eagle, *Harpia harpyja*) and two scarlet macaws were also seen.

An active logging camp was present in Area 6 from which distant howler monkey vocalizations were heard to the north, which tended to verify the evidence of a sighting in that area by loggers. From Area 6 southward, the vegetation gradually changed with elevation and *zapote* (*Manilkara zapote*), an important food species of *Alouatta* and *Ateles*, was not encountered above 700 m. The nature of the forest changed again as the divide was crossed in Area 7, and the vegetation became lusher. No monkeys were observed at this high altitude but our survey time was short.

Areas 8–12 are located south of the divide, where rainfall is much greater than in the north. Augustine, near Area 2, experiences three months with a mean monthly rainfall less than 100 mm and a mean yearly total precipitation of about 1,350 mm, while Punta Gorda to the south (Fig. 1) experiences two dry months and a mean yearly total precipitation of about 3,600 mm. Only the areas west of the Trio Branch (Areas 8 and 9) were surveyed, and no monkeys were recorded; however, there were reports of the presence of *Ateles* to the east of the Trio in Area 9. No *Alouatta* were seen or reported by informants from these areas nor from Area 10. *Ateles* were contacted in Area 10 (Fig. 2), however, and Hubrecht found what may have been a high population density of this species at Quebrada de Oro (Hubrecht, 1986). Disturbance of the forest in these areas seemed to be mostly for the illicit cultivation of *Cannabis*. A 300 acre area just north of the confluence of the Trio and Bladen Branches had been cleared for banana cultivation and more forest was being cut to plant food crops and to construct dories. At the confluence itself, there were several old plantations, a new farm and a recently-cleared plantation which were disrupting part of the home range of at least one group of *Alouatta*. A second group to the west along the Bladen was heard on several occasions, and some limited high forest was noted around Nelson Hill. No *Ateles* were recorded, and inhabitants were adamant that these animals could be located only in the foothills of the Mayan Divide to the north. *Alouatta* were reported by local inhabitants both to the north and south of Bladen Bridge (Area 12) and from the Sierrittas to the east, and were heard to the south in 1984, and to the north in 1983. A large, all-weather bridge was under construction in 1984 which was creating a substantial break in the gallery forest to either side of the road, and dividing the range of the monkeys.

Discussion

Both spider and howler monkeys appear to be patchily distributed throughout the Chiquebul Forest Reserve up to about 650 m, but no evidence of spider monkeys was found below 350 m. It is not surprising that these monkeys appear to occupy areas which have been minimally disturbed by logging activities and hurricanes. Their distribution is different south of the divide; *Alouatta* appear to be restricted to elevations below 100 m, and *Ateles* are present below 200 m (and may occur at much higher elevations). Ongoing logging has disrupted large areas of the Chiquebul Forest, and some severe disruption has resulted from military activities; otherwise, this area appears to be well-regulated. Both loggers and *chicoleros* (those who gather chicle) hunt for food and occasional, indiscriminate shooting of monkeys may occur. Two juvenile *Alouatta* and one adult *Ateles* were discovered living in captivity; these animals were probably obtained by shooting the mother. At lower elevations in the Trio/Bladen area, increasing disruption of gallery forest was evident and will increase following construction of a new series of bridges

Fig. 2. A spider monkey (*Ateles geoffroyi yucatanensis*) in Area 10 (photo provided by author).

along the southern highway; illicit hunting is frequent in this area. There is little or no disruption of the forest at higher elevations, and spider monkeys, jaguars and tapirs probably occur most frequently in this area. Despite numerous informants' enthusiastic reports of "white-faced monkeys", there was no evidence of *Cebus capucinus limitaneus*, and careful cross-examinations indicated that their sightings were clearly suspect. McCarthy (1982) reported the presence of this monkey along the Trio Branch and in the Chiquebul Forest, but this claim could not be substantiated despite surveys conducted in the areas described above.

Prospectus

The important aims of increasing local awareness, community involvement and general education, with a focus on *Alouatta pigra* are already being addressed in Belize (Horwich, 1986). This report addresses additional ways to conserve the habitats of *Alouatta* and *Ateles* within the context of the economic concerns of the Belizean Government. The establishment of another relatively large wildlife refuge for monkeys, as has been done for jaguars in the Cockscomb Basin, has the disadvantage of removing another large tract of land from the long-term silvicultural and agricultural economy of the country. The emphasis here, therefore, is to formulate a compromise between strict non-utilization and regulated utilization of areas so that in the long-term, conservation measures can more than pay for themselves. The monkeys' habitats produce valuable hardwood tree species such as mahogany, cedar and rosewood (see Johnson and Chaffey, 1973). Any long-term conservation plans, therefore, should include the careful extraction of prime quality trees in such a way as to limit disruption of the habitat while maximizing hardwood yields over the long term. Data have been presented showing that at least some primate species can successfully inhabit logged forest (Johns, 1986); this is not a logging-versus-monkeys issue.

Long-term silviculture is at odds with current logging practices in Belize since logging companies represent the interests of short-term investors who seek yields on their investments over two or, at the most, three years. An obvious answer to this dilemma would be to establish the means by which to invest for a longer term, i.e., 15 or 20 years. This type of investment would decrease pressure on companies to remove all possible lumber from an area in one or two years and would enable them to concentrate on gradual, high-quality extraction.

Within the above context, therefore, the following suggestions are offered.

1. Carefully select relatively small areas (10-15 km^2) in which both monkeys and habitats are in good condition, and place full restrictions on their commercial utilization. For example, the areas of Nelson Hill and the Sierrittas to the west and east of the Bladen, respectively, might be placed in this category. Both areas are relatively close to the Southern Highway, and access trails, as can be found in state parks in the United Sates, could provide students and tourists regulated access by which to experience first-hand the awesome nature of huge trees and the fascina-

tion of contact with wild animals. Area 2 provides similar possibilities and is only a short distance from an existing forest station at Augustine.

2. The small areas described could be part of much larger areas (50-100 km^2) in which long-term utilization could be practiced so that the entire area could contribute substantially to the local economy. This might be accomplished by (a) developing much less destructive logging techniques which would include careful selection of prime timber to minimize the size of canopy gaps, on-site portable sawmill operations or new lifting technologies to minimize the need for large dragging tracks, and restrictions on the secondary use of the forest by loggers when obtaining food and shelter; (b) encouraging the harvesting of other renewable forest products, for example, cohune nuts for cooking oil and small tree species for basket-weaving material, which would emphasize traditional Mayan usage of the forest; (c) prohibiting the use of large regulated areas for military exercises and training; and (d) enforcing strict regulation of hunting practices. Within the latter context, there is no apparent reason why certain mammalian species which have been traditionally killed for meat, such as the gibnut (*Agouti paca*), could not provide food resources in the long-term if hunting were carefully regulated. Although licensing is in effect in Belize, it is difficult to enforce. In order to encourage hunters to keep within the limits, the Government could set up a cooperative system that would provide supplies to licensed members and help market their products by providing refrigerated vans and organized marketing to dealers in the towns and villages of the area.

3. Make available the possibility of competitive long-term investment in conservation-oriented silvicultural entrerprises so that special logging concessions for "long-term utilization" areas can be awarded; long-term investments should contribute to the stability of the economy.

4. With respect to all forested areas, it would serve the national interest to enforce restrictions concerning methods of clearing land for plantations or milpa farming. Numerous plantations were visited in which all except the very largest trees had been cut down, in which small seasonal streams and ditches had been completely cut over resulting in rapid erosion and leaching during the wet seasons, and in which clearance of the forest extended to the edge of river banks, also leading to rapid erosion. Many farmers are not clearing land on a rotational basis, but instead plan to produce crops for as long as possible and eventually provide pasture on the ensuing impoverished grassland.

5. An effective conservation effort will be dependent upon successful educational programs designed to increase an awareness of the forest, its limitations and the potential for its utilization. The broad-leaf forests of Belize offer an important national heritage with links to the ancient Maya not only through the existence of large archaeological sites within the forests, but also by the nature of ancient Mayan art (see Fig. 3). Since the population is multi-lingual and of considerable ethnic variety, conservation-orientated publications should be made available in Mayan Kekchi and Yucatec as well as in English and Spanish.

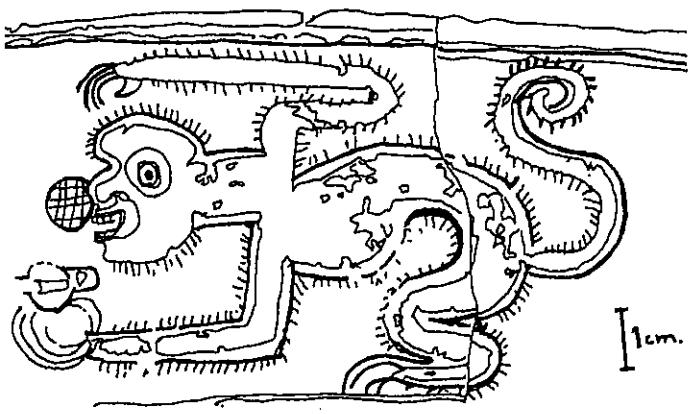

Fig. 3. Representation of a spider monkey on an ancient Mayan artifact from a site near Douglas, Northern District (drawing provided by author).

Conclusions

There is considerable potential for a constructive, large-scale effort to conserve the habitats of primates in Belize by means that would be economically feasible and likely to be of some long-term advantage. This potential is decreasing rapidly, however, as areas that have received little exploitative attention in the recent past are becoming more valuable and more accessible. The organization of long-term investments in conservation-oriented, silvicultural exploitation may be critical to a successful conservation effort.

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Primate Conservation in Peru: A Case Study of the Yellow-tailed Woolly Monkey

by Mariella Leo Luna

There are 27 species of primates in Peru, 26 of which are distributed along the montane and lowland forests of the Peruvian Amazon region, and one species (*Alouatta palliata*) in the Pacific dry forest. According to Peruvian law (R.M. 01710-77-AG/DGFF), 19 Peruvian primates are either endangered, vulnerable, or rare. Currently only three are recognized as endangered: the red uakari (*Cacajao calvus*), the blackmantled howler monkey (*Alouatta palliata*), and the yellow-tailed woolly monkey (*Lagothrix flavicauda*). Three or four more species (e.g. *Ateles belzebuth, Ateles paniscus, Lagothrix lagotricha poeppigii,* and *Aotus miconax*) might now be added to this endangered category.

The black-mantled howler is a highly endangered primate in Peru mainly due to hunting pressure on a semi-isolated population (Saavedra and Green, in press). Unfortunately because it is a common species in other South American countries, it is more difficult to obtain funds or technical support to conserve this species in Peru.

The red uakari is restricted to a small region in the Peruvian Amazon. Surveys show that it has already disappeared from many areas and, that where it still persists, its densities are low (Ministerio de Agricultura, 1985).

The yellow-tailed woolly monkey is particularly important to Peru because it is one of the two endemic primates (the other being *Aotus miconax*) and is the largest endemic animal. Similar to other *Lagothrix, L. flavicauda* has a dense woolly fur, a hairy face, and a hairless strip on the ventral surface of the tip of its tail. The copper-colored pelage gradually darkens to almost black at the base of the skull, the lower back, and the distal end of the limbs and tail. The most conspicuous features of adult *L. flavicauda* are a characteristic white patch surrounding the mouth, and a band of yellow hair on the ventral side of the final third of the tail. Adult males display a golden-blond genital tuft up to 15 cm in length, while some adult females with infants have a much shorter tuft. This species seems to be mainly herbivorous, although it occasionally eats insects. *L. flavicauda* have been observed feeding on fruits, leaves, flowers, buds, giant petioles of *Cecropia* trees, and pseudo-bulbs of epiphytes. They live in groups of 5–18 adults. Most frequently they are found in small groups formed by one or two adult males, two adult females, two sub-adults and one juvenile or offspring.

L. flavicauda inhabits the northeastern montane cloud forest of Peru, from 1,700 to 2,700 (Mittermeier, *et al.*, 1984; Fig. 1). Other primate species occur in the lower part of its habitat like the white-bellied spider monkey, the white-fronted capuchin, and one or more species of night monkeys.

The inaccessibility and ruggedness of the area protected this species for many years and until the late 1950's, there were no roads into the area. The Peruvian government has since started to encourage spontaneous colonization of the montane forest by building roads.

Surveys conducted on the *L. flavicauda* population since 1978, show that this species is highly endangered due to human pressure. Some natural characteristics make this species particularly vulnerable: (1) its low densities, ranging from 0.25 to 1 group per km², (2) its suspected low reproductive rate, (3) its restricted range.

Although the actual area occuppied by *L. flavicauda* remains unknown, its original potential habitat has been estimated as less than 1,300,000 ha. Field studies indicate the species may occupy half of this area; the other half remains unknown. Despite its low population density, *L. flavicauda* is more abundant than the other diurnal primates species in the area. This may be because it is better adapted to its harsh environment. The species also appears to be highly sensitive to habitat alterations.

The main threats to the survival of this species are hunting, selective logging, and deforestation. Hunting of this species seems to be opportunistic and results in group size reduction. A very conservative estimate is that over 600 animals have been killed by peasants in the last ten years. Although these numbers may appear small, they are significant, especially because *L. flavicauda* has such a low reproductive rate. Extensive long-term hunting operations conducted during the construction of the roads are at least partially responsible for the extinction of some local populations.

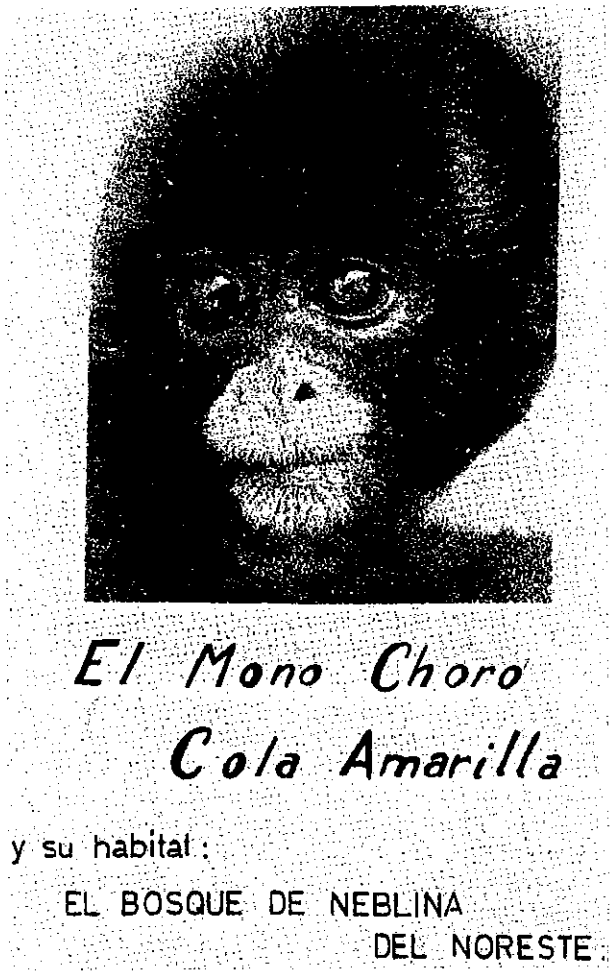

Fig. 2. A 12-page booklet, produced and distributed by the Peruvian Association for Nature Conservation (APECO), explains conservation of the yellow-tailed woolly monkey and its cloud forest habitat.

Within *L. flavicauda's* range, logging is extremely selective, focusing mainly on montane cedar. Between 1979 and 1981, legal logging contracts adding up to 4,200 ha were approved in the range of this species. Later that year logging was banned in the area, but illegal logging still occurs. This illegal logging is intensive enough to disturb the forest structure so that *L. flavicauda* will decrease their use of the area, and sometimes even abandon it. However, the worst effect of the logging operations is that they facilitate and even encourage the clear-cutting of the area.

Using available data on deforestation up to 1981, I estimate that 176,000 ha or more of *L. flavicauda's* potential habitat has already been deforested and converted to various agricultural uses. The distribution pattern of this agriculture has also fragmented the potential habitat. A conspicuous example of this is the forest between the Marañon River and the Utcubama River, which is presently totally isolated from other similar kinds of forest. The resulting fragment is a strip of forest 110 km long but only 10 km wide. I have to emphasize that this is based on 1981 deforestation data. Projecting human population growth and land requirements to the year 1991, an additional 90,000 ha or more of *L. flavicauda* habitat will be deforested.

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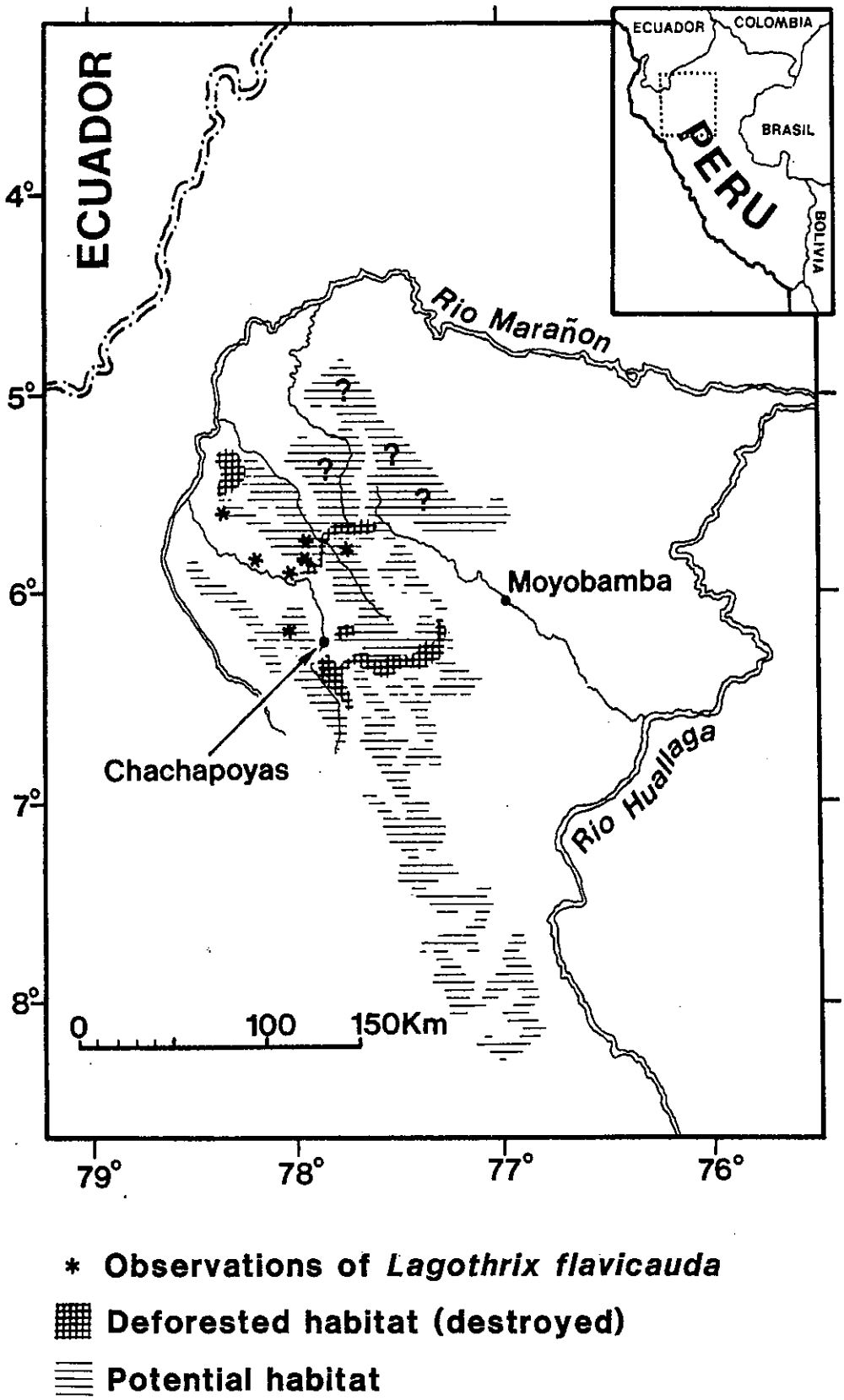

Fig. 1. The probable distribution of the yellow-tailed woolly monkey *(Lagothrix flavicauda)* in northern Peru (map by S. D. Nash).

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International Efforts to Secure a Viable Population of the Golden-Headed Lion Tamarin

by Jeremy J. C. Mallinson

Background

The golden-headed lion tamarin *(Leontopithecus chrysomelas,* Fig. 1) was first described by H. Kuhl in 1820 and inhabits the tropical rain forests of the coastal regions of the state of Bahia, eastern Brazil. By 1972, the species had only been in captivity on three occasions, once at London Zoo in 1869, once in Rio de Janeiro in 1961, and starting in 1971 with Dr. A. F. Coimbra-Filho at the Tijuca Biological Bank and at the Rio de Janeiro Primate Center (CPRJ; see Coimbra-Filho, 1970).

From information collected during the winter of 1983–1984, it was estimated that between 25-50% of the world population of this species had been illegally taken from Brazil and exported from either Bolivia or Guyana, to animal dealers in both Belgium and Japan, as well as one private animal collector near Paris and a small zoo in central France.

At the IVth World Conference on Breeding Endangered Species in Captivity, held at the Flevehof Congress Center in the Netherlands in September 1984, a resolution concerning the future of *L. chrysomelas* was unanimously approved. The participants recognized Brazil's total dedication to the protection of its indigenous flora and fauna, and offered all support in the fulfillment of these conservation aims. The resolution recommended that all international and national conservation agencies should cooperate with the Brazilian Government and that all illegally exported or illegally held *L. chrysomelas* should be confiscated or voluntarily replaced in the Trusteeship of the Brazilian Institute of Forest Development (IBDF). The Brazilian Government was urged as a first step to set up an International Recovery and Management Committee for *L. chrysomelas* to oversee placing the illegally exported animals in appropriate captive breeding institutions with experience in propagating other lion tamarin species.

The Flevehof Resolution was subsequently endorsed by the IUCN/SSC Captive Breeding Specialist Group and Primate Specialist Group, the Fauna and Flora Preservation Society, the International Union of Directors of Zoological Gardens and Council of the National Zoo Federation of Great Britain and Ireland, the World Wildlife Fund, the Jersey Wildlife Preservation Trust, and the Wildlife Preservation Trust International.

The International Recovery and Management Committee

In November 1984, IBDF and the Brazilian Ministry of Foreign Affairs officially approved the Flevehof Resolution. In March 1985, I was requested by IBDF to co-chair with A. F. Coimbra-Filho an International Recovery and Management Committee (IRMC) for *L. chrysomelas.* In June 1985, an inaugural meeting of the committee took place in San Diego with four members present: A. Coimbra-Filho, D. Kleiman, R. Mittermeier and myself. Dr. U.S. Seal also attended the meeting in his capacity as Chairman of the IUCN/SSC Captive Breeding Specialist Group, as well as W. Konstant, then of WWF-U.S. Also represented on the IRMC are the President of the Brazilian Conservation Foundation (FBCN), the Executive Secretary of the Fauna and Flora Preservation Society (FFPS), and two senior Executive Members of IBDF - therefore half the seats are occupied by leading Brazilian conservationists.

Since June 1985, every effort has been made by the IRMC to have all of the estimated 60 *L. chrysomelas* confiscated or voluntarily replaced in the Trusteeship of IBDF The committee has coordinated the international effort to establish a viable captive breeding population of this endangered species by supporting the efforts of international conservation agencies such as CITES and WWF-Traffic (Japan) and by supporting the findings of the Smithsonian N.Z.P.'s team of consultants in advising the Brazilian authorities against reintroducing animals to the Una Reserve which could well impair the survival of the remnant wild population.

On 30 November 1985, 16 of the 24 *L. chrysomelas* that had previously been in the possession of the Belgium animal dealer, Rene Corten, were flown from Amsterdam to Rio de Janeiro, accompanied by a representative of IBDF This successful repatriation represented the culmination of two years of quiet diplomacy, and the goodwill and motivation of the Belgium Ministry of Agriculture, WWF (Belgium), the Brazilian Ministry of Foreign Affairs and IBDF The project was funded by WWF

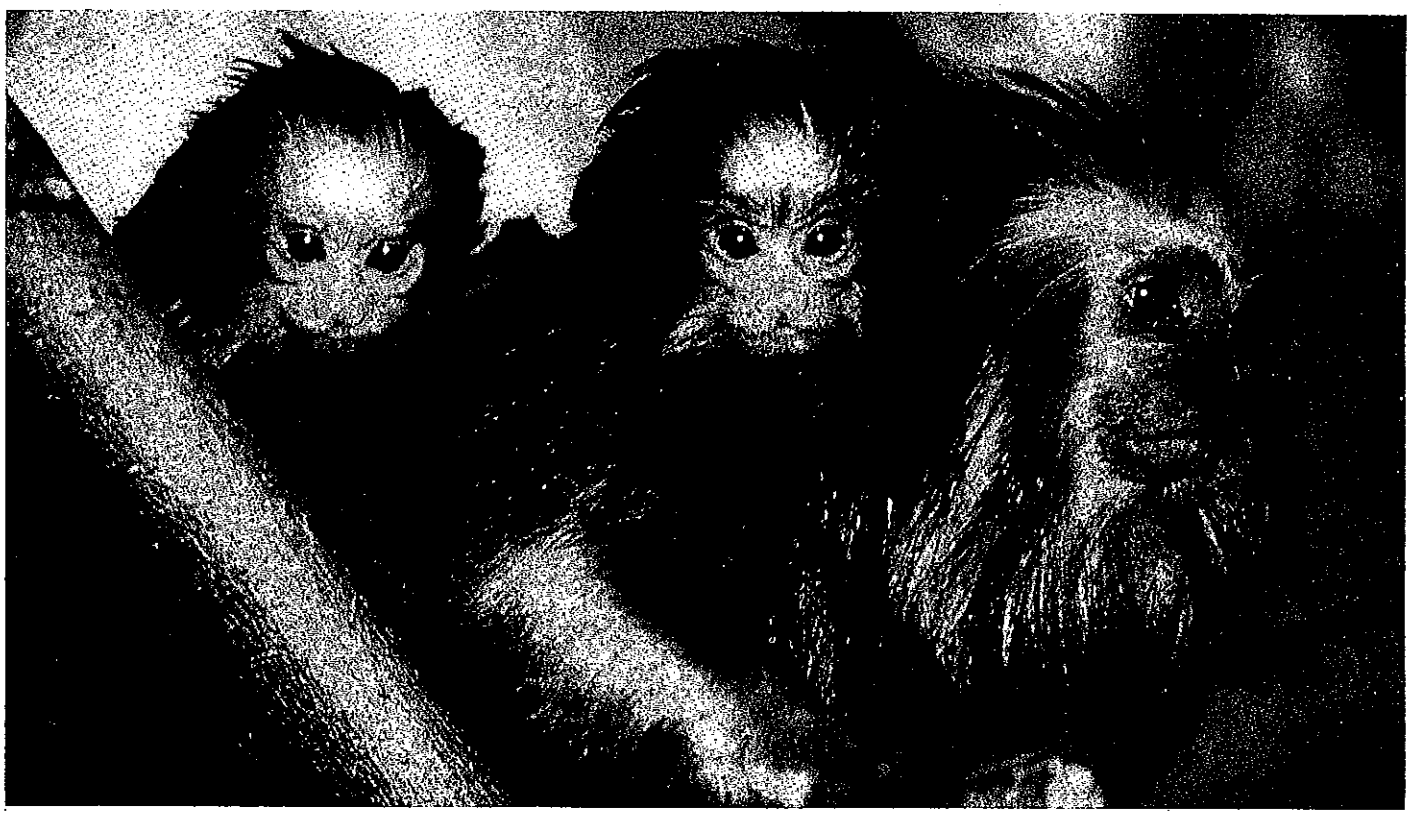

Fig. 1. One-month old male twin golden-headed lion tamarins born at Brookfield Zoo (photo by V. Sodaro).

(Belgium) and the Jersey Wildlife Preservation Trust.

The animal dealer's lawyer issued a statement that the specimens had been legally imported to Belgium on valid export documents from Guyana prior to Belgium becoming a signatory to the CITES Convention, and that there was nothing in either Belgium or international law that could have enforced the handing-over of the animals. He therefore considered such a repatriation a gesture of goodwill on the part of R. Corten.

Due to the CPRJ having in excess of 50 specimens of *L. chrysomelas*, the CPRJ and IBDF decided to take advantage of offers from two leading zoos in the USA, who had contributed so much to the successful breeding program for the golden lion tamirin, *L. rosalia*. During March 1986, 10 *L. chrysomelas* were sent on a breeding loan agreement to the Los Angeles Zoo, and 10 to the National Zoo. During April, two pairs of the latter population were sent on to the Chicago Zoological Society (Brookfield). The director's of these three zoos have now signed the Management Agreement and the Memorandum of Understanding Among Signatories, and hold the animals in the Trusteeship of IBDF. By 31 December 1986, within a ten-month period, the U.S. population of *L. chrysomelas* increased by 25%.

In December 1985, the Director of Zoo La Palmyre, France, who has stated that he received his founder stock of *L. chrysomelas* in July 1977, prior to France becoming a signatory of the CITES convention, agreed to cooperate and to fully accept the IRMC requirements. In May 1986, the zoo became a signatory to the Memorandum of Understanding and the title of the 11 speciments was transferred. The animals at the Zoo La Palmyre are now under the Trusteeship of IBDF Similarly, the Hong Kong Zoological and Botanical Gardens which in 1984 legally imported a trio of *L. chrysomelas* from Japan, agreed to convey the title of the now four specimens in their collection to IBDF In May 1986, they also signed the Memorandum of Understanding.

The announcement made at an environmental committee meeting held in the Diet, Tokyo in April 1986, to have the 12 *L. chrysomelas* that three years previously were imported illegally into Japan returned to the ownership of the Brazilian Government, represents the culmination of a great deal of behind-the-scenes lobbying and diplomacy by the Director of WWF-Traffic (Japan), T. Milliken. The IRMC, and in particular A. F. Coimbra-Filho, were supportive of T. Milliken's efforts, because such a case holds great significance for the future development and implementation of CITES in Japan. IBDF has since requested that 12 animals at present held in three different locations in Japan be sent to the São Paulo Zoo to become part of a scientifically managed, captive population. These 12 Japanese *L. chrysomelas* were repatriated and received by the São Paulo Zoo 12 September 1986.

The Future

In its role as a technical advisor and consultant to IBDF for the management of *L. chrysomelas*, the committee has advocated that all institutions holding the species (whether in Brazil or overseas) should become signatories to the Management Agreement's Memorandum of Understanding, and be required to provide a checklist of the specimens in their collections so that a comprehensive studbook can be established.

As D. Kleiman recently stated, "We know almost nothing about this animal, and the recovery program is the first time an international cooperative breeding effort of this scope has ever been undertaken where it will be possible to start from scratch with newly imported wild-born animals" (Anon, 1986). Also, we have a unique opportunity to collect baseline data on the genetic variability of the founders of a new captive population. Such data will be of major value in the development of a management plan for this species (D. Kleiman, pers. comm.).

At present, the captive population of *L. chrysomelas* is estimated to be between 150-170 individuals. If this total population can be involved in a worldwide management program modeled after the excellent Management Plan that has been so successfully implemented and carried out by the Golden Lion Tamarin Co-operative Management Committee (see Kleiman *et al.*, 1986), there is no reason why this should not become a self-sustaining captive population. It is IRMC's hope that in the future, at an appropriate place and time, following the recommendations of IBDF, such a captive breeding program will be able to contribute materially to a successful program of reintroduction.

In previous papers, I have stressed the importance of national and international cooperation and coordination (Mallinson, 1980, 1984a, 1984b), as well as to the significance of adopting a more interdisciplinary approach if we are going to achieve our ultimate conservation goals (Mallinson, in press).

Since the inception of the IRMC and my tenure as a co-chairperson, I have been in direct contact with a great many accredited conservationists in Belgium, Brazil, France, Hong Kong, Great Britain, Japan, Switzerland and the U.S.A., which have included personnel from national and international conservation agencies, zoos and private animal collections. From such involvements, I would have liked to have reported that the international conservation community has always been quick to collaborate with each other in order to work positively towards achieving a specific conservation goal, such as striving towards the realization of the well-defined objectives of the Flevehof Resolution. However, regrettably, quite a good deal of our committee's work has been both complicated and handicapped by various degrees of misunderstandings and misrepresentations and feelings of territoriality. I have been disappointed in having had to witness the difficulties that some animal preservationists have in working with each other and in getting their conservation act together. However, I do trust that the work of the IRMC is an important example of collaboration between the various diverse disciplines involved in international animal conservation. We hope it can provide a framework for endangered species requiring International Recovery Programs in the future.

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To A. F. Coimbra-Filho for his help and professional guidance, and to D. Kleiman who has allowed me to benefit from her wealth of experience as Chairperson of the Golden Lion Tamarin Management Committee. To the directors of WWF (Belgium) and to WWF-Traffic (Japan), who have aided the recovery program. Also to the governing body of the Brazilian Institute of Forest Development who have so ably supported such a collaborative international conservation effort.

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The Distribution and Conservation Status of Primates in Southern Bahia, Brazil

by Ilmar B. Santos, Russell A. Mittermeier, Anthony B. Rylands and Celio M.C. Valle

Introduction

The Atlantic forest region of eastern Brazil is one of the highest priority areas in the world for primate and tropical forest conservation (Mittermeier *et al.*, 1982; Mittermeier, 1987). It is home to six genera and 21 species and subspecies of primates, of which two genera and 16 species and subspecies are endemic and at least 15 already endangered, some of them to the point where they must be considered literally on the verge of extinction. The southern part of the state of Bahia, in the central portion of the Atlantic forest region, is of particular interest for conservation of these rare and endangered animals. It is the only place where all six Atlantic forest genera are sympatric and also appears to be a Pleistocene refugium (Kinzey, 1982), with at least three of the primates occurring there being endemic and two others mainly confined to this region. More lowland forest remains in southern Bahia than anywhere else in the Atlantic forest region, but it is disappearing rapidly. Although four protected areas exist in southern Bahia, only the two smaller ones (the 485 ha Lemos Maia Ecological Station and the 900 ha Pau Brazil Ecological Station, both belong to the Regional Cocoa Growing Authority, CEPLAC) are well-protected. The two larger ones, the 11,400 ha Una Biological Reserve and the 14,500 ha Monte Pascoal National Park, both belong to the Brazilian Forestry Development Institute (IBDF) of the Federal Government. Both of them are critical to the survival of the fauna and flora of southern Bahia, but they are in a precarious situation and in need of much further attention.

The purpose of this article, which is the first of several on southern Bahia, is to clarify the geographic distribution of the eight primates that occur in this part of the Atlantic forest and to discuss their conservation status (summarized in Table 1). Since southern Bahia has more endangered primates than anywhere else in the Atlantic forest, special emphasis will be placed on the primates and protected areas of Bahia in the years to come. This article is also the first in a series on the primates

Table 1. The Primates of Southern Bahia

Species: *Callithrix kuhlii*
Vernacular Names: Wied's marmoset (Engl.)
Sagui-de-Wied (Port.)
Mico-estrela (Bahian name)
Mico (Bahian name)
Range: From the Rio Jequitinhonha north to the region around Salvador and possibly NE Minas Gerais as well; northern limits still need to be defined
Conservation Status: *Vulnerable*; the most abundant and adaptable primate in southern Bahia, but threatened by widespread forest destruction

Species: *Callithrix geoffroyi*
Vernacular Names: White-faced-tufted-ear marmoset (Engl.)
Geoffroy's tufted-ear marmoset (Engl.)
Sagui-de-cara-branca (Port.)
Souim (Bahian name)
Mico (Bahian name)
Range: From the Rio Jequitinhonha south into northern Espirito Santo as far as the Rio Doce and west into northeastern Minas Gerais
Conservation Status: *Endangered;* a relatively widespread and adaptable species that occurs in an area of much recent forest destruction; in southern Bahia it occurs only in the largely cleared area to the south of the Rio Jequitinhonha and not in the more heavily forested area to the north of this river

Species: *Leontopithecus chrysomelas*
Vernacular Names: Golden-headed lion tamarin (Engl.)
Mico-leao-de-cara-dourada (Port.)
Souim-melado (Bahian name)
Souim-catravo (Bahian name)
Mico (Bahian name)
Saguim-caboclo (Bahian name)
Range: A southern Bahian endemic found only between the Rio de Contas to the north and the region of the Rio Jequitinhonha to the south; it apparently has crossed to the south bank of the Jequitinhonha in some areas and is reported to exist in extreme northeastern Minas Gerais as well, but this remains to be confirmed
Conservation Status: *Highly endangered;* much rarer than other callitrichids in this region and one of the most endangered primates in the Atlantic forest region

Species: *Callicebus personatus melanochir*
Vernacular Names: Northern masked titi (Engl.)
Guigó (Port. and Bahian name)
Range: Eastern and especially southeastern Bahia, northern Espirito Santo as far south as the Rio Doce and adjacent parts of northeastern Minas Gerais; northern and western limits remain to be clearly defined
Conservation Status: *Endangered;* an adaptable species, but spottily distributed and rare

Species: *Cebus apella xanthosternos*
Vernacular Names: Buff-headed southern Bahian capuchin (Engl.)
Macaco-prego-de-peito-amarelo (Port.)
Piticau (Bahian name)
Macaco caete (Bahian name)
Macaco verdadeiro (Bahian name)
Range: A southern Bahian endemic found from the Rio Jequitinhonha north perhaps as far as Salvador and west to the limits of the Atlantic forest; northern and western limits remain to be clearly defined.
Conservation Status: *Highly endangered;* one of the most endangered primates in the Atlantic forest; heavily hunted throughout its range and known only from a handful of localities

Species: *Cebus apella robustus*
Vernacular Names: Robust tufted capuchin (Engl.)
Macaco prego (Port.)
Macaco preto (Port.)
Range: Southern Bahia south of the Rio Jequitinhonha, northern Espirito Santo north of the Rio Doce, and adjacent parts of Minas Gerais
Conservation Status: *Endangered;* a once widespread and adaptable primate and sometimes the most abundant species in remnant forest areas. However, it occurs in a region that has already been largely clear cut and is secure in only two protected areas.

Species: *Alouatta fusca fusca*
Vernacular Names: Northern brown howler monkey (Engl.)
Bugio (Port.)
Guariba (Port.)
Range: Originally, southern Bahia, northern Espirito Santo north of the Rio Doce, and adjacent parts of Minas Gerais
Conservation Status: *Highly endangered;* one of the most endangered Atlantic forest primates, possible already extinct or the the verge of extinction; not seen anywhere within its range for perhaps as long as 40 years

Species: *Brachyteles arachnoides*
Vernacular Names: Muriqui (Engl., Port., Bahian)
Woolly spider monkey (Engl.)
Mono (Port.)
Mono carvoeiro (Port.)
Miriki, Miriti, Mikiri (Bahian names)
Range: Originally, southern Bahia north as least as far as Jequié; south to São Paulo and perhaps adjacent parts of the coastal mountains of Paraná
Conservation Status: *Highly endangered;* one of the most endangered primates of the Atlantic forest; perhaps already extinct or on the verge of extinction in southern Bahia

of the Atlantic forest, and we hope that it and others to follow will provide basic data and guidelines as to how the unique primates of this region can be conserved.

Data in this article are based on a review of the literature, of which there is very little, and on a series of surveys carried out since 1980 under the auspices of the WWF Primate Program and the WWF Program for the Atlantic Forest Region, in collaboration with the Universidade Federal de Minas Gerais (UFMG), the Rio de Janeiro Primate Center (FEEMA-CPRJ), and the Brazilian Conservation Foundation (FBCN), and with the cooperation of the Brazilian Forestry Development Institute (IBDF) and the Regional Cocoa Growing Authority (CEPLAC) of southern Bahia. These surveys started with a one-month survey by Mittermeier, I. Constable and A. F. Coimbra-Filho, and a six-month study by Rylands in 1980 (1983; in press). More information was collected on a two-month survey by Santos and Valle in March-April and August, 1983. Most recently, Santos conducted a one-month survey in November-December, 1986, during which he also rediscovered the thin-spined porcupine (*Chaetomys subspinosus*), not seen in 34 years. Additional in-depth surveys are planned for the near future by Santos, Rylands, and colleagues from the Universidade Federal de Minas Gerais and the Universidade Federal da Paraiba.

Fig. 1. Forest habitat in the vicinity of Una, southern Bahia (photo by A.F. Coimbra-Filho).

The Primates of Southern Bahia

Eight primates occur in the Atlantic forests of southern Bahia (Fig. 1), which is here defined as the area between the Bahia-Espirito Santo border and the city of Salvador, capital of Bahia, and extending inland as far as the interface between the Atlantic forest and the *cerrado* and *caatinga* formations of the interior. These eight primates include three callitrichids and five cebids. The callitrichids are the white-faced marmoset (*Callithrix geoffroyi*), Wied's marmoset (*Callithrix kuhlii*), and the golden-headed lion tamarin (*Leontopithecus chrysomelas*, Fig. 2). The cebids include the northern masked titi monkey (*Callicebus personatus melanochir*), the buff-headed southern Bahian capuchin (*Cebus apella xanthosternos*, Fig. 3), the robust tufted capuchin (*Cebus apella robustus*, Fig. 4), the northern brown howler monkey (*Alouatta fusca fusca)* and the muriqui (*Brachyteles arachnoides*). The black-tufted-ear marmoset (*Callithrix penicillata*), primarily a *cerrado* species with a large range in central Brazil, occurs at the fringes of the Atlantic forest and in the vicinity of the city of Salvador. It can be considered part of the Atlantic forest fauna broadly defined, but will be discussed in these articles only as it relates to the other two callitrichid species. This first article will deal with all species exclusive of the genus *Callithrix*, which will be covered in the another article in this series. A number of taxonomic problems involving these species are now under investigation and must be clarified before more can be said of the distribution and

Fig. 2. Golden-headed lion tamarin *(Leontopithecus chrysomelas)* (photo by R.A. Mittermeier).

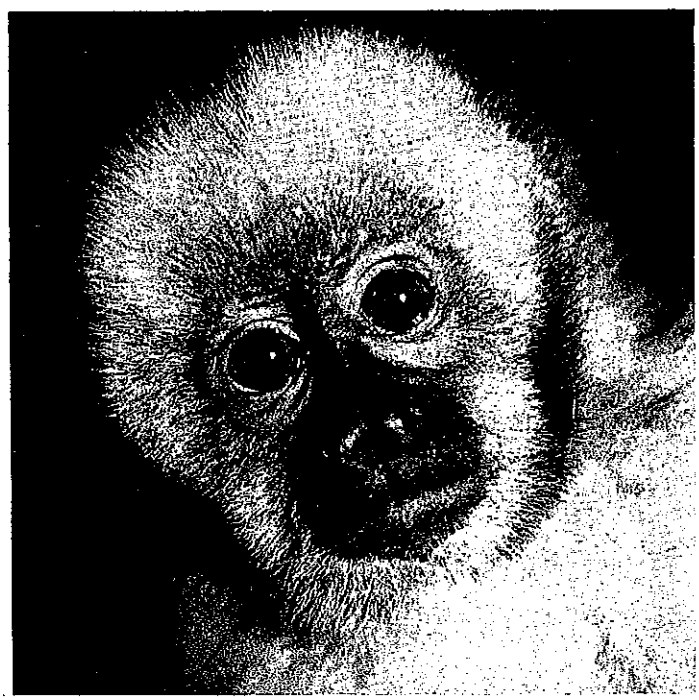

Fig. 3. Juvenile buff-headed southern Bahian capuchin *(Cebus apella xanthosternos)* from the vicinity of Canavieras (photo by R.A. Mittermeier).

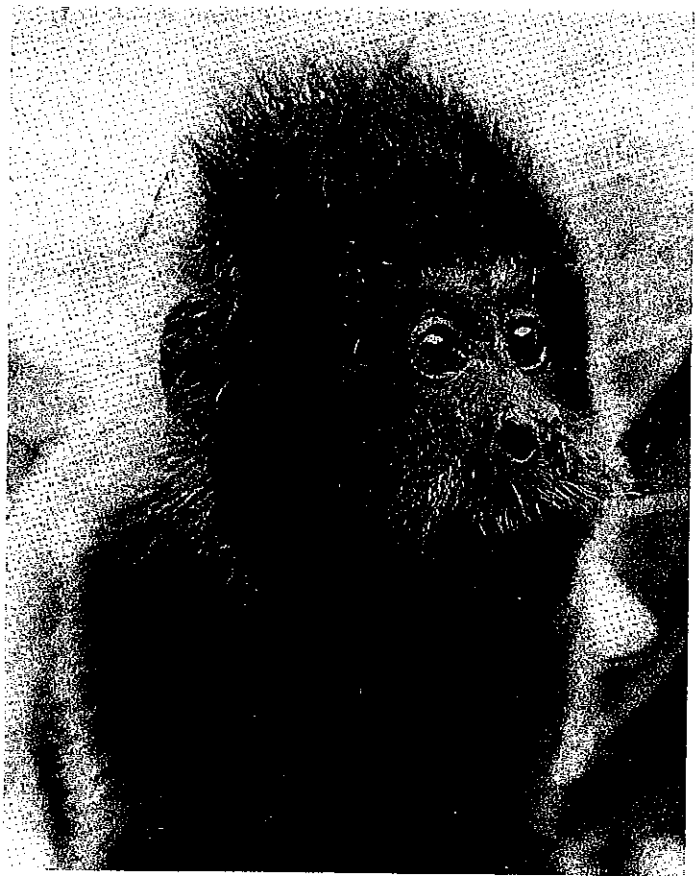

Fig. 4. Female robust tufted capuchin *(Cebus apella robustus)* from the vicinity of Teófilo Otoni, Minas Gerais (photo by I.B. Santos).

conservation of the members of this genus. Furthermore, these small, adaptable monkeys appear to be far less endangered than the other southern Bahian species. In this article, we will focus on the five cebids of this region and especially on the golden-headed lion tamarin (*Leontopithecus chrysomelas*).

Leontopithecus chrysomelas

The golden-headed lion tamarin is a southern Bahaian endemic that is found mainly between the Rio de Contas and the Rio Jequitinhonha. Inland, it extends westward as far as the limits of the Atlantic forest, although probably not as far as the two westernmost localities on the map in Fig. 5. These two locations are in dry *agreste (caatinga)* formations in which this rain forest species almost certainly never occurred, and may well have been based on captive animals obtained by collectors. The southern limit is given by Hershkovitz (1977) as the Rio Jequitinhonha. However, during the course of our investigations, we have received reliable reports from local people indicating that *L. chrysomelas* almost certainly occurs to the south of this river as well. A careful reading of Prince Maximilian zu Wied-Neuwied (1821), the most meticulous of the early explorers of the Atlantic forest, reveals that he only found this monkey as far south as the Rio Pardo. Coimbra-Filho's investigations between the Pardo and the Jequitinhonha in the late 1960's and early 1970's also failed to reveal this species (Coimbra-Filho, 1970; Coimbra-Filho and Mittermeier, 1973,1977). Consequently, the presence of this species south of the Jequitinhonha may be the result of a recent range extension, possibly at the hand of man since the species is often kept as a pet in southern Bahia.

Another source of confusion concerning the range of *L. chrysomelas* is Augusto Ruschi's contention (cited in Coimbra-Filho and Mittermeier, 1973) that this animal occurs in northern Espirito Santo, on a private fazenda (Fazenda Klabin) along the banks of the Rio Mucuri. This locality, which extends the range of the golden-headed lion tamarin three degrees to the south (18° S), has since been carefully checked and proven to be erroneous. However, it does appear that the species occurs in extreme eastern Minas Gerais. Local people in that area are familiar with the animal, but its presence has not yet been confirmed by actual sightings.

In two earlier papers, Coimbra-Filho and Mittermeier (1973,1977) indicated that *L. chrysomelas* appeared to be restricted to the municipalities of Una, Buerarema, Itabuna and perhaps Ilheus, in the central part of the species' range. However, more recent surveys indicate that the animal still occurs in several other municipalities as well, including Itacaré, along the south bank of the Rio de Contas, Camaca on the north bank of the Rio Pardo, and Pedreira to the south of the Rio Pardo. On the other hand, it appears to be entirely absent from the area along the Ilheus-Uruçuca road and the road from Uruçuca to Taboquinhas. This region is almost entirely devoted to cacau plantations, and although people interviewed along these roads by Mittermeier in 1980 were familiar with *Callithrix kuhlii*, none knew of the golden-headed lion tamarin.

To summarize, it appears that *L. chrysomelas* still occurs in remaining Atlantic forest in the coastal region of southern Bahia, between the Rio de Contas and the Rio Jequitinhonha, and has apparently extended its range a short distance to the south of the Rio Jequitinhonha and possibly into extreme eastern Minas Gerais as well. Recent confirmed sightings and reports by local people are plotted in the map in Fig. 6.

The data gathered on *L. chrysomelas* in southern Bahia indicate that this monkey is the most abundant of the three *Leontopithecus*, and the one with the largest remaining forest habitat still available. Its original range was smaller than that of either *L. rosalia* from Rio de Janeiro or *L. chrysopygus* from São Paulo, but habitat destruction in the ranges of these two species has been so widespread that very little of their original habitat remains.

Nonetheless, there is no doubt that *L. chrysomelas* is an endangered species. Habitat destruction and/or modification in southern Bahia is proceeding at a rapid pace, and the forest habitat left for this species is decreasing with each passing day. Indeed, in a six hour drive in 1980 along the BR-101 highway from northern Espirito Santo into southern Bahia, Mittermeier and I. Constable counted 90 lumber trucks carrying the remains of large primary forest trees — and the destruction has increased since that time.

Most of the forest destruction is being carried out by lumber companies from the state of Espirito Santo, which have already devastated most of their own state and almost all of southern Bahia south of the Rio Jequitinhonha. The usual procedure is to remove the most valuable large trees, especially species like jacarandá (*Dalbergia nigra*), which have a very high market value but are now very difficult to find, then cut the smaller trees to produce charcoal, and finally burn what little remains to leave nothing but grassland. This exploitation of the native tropical forest, long considered to be one of the finest anywhere in the world, is done on a purely extractive, short-term basis, with little or no government control and with no interest whatsoever in the future productivity of the region.

Most of the habitat modification, as opposed to outright destruction, is being carried out in connection with cocoa production. Brazil is one of the world's leading cocoa producers, and the range of *L. chrysomelas* is the most important cocoa producing region of the country. Fortunately, cocoa production is being carried out on a far more rational basis than timber exploitation, thanks mainly to the efforts of CEPLAC, the Regional Cocoa-Growing Authority, and its scientific branch, CEPEC. Cocoa is also a crop that requires some shade and has to be grown in areas with larger trees present to provide at least some cover. Several methods of shading are currently used, one of them involving a rubber tree (*Hevea* sp.)/cocoa combination in which the rubber trees provide the shade; the second involving use of fast-growing *Erythrina* sp.; and the third, known locally as *cabruca*, using natural forest trees that have been left standing to provide cover for the cocoa bushes. The last-mentioned method requires the clearance of forest undergrowth to make way for the cocoa plants, but many of the large forest trees are left intact.

Many native animals are able to survive well in *cabruca*, and Wied's marmoset (*Callithrix kuhlii*) appears to do particularly well in these areas. A yellow-fever study carried out by the Rockefeller Institute in the 1940's collected 1,829 *C. kuhlii*, of which 936 (51%) came from cocoa plantations (Laemmert *et al.*, 1946). However, the relationship of *L. chrysomelas* to the *cabruca* is not yet clear. Of the 14 *L. chrysomelas* collected by the Rockefeller team, none were from cocoa plantations. (The figures from Laemmert *et al.*, 1946, reproduced in Table 2, also give some indication of the relative abundance of *C. kuhlii* compared to other monkeys in the region.)

Local people also varied in their responses on this topic. Some indicated that *L. chrysomelas* was sometimes seen in *cabruca*, whereas others stated that it lived only in the forest. Also significant is the fact that no one interviewed along the roads from Ilheus to Uruçuca and Urucuca to Taboquinhas, a region devoted almost entirely to cocoa production, knew of this monkey. What is most likely is that the species can use the *cabruca* from time to time, as long as it has native forest within its home range as well. However, our understanding of this important issue will be clarified in the near future, since a study of *L. chrysomelas* and its relationship to *cabruca* is now being carried out by Maria Cristina Alves in southern Bahia.

In any case, it does appear that *L. chrysomelas* can survive in secondary forest formations of various kinds. Indeed, during the course of our surveys, it was even seen in quite low secondary forest formations, and it occasionally comes down to the ground to cross roads between forest patches as well.

In summary, although *L. chrysomelas* is more widely distributed and apparently more abundant than indicated in earlier publications (Coimbra-Filho and Mittermeier, 1973; 1977) and is still the most abundant of the three lion tamarins, it is clearly an endangered species. Its remaining habitat is being destroyed at a rapid pace and illegal trade has emerged as a factor as well. The animal has always been kept as a pet in small numbers in the region, but an illegal international trade developed in the 1980's (Mallinson, 1984; Konstant, 1986) and a substantial trade to supply private collectors exists within Brazil as well. Furthermore, *L. chrysomelas* has thus far been found in only two protected areas, the tiny Lemos Maia Expermental Station and the Una Biological Reserve. Lemos Maia is too small to ensure the survival of this species, and the situation in Una is precarious. A detailed investigation of the Una Reserve is needed to determine the status of remaining *L. chrysomelas* populations occurring there, and a major international effort to improve its status must be undertaken as soon as possible. At the same time, several new protected areas should be established as well, and the findings of our surveys have already given some preliminary indications as to where these might be located.

Fortunately, a captive populaion of at least 170 animals now exists, 120 or more of them in Brazil and an additional 50 or more in the U.S.A., Europe, and Hong Kong (J. J. C. Mallinson, pers. comm.). The captive populaion is now the responsibility of the special Golden-Headed Lion Tamarin Management Committee, very ably co-chaired by Jeremy J. C. Mallinson of the Jersey Wildlife Preservation Trust, and Adelmar F. Coimbra-Filho, Director of the Rio de Janeiro Primate Center, and efforts are being made to manage this population in the most scientific manner possible. Hopefully, this program will prove as successful as that for the golden lion tamarin, and will ensure the long-term survival of this species in captivity.

Callicebus personatus melanochir

The northern masked titi monkey is one of the three subspecies of *Callicebus personatus*, an Atlantic forest endemic, and it is found in eastern and especially southeastern Bahia, northern Espirito Santo north of the Rio Doce and adjacent parts of Minas Gerais (Fig.7). However, given the widespread destruction of forest in northern Espirito Santo and Minas Gerais, southern Bahia must be considered the main stronghold for this animal. An adaptable species, *Callicebus personatus* can live in a wide variety of forest formations, and may be locally abundant (*e.g.*, in the Monte Pascoal National Park), but it is the rarest of the smaller primates in this region. During our surveys, we found it in only three sites in southern Bahia: the Lemos Maia Ecological Station, the Monte Pascoal National Park, and in the vicinity of Teixeira de Freitas. These sightings, together with known museum localities (from Kinzey, 1982), are plotted in Figs. 7 and 8.

Like most other animals of any size in southern Bahia, *Callicebus personatus* is hunted for food by local people and can easily be located by its loud early morning vocalizations. However, since it is small, it is not as heavily persecuted as the larger species. Fortunately, a good-sized population appears to exist in the Monte Pascoal National Park, and if the future of the existing protected areas in southern Bahia can be assured, the prospects for the survival of this animal are good.

No captive breeding program exists for *Callicebus personatus melanochir* at this time, and there are no individuals in captivity. However, the Rio de Janeiro Primate Center has plans to initiate such a program in the near future.

Cebus apella xanthosternos

The buff-headed capuchin is a southern Bahian endemic and one of four Atlantic forest subspecies of the wide-ranging *Cebus apella*, which has a larger geographic distribution than any other primate in the Neotropical region. However, *C. a. xanthosternos* is so distinctive that it might well warrant recognition as a separate species, and its taxonomic status is currently under investigation (H. Seuanez, pers. comm.). This monkey occurs from the Rio Jequitinhonha north perhaps as far as the region of Salvador and at least as far as Valença, and west at least to the limits of the Atlantic forest (Fig. 9, 10). Contrary to Kinzey (1982), who shows it extending south of the Rio Jequitinhonha, *C. a. xanthosternos* apparently does not cross this large river and is replaced to the south of it by *Cebus apella robustus*. We have examined the skins in the Museu Nacional in Rio de Janeiro upon which the localities south of the Rio Jequitinhonha are based and found them to be incorrectly identified.

Two specimens in the U.S. National Museum (00518266, 00518267) are problematic, in that they come from the Serra do Iuiu, in the vicinity of the towns of Carinhanha and Malhada on the Minas Gerais border. Carinhanha and Malhada are right on the Rio São Francisco, far to the west of any other known localities for this monkey and well outside the limits of the Atlantic forest. These specimens were collected in 1949 and have most of the characteristics of *Cebus apella xanthosternos*, except that they are very dark. They may represent a transitional form or just an isolated population dating from a period when the moist forests extended further inland in Bahia. Or it may be that *C. a. xanthosternos* once ranged into other vegetation types as well, and was not restricted to Atlantic forest formations. Further investigation of the Carinhanha-Malhada area might prove interesting if any forest is still to be found there.

This monkey is one of the three or four most endangered Neotropical primates. During our surveys it was located in only two localities: the Lemos Maia Ecological Station and in the vicinity of Valença and Guibim and it was recently reported from the Una Biological Reserve as well (B. Beck, pers. comm. 1986; Fig. 9).

It is the largest primate that definitely still survives in southern Bahia and is heavily hunted for food wherever it occurs. As a result, it has been wiped out over much of its range. Special efforts should be made to determine its status in the Una Biological Reserve, which is the only protected area of any size in the area to the north of the Jequitinhonha.

Fortunately, a captive breeding program has already been inititated for this monkey at the Rio de Janeiro Primate Center, and it includes several individuals born in captivity. This colony will be expanded in the future and a number of European institutions are also interested in *C. a. xanthosternos*, with the Zoological Society for the Conservation of Species and Populations in West Germany even having initiated a fund-raising campaign especially for it in 1985 (R. Wirth, pers. comm.).

Cebus apella robustus

As indicated above, the robust tufted capuchin (Fig. 4) replaces the buff-headed southern Bahian capuchin to the south of the Rio Jequitinhonha, and extends as far south as the Rio Doce in Espirito Santo and west into adjacent parts of Minas Gerais (Kinzey, 1982; Figs. 11, 12). It is found in a quite devastated portion of the Atlantic forest, and was not seen in any locality during the course of our survey work in southern Bahia leading us to believe that its status should be upgraded from vulnerable (Mittermeier, 1984; Mittermeier *et al.*, 1982) to endangered. Fortunately, it is abundant in the large, 25,232 ha Sooretama Biological Reserve and the adjacent 21,787 ha Reserve of the Rio Doce Valley Company in northern Espirito Santo (Mendes, 1986; Mittermeier, pers. obs.), and exists in the 2,216 ha Corrego do Veado Biological Reserve in Espirito Santo as well.

This species is hunted for food and has suffered from widespread habitat destruction within its range, but it appears to be well represented in several key protected areas outside southern Bahia. These hopefully will be adequate to ensure its survival. No captive breeding projects exist for this subspecies, and we hope that one will be inititated in the near future.

Alouatta fusca fusca

The northern brown howler monkey has been recorded from northern Espirito Santo north of the Rio Doce and adjacent parts of northeastern Minas Gerais (Kinzey, 1982). No museum specimens exist from southern Bahia, but residents are familiar with the animal (Fig. 13). Nonetheless, it was never actually sighted or heard during field work in southern Bahia, nor was it encountered in the Corrego do Veado, Sooretama or Rio Doce Valley Company Reserve in northern Espirito Santo during surveys carried out in 1980 and 1986 (Mittermeier *et al.*, 1982; Mendes, 1986), although Aguirre (1947) records it as one of the primates occurring in Sooretama. Indeed, this subspecies has not been seen alive by scientists in perhaps 40 years, and there is some doubt as to whether it still survives at all. If it does still occur in southern Bahia, it will only be in tiny, isolated populations with little chance for long-term survival.

There is some confusion as to the taxonomic status of this subspecies and whether it should be considered distinct from the southern subspecies, *Alouatta fusca clamitans*, which is far more abundant. However, most authorities agree that it is a distinct taxon (*e.g.*, Ihering, 1914; Kinzey, 1982) and, as such, it must be considered one of the most endangered Neotropical primates.

Given its precarious situation and the heavy hunting pressure on large primates in southern Bahia, it may be advisable to remove any individuals located in unprotected areas to the Rio de Janeiro Primate Center to establish a captive breeding nucleus.

Brachyteles arachnoides

The muriqui is the largest Neotropical primate and one of the most endangered of all primate species. It originally occurred from Jequié in southern Bahia, south as far as São Paulo, and perhaps into Paraná as well (Aguirre, 1971; Fig. 14), but it is now limited to only a tiny fraction of this original range. Indeed, our survey team, which has focused on this animal for the past seven years, has only been able to confirm its presence in some 10 widely separated localities, for a total documented population of 350-400 animals (Mittermeier, 1987; Mittermeier *et al.*, this volume).

In southern Bahia, we have had reports of its continued existence in three localities, but neither of these have been confirmed by actual sightings. These localities include one area near Juçari, one in the vicinity of Belmonte and a third near Santa Maria Eterna on the left bank of the Rio Jequitinhonha (Fig. 15). Consequently, the species must be considered on the verge of extinction, if not already extinct, in southern Bahia.

Since it definitely does not occur in any of the existing Bahian protected areas, it seems that little can be done for it in this state. The best option for any remnant groups that may be located in doomed forests is probably to capture them and transfer them to the Rio de Janeiro Primate Center, which has a large facility, currently unoccupied, for muriquis, and plans to establish a breeding program. At present, there are only three muriquis in captivity, all of them in a private collection in Paraná.

Conclusions

It should be clear that the most important protected area for primates in southern Bahia is the 11,400 ha Una Biological Reserve. The larger Monte Pascoal National Park is surprisingly poor in primates, with only *Callicebus personatus melanochir* recorded from it with certainty, whereas Una has at least four of the eight southern Bahia primate species. Furthermore, Una is the only protected area of any size in the critical region to the north of the Rio Jequitinhonha. Unfortunately, Una suffers from many serious problems. Only about 5,267 ha actually belong to the government and are properly demarcated, with the remainder still awaiting disappropriation. And even this core area as of 1983 had been illegally invaded by some 120 families, who have clear-cut at least one-third of the reserve. Only a small portion of the reserve is adequately protected, mainly in the vicinity of the guard post, and poaching continues to be a problem as well. Action must be taken in the next two to three years to increase the size of this reserve and protect all of it properly if it is to have any hope of surviving.

In addition to the important primate fauna of Una, this reserve harbors the endangered maned sloth (*Bradypus torquatus*), and probably a population of the rare, recently rediscovered thin-spined porcupine (*Chaetomys subspinosus*). The birds, reptiles, plants and other wildlife remain to be investigated in detail, but are likely to prove as interesting as the mammals.

A major effort to ensure the survival of the Una Biological Reserve is required as soon as possible, and should receive the full backing of the international conservation community and the appropriate Brazilian institutions. At the same time, continuing survey work should investigate the possibility of establishing new reserves in whatever other significant forest areas remain.

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For Figs. 5-15 see the following pages.

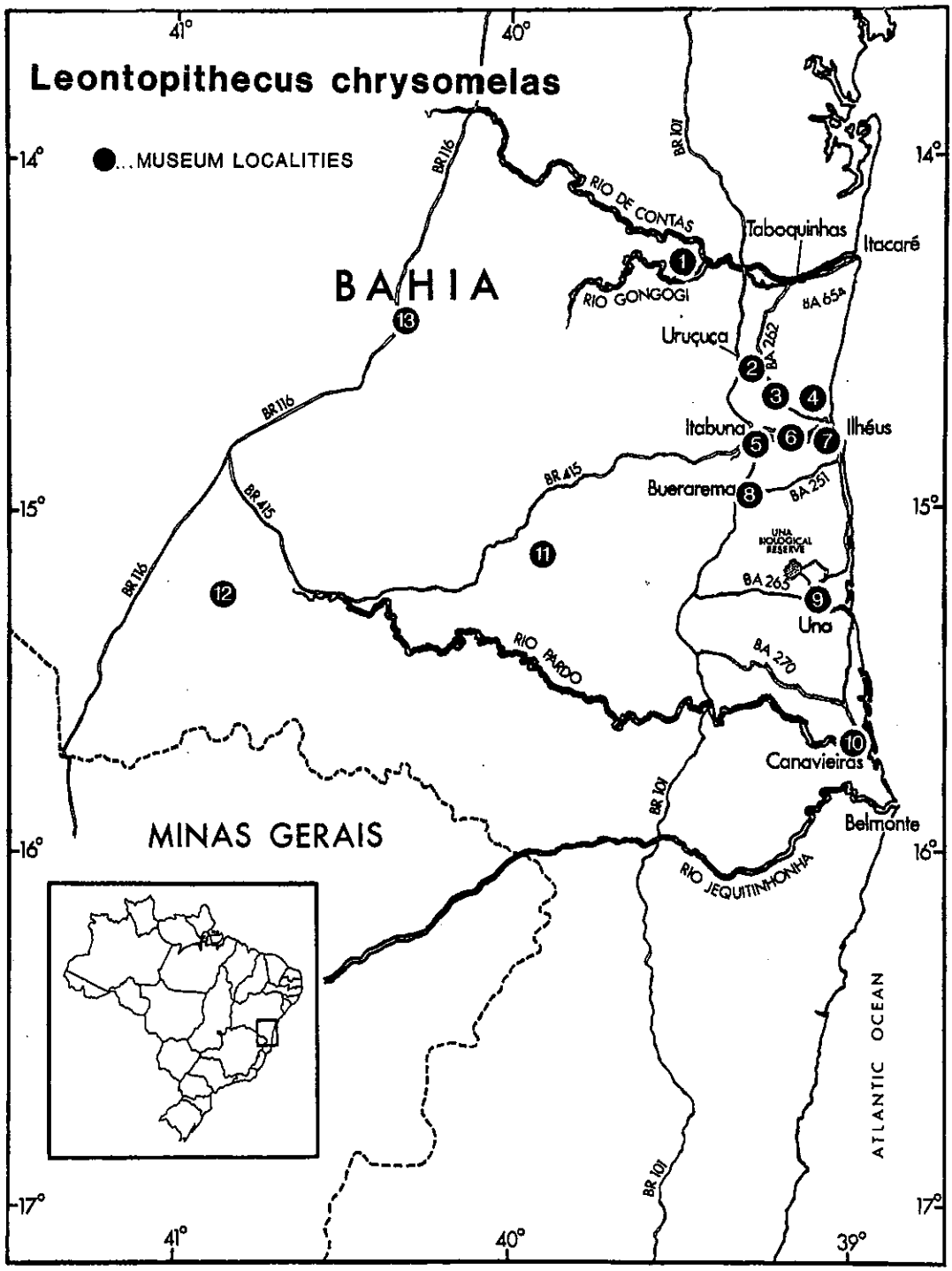

Fig. 5. Museum localities for *Leontopithecus chrysomelas* (from Hershkovitz, 1977; figure by S.D. Nash).

1. Rio Gongogi (14° 12′S, 39° 38′W)
2. Uruçuca (14° 35′S, 39° 16′W)
3. Fazenda Almada, Rio Almada (14° 38′S, 39° 12′W)
4. Uruçutuca (14° 39′S, 39° 03′W)
   Fazenda São José, Rio do Braço, Pontal (14° 39′S, 39° 01′W)
5. Rio Ilhéus, Itabuna (14° 48′S, 39° 16′W)
   Fazenda Borrachudo, Itabuna (14° 48′S, 39° 16′W)
6. Pirataquissé (Fazenda) (14° 50′S, 39° 05′W)
7. Ilhéus (14° 49′S, 39° 02′W)
   Sertão de Ilheus (14° 49′S, 39° 02′W)
8. Buerarema, Highway km 5 (14° 57′S, 39° 19′W)
   Fazenda Fortuna, Buerarema (14° 57′S, 39° 19′W)
   Ribeirão da Fortuna, Buerarema, Estação da Mata do Cacau (14° 57′S, 39° 19′W)
9. Una (15° 18′S, 39° 04′W)
10. Rio Pardo (15° 39′S, 38° 57′W)
11. Ribeirão das Minhocas, Rio Ilhéus (15° 12′S, 39° 57′W)
12. Barra da Vereda, Rio Pardo (15° 15′S, 40° 39′W)
13. Poções (14° 31′S, 40° 21′W)

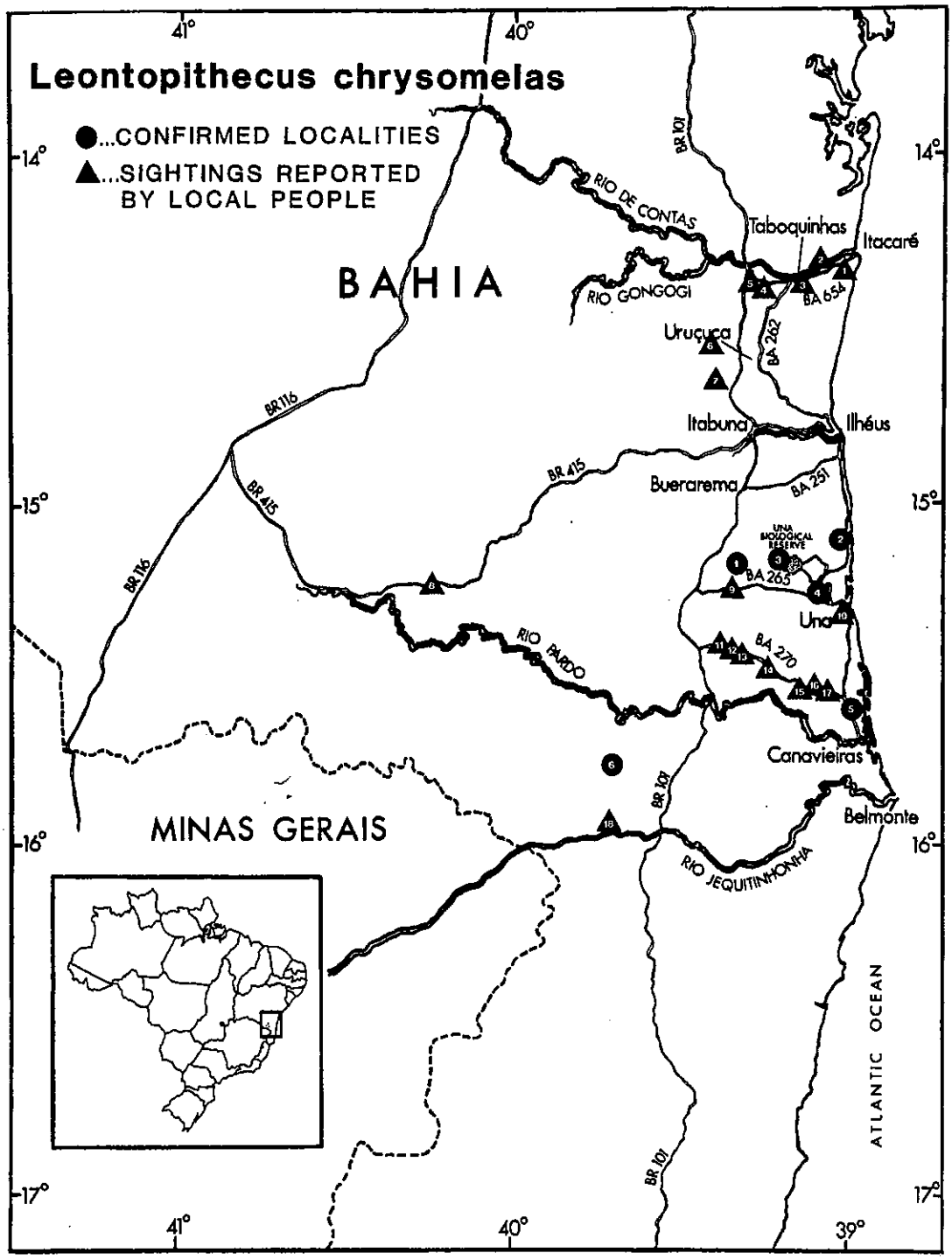

Fig. 6. Confirmed localities for *Leontopithecus chrysomelas* (based on sightings by the authors), and sightings reported by local people (figure by S.D. Nash).

Confirmed localities (circles)

1. Fazenda Piedade (north of Una-São José Road - 15° 10′S, 39° 15′W)
2. Una - Ilhéus road in restinga-Piacaba/white sand forest interface (15° 15′S, 39° 01′W)
3. Una Biological reserve (IBDF)
4. Lemos Maia Experimental Station (CEPLAC)
5. Vicinity of Poxim do Sul
6. Fazenda Santa Inês (15° 46′S, 39° 40′W)

Sightings reported by local people (triangles)

1. 5 km from Itacaré (km 25 on Taboquinhas - Itacaré road)
2. km 18 on Taboquinhas - Itacaré road
3. km 14 on Taboquinhas - Itacaré road
4. km 14 on Taboquinhas - BR 116 road
5. km 22 on Taboquinhas - BR 116 road
6. Pimenteira (39° 30′W, 14° 33′S)
7. Barra (39° 25′W, 14° 40′S)
8. Vicinity of Itapetinga
9. 43 km from Una on Una - Arataca road
10. Una - Canavieiras road (39° 2′W, 15° 30′S)
11. km 11 on BR 116 - Canavieiras road
12. km 12 on BR 116 - Canavieiras road
13. km 14 on BR 116 - Canavieiras road
14. km 17 on BR 116 - Canavieiras road
15. km 19 on BR 116 - Canavieiras road
16. km 23 on BR 116 - Canavieiras road
17. Vicinity of Canavieiras
18. Fazenda do Déde (left bank of Rio Jequitinhonha)

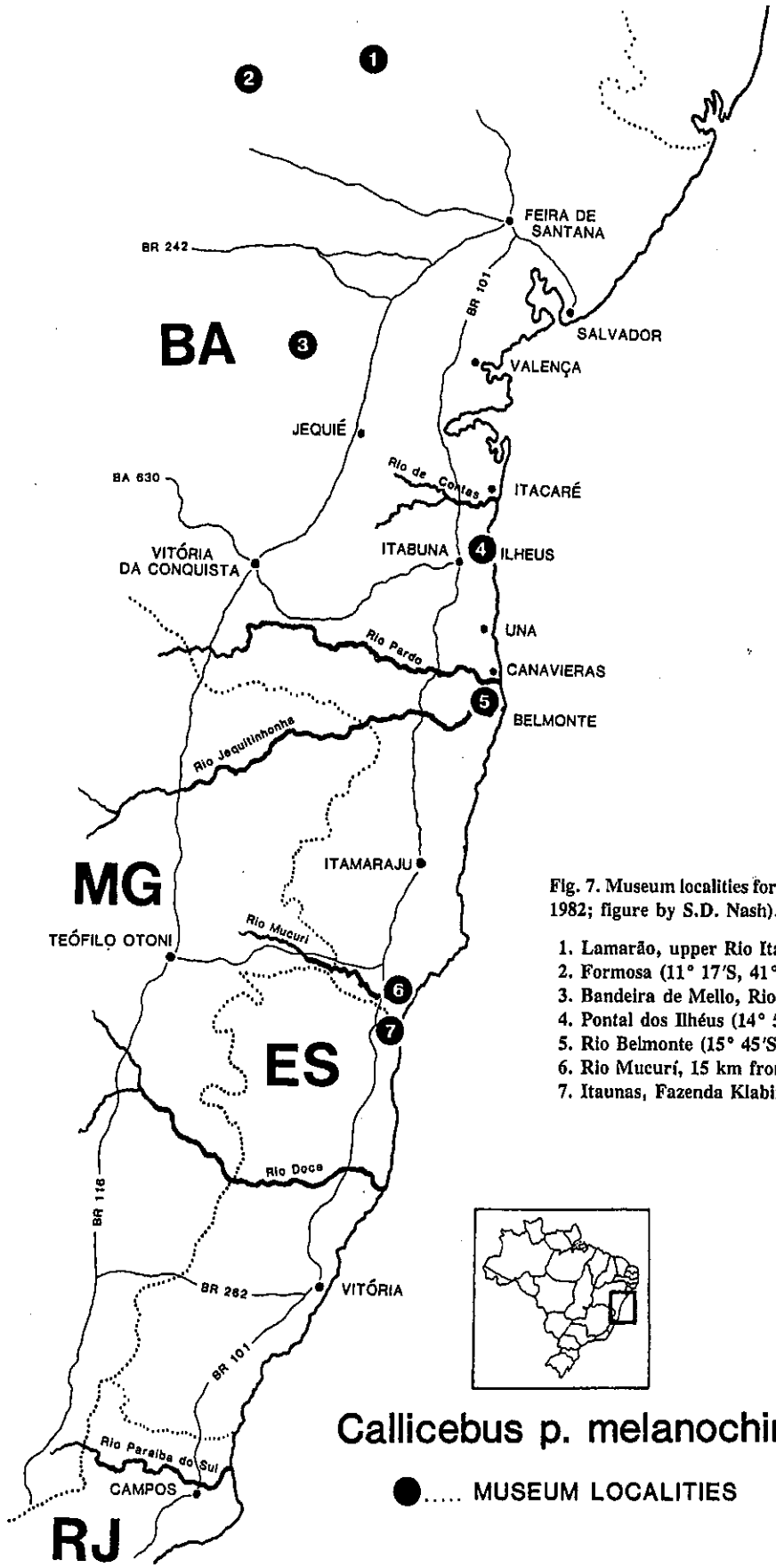

Fig. 7. Museum localities for *Callicebus personatus melanochir* (from Kinzey, 1982; figure by S.D. Nash).

1. Lamarão, upper Rio Itapicurú (10° 46′S, 40° 21′W)
2. Formosa (11° 17′S, 41° 02′W)
3. Bandeira de Mello, Rio Paraguassú (13° 03′S, 40° 49′W)
4. Pontal dos Ilhéus (14° 50′S, 39° 01′W)
5. Rio Belmonte (15° 45′S, 38° 53′W)
6. Rio Mucurí, 15 km from coast (18° 05′S, 39° 34′W)
7. Itaunas, Fazenda Klabin (18° 25′S, 39° 42′W)

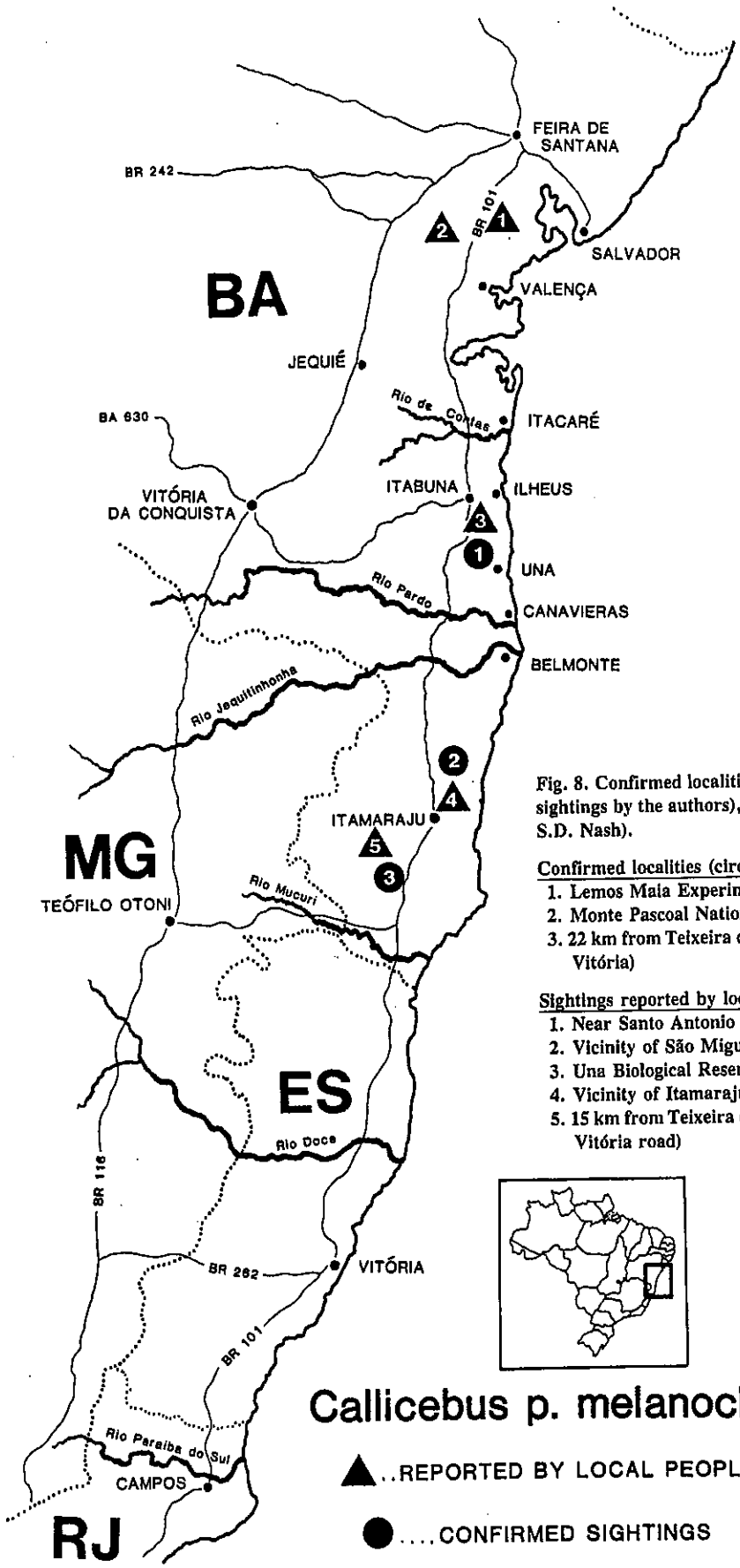

Fig. 8. Confirmed localities for *Callicebus personatus melanochir* (based on sightings by the authors), and sightings reported by local people (figure by S.D. Nash).

Confirmed localities (circles)

1. Lemos Maia Experimental Station (CEPLAC)
2. Monte Pascoal National Park (IBDF)
3. 22 km from Teixeira de Freitas (left side of BR 101, Teixeira de Freitas - Vitória)

Sightings reported by local people (triangles)

1. Near Santo Antonio de Jesus
2. Vicinity of São Miguel das Matas
3. Una Biological Reserve (IBDF)
4. Vicinity of Itamarajú
5. 15 km from Teixeira de Freitas (left side of BR 101, Teixeira de Freitas - Vitória road)

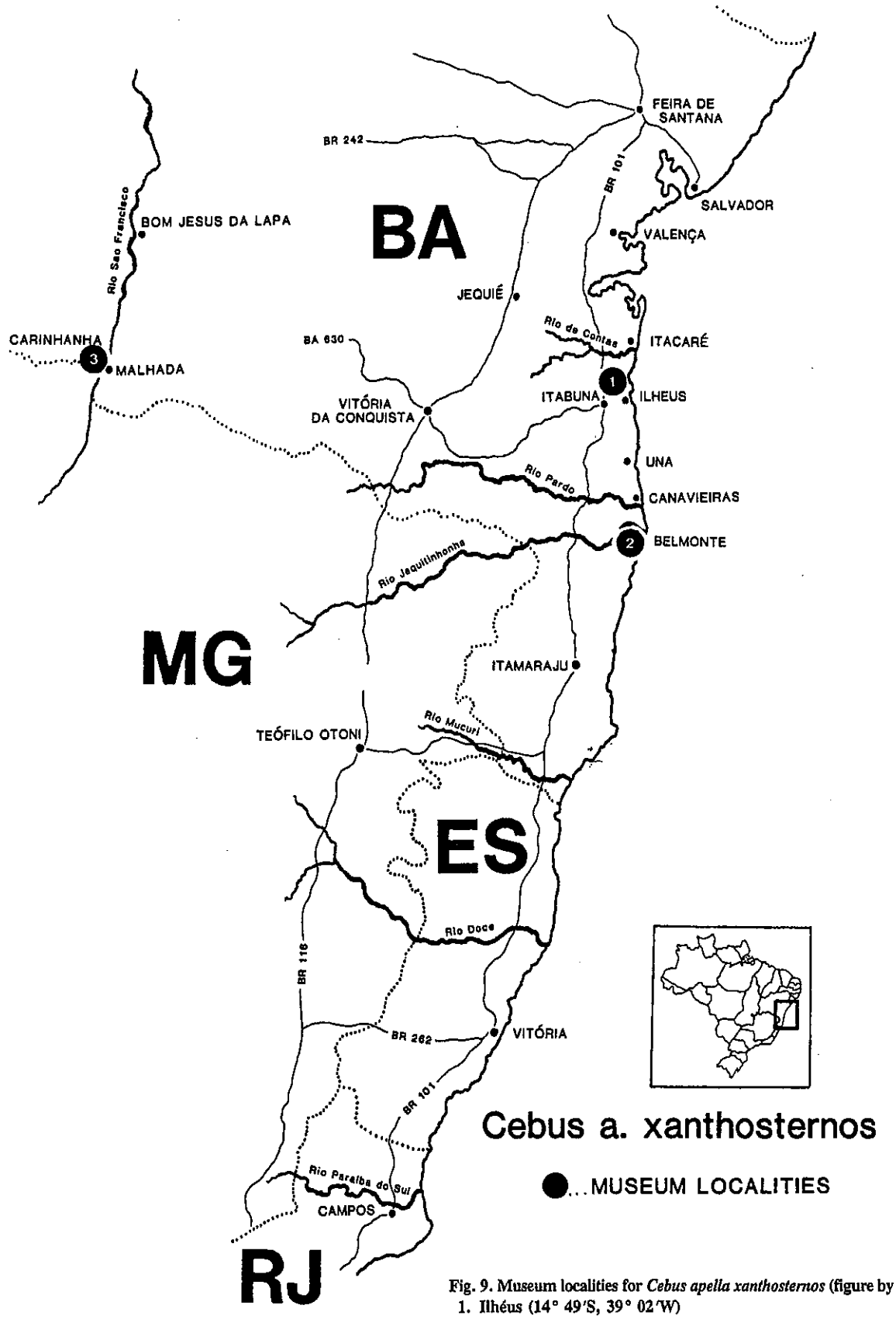

Fig. 9. Museum localities for *Cebus apella xanthosternos* (figure by S.D. Nash).

1. Ilhéus (14° 49′S, 39° 02′W)
2. Belmonte, Passui (15° 51′S, 38° 54′W)
   Belmonte, Vitória, Fazenda Vitória
3. Carinhanha, Malhada, Serra do Iuiu, Fazenda da Serra

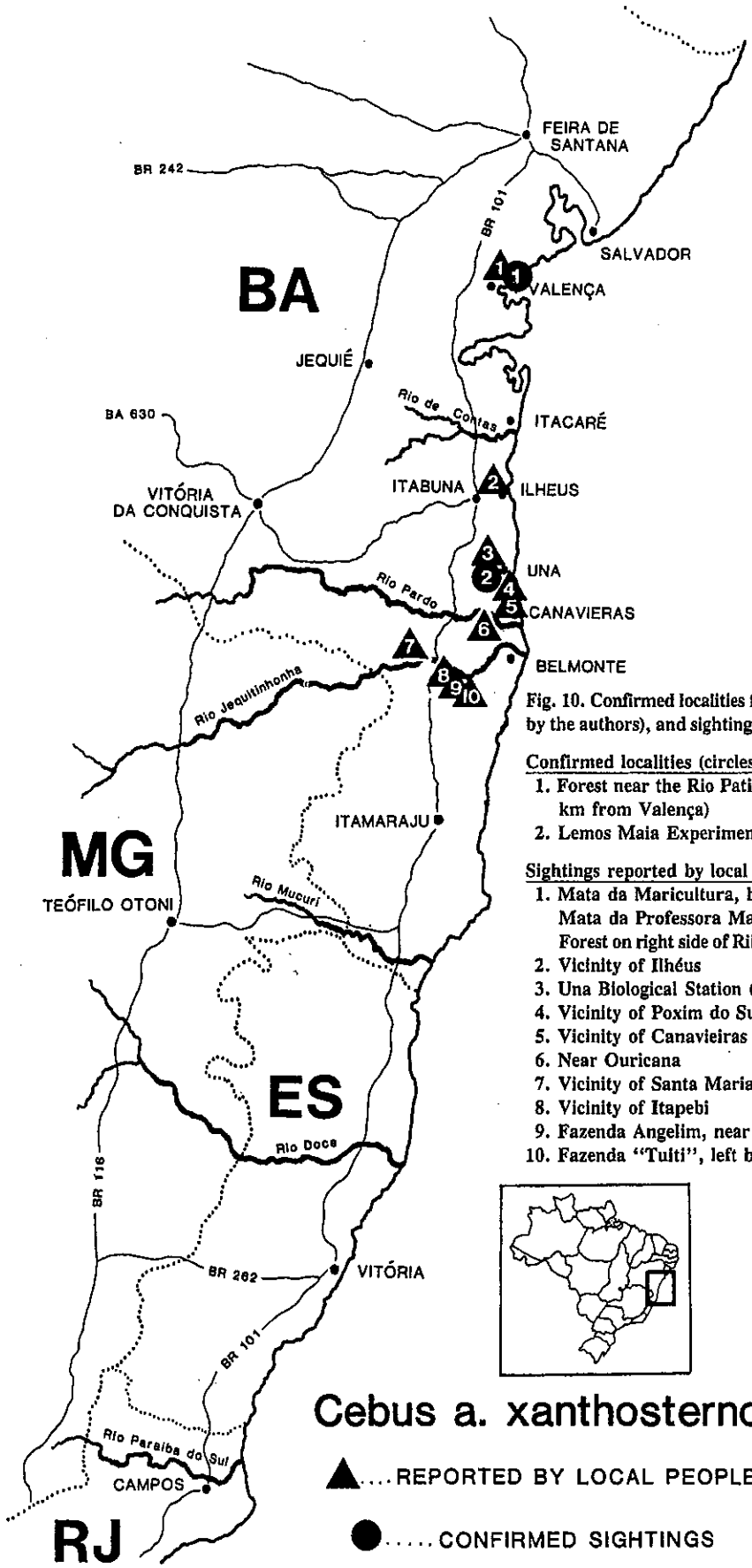

Fig. 10. Confirmed localities for *Cebus apella xanthosternos* (based on sightings by the authors), and sightings reported by local people (figure by S.D. Nash).

Confirmed localities (circles)

1. Forest near the Rio Patipe (left side of the Valença - Guaibim road, 15 km from Valença)
2. Lemos Maia Experimental Station (CEPLAC)

Sightings reported by local people (triangles)

1. Mata da Maricultura, between Valença and Guaibim
   Mata da Professora Macária, near Mata da Maricultura
   Forest on right side of Ribeirão Patipe, left side of Valença - Guaibim road
2. Vicinity of Ilhéus
3. Una Biological Station (IBDF) (B. Beck, pers. comm.)
4. Vicinity of Poxim do Sul
5. Vicinity of Canavieiras
6. Near Ouricana
7. Vicinity of Santa Maria Eterna, left bank of Rio Jequitinhonha
8. Vicinity of Itapebi
9. Fazenda Angelim, near Córrego do Angelim
10. Fazenda "Tuiti", left bank of Rio Jequitinhonha

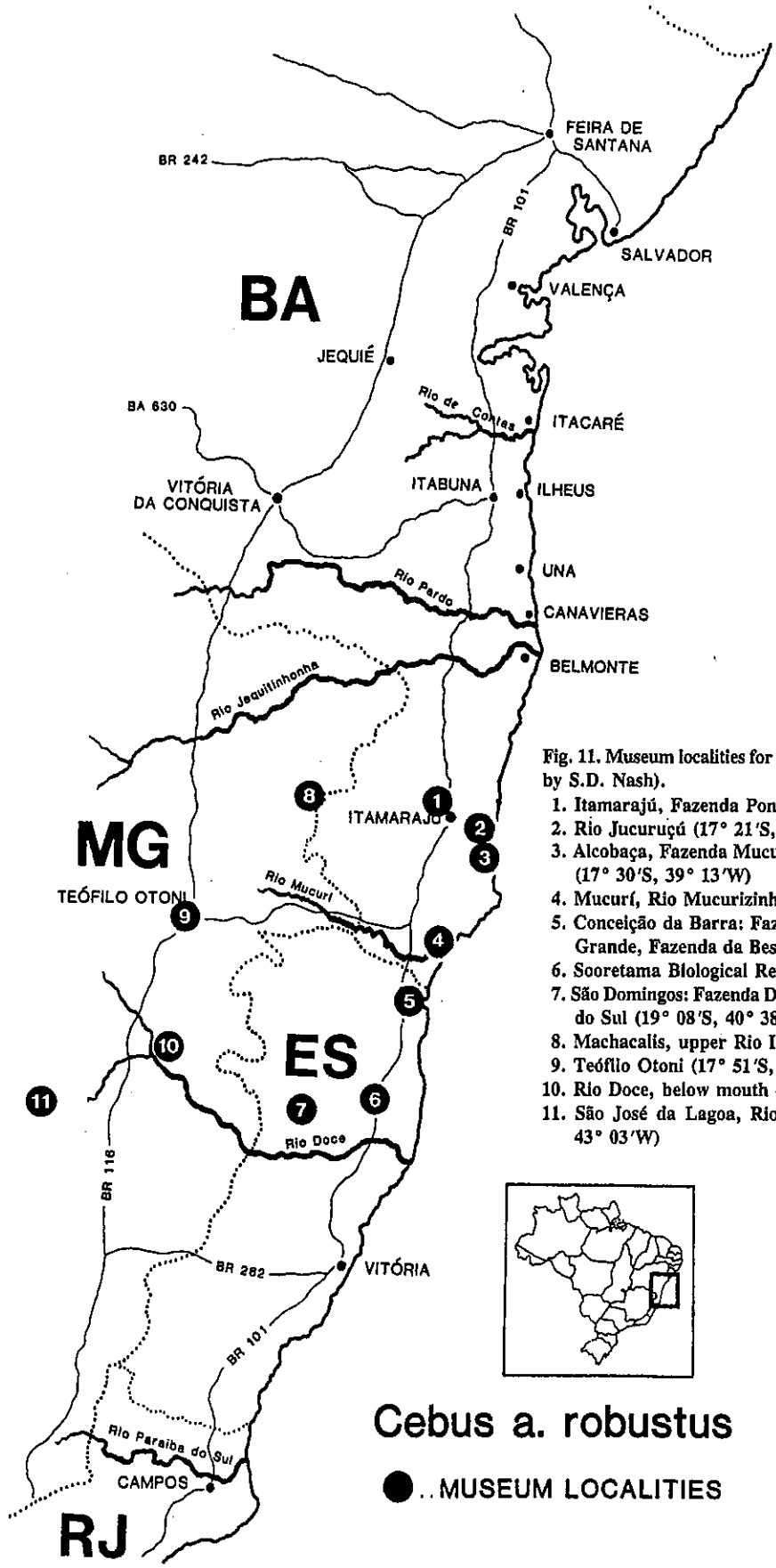

Fig. 11. Museum localities for *Cebus apella robustus* (from Kinzey, 1982; figure by S.D. Nash).

1. Itamarajú, Fazenda Pontal (17° 04′S, 39° 32′W)
2. Rio Jucuruçú (17° 21′S, 39° 13′W)
3. Alcobaça, Fazenda Mucuge, Sapucaieira, Fazenda Vargem do Outeira (17° 30′S, 39° 13′W)
4. Mucuri, Rio Mucurizinho (18° 04′S, 39° 35′W)
5. Conceição da Barra: Fazenda Córrego do Conrado, Fazenda Córrego Grande, Fazenda da Besta, Fazenda Santa Cruz (18° 35′S, 39° 45′W)
6. Sooretama Biological Reserve (IBDF)
7. São Domingos: Fazenda Dez de Agosto, Fazenda São José, Fazenda Braço do Sul (19° 08′S, 40° 38′W)
8. Machacalis, upper Rio Itanhaém (17° 05′S, 40° 45′W)
9. Teófilo Otoni (17° 51′S, 41° 30′W)
10. Rio Doce, below mouth of Rio Suaçui (18° 50′S, 41° 46′W)
11. São José da Lagoa, Rio Doce (on upper Rio Piracicaba) (19° 45′S, 43° 03′W)

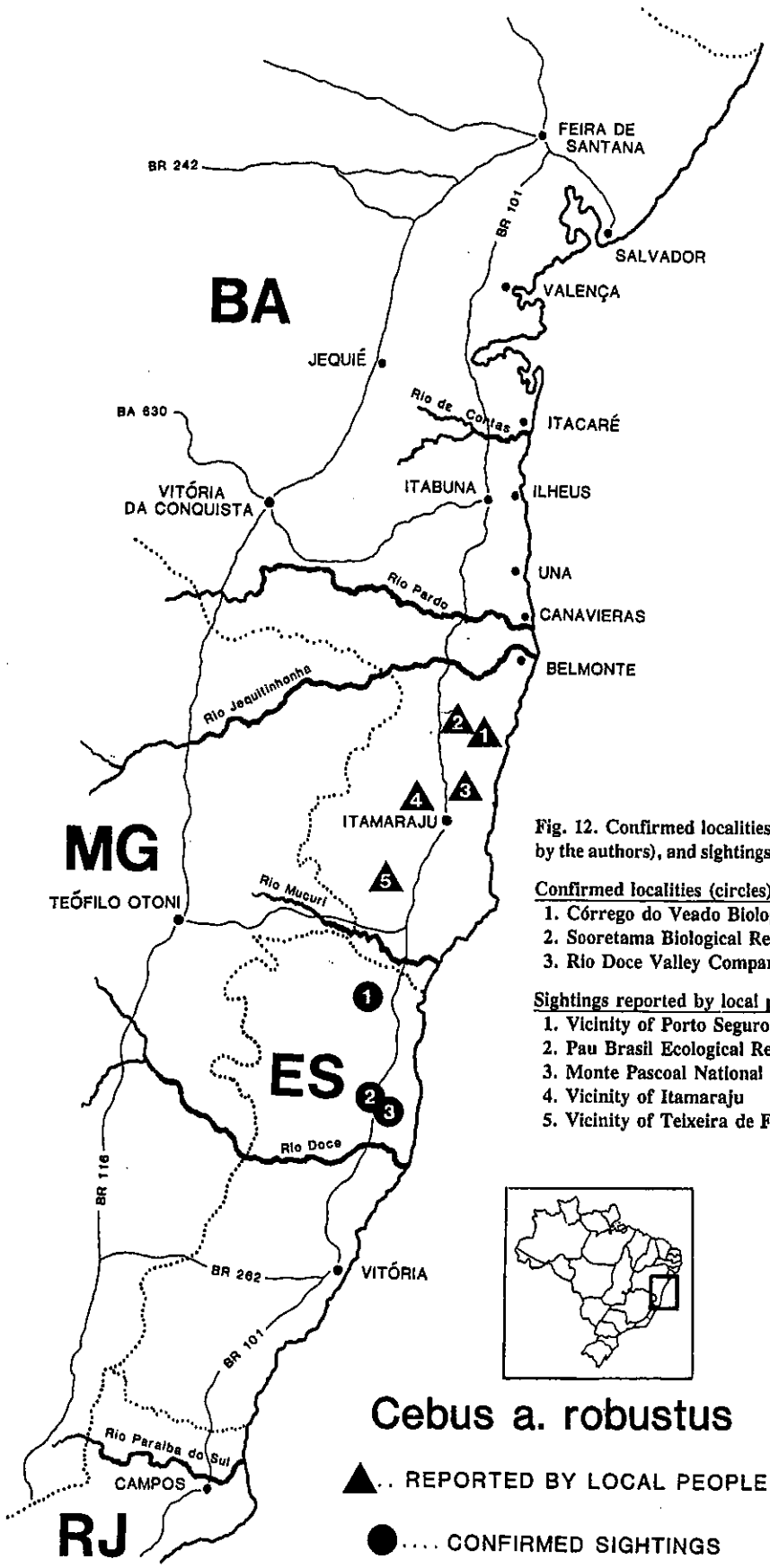

Fig. 12. Confirmed localities for *Cebus apella robustus* (based on sightings by the authors), and sightings reported by local people (figure by S.D. Nash).

Confirmed localities (circles)

1. Córrego do Veado Biological Reserve (IBDF), Espírito Santo
2. Sooretama Biological Reserve (IBDF), Espírito Santo
3. Rio Doce Valley Company (CVRD) Forest Reserve, Espírito Santo

Sightings reported by local people (triangles)

1. Vicinity of Porto Seguro
2. Pau Brasil Ecological Reserve (CEPLAC)
3. Monte Pascoal National Park (IBDF)
4. Vicinity of Itamaraju
5. Vicinity of Teixeira de Freitas

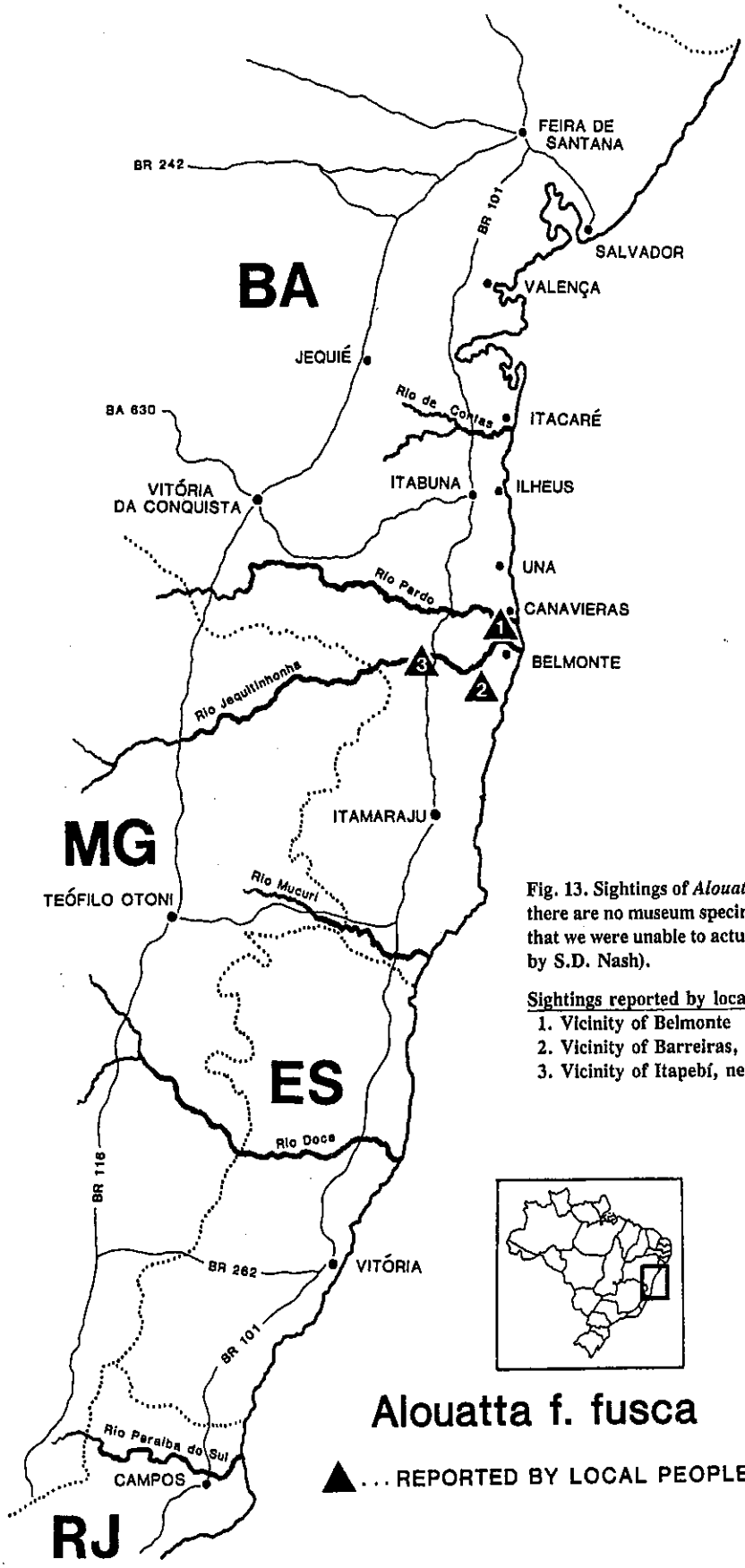

Fig. 13. Sightings of *Alouatta fusca fusca* reported by local people (note that there are no museum specimens for this subspecies from southern Bahia and that we were unable to actually see it during the course of our surveys; figure by S.D. Nash).

Sightings reported by local people (triangles)

1. Vicinity of Belmonte
2. Vicinity of Barreiras, Itapebí - Belmonte road
3. Vicinity of Itapebí, near Rio Jequitinhonha

Fig. 14. Museum localities for *Brachyteles arachnoides* (circles), together with localities confirmed by Aguirre (1971) and localities where the species once occurred but is now extinct according to Aguirre (1971). Note that this map does not give the full range of *Brachyteles*, only the northern portion. For a complete range map of the species, see Aguirre (1971), and Mittermeier *et al.* (this issue; figure by S.D. Nash).

Museum localities

1. Rio Gongogi, Santo do Palhão (14° 14′S, 39° 29′W)
2. Belmonte, Barreiras (16° 04′S, 39° 20′W)
3. Colatina, Rio Doce (19° 32′S, 40° 37′W)
4. Itarana, Jatibocas (19° 53′S, 40° 52′W)
5. Santa Leopoldina (20° 06′S, 40° 32′W)
6. Caparaó, Iuna (20° 32′S, 41° 54′W)
7. Engenheiro Reeve (now Rive), Município de Alegre (20° 46′S, 41° 28′W, at 500 m)
8. Fazenda Floresta, Rio Matipó (19° 53′S, 42° 33′W)
9. Pico Campestre, Araponga (20° 40′S, 43° 32′W)
10. Governador Valladares

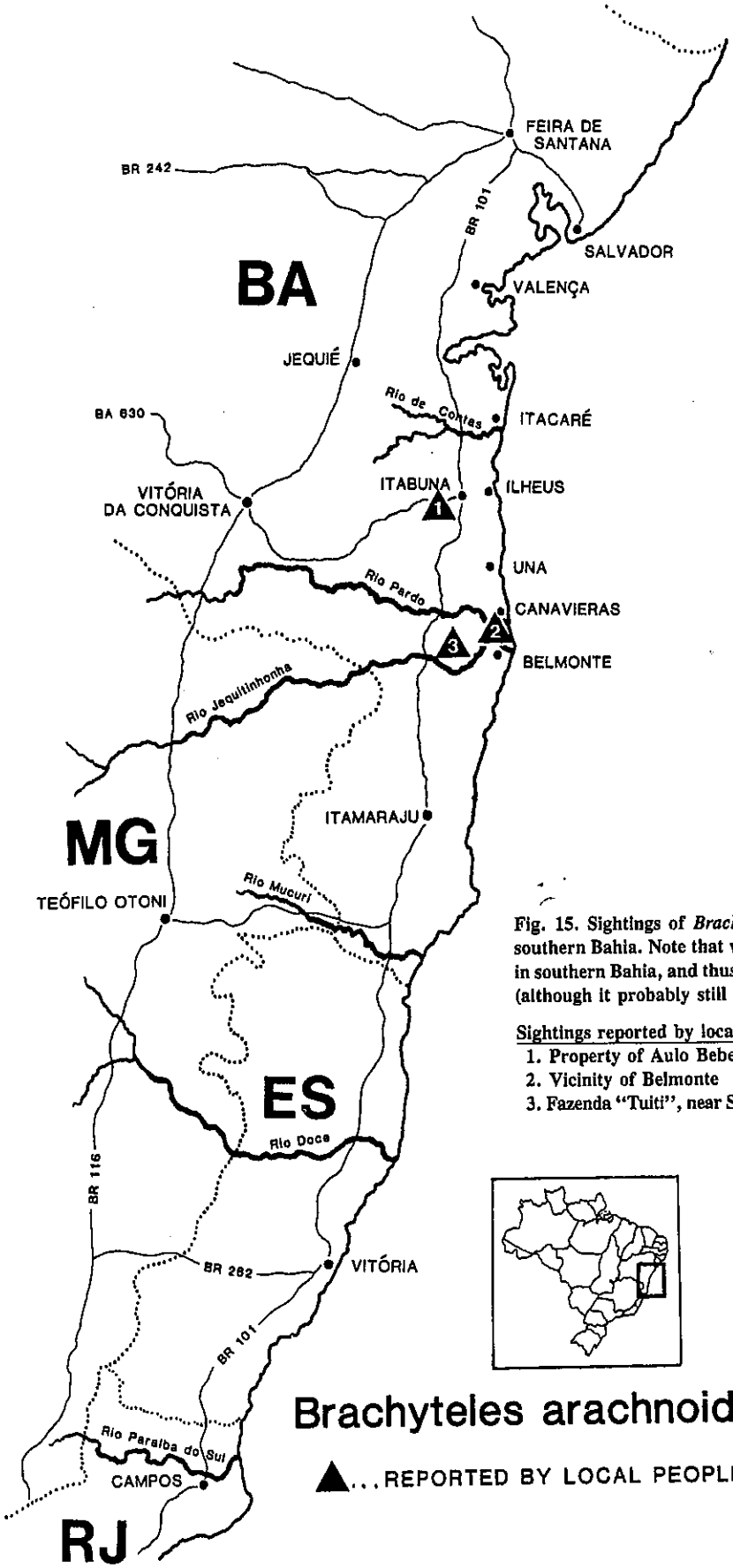

Fig. 15. Sightings of *Brachyteles arachnoides* reported by local people in southern Bahia. Note that we were unable to observe this species anywhere in southern Bahia, and thus cannot confirm that it still survives in that state (although it probably still does in small numbers; figure by S.D. Nash).

Sightings reported by local people (triangles)

1. Property of Aulo Bebert near Juçari
2. Vicinity of Belmonte
3. Fazenda "Tuiti", near Santa Maria Eterna, left bank of Rio Jequitinhonha

Current Distribution of the Muriqui in the Atlantic Forest Region of Eastern Brazil

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The muriqui or woolly spider monkey (*Brachyteles arachnoides*, Fig. 1) is the largest of the Neotropical monkeys and also one of the most endangered. A monotypic genus restricted to the Atlantic forest region of Brazil, the muriqui is now down to only a small fraction of its original population, and could go extinct before the turn of the century if a concerted international effort is not made to ensure its survival.

Fig. 1. Adult male muriqui from Fazenda Montes Claros, Caratinga, Minas Gerais, Brazil (photo by A.L. Young).

The muriqui once ranged almost continuously from the southern part of the state of Bahia, through Espírito Santo, Rio de Janeiro and eastern Minas Gerais, as far south as the coastal mountains of the state of São Paulo, and possibly into the state of Paraná as well (Fig. 2). In the late 1960's, the Brazilian conservationist, Alvaro Aguirre, carried out a detailed survey of the entire range of the muriqui, and concluded that the population of this species had declined from an estimated 400,000 individuals at the time of the European discovery of Brazil in 1500 to only about 3,000 as of 1971 (Aguirre, 1971). The following year, Adelmar F. Coimbra-Filho, the pioneer of Brazilian primatology, estimated the population at no more than 2,000 (Coimbra-Filho, 1972). In 1976, Valle discovered a population of muriquis at Fazenda Montes Claros, near Caratinga in the state of Minas Gerais, where the species was believed extinct, and called attention to its importance. In 1977, the Japanese primatologist, Akisato Nishimura, visited Montes Claros and Rio Doce for two weeks and published an article on the species (Nishimura, 1979). Finally, in 1979, World Wildlife Fund began a long-term research program on the primates of the Atlantic forest region, in collaboration with Coimbra-Filho at the Rio de Janeiro Primate Center (FEEMA-CRPJ) and Valle at the Universidade Federal de Minas Gerais (UFMG), and later Almirante Ibsen de Gusmão Câmara of the Brazilian Conservation Foundation (FBCN). The joint team began its work at Fazenda Montes Claros, and immediately recognized the importance of the muriqui as an endangered monotypic genus endemic to the Atlantic forest and also as a conservation symbol for the region as a whole. Indeed, this large, attractive primate was considered an ideal "flagship species" for a campaign to focus national and international attention on the Atlantic forest as one of the most endangered biomes on our planet (Mittermeier *et al.*, 1982; Mittermeier, 1984; 1986, 1987a. 1987b; Valle *et al.*, 1982, 1983).

This collaborative research program on Atlantic forest primates has now been underway for eight years, and has included a wide variety of primate field studies, several of which have been described in earlier issues of *Primate Conservation*. Included among these studies are several ecological investigations of the muriqui at different sites in the Atlantic forest (*e.g.*, Young, 1983; Valle *et al.*, 1984; Milton, 1984, 1985a, 1985b, 1985c, 1986; Fonseca, 1985a; Strier, 1986), and continuing survey work to locate remaining populations of this important species (Mittermeier *et al.*, 1982; Milton and de Lucca, 1984; Mittermeier, 1984, 1985, 1986, 1987a). Although the region in question is vast and a great deal of survey work still needs to be carried out, the information gathered thus far enables us to give a rough picture of the current distribution and minimum population of the muriqui in its natural habitat. The purpose of this paper is to summarize the information gathered thus far, and to make suggestions as to where further investigations might be conducted.

On the basis of survey work carried out to date, we can confirm the existence of 11 different populations of muriqui in the states of São Paulo, Minas Gerais and Espírito Santo, including a new locality, Cunha, in São Paulo (Fig. 2), not mentioned in earlier publications. Although the species occurred until very recently in the states of Rio de Janeiro and Bahia as well, and probably still survives in remote areas, we have not yet been able to confirm its continued existence in these two states during this decade. The muriqui may occur in the state of Paraná as well, but this has never been confirmed and no museum specimens exist.

It is important to emphasize that we are taking a very conservative approach to estimating remaining numbers of muriqui in the wild, and are counting only those individuals that we have been able to document with certainty. It is very likely that more muriquis exist in most of the areas investigated, and that they occur in several other areas as well. However, with a species that has long been a target for hunters, is still poached on occasion, and is often confused with the more abundant howler monkey (*Alouatta fusca*), we believe that it is a mistake to extrapolate density figures over large areas and to give too much credence to reports by local people. Indeed, local people will often report that the species still exists in an area, but when questioned further reveal that they haven't seen it in years or even decades. Consequently, we have counted only those animals whose existence has been confirmed by our survey teams or by other researchers in whom we have full confidence.

As indicated above, hunting has been a factor in the decline of the muriqui, and the animal is still shot occasionally for food, for sport, or to obtain infants as pets (Figs. 3, 4), especially in the remote coastal mountains of São Paulo and in southern Bahia. However, the main factor in the precipitous decline of the muriqui has been habitat destruction. Although the muriqui once occurred almost continuously from Bahia to São Paulo (Aguirre, 1971; Fig. 2) and was so abundant that the expeditions of early naturalists sometimes lived almost entirely on its meat (Wied, 1821), its forest habitat has now been reduced to only about 1-5% of its original extent. The destruction of the Atlantic forest is described

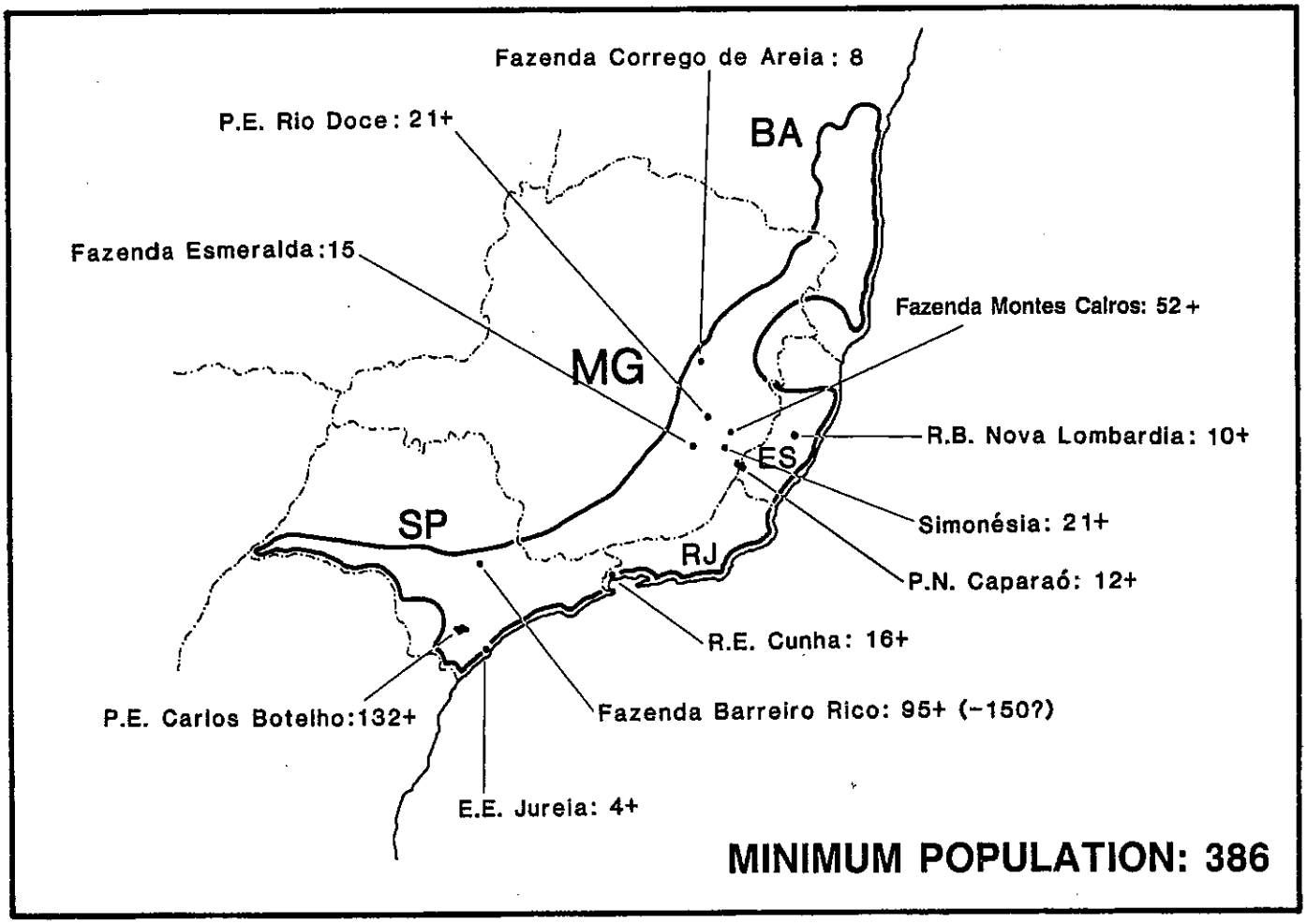


Fig. 2. Map of the past and present distribution of the muriqui. The thick, continuous line gives the original range of the species as determined by Aguirre (1971); the specific localities and numbers (of individuals) are the only confirmed muriqui populations known at this time (map by S.D. Nash).

in far more detail in other publications (e.g., Fonseca, 1985b; Mittermeier *et al.*, 1982; Mittermeier, 1984, 1987a), and will not be discussed further in this article. Suffice it to say that this species, like most of the other forest animals in this region, now has only a tiny fraction of its original habitat left. Furthermore, unlike some of the smaller, rapidly-breeding, more adaptable species like the marmosets (*Callithrix* spp.), and to a lesser extent the capuchins (*Cebus apella* sspp.) and the howlers (*Alouatta fusca*), the muriqui is usually more demanding in choice of habitat, less able to make use of many of the forest fragments that do remain, and much slower to re-establish itself in areas under protection. It is usually the first species to disappear from an exploited area, and must be considered one of the four or five most endangered primates in the Atlantic forest and in the entire Neotropical region (the other highly endangered taxa being the black lion tamarin, *Leontopithecus chrysopygus*; the golden lion tamarin, *Leontopithecus rosalia*; the buff-headed southern Bahian capuchin, *Cebus apella xanthosternos*; and the northern brown howler monkey, *Alouatta fusca fusca*).

In the remainder of this article, we review what is known of the current distribution of the muriqui and provide a brief description of each of the areas in which it still occurs.

Minas Gerais

Five of the 11 documented populations of muriqui (Fig. 2) occur in the eastern portion of the state of Minas Gerais, once known as the *Zona de Mata* or Forest Zone. Unfortunately, very little forest remains in the area, with by far the largest tract being the 35,000 ha Rio Doce State Forest Park. Few, if any, other forest remnants reach even 1500 ha. The muriqui populations of Minas Gerais have received the most attention and are the best studied, in part because the Muriqui Campaign (Valle *et al.*, 1982, 1983; Mittermeier, 1984, 1985, 1986, 1987a) has focused on this state, and in part because the muriqui populations in Minas Gerais are readily accessible and occur in small, circumscribed, easily-studied areas.

Although it is likely that a handful of other populations will be discovered in Minas Gerais, especially in the Serra do Brigadeiro and perhaps in other private landholdings as well, we expect that most of the muriqui populations have already been located in this state and that the current estimate of approximately 125 individuals will not be greatly increased by future discoveries (although hopefully it will grow as a result of improved protection in the areas already identified).

1. Fazenda Montes Claros

Fazenda Montes Claros is a privately-owned coffee plantation located some 55 km from the town of Caratinga. It has an 880 ha tract of forest that has been protected by its owner, Sr. Feliciano Miguel Abdala, for 45 years, and the muriqui population there is the largest documented thus far for Minas Gerais. It is also the best-studied of all muriqui populations, having been investigated on and off since 1979 and almost continuously since 1982 (Nishimura, 1970; Young, 1983; Valle *et al.*, 1984; Fonseca, 1985a; Strier, 1986; Nishimura *et al.*, 1987; F.D.C. Mendes, pers. comm.). Two groups occur in the Montes Claros forest: the Matão Group, which, as of July, 1986, consisted of 34 individuals (8 adult males, 10 adult females, 1 subadult female, 14 juveniles, and 1 infant; Strier, this issue), and the Jaó Group, which, as of April, 1984, contained 18 individuals (12 adult males, 4 adult females and 2 juveniles), for a total population of 52 individuals (see Strier this issue, pp. 73-74). A research station, known as Estação Biológica de Caratinga, has been established at Fazenda Montes Claros with support from World Wildlife Fund and the UFMG and on land donated by Sr. Abdala. It has already become a nationally and internationally known research and training site and should become even more important in the future (Mittermeier, 1987; Brownlee, 1987).

Fig. 3. Muriqui, tufted capuchin *(Cebus apella nigritus)*, and several birds poached in the Carlos Botelho Reserve in 1973 (photo by B.V. de Moura Netto).

2. Fazenda Esmeralda

Another privately-owned area, Fazenda Esmeralda is located 33 km from Rio Casca and is the property of Sr. Antonio Cupertino Martins Teixeira. It has a tiny, 44 ha patch of forest that harbors a population of muriquis. This population was studied by Fonseca (1985a) and more recently by Lemos de Sa, and, as of February, 1987, had a population of 15 animals (6 adult males, 3 adult females, 1 subadult male, 1 juvenile male, 2 juvenile females, 1 infant male, 1 infant female). The forest in question is entirely secondary, and the muriqui group living there is probably at carrying capacity. It fell from 18 to 15 during 1986, with three recorded deaths, the only deaths thus far recorded in any of the muriqui studies carried out since 1979.

This population is especially interesting, since it shows that muriquis can hang on in at least some degraded forests if they are not subjected to hunting pressure. However, it is doubtful that this population can persist indefinitely, meaning that some management and interchange of animals will be necessary in the future. In any case, continued research and monitoring of this population is likely to provide interesting insights into muriqui ecology.

3. Mata do Sossêgo, Simonésia

The Mata do Sossêgo Forest is situated on the border between the towns of Simonésia and Manhauçú, and covers about 800 ha of rugged, steep terrain in the hands of eight different landowners. It was discovered as a result of the Muriqui Campaign, and has been the subject of a grass roots campaign headed by Eduardo Pinheiro, son of a gas station owner in Manhuaçú. This campaign has generated a great deal of popular support and recently resulted in the creation of a local conservation association entitled Associação dos Amigos do Meio Ambiente (see Announcements). With World Wildlife Fund assistance, the group will now begin purchasing the forest from its owners, all of whom are in favor of establishing a reserve at the site. A preliminary survey in May, 1984 by Alves and Machado Pinto revealed the presence of at least 21 muriquis in this forest, and subsequent observations have confirmed these figures. Plans are also underway to establish a research laboratory along the lines of the Estação Biológica de Caratinga at Fazenda Montes Claros to begin long-term monitoring of the Mata do Sossego population.

4. Fazenda Córrego de Areia

Fazenda Córrego de Areia is yet another privately-owned area located 26 km from the town of Peçanha. It is owned by Sr. Nicomedes Carvalho, and has a tract of approx. 60 ha of forest that is contiguous with an additional 75 ha of forest owned by three other individuals. When this forest was last investigated by Mittermeier, Young and Machado Pinto in July, 1981, it had a population of at least eight muriquis, but no further investigations have been carried out there in the past six years. Some evidence of hunting (*e.g.*, shotgun shells, traps) was found in the forest, but it was uncertain whether the muriquis themselves were being hunted. This area should be reinvestigated as soon as possible to determine the current status of the population there.

5. Rio Doce State Forest Park

At 35,000 ha, the Rio Doce State Forest Park is one of the largest and most important areas of lowland forest remaining in the entire Atlantic forest region. It is under the jurisdiction of the State Forestry Institute (IEF) of Minas Gerais, and is rapidly becoming an important research and training center, especially for students from the Universidade Federal de Minas Gerais. Several primate surveys have been conducted there since 1980, and a small population of muriquis was first located in September, 1981. Although the park is regularly patrolled, it is immediately adjacent to several large population centers, and poaching still takes place from time to time. The muriqui population in the park is very sparsely distributed, probably as a result of poaching. Based on reports by guards, there are at least three groups of muriquis in Rio Doce, but Santos, Valle and Machado Pinto were only able to count one group with at least 21 individuals. Further research is needed to locate other groups and to determine how they can best be protected. With such a large area at its disposal, the population should be able to expand considerably if poaching can be prevented.

São Paulo

Although only four populations of muriqui have thus far been confirmed for the state of São Paulo, for a total of some 250 animals, it is likely that the vast majority of the remaining muriqui population is to be found in this state and that most future discoveries will be there. Indeed, the vast Serra do Mar coastal range and associated mountains such as the Serra da Paranapiacaba cover some 1.3 million ha, much of it still forested. More than half of all the forest left in the entire Atlantic forest region is to be found in the coastal mountains of São Paulo, and many of the steep slopes and hidden valleys are still largely inaccessible. Much further research is needed in the Serra do Mar, and it is almost certain to reveal significant new muriqui populations numbering in the hundreds or perhaps even the low thousands.

Areas worth investigating in the future, in addition to those where populations have already been confirmed, include the Jacupiranga, Alto Ribeira and Serra do Mar State Parks, the Itatins and Xitué State Reserves, the Serra da Bocaina National Park and the large forest reserve belonging to BANESPA, the São Paulo State Bank.

However, it is important to note that poaching still takes place in the Serra do Mar, and that protecting many of these remote populations will be much more difficult than protecting the small, circumscribed populations in Minas Gerais (Fig. 3).

In the interior of São Paulo, now almost entirely deforested, very few muriqui are likely to remain, and it is probable that the population at Fazenda Barreiro Rico is the only one left inland from the Serra do Mar.

1. Fazenda Barreiro Rico

Fazenda Barreiro Rico is a privately-owned cattle ranch belonging to Sr. José Carlos Reis de Magalhães and his family. Located at the juncture of the Rio Tietê and the Rio Piracicaba in the interior of the state, the property has a total of 3,259 ha of forest divided into five patches. Of these, four have confirmed populations of *Brachyteles*.

Next to Montes Claros, the muriqui population of Barreiro Rico has received the most attention, with studies having been conducted there on and off from 1979 to 1983 by Torres de Assumpção (1981) and Milton and de Lucca (Milton, 1984, 1985a, 1985b, 1985c, 1986; Milton and de Lucca, 1984). The 1984 survey by Milton and de Lucca located some 85 individuals in three of the five patches of forest at Barreiro Rico, and suggested that the population of the ranch as a whole was probably 100+. Subsequent to their investigation, Sr. Magalhães encountered a group of at least 10 muriquis in a fourth patch where Milton and de Lucca did not find any animals, bringing the minimum population up to 95. Sr. Magalhães, a very experienced naturalist with decades of field experience, believes that the population at Barreiro Rico may be as large as 150 (J. C. R. de Magalhães, *in litt.*, Dec. 17, 1984).

2. Carlos Botelho State Park

The 37,644 ha Carlos Botelho State Park is situated in the Serra de Paranapiacaba of São Paulo, and has some of the finest, least disturbed and best protected forest remaining in the Atlantic forest region. Under the jurisdiction of the State Forestry Institute of São Paulo, this park was created in 1982 by fusing four smaller reserves that had been in existence since 1941. Following a preliminary survey by Mittermeier in 1981, an eight-month study was carried out by Paccagnella from October, 1985 to June, 1986. She was successful in locating a total of 132 muriquis, the largest population thus far documented for this species. Furthermore, since only a small portion of this reserve was investigated, it is possible that the population is much higher. Indeed, extrapolating the densities arrived at in the area investigated to the park as a whole, Paccagnella estimated a total population of 500-800 muriquis for all of Carlos Botelho.

In the past, poaching was a problem in Carlos Botelho (Fig. 3), and it still occurs from time to time, the most recent case having been in July, 1984. However, the park is well-patrolled and managed by the director, Sr. Bento Vieira de Moura Netto and his staff, and it should definitely be considered a major stronghold for the muriqui.

Further research on this important and very interesting population should be carried out as soon as possible.

Fig. 4. Juvenile muriqui being kept as a pet in the vicinity of the Itatins Reserve, in the Serra do Mar region of São Paulo, April, 1982 (photo by J.P. de Oliveira Costa).

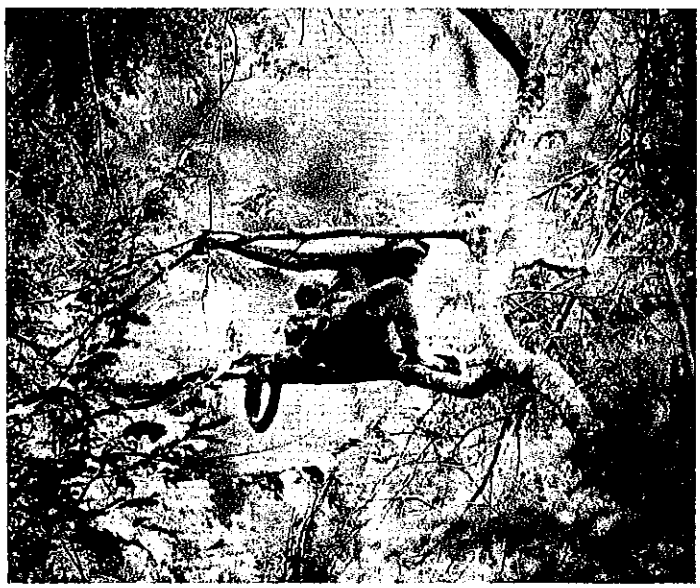
Fig. 5. Close-up of the captive juvenile show in Fig. 4 (photo by J.P. de Oliveira Costa).

3. Jureia Ecological Station

The Jureia Ecological Station is a 20,000 ha protected area belonging to SEMA, the Special Secretariat for the Environment of the Federal Government. An isolated, forest-covered massif right on the coast, it is connected to other parts of the Serra do Mar by a stretch of low altitude forest. In September, 1982, three to four muriquis were seen by Carlos Eduardo Dias Camargo during an ornithological study of the reserve (J. P. de Olivera Costa, pers. comm.), and in February, 1985, four individuals were again seen by primatologist C. Torres of the University of São Paulo. The population of *Brachyteles* in Jureia is almost certain to be larger, but more in-depth surveys will have to be conducted in this area before anything more can be said about its muriqui population.

4. Cunha State Reserve

The Cunha State Reserve covers 2,230 ha of forest in extreme eastern São Paulo on the Rio de Janeiro border and adjacent to the much larger Serra da Bocaina National Park. Created in 1977, this reserve is under the jurisdiction of the State Forestry Institute, which began a faunal inventory there in October, 1984, in collaboration with the Zoology Dept. of the Universidade de Taubaté. The university team carried out six excursions into the reserve, and observed muriquis on two occasions, the first in July, 1985 in an area known as Grotão dos Monos, and the second in October, 1985 in the Serra da Indaiá. Six animals were seen in the first sighting and 10 in the second, meaning that there are at least two groups and a minimum of 16 individuals in this reserve. We are grateful to Luiz Eduardo Correa Lima of the Universidade de Taubaté for reporting this discovery to us, which brings the number of confirmed muriqui populations up to 11.



Various photos of muriquis by Andrew Young.

Espírito Santo

Only two populations of muriqui have been located thus far in the state of Espírito Santo, one on the Espírito Santo side of the Caparaó State Park and one in the Nova Lombardia Biological Reserve. A survey of six protected areas carried out from July, 1985 - January, 1986 in Espírito Santo (Mendes, 1986) failed to reveal any additional muriqui populations, but unconfirmed reports indicated that populations might very well still exist on several private holdings in the vicinity of the Pedra Azul State Reserve. Although a few more populations may be located in Espírito Santo in the future, as in Minas Gerais it is unlikely that there will be major new discoveries.

1. Caparaó National Park

The 17,468 ha Caparáo National Park straddles the Minas Gerais-Espírito Santo border, and includes the highest peak in Brazil south of Amazonia (Pico da Bandeira, 2,890 m). After several preliminary surveys. Alves succeeded in locating a group of 12 muriquis in a forest adjacent to Caparaó on the Espírito Santo side, but not actually within the park boundaries. It is likely that more muriqui groups will be found in this region, but no further surveys have been conducted there since 1984. A detailed study should be carried out in Caparaó, and the possibility of habituating a group of muriquis for the many tourists that come to Caparaó to climb Pico da Bandeira should be investigated as well.

2. Nova Lombardia Biological Reserve

The Nova Lombardia Biological Reserve, like Caparaó, is under the jurisdiction of the Brazilian Forestry Development Institute (IBDF) of the Federal Government. Located in the mountains of Espírito Santo near the town of Santa Teresa, this reserve covers 4,450 ha and includes significant tracts of undisturbed forest. Along with Rio Doce and Barreiro Rico, it is home to five primate species, making it one of the richest areas for primates in the Atlantic forest region. Four surveys have been conducted there by our teams since 1980, and none have yet been successful in actually sighting muriquis. However, Valle, Santos and Machado Pinto heard distant muriqui vocalizations during a survey conducted in May, 1982, and reserve guards reported sighting 10 individuals in 1987. Further investigation of the most remote portions of this reserve are needed to determine if more than one group exists in this reserve.

Rio de Janeiro

Most of the primate studies carried out over the past eight years in Rio de Janeiro have focused on the lowland areas, and especially on remaining populations of the golden lion tamarin (*Leontopithecus rosalia*). Some preliminary survey work was carried out in 1980 in Itatiaia and Serra dos Orgãos National Parks and several investigations have been conducted in the Desengano State Park, all areas where the species definitely once occurred, but the montane areas of Rio de Janeiro have received far less attention than Minas Gerais, Espírito Santo, São Paulo and southern Bahia. None of the surveys carried out thus far have succeeded in locating muriqui populations, but is is likely that the animal still exists in some of the areas identified by Aguirre (1971). Promising sites for future investigation include the most remote portions of the Itatiaia and Serra dos Orgãos National Parks and adjacent areas, the Guapi-Açú region around the Rio de Janeiro Primate Center, the Tinguá Forest near Petrópolis, the Mambucaba Forest near Angra dos Reis, and the Desengano State Park. Numbers in Rio could eventually equal or exceed those in Minas Gerais, but given the difficulty of locating populations thus far, it is clear that much more intensive field work will be needed to find muriquis in this state.

Bahia

Although the muriqui was once abundant in Bahia, it is now almost certainly on the verge of extinction in this state. After Minas Gerais, southern Bahia has received the most attention from our survey teams, but no populations have yet been located. Local people are familiar with the animal and it has been reported from two sites (Santos *et al.*, this volume), but these populations, if they in fact still exist, have little hope for survival. Southern Bahia is a poor region, and hunting of all kinds of wildlife is common. Large monkeys such as the muriqui, the brown howler and the capuchins are favorite targets and have disappeared almost everywhere, and the protected areas that do exist (none of them with muriqui populations) are under a wide variety of pressures.

Summary

In summary, the confirmed population of muriquis at this time stands at 386 individuals, in 11 different areas in three states. This is an extremely small number of a unique, monotypic primate genus, and the fact that many of the isolated populations are quite small means that inbreeding could be a serious problem in the future. Much more survey work is needed to locate other muriqui populations, detailed behavioral and ecological studies should continue or be initiated at all the sites mentioned here, and a genetic analysis of the entire known population should commence in the near future. These kinds of information will be essential for the development of long-term management strategies to ensure the survival of this magnificent species, so important to Brazil and to conservation in general.

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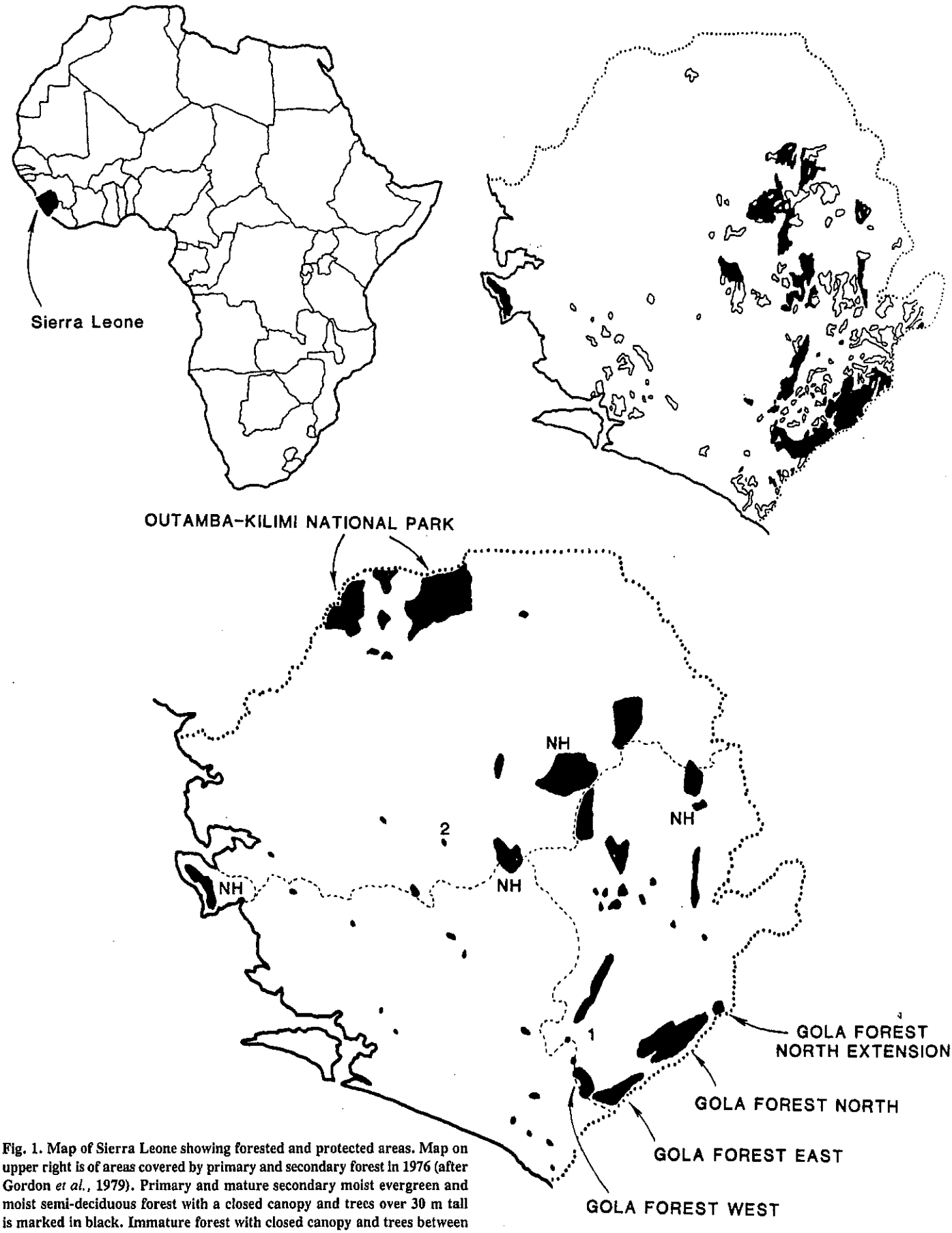

Fig. 1. Map of Sierra Leone showing forested and protected areas. Map on upper right is of areas covered by primary and secondary forest in 1976 (after Gordon *et al.*, 1979). Primary and mature secondary moist evergreen and moist semi-deciduous forest with a closed canopy and trees over 30 m tall is marked in black. Immature forest with closed canopy and trees between 10-30 m tall is left white. Map in lower center shows the location of the National Park, the Forest Reserves (non-hunting forest Reserves are labelled NH), two proposed Game Sanctuaries (1. Tivai, 2. Mamunta-Mayoso Swamp) approximately to scale (after Clarke, 1969), and the provincial borders (broken line; maps by S. D. Nash based on author's originals).

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Africa

Conservation of Primates in the Gola Forest Reserves, Sierra Leone

by A. G. Davies

Sierra Leone covers an area of 72,278 km² on the coast of West Africa. Tropical rain forests potentially could have covered over 50% of the country a century ago (Cole, 1980). However, by 1976 less than 5% of the country was estimated to be covered by primary and old secondary forest, and only 1,700 km², equivalent to 2.3% of the country, was closed-canopy forest within Forest Reserves (Gordon *et al.*, 1979; Kernan, 1980; Fig. 1). Inevitably the forest fauna, which includes eight species of primates, has dwindled as a result of this habitat loss.

The Gola Forest Reserves (745 km²) are the only sizeable tracts of lowland forest in the country (Fig. 1). All three reserves are part of the concession area of Forest Industries Corporation, a Sierra Leonean company under the Ministry of Trade, which supplies the nation with timber for furniture and building. Sierra Leone cannot afford to import timber and so must continue to exploit these reserves. However, exploitation is currently being conducted without regard to long-term management considerations and little attention has been paid to wildlife protection.

Fig. 2. Sierra Leone Forest Division personnel packing food and equipment prior to a 2-week botanical survey of the Gola Forests (photo by A. G. Davies).

The Sierra Leone Ministry of Agriculture, National Resources and Forestry, which has charge of the Gola Forest, is interested in developing a management plan for the Reserves which combines sustained-yield timber exploitation with wildlife preservation. Therefore, in 1984-85 I conducted a series of surveys in the Gola Reserves to identify areas which might be suitable for wildlife conservation (Fig. 2). Five sites were selected which sampled both primary and logged forests, and different intensities of hunting.

At each site eight days were spent walking around a rectangular trail of about 2 km in length, mapping primate groups and their calls. At the end of a survey the number of groups of each species within the immediate vicinity of the survey trail (an area of about 1 km²) was mapped. The population density of each species was calculated, in relative abundance units, as the sum of all groups within the vicinity of the trail plus more distant groups that were detected, which were given an arbitrary abundance value of 0.3 (equivalent to 30% of their home range being within the intensively surveyed area). This allowed conspicuous differences between survey sites to be compared.

Data were also collected by researchers working on Tiwai Island, where the number of groups using a 60 ha study area was estimated. Cautious comparsion could then be made between the old secondary forest on Tiwai, where there was little hunting, and the Gola survey sites.

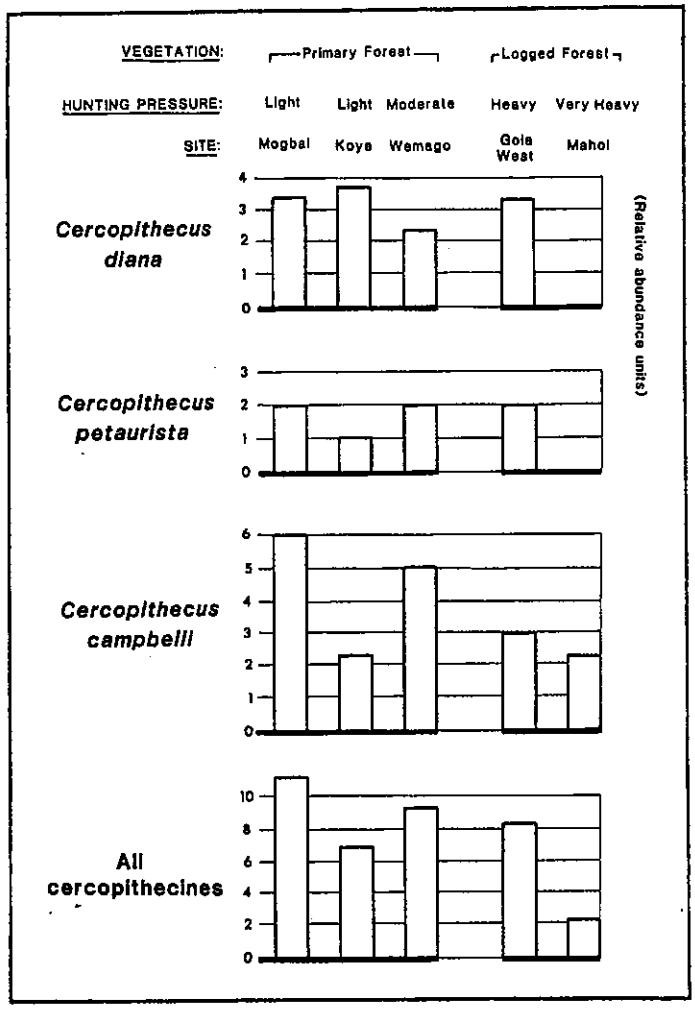

Fig. 3. The group density of cercopithecine monkeys remained fairly consistent in the primary forest sites and even the intensely logged site (Gola West), but all three species suffered losses in the intensively hunted forest where only Campbell's monkey managed to survive.

Effects of Timber Extraction on Primates

Selective logging of timber species within the Gola Forest Reserves involves the cutting of commercial tree species which have a girth larger than 2-2.6 m. At one survey site, six such trees were cut within an eight hectare plot. At the second logged forest site felling was more intensive and 51 stumps were recorded within eight hectares. The latter plot also had many more skid paths and roads.

Chimpanzees (*Pan troglodytes*) were recorded in logged forests and many different habitats, but were rare regardless of the habitat type throughout the Reserves. The Diana monkey (*Cercopithecus diana*) a forest species restricted to the south and east of Sierra Leone, was also observed inhabiting several logged forests. The olive colobus (*Procolobus verus*), a species often seen in association with Diana monkeys and other cercopithecines in the secondary vegetation and riverine forests of southern Sierra Leone (Oates, 1980), can probably adapt to timber extraction, but too few observations were made to confirm this. Campbell's monkeys (*Cercopitheus campbelli*), spot-nosed monkeys (*Cercopithecus petaurista*) and the largely terrestrial sooty mangabeys (*Cercocebus torquatus*) are all very adaptable species and can reach high densities in forest from which commercial timber has been extracted. These species were common in the closed-canopy secondary forest on Tiwai. Red colobus (*Procolobus badius*) and black-and-white colobus (*Colobus polykomos*) have been recorded in gallery forest in woodland savanna (Harding, 1983), but are more abundant in rain forest and were commonly seen in the closed-canopy, secondary forests on Tiwai. Despite

this adaptability, red colobus appears to be especially sensitive to heavy logging.

Hunting

The intensity of hunting in the Gola Reserves varies, but nowhere is it absent. Furthermore, it cannot be wholly separated from timber extraction because logging roads offer easy access for hunters into forested areas. The lowest intensity of hunting, which occurs in the central parts of Gola North, consists of occasional visits by single hunters or small parties of men for one or two days. However, it is not uncommon for gangs of commercial hunters to exploit areas systematically over several days, especially in the logged forests of Gola East and West. The main market for monkey meat is neighboring Liberia, where the meat is sold for much-wanted dollars.

With intense hunting pressure in lightly logged forest, all monkeys except Campbell's monkey and the wide-ranging mangabeys were eliminated. Spot-nosed monkeys may survive but are difficult to observe. With moderate hunting pressure in intensively logged forest, Campbell's monkey numbers increased and both Diana and spot-nosed monkeys occurred, the former at high density. Since cercopithecine numbers were lowest in intensively hunted but lightly logged forest and higher in moderately hunted and intensively logged forest, it appears that hunting has the greater adverse effects on these monkeys (Fig. 3-4).

The two large colobine species, which were preferred prey, suffered even more from hunting. The black-and-white colobus was all but eliminated by moderate hunting in heavily logged forest, although it did occur in all the primary forest sites. However, the red colobus was absent from both logged forests where hunting was common, and was not seen in a primary forest area where only moderate hunting occurred (Fig. 5).

Fig. 4. Hunter with an adult male spot-nosed monkey (*Cercopithecus petaurista*) (photo by A. G. Davies).

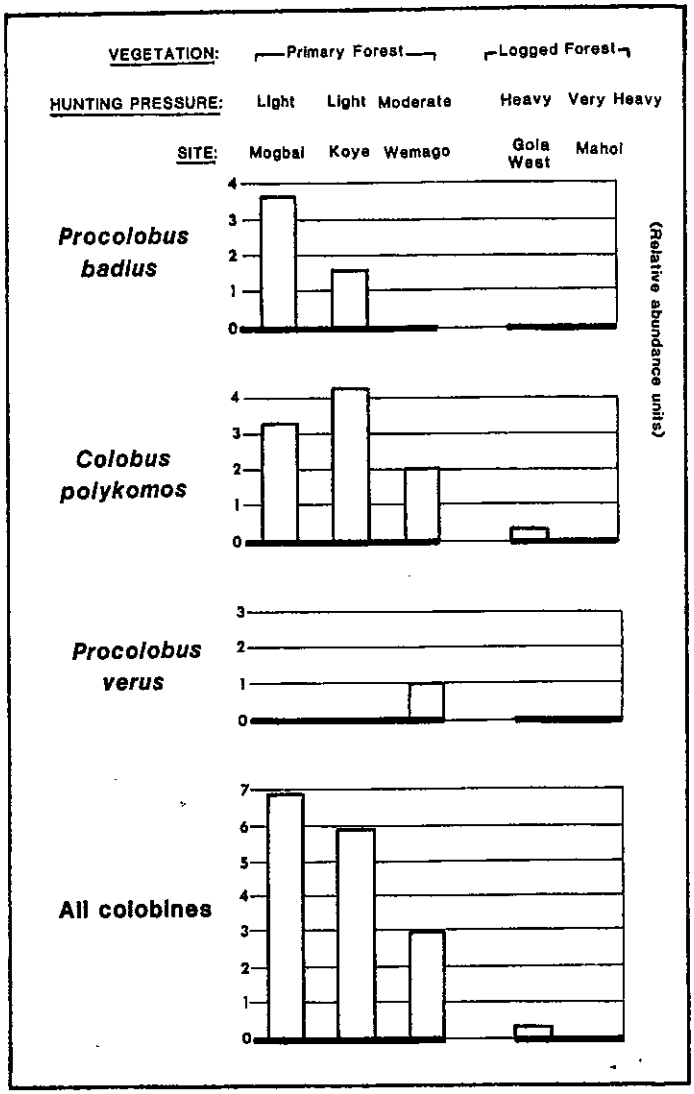

Fig. 5. The group density of colobines declined progressively with hunting pressure in both primary and logged forests. Red colobus were eliminated from primary forests by hunting, but black-and-white colobus fared better and even survived in intensively logged forest where hunting was moderate. Olive colobus were seldom seen.

The effect of hunting on chimpanzees was difficult to determine because so few were encountered. Chimps were in both areas where hunting was intense, but the overall low population densities within the reserves suggest that numbers may be low because of hunting pressure.

Conservation Recommendations

The single most urgently needed conservation action is the strict control of hunting in the Gola Forest Reserves. Hunting is already illegal, but the law has been only lightly enforced. Given manpower shortages, patrols will initially have to focus on a few high priority areas to be effective. Some forest should be left unlogged so it is less accessible to hunters.

The adaptability of most of the primate species to timber extraction means that most species can be maintained in logged forests, as long as hunting can be controlled. However, the red colobus adapts poorly to logged forest, as is the case for other rare and endangered species like the bongo (*Boocercus euryceros*) and the white-breasted guineafowl (*Agelastes meleagrides*). Populations of these species will only be preserved in primary forest. Conversely, other rare species, like the pygmy hippopotamus (*Choeropsis liberiensis*) and olive colobus, require riverine and swamp vegetation or young secondary forest. Therefore, a variety of habitats must be preserved.

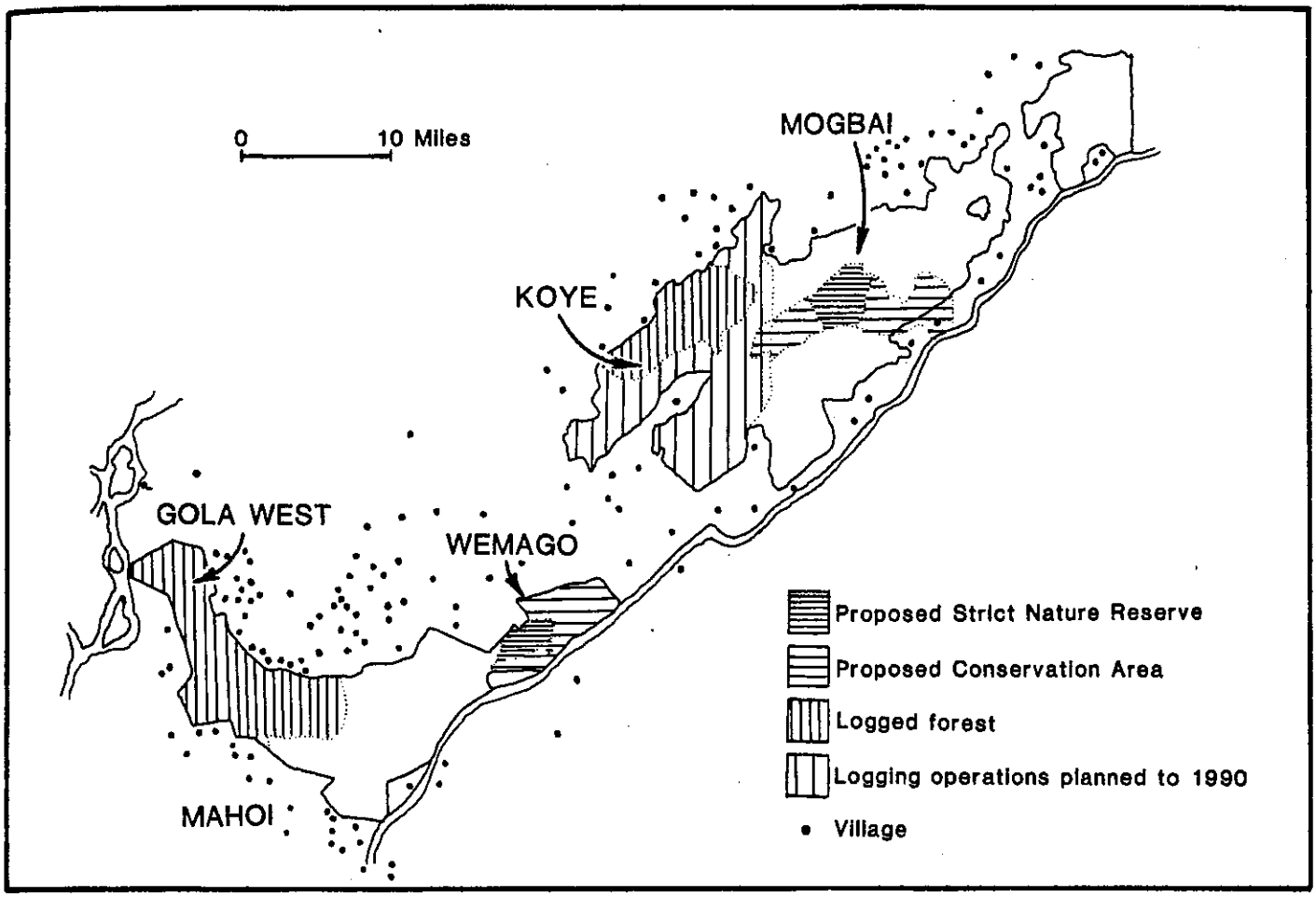

Fig. 6. Proposed conservation areas, logged forest and areas for which logging is planned in the Gola Forest Reserves up to 1990 (map by S. D. Nash based on author's original).

In view of this, and the need to expolit the Gola Forests for timber, two areas larger than 30 km² have been recommended as Strict Nature Reserves, in which hunting and timber exploitation are prohibited. Each Strict Nature Reserve should be surrounded by a patrolled conservation area which would act as a protective buffer even if logged.

The proposed Nature Reserves are Mogbai in Gola North and Bagra Hill in Gola East (Fig. 6). These two reserves will make up part of a network of conservation areas, that should include Tiwai and adjacent islands, to preserve a diversity of habitats, primates and other animals.

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Prospects for Conservation of Forest Primates in Nigeria

by P. A. Anadu

Introduction

Eighteen non-human primate species, representing 82% of Nigeria's primate fauna, live either in the high forest and forest relics of southern Nigeria or in forest outliers in the Guinea Savanna. Many of these animals, especially the anthropoid primates, face an uncertain future. Their habitat is shrinking at an alarming rate under the combined onslaught of intense logging, oil exploration, road construction, plantation forestry and rising demands for farmland, shelter and fuelwood by a rapidly growing human population. Today no significant areas of closed forest exist outside the freshwater swamp forests of the Niger Delta and the government-controlled forest reserves. Even these so-called forest reserves have not escaped encroachment as illegal felling and intense hunting are conducted on a large scale.

There is, however, growing sympathy for wildlife conservation both in government circles and among the enlightened populace, but not enough is being done.

This paper examines the general problems of wildlife conservation in the forest zone, the adequacies of current measures for the protection of forest primates, and future prospects in the light of recent developments in Nigeria.

Current Status of Primate Conservation

Eighteen of the primates known to occur in Nigeria are found in the forest zone, with some species extending into the fringing and relic forests of the derived and Guinea savanna zones. Twelve of these primates are judged to be rare and severely threatened at the moment (Table 1). Three others, *Arctocebus calabarensis* (Smith), *Euoticus elegantulus* (Le Conte), and *Cercopithecus mona* (Schreber) are rated as common, but their continued survival is by no means guaranteed. Only the ubiquitous dwarf galago, *Galago demidovii* (Fischer), appears to be in no great danger now. It frequents colonizing forest, and appears to be strongly associated with the umbrella tree *(Musanga cecropioides)*, which grows profusely wherever a gap is created in the forest canopy (Coe, 1975). The putty-nosed guenon *(Cercopithecus nictitans martini* Waterhouse) is neither common nor rare. It is the second commonest guenon (after the mona, *C. mona*) found in bushmeat stalls. Small troops of *Cercopithecus erythrogaster* (Gray) may occasionally be encountered foraging silently in low, dense vegetation on the edge of forest streams, and Anadu and Oates (1982) suggested that this guenon may be more common than was widely believed.

Legal Protection

Under the Wild Animals Preservation Law (1916), which is still in force throughout southern Nigeria, the hunting or capture of the great apes, *Pan troglodytes* (Blumenbach) and *Gorilla gorilla* (Savage and Wyman), is absolutely prohibited. Colobus monkeys, on the other hand, may be hunted under license, while technically all other primates may be taken without a license outside a game reserve.

In the northern states, all primates are legally protected in Kano State (Anon, 1978), while in Borno, Bauchi and Gongola states all primates except prosimians, the red patas *(Erythrocebus patas* Schreber), and the olive baboon *(Papio anubis* J.B. Fischer) are protected (Hall, 1976). Elsewhere, only the gorilla, chimpanzee, western black-and-white colobus *(Colobus polykomos vellerosus* I. Geoffroy), and the red colobus *(C. badius preussi* Matschie) are listed as protected animals under the 1963 Wild Animals Law.

An important recent development is the promulgation by the federal government of the Endangered Species (Control of International Trade and Traffic) Decree in 1985. The purpose of this important decree is to provide a legal basis for prosecuting people who violate those international conventions to which the country is a signatory (CITES, ACCN, etc.). Under the decree, the export of the golden potto *(Arctocebus calabarensis)*, all colobus monkeys, all mangabeys, the chimpanzee, the gorilla and the drill *(Papio leucophaeus* F. Cuvier), are absolutely prohibited. It is also an offence to hunt or capture any of these protected primates. An export permit may be granted by the Minister in charge of wildlife matters for the export of Bosman's potto *(Perodicticus potto* Muller), galagos and guenons, if the Minister is satisfied that such export will not be detrimental to the survival of the species.

In addition to these laws, Nigeria currently has one national park and 16 game reserves (Fig. 1). Nineteen other reserves are planned (Table 2) but it is doubtful whether any of these will go beyond this stage in the near future, given the severe economic difficulties of the country. It will be readily noted that there are no functional reserves east of the Niger River and south of the Benue River, while in western Nigeria the only game reserves in the forest zone proper are to be found in Bendel State. However, the Opara and the Upper Ogun/Old Oyo Game Reserves, which lie in the Guinea Savanna, contain suitable habitats for forest primates (Monath and Kemp, 1973; Adekunle, 1971; Happold, 1973; Geerling, 1974); and, moreover, the western black-and-white colobus *(C. p. vellerosus)* has been seen along the Oli River which flows through the Kainji Lake National Park (Afolayan, pers. comm.).

Unfortunately, most of these reserves are little more than paper reserves, with neither a master plan for their development, nor infrastructural facilities, nor effective protection against poachers.

Problems of Wildlife Conservation in the Forest Zone

The problems of effective wildlife conservation in Nigeria include: excessive demand for farmland, fuelwood, and hardwood timber which has led to extensive habitat destruction; absence of a conservation ethic among the populace; weak enforcement of and inadequacies of existing wildlife laws; and an acute shortage of financial resources. These problems are particularly pronounced in southern Nigeria because of 1) the high population density, which in some eastern states exceeds 400 persons/km² (Barbour *et al.*, 1982), 2) outmoded wildlife laws, and 3) the popularity of bushmeat.

Habitat Destruction

The remaining rainforest blocks of southern Nigeria (Fig. 2) are under tremendous pressure from plantation forestry, urbanization and an ever-growing demand for farmland, timber and fuelwood. Even the so-called forest reserves have been encroached upon, and about 24% of their total area has been converted into a mosaic of farmland, forest plantations, tree crops (notably rubber and oil palm) and bush fallow. The annual rate of forest destruction was estimated to be about 2.1% in 1981, and was expected to rise to 2.2% by 1985 (FAO, 1981).

Logging and plantation forestry pose great threats to the survival of natural forests. Owing to a steep rise in the demand for building and construction materials after the civil war, including sawn wood, poles and plywood, the timber trade became very lucrative. One forest compartment, measuring one square mile (2.59 km²) is estimated to be worth about ₦500,000 (₦1.00 = US$1.33, September 1986), (see Anadu and Oates, 1982). This attracted many log contractors, some of whom operated illegally (Ikumogunniyi, 1980; Kio, 1983). It is perhaps instructive that the number of sawmills in Nigeria rose from 400 in 1975, to 1,030 in 1981 (Kio and Ball, 1982).

Large-scale plantation forestry was accelerated in the mid-sixties following the failure of natural regeneration under the Tropical Shelterwood System (T.S.S.) to meet the growing local demand for timber (Oseni, 1969; Kio, 1979). In the south, establishment of forest plantations, mainly for the production of timber and pulpwood, rose from approximately 20,000 ha in 1965, to 146,300 ha in 1980, with a projection of 270,300 ha by the end of 1985 (FAO, *op.cit.*). Since the plantations are being established by state forestry departments, it is obvious that large areas of natural forest within the so-called forest reserves will eventually become converted to artificial plantations. In one classic example, the Omo Forest Reserve (approx. 1,400 km²) near Ijebu-Ode in Ogun State, is being clear-felled and replanted with gmelina *(Gmelina arborea)* to feed a large pulp mill nearby. The project, which is funded

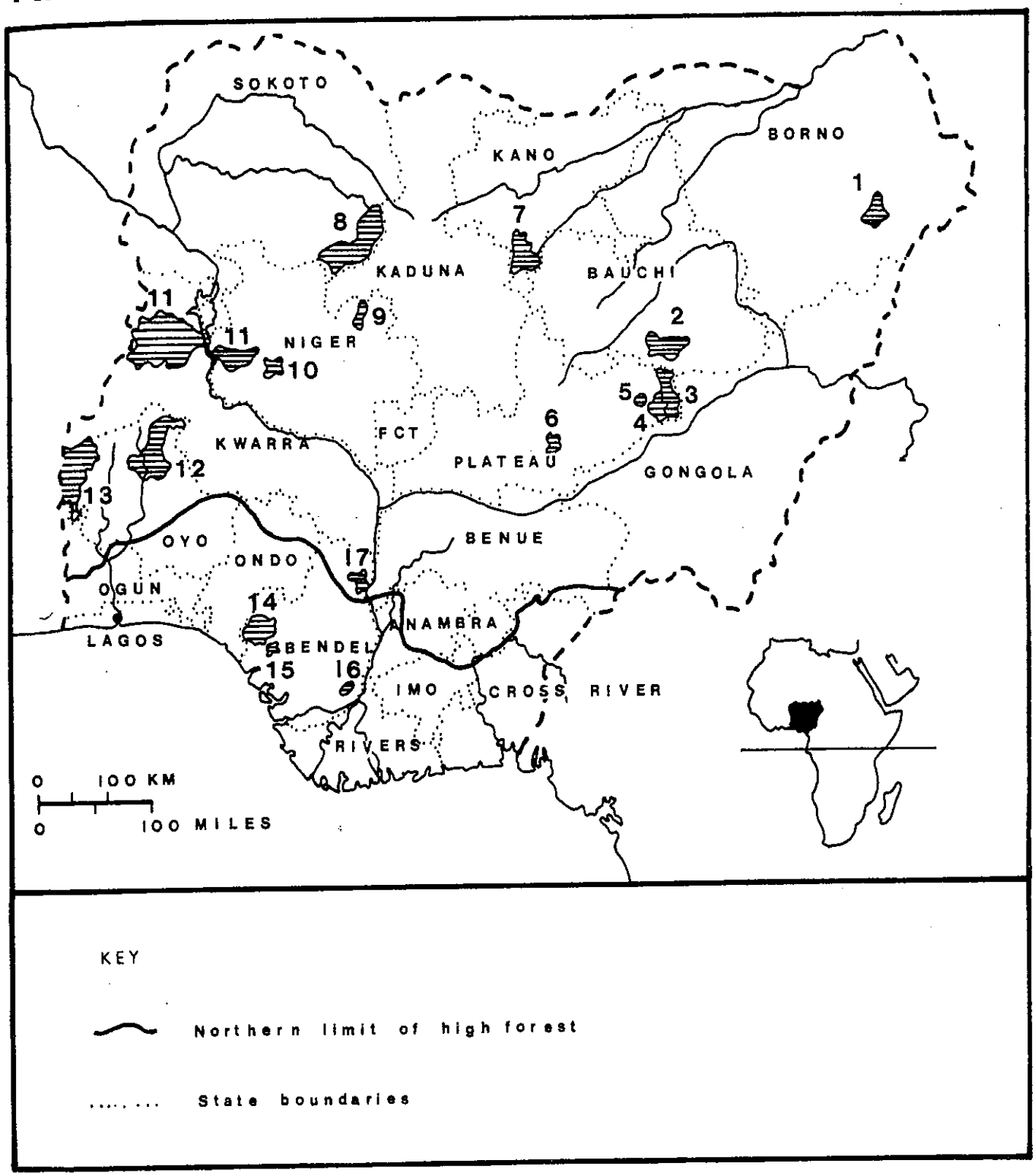

Fig. 1. Nigeria's 16 established game reserves and one national park as of December, 1985 (numbers correlate with names in Table 2; figure provided by author).

with a loan from the World Bank, is already well-advanced, and much of the adjacent Oluwa Forest Reserve is also slated for conversion to gmelina.

Shifting cultivation and urbanization have, however, been responsible for the destruction of much of the high forest. Owing to the rapidly expanding human population (ca. 100 million; growth rate, 2.5-3.0% p.a.), the pressure on land is such that the period of fallow has shortened to as little as 3-4 years in some parts of the country, notably in the eastern states. Shortage of fertile agricultural land has also led to encroachment on the forest reserves. Indeed many communities and vested interests have in the past successfully put pressure on their state governments to degazette some rich forest reserves, and it is feared that under the current drive towards national self-sufficiency in food production, more productive forests will disappear. Moreover, *taungya* farming, which was incorporated into the forest plantation scheme as a means of alleviating land hunger, appears now to be widely abused. According to Ola-Adams (1977, 1981), 260 ha are lost annually in the Akure Forest Reserve (Ondo State) to *taungya* farmers, while in the Ogbesse

River Forest Reserve, also in Ondo State, 2,000 ha have become permanently converted into farmland.

A growing population needs more land on which to build more houses. Farmlands are converted into human settlements and more forest has to be cut down to provide fresh farms.

Oil exploration has also contributed to forest destruction. Some oilfields are actually located inside forest reserves (Anadu and Oates, 1982), and their service roads, which criss-cross the Niger Delta, provide hunters with easy access to remote parts of the forest.

Hunting and Hunting Laws

Hunting is one of the traditional occupations in Nigeria, and "bushmeat", the flesh of wild animals, is very popular. In the south it is estimated that 80% of the population eat bushmeat regularly (Ajayi, 1979; Martin, 1983). Moreover, almost all wild animals, including all primates, are used as ingredients of magical or medicinal concoctions (Ajayi, *op.cit.*). Hunters, therefore, have a ready and lucrative market.

Hunting takes place by day and especially by night throughout the year. Most hunters now use locally-made breech-loading shotguns which fire imported ammunition, instead of the traditional muzzle-loader or "Dane gun". At night, acetylene headlamps are used to blind the quarry, and hunters will shoot anything larger than 2 kg. Their favorite quarry are antelopes, bushpig, large rodents and large primates (Martin, *op.cit.*). Unfortunately, the 1916 Wild Animals Preservation Law does not empower forest officers to arrest or prosecute offenders; this is the responsibility of the police who are already fully stretched trying to cope with keeping law and order. Hunters, therefore, continue to shoot both protected and unprotected animals, and hardly ever get prosecuted.

Inadequate Funding of Wildlife Projects

Wildlife administration has traditionally been the responsibility of the various state and federal departments of forestry. Consequently the size of the wildlife vote depends on how much sympathy the Federal Director of Forests (or State Chief Conservator of Forests) has for game conservation. It is instructive that the total capital allocation to wildlife projects by the Federal Government from 1975-1982, amounted to only approximately ₦2.16 million. By contrast fishery projects were allocated ₦56.17 million, and livestock ₦217.97 million, during the same period. The situation in the states which depend almost entirely on federal funding is better imagined. Such lopsided allocation of funds does not reflect the fact that game meat accounts for 13%, and fish and seafood 17.4%, of the average daily per capita animal protein consumption of the nation (FAO, 1977). Obviously the only reason for the inability of wildlife to compete effectively for funds, in spite of the significant contribution it makes to animal protein intake, is that it is an appendage of a larger department. Until it is upgraded to a full-fledged department, all the talk about protecting wildlife for sustained yield cropping may never be translated into concrete action. Promulgating laws and creating game conservation areas without funds and trained personnel to administer them merely creates the false impression that wildlife is receiving adequate protection.

Suggestions for Effective Primate Conservation

From the above account it is obvious that forest primates are not adequately protected in Nigeria. The reasons are largely socio-economic, and without addressing these problems the prospects for primate conservation will remain gloomy. Conservation education at all levels of society, coupled with stricter enforcement of wildlife laws and plugging of loopholes in existing laws would appear to be obvious solutions. Other desirable measures would include:

(1) creation of more sanctuaries (or, better still, national parks), e.g. in the Cross River area, the Mambilla Plateau, and Ifon or Idanre Forest Reserve (Ondo State);
(2) provision of more funds for recruitment of staff, provision of infrastructure and equipment, and research to provide basic information needed for meaningful management decisions;
(3) encouraging farmers to adopt improved farming and animal husbandry techniques in order to check the menace of shifting cultivation and increase the supply of livestock meat;
(4) tackling the problem of rapid population growth;
(5) encouraging healthy interstate rivalry in wildlife conservation through provision of financial incentives by the federal government.

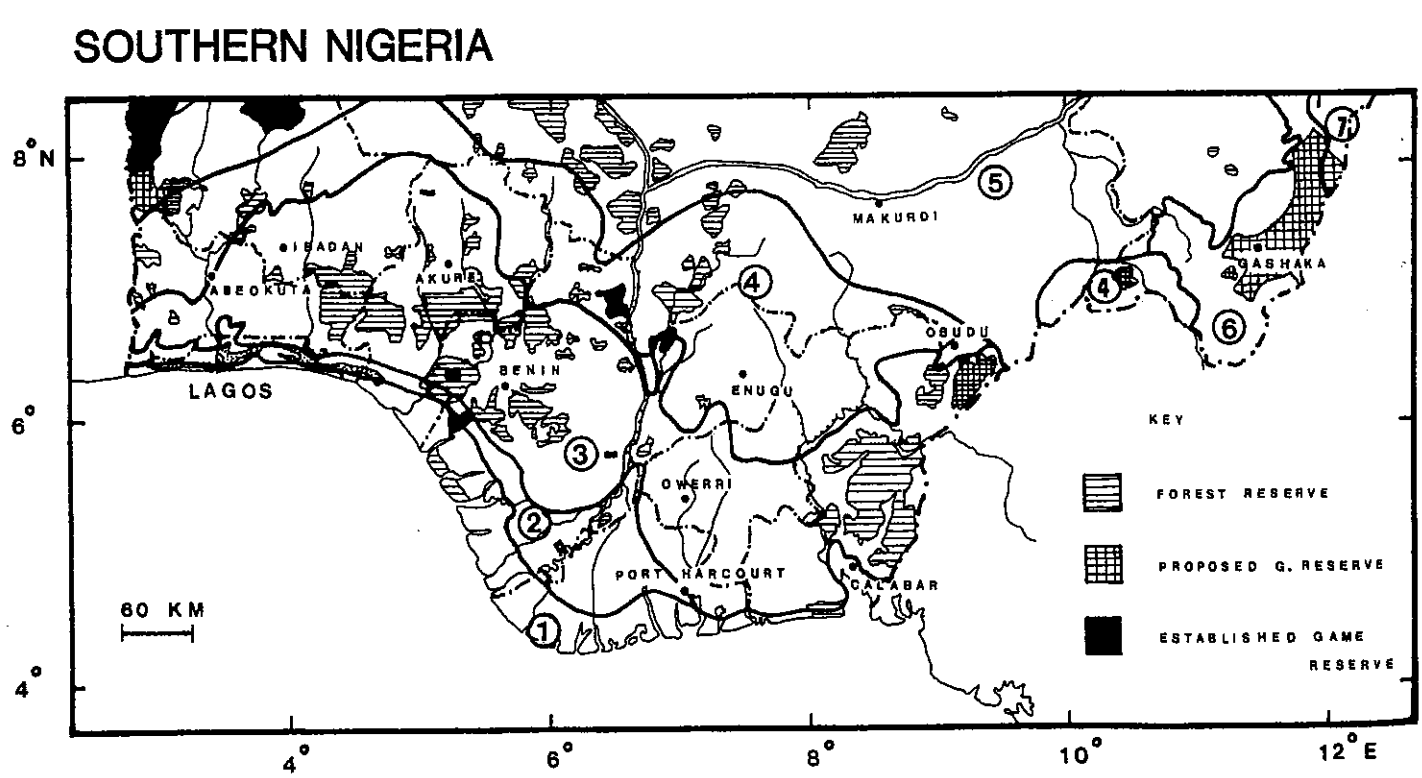

Fig. 2. Southern Nigeria showing vegetation zones, forest reserves and game reserves (map provided by author).

1 = Coastal Mangrove Swamp; 2 = Deltaic Swamp Forest; 3 = Lowland Rainforest; 4 = Derived Savanna; 5 = Southern Guinea Savanna; 6 = Montane Forest and Grassland; 7 = Northern Guinea Savanna.

Unfortunately all these prescriptions involve huge capital outlays which neither the states nor the federal government can afford now or in the foreseeable future. Conservation education, for instance, involves the production of textbooks and audio-visual materials suitable for primary and secondary school pupils or community viewing centers, as well as the recruitment of suitably motivated personnel. Similarly, persuading farmers to adopt improved crop varieties involves costly subsidies, but perhaps has a good chance of being seriously pursued now that agriculture is the focus of national development. The population problem on the other hand is bedeviled by religious and cultural sentiments, and it is not surprising that in spite of campaigns by the Planned Parenthood Federation and the availability of free family planning facilities, the population has continued to grow steadily.

Nevertheless, the nation has a responsibility to tackle these problems, not only because there can be no meaningful economic progress if the population problem and agricultural modernization are ignored, but also because of the national and international significance of the rainforest. The consequences of total destruction of the rainforest have been too eloquently argued by several authors (e.g. Struhsaker, 1978; Whitmore, 1980; Raven, 1981) to need recounting. It is, however, important to emphasize that the Nigerian rainforest contains an assemblage of species not exactly repeated elsewhere. Two guenons, the white-throated monkey *(Cercopithecus erythrogaster)* and Sclater's red-eared monkey (*Cercopithecus erythrotis sclateri* Pocock) are endemic to Nigeria, and elements of the Guinean and Congolese forest blocks uniquely co-occur in the country. Furthermore, the question of where a Pleistocene forest refuge occured in Nigeria has not been fully resolved. Booth (1958) proposed the Niger Delta on zoogeographical grounds, while Hall (1981) proposed the Oban Forest on the basis of phytogeographical evidence.

The fauna and flora of the Nigerian rainforest ecosystem are still poorly understood and it is important that they be saved because of their scientific and potential economic values.

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Table 1. Ecological and Conservation Status of Nigerian Primates

	Geographical Distribution	Preferred habitat	Abundance Rating	Conservation status
Colobinae				
Colobus polykomos vellerosus (I. Geoffroy)	Western Nigeria	Fringing forest in the derived and Guinea Savanna zones	Rare	++++; hunting and international traffic prohibited
Colobus badius preussi (Matschie)	South-eastern Nigeria	Mature rainforest	Rare, probably extinct in Nigeria	++++; hunting and international traffic prohibited
Colobus guereza (Rüppell)	Upper Benue valley and adjacent catchment area	Riparian, colonizing or montane forest in the Guinea savanna zone	Rare	++++; hunting and international traffic prohibited
Procolobus verus (van Beneden)	Southern Nigeria	High forest, and riparian forest in the derived and Guinea Savanna zones of Southern Nigeria	Rare in the forest zone	++++; hunting and international traffic prohibited
Pongidae				
Pan troglodytes verus (Schwartz)	Southern Nigeria	Mature lowland rainforest and montane forest	Rare	++++; hunting and international traffic prohibited
Gorilla gorilla gorilla (Savage and Wyman)	South-eastern Nigeria, probably confined to the Obudu area	Dense secondary and montane forest	Rare	++++; hunting and international traffic prohibited

Notes:
Southern Nigeria means below the Niger-Benue confluence (approx. 8° N latitude);
South-eastern Nigeria means east of the Cross River;
Not specifically protected means not legally protected outside game conservation areas
Abundance rating:
Very Common = Large troops encountered in the preferred habitat without much effort
Common = Will probably be seen by an observer without much effort
Uncommon = Likely to be seen with some effort
Rare = Not likely to be seen except after the most determined search
Conservation status categories follow Wolfheim (1983) viz.:
0 = Safe
+ = Vulnerable
++ = Threatened Somewhat
+++ = Threatened Substantially
++++ = Threatened Severely

Table 2. Nigeria: Game Reserves (1986)

Established (Serial Numbers correspond to numbers in Fig. 1)

Game Reserve	State	Area (sq km)	Date gazetted
1. Sambisa	Borno	517	1978
2. Yankari	Bauchi	2240	1955
3. Pai River	Plateau	2214	1972
4. Wase Game Sanctuary	Plateau	1865	1972
5. Wase Rock	Plateau	0.93	1972
6. Pandam Wildlife Park	Plateau	362.7	1972
7. Falgore (Kogin Kano)	Kano	920	1972
8. Kwaiambana	Sokoto	2613	1971
9. Alawa	Niger	296	1971
10. Dagida	Niger	294	1971
11. Kainji Lake National Park	Kwara & Niger	5341	1975
12. Upper Ogun/Old Oyo	Oyo	2512	1973
13. Opara	Oyo	2486	1973
14. Okomu Wildlife Sanctuary	Bendel	69.6	1985
15. Gilli Gilli	Bendel	363	1916
16. Kwale	Bendel	3	1916
17. Orle River	Bendel	352	1916

Proposed

1. Anambra
2. Ankwe
3. Abuja Fed. Capital National Park
4. Baturiya (Nguru) Wetlands
5. Boshi-Okwango-Boshi Extension
6. Chingurme-Duguma
7. Dampar
8. Gashaka-Gumti
9. Ibi
10. Kamuku
11. Kambari
12. Kashimbila
13. Lake Chad
14. Lame/Burra
15. Meko
16. Mutum Biyu
17. Nasarawa
18. Udo Game Complex
19. Udi/Nsukka

Table 1. Ecological and Conservation Status of Nigerian Primates

	Geographical Distribution	Preferred habitat	Abundance Rating	Conservation status
PROSIMII				
Lorisidae				
Arctocebus calabarensis (Smith)	Eastern Nigeria	Low dense growth in young secondary forest and edge of farmland; young secondary forest relics in derived savanna	Common	+; not specifically protected, but international traffic absolutely prohibited
Perodicticus potto (Müller)	Southern Nigeria	Old secondary forest and forest outliers in the derived savanna	Rare	++++; not specifically protected, but license required for export
Euoticus elegantulus (Le Conte)	Eastern Nigeria	Young secondary and mature forest	Common	+++; not specifically protected, but license required for export
Galago demidovii (Fischer)	Southern Nigeria	Dense secondary forest and forest outliers in the derived savanna	Very common	+; not specifically protected, but license required for export
Galago alleni (Waterhouse)	Eastern Nigeria	Young secondary and mature forest	Rare	++++; not specifically protected, but license required for export
Galago senegalensis (E. Geoffroy)	North of the rainforest zone (except east of the R. Niger)	Savanna, except Sahel Savanna	Very common	0; not specifically protected, but license required for export
ANTHROPOIDEA				
Cercopithecidae				
Cercopithecinae				
Papio anubis (J. B. Fischer)	North of the rainforest zone	Savanna, derived-Sahel zone	Very common	0; not specifically protected, but license required for export
Papio (Mandrillus) leucophaeus (F. Cuvier)	South-eastern Nigeria	Hilly rocky country in the rainforest zone	Rare	++++; not specifically protected, but international traffic absolutely prohibited
Cercocebus torquatus (Kerr)	Southern Nigeria	Mature secondary forest, fresh water swamp forest, and forest relics in the derived savanna	Rare	++++; not specifically protected, but license required for export
Cercopithecus aethiops tantalus (Ogilby)	North of the rainforest zone	Riparian forest in the Guinea and Sudan Savanna; occasionally in the derived savanna	Very common	0; protected in some northern states; license required for export
Cercopithecus erythrogaster (Gray)	Western Nigeria	Low dense riparian vegetation inside mature rainforest; deltaic swamp forest	Common	++; not specifically protected, but license required for export
Cercopithecus erythrotis sclateri (Pocock)	Eastern Nigeria between the Niger and the Cross River	Mature rainforest and deltaic swamp forest	Rare	++++; not specifically protected, but license needed for export
Cercopithecus erythrotis camerunensis (Hayman)	Southeastern Nigeria	— do —	— do —	— do —
Cercopithecus mona (Schreber)	Southern Nigeria and in forest outliers in the Guinea Savanna	Young secondary forest, especially riparian forest	Common	++; protected in some northern states, but not specifically in the south; license required for export
Cercopithecus nicitans martini (Waterhouse)	— do —	Mature high forest	Uncommon	+++; protected in some northern states but not specifically in the south; license required for export
Erythrocebus patas (Schreber)	North of the rainforest zone	Principally Guinea, Sudan and Sahel Savanna, occasionally in the derived savanna	Very common	0; not specifically protected, but license required for export

Gabon: A Fragile Sanctuary

by Caroline E. G. Tutin and Michel Fernandez

Gabon lies on the equator on the west coast of Africa and covers an area of 267,000 km². It is a country which, in 1986, is still a sanctuary for primates and for tropical forest ecosystems. Three factors are largely responsible: the relatively low density of the human population (mean, 4.2 per km²); the considerable mineral wealth, especially the off-shore oil reserves, revenues from which represented 60% of the State's income in 1985; and the difficulties of access to the interior of the country which have restricted selective logging to coastal areas. These factors have combined to naturally protect the majority of Gabon's forests until now, but this situation is beginning to change rapidly.

At least 20 species of primates occur in Gabon: five prosimians, 13 diurnal monkey species and two species of apes. We say "at least", as the existence of one of the species of monkey, provisionally named *Cercopithecus (lhoesti) solatus* was discovered in 1984 by M.J.S. Harrison, the presence of drills (*Mandrillus leucophaeus*) in south-central Gabon was only recently confirmed (see Footnote), and further discoveries are possible. Gabon represents a major sanctuary for both lowland gorillas (*Gorilla g. gorilla*) and chimpanzees (*Pan t. troglodytes*) (Tutin and Fernandez, 1984) and for certain other primate species, notably black colobus (*Colobus satanas*) and mandrills (*Mandrillus sphinx*).

Tropical forest covers 85% of Gabon and while annual rainfall is relatively low, exceeding 3,000 mm only in coastal areas, the persistent cloud cover, low evaporation rate and subsequent high humidity during the three-month dry season, are perhaps responsible for maintaining these forests even in areas where annual rainfall is as low as 1,500 mm. Savanna covers the remaining 15% of Gabon's area and many of the savanna zones appear to have been created by human activities, possibly as early as the 15th or 16th century. It seems likely that the forests in much of Gabon are in a state of fragile equilibrium, surviving in a marginal climate but probably particularly susceptible to any kind of disturbance.

Footnote:
Early reports (Malbrandt and MaClathy, 1949) of drills being present in parts of Gabon were discounted by Grubb (1973), who concluded that the Sanaga River in Cameroon divided the ranges of the two species (drills to the north, mandrills to the south) and thus nowhere did the two species occur sympatrically. However, large groups of drills were observed in the Lopé Reserve far south of the Sanaga in central Gabon, in September 1984 by E.A. Williamson and M.E. Rogers, and in April 1986 by M. Nicoll. These three zoologists were aware of the possibility of confusion between drills and mandrills, but clearly observed adult males which lacked bright facial coloration and the characteristic yellow mandrill "bib". Mandrills are far from common in central Gabon and it seems that drills are extremely rare.

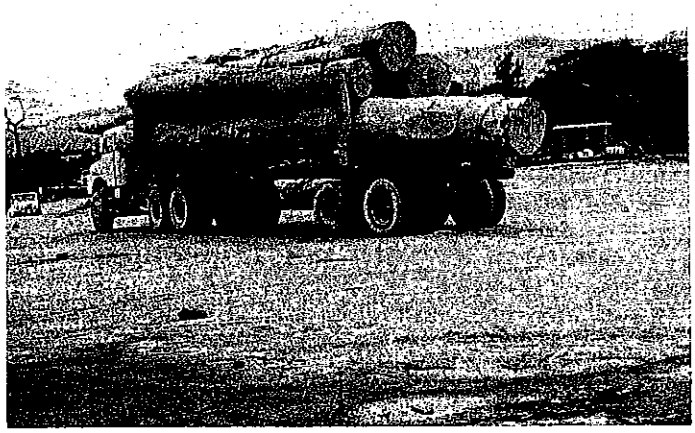

Fig. 1. A truck transporting *okoumé* logs from central Gabon (photo by Tutin and Fernandez).

Before the discovery and exploitation of off-shore oil reserves, selective logging was the major industry of Gabon, representing 80% of revenues in 1965. In 1983, income from forestry activities represented only 2% of the GNP (Anon., 1984). Logging in Gabon is highly selective and 90% of trees cut are of a single, endemic species called *okoumé* (*Aucoumea klaineana*, family Burseraceae; Fig. 1) which produces a light-weight wood readily transformable into plywood. The average density of *okoumé* is 1.5 trees per hectare and so, while the forest structure is certainly altered by the extraction of these trees, the damage is less than in Malaysia, for example, where 17 trees per hectare are felled (Johns, 1981).

No national parks exist in Gabon but there are five protected areas, see Figure 2. Of these, three are Faunal Reserves administered by the Wildlife Department of the Ministry of Eaux et Forêts: Sette Cama (3,500 km²) on the southern coast, Moukalaba (1,000 km²) in the southwest, and the Lopé (5,000 km²) in central Gabon. Wonga-Wongué (2,000 km²) in the northwest is the Presidential Reserve and is run privately, and M'Passa (100 km²) in the northeast is a Biosphere Reserve run by the National Centre for Scientific and Technical Research, which has an ecological laboratory there. Management and protection practices vary: Wonga-Wongué is well protected from poachers but some official hunting occurs; M'Passa enjoys no special protection and as there are very few scientists now working at the ecological laboratory, hunting has become a serious threat. The Wildlife Department has recently built camps at the Lopé (1982) and at Moukalaba (1986), but Sette Cama is not staffed and the oil company Shell Gabon has a base within the Reserve.

The impact of selective logging in Gabon, as elsewhere, is two-fold: direct habitat alteration through felling trees and constructing roads, and indirect disturbance by opening up new areas for hunting and settlement. The Ministry of Eaux et Forêts, which supervises all forestry activities, has divided the country into three Zones, see Figure 2. Zone 1 covers approximately 40% of Gabon and is the zone of easy access where the felled *okoumé* logs can be transported by water (navigable rivers or the sea) to their point of processing or exportation. Selective logging has been underway in Zone 1 since the beginning of the century and only isolated patches of virgin forest remain. Many areas have been logged two or three times at 30 year intervals. Three of the five protected areas in Gabon are in Zone 1 and the forests of all three have been selectively logged at least once. Zone 2 extends eastward to the geographical limit of *okoumé* distribution and covers approximately 35% of the country. The construction of a railway line from Libreville to Franceville has opened up the forests of Zone 2 to selective logging - previously, transport costs were prohibitive. Logging permits for Zone 2 were issued in 1970 when construction of the railway began, and the entire area is allocated to large forestry companies which are moving from Zone 1 to Zone 2 as the train advances. Currently, the line is open as far as Lastoursville and by the end of 1986 the railway will be completed. Permits for repeated logging in Zone 1 are now only issued to Gabonese nationals and so all of the large, foreign-based, forestry companies will be working in Zone 2. It is safe to say that in 10-15 years time, no large areas of virgin forest will remain in the 75% of Gabon covered by Zones 1 and 2. The majority of the Lopé Reserve is in Zone 2. At present, two logging companies are working permits in the Reserve. At a meeting on 31 May 1986, officials from the Ministry of Eaux et Forêts stated that they would revoke none of the permits within the Lopé Reserve, despite the fact that a law enables them to do so and clearly states that within a Faunal Reserve, flora as well as fauna are totally protected.

The forests of Zone 3, which have no *okoumé*, are not threatened at present as tropical hardwoods alone do not allow profitable exploitation at such great distances from the sea ports. The fifth of Gabon's reserves, M'Passa, is in Zone 3, but covers an area of only 100 km².

The presence of men and machines during timber extraction certainly disturbs all animals, but it is impossible to assess the short and longer term impact of selective logging on primates in Gabon without conducting a specific study. *Okoumé* is not a primate food species and so ef-

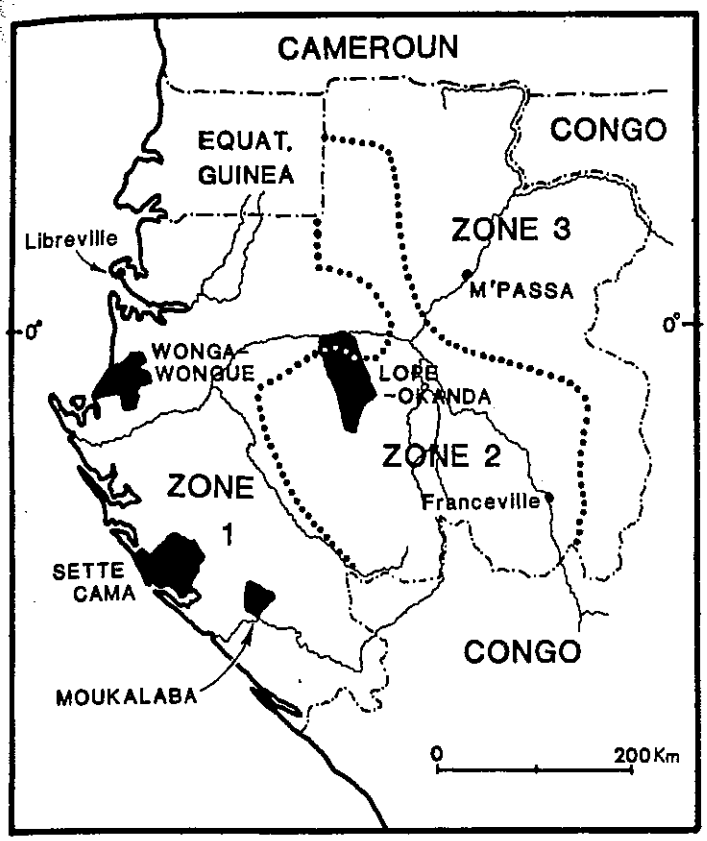

Fig. 2. Protected areas (in black) and zones of selective logging activity (dotted lines) in Gabon (map by S. D. Nash based on authors' original).

fects are likely to come from changes in the structure of the habitat, thus exerting different influences on terrestrial and arboreal species. Light-gaps and clearings in the forest, created by natural tree-fall, or at increased frequency by timber extraction, are rapidly colonized by herbaceous plants and seedlings of light-tolerant tree species. Many of these species are important food plants of gorillas and mandrills and the changes in vegetation following selective logging may be favorable to these primates. The activities of large mammals, particularly elephants, play an important role in determining the subsequent plant succession in forest clearings in Gabon; when present at high densities elephants possibly cause irreversible changes in forest structure and floral composition. So, while we cannot yet assess the precise effects of selective logging on individual primate species, it seems very likely that the balance of the plant and animal communities will be altered considerably.

Workers at forestry camps hunt with guns and snares and hunting often continues long after the logging, as the newly built roads permit entry into previously inaccessible areas. All except the smallest of primates are regularly hunted for meat and while subsistence hunting by small rural communities has a limited impact, professional hunters who provide meat for larger towns can decimate the fauna of a particular area in a short time. Infant primates, captured when their mothers are killed, are offered for sale, and, in the case of gorillas and chimpanzees, this is a cause for concern. While both species are totally protected by Gabonese law, infants do appear on the market from time to time. Repetitions of the recent cases in Cameroon and Congo, of orphaned gorillas in need of "rescue", could easily occur in Gabon and thus it is imperative that all countries adhere strictly to the letter of CITES, which excludes exportation of illegally captured animals.

The recent drop in oil prices holds dramatic consequences for Gabon: oil revenues for 1986 will be 50% less than for 1985, and so the national budget has to be almost halved. As oil revenues are not expected to recover substantially before 1990, pressure is great to boost other sectors of the economy, with timber being particularly important as selective logging in Zone 2 will create business for the state financed railway.

No magical solutions exist for Gabon's conservation problems but it would be encouraging if some actions could be implemented to prevent erosion of this fragile sanctuary. The priority is a detailed study of the exact impact of selective logging as practiced in Gabon. If selective logging creates a lasting, or permanent, effect on the ecosystem, then efforts must be mounted immediately to defend at least part of the Lopé's virgin forests. Creating national parks in tropical forest areas cannot be considered an attractive proposition to developing countries. The trees represent an important economic resource and, if not exploited, the financial loss can never be matched by income from future tourism as in grassland savanna areas. It is unrealistic to expect conservation *per se* to figure in the political priorities of a developing country like Gabon, especially at a time of economic difficulties in a country with no direct experience of ecological disasters. If Gabon's virgin forests are demonstrated to be ecologically important, then the threat to their continued existence can only be countered by international aid.

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Report from the Zaire Gorilla Conservation Project

by Rosalind and Conrad Aveling

Introduction

The three subspecies of *Gorilla gorilla* occupy a discontinuous range across equatorial Africa from Cameroon to Rwanda. The lowland gorilla (*Gorilla g. gorilla*), occurs within the borders of Cameroon, Equatorial Guinea, Gabon, Central African Republic, Congo and Angola (Cabinda enclave). It is separated by nearly 1,000 km from the somewhat misleadingly named eastern lowland gorilla (*G. g. graueri*) which occurs in scattered pockets of both lowland and mountain forests of eastern Zaire between the Lualaba River and the western edge of the Albertine Rift. On the eastern side of the Albertine Rift occur two populations of the third subspecies, the mountain gorilla (*G. g. beringei*), in the approximately 400 km² of the Virunga Volcanoes of Zaire, Rwanda and Uganda and in the 310 km² of the Bwindi Forest of Uganda. Of the three subspecies *G. g. beringei* is by far the most endangered, with only approximately 400 individuals. Since G.B. Schaller's pioneering work 25 years ago, research on both the ecology and ethology of eastern gorillas has focused on the Virunga gorilla population, as have more recent conservation initiatives.

Since 1979, a conservation project funded by a consortium of organizations has done much to assure the protection of the *G. g. beringei* gorillas living on the Rwandan side of the volcanoes in the Parc National des Volcans. Censuses in 1978 (Weber and Vedder, 1983) and 1981 (Aveling and Harcourt, 1983) highlighted the plight of the gorillas occupying the Zaire sector of the Virungas in the Parc National des Virungas, which represents nearly two-thirds of the conservation area. As a result, in 1984, the Frankfurt Zoological Society in collaboration with WWF, IUCN and the Institut Zairois pour la Conservation de la Nature, launched the Zaire Gorilla Conservation Project with improvement in the protection of the Zairian Virunga gorillas as one of the main priorities. The project's other brief is to update information on the conservation status of the *G. g. graueri* populations of eastern Zaire about which, with the exception of Goodall's survey in 1979 (Goodall, 1980), little additional information has been gathered since Schaller and Emlen's survey of 1959-1960 (Schaller, 1963). This paper presents a summary of the progress of the Zaire Gorilla Conservation Project since its inception in July 1984, and comments on prospects for conservation of both eastern subspecies of gorilla.

Conservation and Status of *G. g. beringei*

Tourism. The Mountain Gorilla Project in Rwanda has demonstrated that the development of controlled tourism based on gorilla viewing is one of the most effective ways of protecting gorillas. The park revenue generated demonstrates to the authorities the value of gorilla conservation in economic terms and provides them with the means to improve their conservation measures. Furthermore, the daily monitoring of the habituated families provides direct protection by discouraging poachers. Currently the Parc National des Volcans in Rwanda earns nearly U.S. $250,000/year from tourist receipts making tourism the third source of foreign currency for the country, in large measure due to the publicity generated by the gorillas.

One of the first priorities therefore in Zaire was to start a gorilla viewing program in the Parc National des Virungas. In this respect the early results have been very encouraging. Three families of gorillas living near the edge of the park, and therefore accessible for visitors, have now been habituated, and one of them has been receiving once-a-day visits from a maximum of six people since September, 1985. Within a period of 10 months tourist receipts for the gorilla sector of the park rose from virtually zero to approximately U.S. $1,800/month. With increasing interest and the opening of the other two families to tourism, the figure will continue to rise sharply. These developments have attracted high-level interest and support for gorilla conservation within Zaire. There are also beneficial spin-offs for the park in general, with more visitors being attracted to the oldest and one of the most spectacular parks in Africa. The Parc National des Virungas comprises within its 8,000 km² such diverse habitats as the Ruwenzori Mountains in the north, the tropical lowland forests of Watalinga and the Ituri, the Semiliki River, Lake Edward, the savannah plains of Rwindi, and to the south the active volcanoes Nyragongo and Nyamulagira which have produced spectacular and regular eruptions over the past 15 years.

Park support. The gorillas are threatened directly from poaching and indirectly from the illegal activities of woodcutters, bamboo collectors, water collectors, smugglers, and poachers of other animals. Although a trade in gorilla heads and live infants developed in the mid-1970s and may still occasionally occur, this trade has reduced, and the gorillas are now probably more at risk from wire snares set to catch bushbuck and duiker. These snares may be a major cause of mortality, particularly of immatures, and at least a dozen animals from monitored groups have missing or mutilated hands or feet.

From the start the Zaire project has taken measures to improve surveillance and protection in the park. The ability of the park wardens to manage their sectors has been enhanced through provision and maintenance of vehicles and a radio network. Rations have been supplied for increased patrols, and uniforms and equipment provided to park guards to enable them to operate more effectively in cold and wet conditions. The increase in patrolling and snare removal by the guards has certainly helped reduce the risk to the gorillas, although the setting of snares is a continuing problem.

Census of the Virunga Gorilla Population

As part of the regular monitoring of the Virunga gorilla population a census of the entire Virunga ecosystem, funded by the Zoological Societies of Frankfurt and New York, was carried out by a team of nine fieldworkers from Zaire and Rwanda in May-June, 1986. This census produced the highest total count of gorillas since the early 1970s. A total of 279 gorillas were counted comprising 29 families and 11 lone males, as compared with 260 in 1973, 252 in 1978, and 242 in 1981. A number of groups use both Zaire and Rwanda and both Ugandan groups use either Zaire or Rwanda (Uganda's 30 km² is only 8% of the conservation area). Dividing the shared groups equally between Rwanda and Zaire gives an approximate number of 172 for Zaire and 107 for Rwanda, reflecting the roughly two thirds/one third split of the conservation area be-

Table 1: Comparison of Gorilla Census Results

Census	Total counted i.e. min. no.	Range	No. groups	Lone males	Mean gp. size	% immature
1973	261	261-290	31	15	7.9	39.8
1978	252	252-285	28	6	8.8	35.8
1981	242	242-266	28	5	8.5	39.7
1986	279	279-307	29	10	9.2	48.1

tween the two countries.

The results are encouraging as they suggest that there has been an increase in the number of gorillas. Furthermore the mean group size has risen to 9.2, the highest for all the censuses (Table 1). In addition, the mean group size for Zaire in 1986 is 9.1 which indicates a reversal in the downward trend for Zaire that showed up between 1978 and 1981 when mean group size dropped from 9.7 to 7.4. Meanwhile, in Rwanda during the same period mean group size has not changed significantly (9.7 - 9.3).

Further evidence that this is an increasing population comes from the fact that the percentage of immatures in the population has risen from 39.7% in 1981, to 48.1% in 1986. Looking at the different sectors of the population in more detail provides further evidence of the effect of the conservation measures undertaken in recent years. If the population is divided into "protected" groups (i.e. groups regularly monitored by the two tourism programs and the Karisoke Research Centre) and "non-protected" groups (i.e. the rest), the percentage of immatures is 50.8% in "protected" groups and only 40.8% in "non-protected" groups with mean group sizes of 10.4 and 7.1 respectively.

The increase in group size and percentage of immatures in Rwanda between 1978 and 1981 was attributed to the better degree of protection that came with the launch of the Rwandan Mountain Gorilla Project in 1979. During that period a decline continued in Zaire where protection remained inadequate. Between 1981 and 1986, we now see an improvement in the Zaire population, which again coincides with a period of improved protection through the activities of the Zaire Gorilla Conservation Project, while in Rwanda, where protection has remained good, the population has remained stable.

Conservation and Status of *G. g. graueri*

G. g. graueri is much more widespread and numerous than *G. g. beringei*, although no precise figure can be given as this subspecies is found in many fairly discrete populations over a vast area of mostly inaccessible lowland and montane forest. During the first two years of operation, most project activities have been concentrated on the highly threatened *G. g. beringei* subspecies, but a start has nevertheless been made on gathering information on *G. g. graueri*. Many of the areas that Schaller and Emlen visited in 1959, are now completely inaccessible by vehicle due to drastic deterioration of roads and bridges. In general, however, it can be said that populations that occurred at that time in montane forest (above 1,500 m) outside existing national parks, are now extinct or highly threatened due to a dramatic increase in the rate of clearance of these forests over the last 25 years for agriculture and pastures. Populations in forests below 1,500 m are less threatened as the rate of clearance is considerably lower. Fortunately two very large national parks were created in the 1970s within the range of *G. g. graueri*.

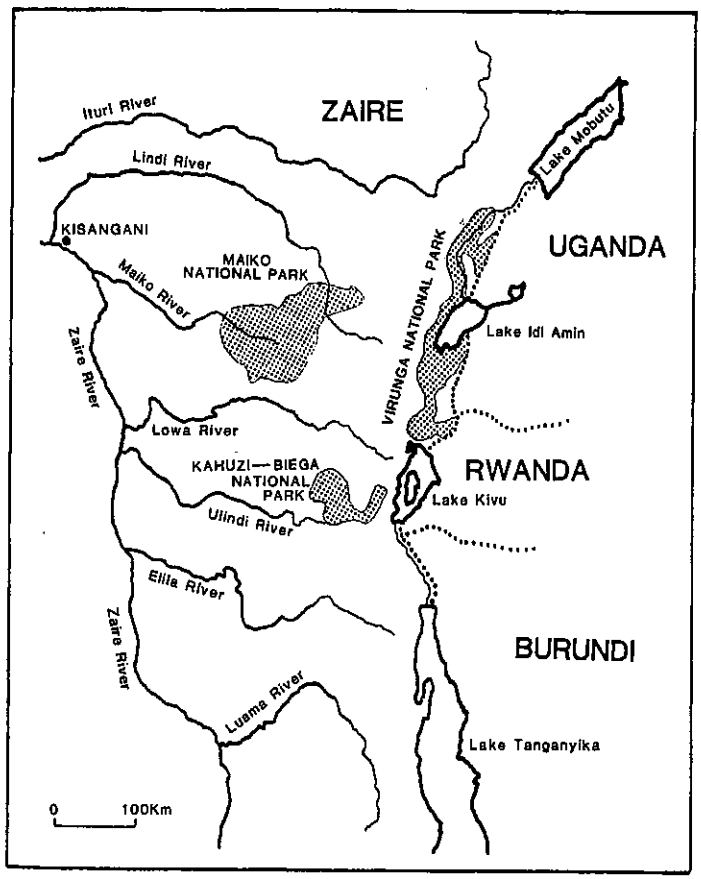

Fig. 1. Map showing the three national parks in eastern Zaire within the range of *Gorilla gorilla beringei* (Virunga National Park) and *G. g. graueri* (Maiko, Kahuzi-Biega and Virunga National Park) (map by S.D. Nash from authors' original).

Parc National de Maiko is a 10,000 km² area of remote lowland tropical rainforest (Fig. 1). Gorillas are known to exist throughout much of the park, although probably in sparser densities than in montane forest. Gold diggers, hunters and rebels are also found throughout the park and gorillas are known to be hunted for food in this region. The park's infrastructure is inadequate, with a guard force of about 35 responsible for one million hectares of rainforest. The two substations are situated at 30 and 40 km from the park boundary, the northern station also being 160 km from the nearest motorable road. However, despite these seemingly discouraging statistics, there is no forest clearance and the gorillas probably remain reasonably protected by the size and remoteness of the region.

Parc National de Kahuzi-Beiga comprises 6,000 km² of both montane and lowland forest both inhabited by gorillas. In 1979, Murnyak (1981) estimated a total of about 240 gorillas within the original 600 km² of the park; however, with the 10-fold increase in the size of the park in the mid-1970s, to encompass mainly lowland forest, the gorilla population must be much higher. As with Parc National de Maiko, surveillance of the lowland forest extension is almost non-existent and many people use and even occupy the park. Furthermore dense human populations live along the eastern boundary of the park and to a lesser extent along parts of the northern and southern boundaries. A German Technical Aid (GTZ) project, launched in 1985, is giving technical assistance to the park and helping revitalize the tourism program based on gorilla viewing which has existed since the early 1970s.

Parc National des Virungas is unique in that it is the only park which contains both eastern subspecies of gorilla. The *G. g. graueri* gorillas occur on Mount Tschiaberimu, situated in the northern sector of the park on the western escarpment of the Albertine Rift at the northern end of Lake Edward. This 30 - 40 km² patch of montane forest was, until recently, connected to the vast area of montane and lowland forest to the west. Over the last five years, forest clearance for agriculture and pasture has resulted in the almost complete isolation of this area from the main forest block. Mount Tschiaberimu comprises mainly bamboo forest above 2,600 m, with montane forest on the northern, western and eastern slopes down to 2,100 m. Gold digging along all the streams in the bamboo zone has been intensive, causing serious but localized damage to the habitat. Hunting of many species, including gorillas, has also taken place. Two surveys were made of the region in January and April, 1986, and a total of three gorilla families and one lone silverback were found, representing 25-30 animals. All the gorillas were in the most dense bamboo thickets, even during the dry season when the bamboo was not producing shoots. In view of the intense human pressures in and around this section of the park, the number of surviving animals is encouraging. The count is a minimum one and it is likely that not all the gorillas on the mountain were located. Gold prospecting has now been stopped, the project has provided the guards with uniforms and equipment, and regular surveillance of the area has restarted. Monitoring of this population by the project will continue.

Many pockets of mixed montane forest and secondary vegetation exist in the intensively cultivated highlands of the Kivu region to the west of the Albertine Rift, and in some areas gorillas seem to thrive in this

mixed habitat. One such area is worth mentioning to illustrate the point. About 60 km to the west of the southern sector of the Parc National des Virungas, is an intensively cultivated area of land around the Shingisha and Mabeshe Hills in the Masisi highlands. The area comprises cattle ranches, tea plantations and small-scale local farming. About ten years ago, the owner of a cattle ranch decided to try to protect the gorillas using the area, and encouraged the local people to do the same. His efforts have resulted in the extraordinary situation of an increasing gorilla population in an area intensively populated by humans. The gorillas now exist mostly in the fallow fields, eating the abundant *Pennisetum* grass (elephant grass) and supplementing their diet with wild banana stems, vines and various other plant species to be found in the tiny forest remnants. They often nest no more than 30 m from the houses and can be seen crossing fields of beans or maize, without feeding on them, to get from one fallow field to the next. The gorillas have even been observed in pastures among the cattle, as have chimpanzees which are abundant in the area. The gorillas have also been seen eating the bark of *eucalyptus* trees, an exotic species introduced only about 60 years ago. Inevitably the gorillas have become partially habituated to humans and can easily be observed. Unfortunately, their long-term prospects are not good as increasingly intensive land use leaves fewer fields fallow, and the gorillas will probably either die out or be forced back into the neighboring large tracts of relatively undisturbed forest. At present about 70 gorillas live in this area of about 30 km², inhabited by perhaps 5,000 - 10,000 people. The people cannot relocate so there seems little hope of implementing any worthwhile protection measures for the area, but the case is an interesting example of the adaptability of this great ape.

Outlook for Conservation of Eastern Gorillas

The Zaire project is two years into a three year agreement, but is likely to be extended in both span and scope. An environmental education program is being launched this year, initially targeting the populations around the parks of Virunga and Kahuzi-Biega. Meanwhile the program of practical assistance to the Institut Zairois pour la Conservation de la Nature will continue to consolidate current conservation measures and initiate new ones for both subspecies.

Those parts of the *G. g. beringei* population in adjacent countries will benefit from the continuing Mountain Gorilla Project in Rwanda, and the Bwindi Forest Conservation Project due to start this year in Uganda. The willingness of the national authorities of Zaire, Uganda, and Rwanda, and the international conservation organizations to cooperate in conservation of the mountain gorilla is demonstrated by the Virunga census just completed, and is, of course, vital for this highly endangered subspecies.

It is well known that national parks in Zaire have suffered a period of decline over the last 6 - 8 years, through lack of funds and general mismanagement. However, with the appointment in 1985 of a dynamic and dedicated new Director of Parks, Citoyen Mankoto ma Mbaelele, the outlook for conservation has taken a dramatic turn for the better. The lowest paid guard, who in 1985 was earning U.S. $3/month (often several months late), now earns five or six times that amount, and further salary increases are planned for 1987. Misuse of park revenue is slowly being curbed with the result that more will be available to equip and run the parks. With renewed confidence in the new regime, international conservation organizations are beginning to look again at Zaire as a worthwhile place to invest conservation funds. The Institut Zairois pour la Conservation de la Nature faces enormous problems and urgently needs the help of international organizations in its task of preserving perhaps the greatest diversity of habitats to be found in any country in Africa.

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Conservation Efforts at the Tana River Primate Reserve, Kenya

by James G. Else

Introduction

Two endangered African primate subspecies, the Tana River red colobus *(Colobus badius rufomitratus)* and the Tana River crested mangabey *(Cercocebus galeritus galeritus)*, are found in small galley forest patches along the lower Tana River (mainly within the Tana River Primate Reserve) in Eastern Kenya (Fig. 1). These two subspecies, together with a subspecies of the Sykes monkey *(Cercopithecus mitis albotorquatus)* are found only in the Tana area, and represent the only primates endemic to Kenya (Kingdon, 1971).

In 1985, C. Marsh resurveyed the status of the red colobus and crested mangabey, and the Tana Reserve in general (Marsh, 1985). At the same time, J. Allaway undertook an evaluation of the Bura Irrigation Scheme, situated upriver from the reserve, to assess adverse effects of the scheme on natural resources (Allaway, 1985). Both reports expressed concern over the apparent deterioration of the Tana Reserve, and strongly recommended that an action plan be initiated to evaluate thoroughly the reserve's status, and ascertain reasons for the decline in the vegetation and primate populations. This was seen as the first step in the development of a management program for the reserve, including the acquisition of funds for the Wildlife Conservation and Management Department (WCMD), Ministry of Tourism and Wildlife, Kenya, to strengthen reserve facilities.

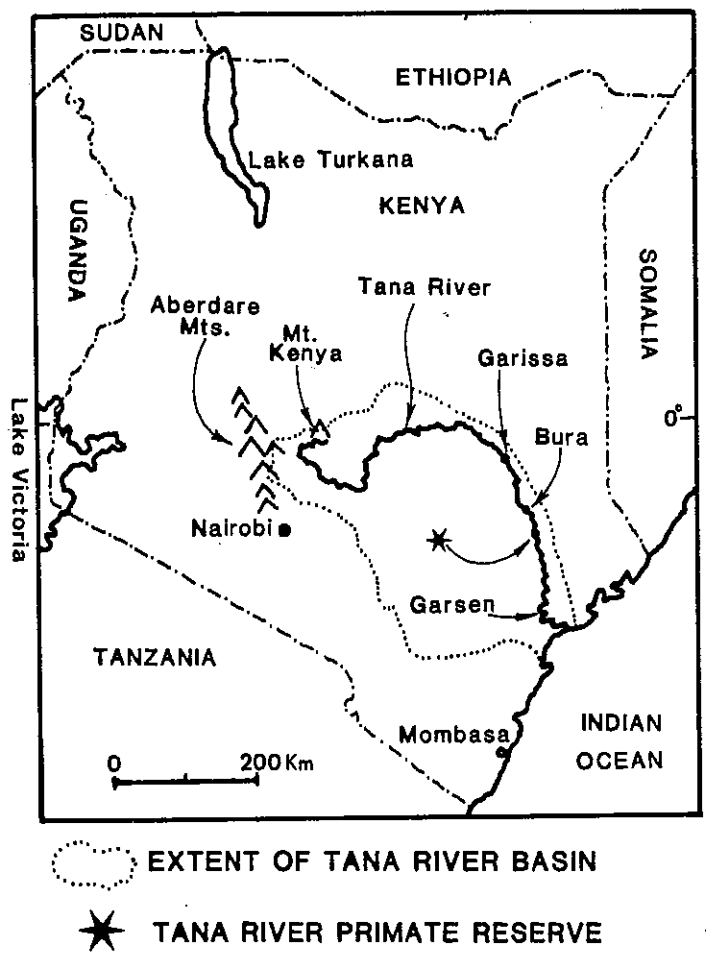


Fig. 1. Location of the Tana River Primate Reserve in Kenya (map by S.D. Nash based on author's original).

Since primates are a central issue, and can be used as "indicators" of the reserve's status, the Institute of Primate Research (IPR), which is part of the National Museums of Kenya (NMK), is working with WCMD to effect these recommendations.

Current Reserve Status and Project Objectives

A significant amount of background information is available for primates in the lower Tana region. Early population estimates, the ecology and social organization for both the Tana mangabey (Homewood, 1976; 1978) and colobus (Marsh 1981a, b, c) are well documented. A proposed management plan for the establishment of the Tana Primate Reserve was prepared (Marsh, 1976), and the area subsequently gazetted as a National Reserve later that year.

In the ten years since the establishment of the Tana River Primate Reserve, the crested mangabey and red colobus populations have declined by an estimated 25% and 83% respectively (Marsh, 1986). There has also been a significant decline in several major tree species, many of which comprise a major portion of the primates' diets. Explanations for the population declines include poaching, disease, interspecific primate competition, drought, and forest senescence. Forest change due to poor tree regeneration and reduction in primate food supply appear to be the most probable explanations (Marsh, 1986).

A series of research studies, designed to address the primate decline, have been initiated. The overall objectives of these projects are as follows.

1. Assessment of the regional ecology of the Tana area and determination of the impact of human development (Tana River dams, Bura Irrigation Scheme, and human activity bordering the reserve).
2. A vegetational survey of the reserve to learn the forest condition, regeneration and succession.
3. A census of primate populations in the reserve with a view of documenting which populations have declined.
4. Determination of the reason(s) for the decline in primate populations.
5. Investigation of current primate population trends and responses to vegetational changes.
6. Development of a series of recommendations for an overall management plan for the Tana Reserve based on project findings.
7. Upon the finalization and approval of a management plan, the application for funding to effect such a plan.

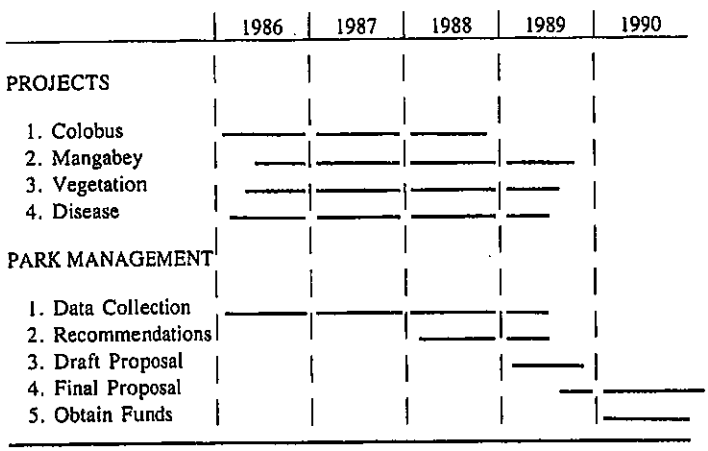
Ongoing Projects and Scientific Personnel

Four separate but closely related studies are initially to be undertaken.

1. Red Colobus Ecology: Feeding, ranging, group counts and composition (survey), social behavior, reproduction, time budgets; phenology of selected food tree species within major study site/forest block; tree enumeration within major study area, including some data on regeneration.
2. Crested Mangabey Ecology: Same as for red colobus above; three sites to be selected for intensive study with brief surveys in as many other forest blocks as possible.
3. Vegetation Survey: Broad coverage of regeneration in as many forest blocks as possible, including phenology; experimental regeneration; trial implementation of planting.
4. Disease Survey: General screening of faeces from study animals to determine parasite burdens. Animals which die during the study period will be thoroughly necropsied and tissue samples collected. It is hoped that a select number of animals can be trapped and immediately released so that blood can be collected.

The above projects should provide communal data on plant enumeration and phenology, primate censuses (group counts and composition) and ecology, and diseases. All project information will be used in the preparation of a joint document which will be the basis for a proposed conservation action plan for the management of the Tana Reserve. The time frame for all projects and the development of a management plan is given in Table 1.

Table 1. Tana Project Time Frame



Kenyan Participation and Training

The involvement of Kenyan scientists is crucial to the success of the Tana Project and implementation of the recommended long-term policies. The project has been designed so that each foreign participant will have a Kenyan counterpart.

Proposed and ongoing training activities are as follows:

1. Five recent University graduates from WCMD are being assigned to the Tana Project on a two-week rotational basis. This will provide the participants with practical wildlife management experience and expose them to applied research. If any of the candidates prove to be especially suited to the Tana Project, he or she could be assigned to the study on a permanent basis or be supported for graduate studies.
2. A 1986 University of Nairobi Zoology Graduate has been recruited and assigned to the red colobus study. He will spend one year at the reserve, gaining practical experience, and then enroll for a MSc at the Zoology Department, University of Nairobi.
3. Two 1987 graduates in Zoology and Botany will be identified to work on the Crested Mangabey Project and Vegetational Project respectively. They will be enrolled into MSc programs at a Kenyan University.

Project Management and Funding

A scientific advisory committee has been formed to oversee the development of the Tana Project and supervise the individual studies. This is made up of six individuals, representing NMK, WCMD, World Wildlife Fund, New York Zoological Society and Emory University.

This multidisciplinary project will be funded from a variety of sources. Funds have been granted for the establishment of a permanent research camp, recurrent camp expenditures, vehicles and salary support for overseas and Kenyan scientists and students. Institutions and agencies that have committed substantial funds and/or personnel include NMK, WCMD, New York Zoological Society, World Wildlife Fund, Yerkes Regional Primate Research Center and Emory University.

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The Values and Problems of Wildlife Conservation in Tanzania

by Samuel K. Wasser

Tanzania is unique among the nations of Africa and the world in terms of the amount of land it has devoted to wildlife conservation, and in the abundance and diversity of animals found there. Twenty-five percent of Tanzania's land is conserved: 5% in national parks, 10% in game reserves, 10% in forest reserves (Borner and Maregesi, 1985). This includes huge areas such as Serengeti National Park (14,504 km²), Ruaha National Park (12,950 km²), and Selous Game Reserve (51,800 km² — the largest conservation area in Africa and the second largest in the world). These wildlife areas contain awe inspiring amounts of wildlife. The northern Arusha region alone, bordered on the west by the Serengeti and extending east to include Mt. Kilimanjaro, contains more wildlife than the whole of Kenya (Ecosystems Ltd., 1985). Moreover, despite being one of the poorest nations in the world, Tanzania currently gives approximately three times more of its GNP to conservation than does the U.S. (Borner and Maregesi, 1985).

The moist forests of Tanzania provide another unique and often unrecognized resource. These forests, covering 10,000 km² or 1-2% of Tanzania (Lovett, 1985), are some of the biogeographically most interesting in the world. Both Tanzania and Kenya are extremely arid countries with nearly half of Tanzania receiving less than 760 mm of rain annually, and 96% of the country less than 1,270 mm (Griffiths, 1972). However, along the eastern sides of Kenya and Tanzania lies a discontinuous arc of block-fault mountains, over 100 million years old (Griffith, in press). Moist air coming from the Indian Ocean rises and cools to release up to 3,000 mm of fairly evenly distributed rainfall annually. The result is an arc of montane forest islands, each surrounded by a sea of arid land. The plants and animals in these ancient, highly stable forests have been evolving independently for tens of thousands of years. Consequently, astounding rates of endemism in nearly every taxonomic group examined, including the primates, are being discovered (Lovett and Wasser, in press). The southern mountains in the arc which lie in Tanzania are the richest in numbers of species and endemics. Because of this, Tanzania's forests have now become internationally recognized as one of the eleven key areas in the world for biological inventory. One-fourth of the 2,000 forest plant species are endemic (Lovett, 1985); and there are 31 species of endemic amphibians, 18 species of endemic lizards, 9 species of endemic snakes (Howell, in press), 10 species of endemic birds (Stuart, 1981) including the recently discovered rufous-winged sunbird (*Nectarinia rufipennis*; Jensen, 1983) found only in the Uzungwa Mountains, and at least five species and many subspecies of endemic mammals. The endemic mammals include three subspecies of primates: the Zanzibar red colobus (*Colobus badius kirkii*) of Zanzibar Island, the Iringa red colobus (*C. b. gordonorum*) of the Uzungwa Mountains and the Southern Highlands (both of these colobus are sometimes considered distinct species), and the Sanje crested mangabey (*Cercocebus galeritus sanjei*) restricted to the Uzungwa Mountains (Homewood and Rogers, 1981).

The high levels of endemism in the Tanzanian forests are believed to be due to their role as forest refuges, the result of their exposure to moist southeast monsoon winds during the aridity of glacial periods (Rodgers, Owen and Homewood, 1982). The Uzungwa Mountains are particularly rich, being the only mountains in the eastern arc chain that contain unbroken forest cover from 300 to 2,600 m. This altitudinal range has probably contributed greatly to the relatively high species richness (Rodgers and Homewood, 1982), perhaps by reducing rates of competitive exclusion (see Kingdon, 1981).

Given the biological value of the Uzungwa Mountains, efforts were initiated several years ago by Alan Rodgers to make the area a national park. The Tanzanian National Parks and their Ministry of Natural Resources Division of Forestry have now agreed on the Uzungwa Forest as a national park, and it will begin operating as such as soon as funds are available.

Tanzania, however, faces serious difficulties in the long-term conservation of its rich wildlife resources. As already mentioned, it is one of the poorest nations in the world. This very poverty may have helped its wildlife to remain the spectacle that it is today, but pressures on wildlife are growing. The current rate of population increase is 3.5% annually. There is an increasing demand for imported goods, for which importers need foreign currency. Accordingly, the black market value of the dollar has soared, causing merchants to raise their prices. Worse yet, average wages have not changed in response. They remain a mere US$35.00 per month, not much when a kilo of meat costs $3.50.

The above pattern, coupled with the world market for trophies, has made exploitation of Tanzania's wildlife a lucrative alternative. Wildlife can provide vast quantities of meat and orders of magnitude more money from the sale of products such as ivory and rhino horn than can be made from legal wages. Not surprisingly, poaching now occurs at record levels in Tanzania. Poachers have decimated the rhino population and cut the elephant population in half over the last ten years. They have also killed hundreds of buffalo and hippo for meat. Poaching operations are being fortified by large sums of money from abroad, and a new breed of poacher is emerging as a result. Instead of bows and arrows, poachers now use large calibre automatic weapons and fruits laced with high potency poisons. The government is poorly equipped to prevent this poaching and lacks foreign currency to buy fuel, spare parts, and ammunition. Worse yet, antipoaching rangers stand to gain greatly from colluding with the poachers either by telling them where patrols will be, or by poaching themselves. This corruption of duty is thought to be a serious and growing problem.

The conservation of forest wildlife presents somewhat different problems. Direct poaching does not seem to be the most serious problem threatening forest monkeys. There is currently little value for their skins and other game are easier to kill for meat (although tree-hyrax snares do not discriminate against young mangabeys). The biggest problem facing forest wildlife in Tanzania is destruction of its habitat. In some areas of Tanzania, forest is being reduced at a rate of 25% annually. Although theoretically much of the country's moist forest is protected in forest reserves, in fact the Forest Division lacks the resources to enforce this.

Montane forests act like giant sponges producing a rich continuous flow of water to the land below. The forest in these lowland areas are the first to be cleared for agriculture. Firewood and building material such as poles and insect-resistant lumber is taken legally and poached from the montane forest. Later, the montane forest also becomes attractive to settlers.

Despite these problems, Tanzania still has tremendous conservation potential. Tourism could undoubtedly generate enough foreign currency to justify wildlife conservation in Tanzania to Tanzanians. Tourism is currently at only 40% of its level when the Tanzanian-Kenyan border was closed in 1977 (Ecosystems Ltd., 1985). The national parks have more than enough land and animals to accommodate tourists with low impact on the conserved habitats. There are also still vast amounts of arable land that can be utilized long before national park land is severely threatened (although forest land, some game migratory routes, and the western corridor of the Serengeti may provide exceptions to this).

The people of Tanzania are also beginning to understand the water-catchment value of forests, as well as the need to provide acceptable alternative sources of building materials and firewood such as tree plantations (Final Report of "Forests are Wealth" Campaign, Tanzania, 1982). Local tree planting projects have already been started that offer enormous potential.

The high endemism in Tanzanian forests obviously provides a potential reservoir of genetic diversity for cash crops, both for Tanzania and the world. Forty percent of the world's wild *Coffea* plant species are found in Tanzania's forests, and 25% can only be found there. This constitutes a large portion of the genetic reserves for the world's coffee (Brid-

son, 1982). The genus *Saintpaulia*, which includes the African violet, is only found in eastern Kenya and Tanzania; and 18 of these 23 wild species, including the African violet, are restricted to Tanzanian forests (Lovett, 1985). Tanzania's forest plant species could provide an enormous resource for production of medicines as well.

In conclusion, the long-term value of conserving resources in Tanzania is high, both for people of the western world as well as for the people of Tanzania. To successfully conserve these valuable resources, at least three issues must be addressed. First, the Tanzanian people must be convinced of the need to act now, before the current levels of destruction lower the value of the resources to a degree that makes them no longer worth conserving. This needs education, and studies have shown that radio and newspapers are among the best vehicles for this (Johnson, 1983). Second, Tanzania needs money for tree plantations and to initiate local interest and training for their maintenance and operation. Perhaps most acutely, Tanzania desperately needs funds for antipoaching operations, including ranger incentive programs. Lastly, international pressure must be applied to outside nations to end the world market for all wildlife products, such as horns and ivory. No matter how hard Tanzania tries, its efforts will only be successful if coupled with such pressures from outside. While the major trophy animals are not primates, the effective conservation of all Tanzania's resources will only come about through the widespread adoption of a conservation ethic. This will not be achieved while current poaching levels and their local acceptance continue.

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Conservation Status and Distribution of Lemurs in the West and Northwest of Madagascar

by Jean-Jacques Petter and Fanantenana Andriatsarafara

Western Madagascar includes two different climatic zones: in the north a very limited and moister zone called the *Sambirano*, and in the south a very wide and dryer zone. The climate is characterized by two distinctive seasons: five months of very warm weather and frequent storms (Nov.-March) and seven months of severe dryness (April-Oct.).

The vegetation does not vary much from north to south, but changes dramatically from east to west according to geological strata and rainfall which progressively decreases. The Malagasy lemurs have responded to this climatic variation by either specializing to micro habitats which meet their metabolic requirements (Cheirogaleidae in coastal zones and gallery forests) or by speciating.

La Faune de Madagascar (1977) includes twelve maps of lemur distribution which continue to be accurate for the West in spite of the great reduction in forested area. Since 1970, little new information has been added to this work. We will outline here some of the new data gathered since this work was published, and some of the most important questions remaining.

Fig. 1. *Phaner furcifer* from Analabe Reserve (photo by R. A. Mittermeier).

Cheirogaleus

A persistent problem with this group is whether *Cheirogaleus medius* and *Cheirogaleus major* are sympatric in any part of their ranges. *Cheirogaleus major crossleyi* is a typical form of the East, whereas *Cheirogaleus medius* lives in the West and South. Recently, some *Cheirogaleus major* have been caught on the Massif of Bongolava, northwest of Tsiroanomandidy where *Cheirogaleus medius* probably occur. *Cheirogaleus major* is also likely to be present in the forest of Ankarafantsika where *Cheirogaleus medius* is abundant.

Microcebus

Similarly to the cheirogaleids, *Microcebus murinus rufus* from the East has been seen in the West in the forests of Ankarafantsika and Morondava where *Microcebus murinug murinus* occurs.

Microcebus coquereli has a distribution almost identical to *Phaner's* in the West, except perhaps to the south where Mangoky acts as a limit. *M. coquereli* has not been observed in the North nor in the East. We do not know whether it is present in remaining forests of Bemaraha.

Phaner

Phaner (Fig. 1) has dispersed far north and even into the northeast, where we have seen it in the forest of Cape Masoala. We do not know if this species can be found on the slopes of Tsaratanana. On the western coast, its distribution is rather disjunct.

A specimen from Leyden Museum, collected by Audebert, is greyer and nearly twice as large as the specimens from Morondava. We can not find the locality given, *Passume Est de Madagascar*, on the map; possibly it is *Ampasimbe* situated between Nosy-Varika and Ambositra, an area still very poorly known. If the size of the museum specimen is accurate, a larger species may still exist in the forest of this area.

Recently, *Phaner* was found in the Bemaraha and east of Sakaraha in the forest of Zombitsy (G. Randrianasolo, pers. comm.), but we do not yet know whether it exists further north. Its presence between the Tsiribihina and Manambolo Rivers should be confirmed.

Daubentonia

Daubentonia madagascariensis was recorded on the Ampasindava Peninsula in 1931 by the Franco-Anglo-American Expedition. An animal was killed in 1957 near the village of Ambaliha. Much earlier, Kaudern (1914) pointed out *Daubentonia's* probable presence in the forest of Ankarafantsika on the right bank of the Betsiboka. At the present time we know it exists in the Bemaraha. In October 1985, G. Randrianasolo reported that the guard of Antsalova Reserve found an aye-aye half-consumed by dogs.

In the North, there are reports of aye-aye to the east of Montagne d'Ambre. We have found signs of the species outside a village near the little forest of Sahafary.

It seems possible that a few aye-ayes can still be found in the area between Ambilobe and Analalava and also in the dampest forests of Antsalova. As this animal is threatened with extinction directly, and indirectly by the disappearance of forests, everywhere within its range, it would be desirable if animals are caught to put them into protected areas such as the Lokobe Reserve at Nosy-Be or the Ambohitantely Reserve.

Lemur

Eight kinds of lemur are present in the West: *Lemur coronatus* and *Lemur fulvus sanfordi* farthest to the North, *Lemur macaco macaco* (Fig. 2) and *L. m. flavifrons* in the *Sambirano*, *Lemur mongoz*, *Lemur fulvus fulvus* (light form), *L. f. rufus* (Fig. 3) and *L. catta* more in the South.

Lemur mongoz, which existed all along the Betsiboka River, can still be found around Kinkony Lake and Ampijoroa Lake in the forest of Ankarafantsika. No information is available on its distribution in the rest of this forest. The species may also exist on a quite lonely holy mountain, Vohilena Mountain, where it is *fady* (sacred), near the source of an affluent of the Betsiboka to the north of Anjorobe.

In 1984, A. Peyreiras met with a small group of *Lemur macaco flavifrons* between Maromandia and Befotaka. The range of this species may now be limited to a few patches of forest along the road and westward to Analalava. The southern limit may be the small Maevarano River. *L. m. flavifrons* might exist also in the forest situated about 30 km to the east of this road, but this remains to be checked.

Fig. 2. *Lemur macaco* **female (above) and male (right) from Nosy Komba (photo by R. A. Mittermeier).**

Fig. 3. *Lemur fulvus rufus* **from the Analabe Reserve near Morondava (photo by R. A. Mittermeier).**

Between Antsohihy and Befandriana, *Lemur fulvus fulvus* is present. This subspecies also exists on the plateau of Bealanana (near Bemanelika at 1,800 m).

Nothing is known about which species exist west of Tsaratanana.

Hapalemur

Hapalemur griseus occidentalis has been found in two zones in the West: near Bemamba Lake to the north of the Manambolo River, and in the forest of Ambanja as well as Ampasindava Peninsula. This animal could also exist in several other areas in the West.

Lepilemur

The western distribution of *Lepilemur* (Fig. 4) has not been examined since 1977. A very large animal was seen in Tsaratanana Reserve a few years ago, but there is not enough information to determine whether this is a distinct form.

Avahi

Avahi laniger occidentalis (Fig. 5) appears to be restricted to an area including Ankarafantsika Reserve and the forests farther to the north of the Sofia River, although this should be verified.

Propithecus

Among the five subspecies of *Propithecus verreauxi* in the West, *Propithecus v. coronatus* seems to be the most threatened. It lives only in a small area between the lower Betsiboka and Mahavavy Rivers, where some forest remains. It also survives in the last patches of forest extending to the south through the area of Tsiroanomandidy.

Some of the animals in this area are severely threatened and could be caught and released into Ambohitantely Reserve, which is more seriously protected and where the species existed about twenty years ago.

P. v. deckeni has been reported present around Kinkony Lake, southwest of Majunga. This report extends its distribution to the south.

Fig. 4. *Lepilemur edwardsi* from Ampijoroa in the Ankarafantsika Reserve, one of the *Lepilemur* spp. found in the western forests (photo by R. A. Mittermeier).

Fig. 6. *Propithecus verreauxi coquereli* from Ampijoroa in the Ankarafantsika Reserve (photo by R. A. Mittermeier).

Fig. 5. *Avahi laniger occidentalis* (photo by J.-J. Petter).

P. v. coquereli (Fig. 6) has been reported present between Antsohihy and Befandriana, a range extension to the north. It is not known why *P. verreauxi* has not been found north of this area.

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Asia

Priorities in Asian Primate Conservation

by Ardith A. Eudey

Introduction

A number of factors set Asia's primates apart from the primate faunas found elsewhere in the world. To a degree that is not exhibited by other primates, Asian species play significant roles not only in rain forest ecosystems but also in a variety of arid and especially temperate ecosystems. They also are found in significant numbers and kinds in island as well as continental areas. There is no other region where commensalism between other primates and humans is so well established. This is, in part, a consequence of the toleration and respect (or at least avoidance) that has been afforded primates and sometimes all animals by several of Asia's great religions, although this toleration may be breaking down as secularism becomes more widespread. The following factors also combine to present unique problems for conserving primates and maintaining their diversity in Asia: heavy trapping for export, with Asia being the overall major supplier of primates for biomedical research during this century (Mack and Mittermeier, 1984); guerrilla warfare and saturation bombing; excessive habitat destruction, including commercial exploitation of forests to obtain hardwoods for plywood and veneers (Myers, 1980); and general high levels of population pressure, which have existed in some areas for centuries.

The Asian Action Plan

For over three years, I have been compiling what has become the Action Plan for Asian Primate Conservation for the period 1987-1991. This compendium is one of four regional action plans being prepared under the auspices of the Primate Specialist Group of IUCN's Species Survival Commission. The African Action Plan, which was compiled by J.F. Oates, was published in 1985. More than 50 primatologists and conservationists have contributed to the Asian Action Plan, which was published in February, 1987, and is now being distributed.

Two major problems have had to be addressed in the preparation of the Asian Action Plan: (1) adoption of a classification for Asian primates, and (2) identification of distinct communities and ecosystems for the conservation of Asian primates.

Conservation Priority Ratings for Asian Primate Species

Sixty-three species representing perhaps as many as 14 genera are recognized provisionally in the Asian Action Plan, but the actual diversity of Asian primates on both the generic and specific levels remains to be established. The Asian Colobinae, as is true also for the African assemblage of the subfamily (see Oates, 1985), has no generally accepted classification, but all recent classifications do make a distinction between a group of "odd-nosed" and other colobine monkeys. The assemblage of Asian colobine monkeys that have been regarded as congeneric and assigned to *Presbytis* (see, for example, Napier, 1985) appears to be most seriously in need of revision (Weitzel, 1983; Brandon-Jones, 1984; Weitzel *et al.*, in press). Groves' multigeneric model, that along with *Presbytis* resurrects *Semnopithecus* and *Trachypithecus* (including *Kasi*), tentatively has been adopted. Brandon-Jones (1984) calls the former "surelis" and the latter "langurs" and "leaf monkeys" respectively, but the name sureli may not be entirely satisfactory. To a lesser extent, the classification of the Hylobatidae also is problematic. The classification accepted in the Asian Action Plan is that used by Haimoff *et al.* (1984) and Marshall and Sugardjito (1986), in which *Symphalangus* is synonymized with *Hylobates* and nine lesser ape species are recognized. The five species generally recognized in the field for the lar group are accepted in this system. Dao (1983) proposes, however, that the subspecies assigned to *H. concolor* actually represent two species, *H. concolor* and *H. leucogenys*. Likewise, *Tarsius* may consist of more than the three commonly recognized species. Niemitz (1984) suggests, for example, that there may be two species on Sulawesi, *T. spectrum* and *T. pumilus*. The primate species provisionally accepted in the Asian Action Plan are listed in Table 1.

Asian primate species, following Oates (1985), have been rated for conservation action according to three parameters: (1) degree of threat to population, (2) taxonomic uniqueness of species, and (3) association of species with other threatened forms. Thirty-seven species (59% of all Asian species) are judged to need some kind of conservation action, and an additional 15 species are regarded as vulnerable. The species with high conservation priority ratings are identified in Table 2.

Biogeographical Regions

The greatest diversity of primates in Asia is found in equatorial Sundaland, which consists of more than 13,000 islands and the Malay Peninsula and contains the most extensive moist evergreen forest in Asia (see Fig. 1). At least 26 primate species occur within this region, including the only Asian member of the Pongidae (the orang-utan, *Pongo pygmaeus*) and six of the nine lesser apes. Much of the island dispersal of Asian primates appears to be associated with eustatic fluctuations of sea level during the Quaternary, and the diversity of primates remains to be established for many areas, especially for Sundaland. When Sundaland was exposed, the most recent episode ending about 10,000 years ago, species could have dispersed widely and, as a consequence, species (and subspecies) boundaries are not necessarily coincident with island boundaries. Deep and wide river valleys ran between the present-day islands, however, and may have contributed to the isolation of populations (see Verstappen, 1975).

On the mainland, a second region of species diversity is the series of mountain ranges characterized by moist deciduous forest that extends into southern Asia from the Yunnan Plateau in China (see Fig. 1). These ranges include the Annamitic Cordillera, Dawna Range, and the series of mountains south of the Brahmaputra River and extending eastward, including the Khasi, Lushai, and Chin Hills. Quaternary glacial phenomena also appear to have caused considerable climatic and environmental change in continental southeast Asia (see Verstappen, 1975). The emergence of the Sunda and Sahul shelves with eustatic lowering of sea level contributed to a continental climate with lower precipitation and a longer dry season and a corresponding reduction of rain forest, resulting in habitat discontinuities that may have contributed to differentiation of populations.

The task of identifying distinct communities and ecosystems for the conservation of Asian primates is in a preliminary stage. For the Asian Action Plan, primary reliance was placed on the system of biogeographical realms and provinces (ecosystematic or biotic subdivisions of the former) developed on the basis of vegetation types by Udvardy (1975, 1985). Supplementary information was derived from Hou (1983) and Marsh (1987). Most species occur within the Indomalayan Realm in moist evergreen and moist deciduous forest south of the Himalaya chain and continuing Sichuan (Szechwan) mountains. The ranges of some primates extend into the Palaearctic Realm, while some other species are found exclusively in this realm in east Asia.

In the Asian Action Plan three types of ecosystem are identified as being of particular importance for conservation action and maintaining diversity: (1) those containing many species, (2) those with high levels of species endemism, and (3) those containing marginal populations, sometimes of widely distributed species, under extreme selection pressure.

Table 1. List of Asian Primate Species

Species	Common Name
Family Lorisidae	
Subfamily Lorisinae	
Loris tardigradus	Slender loris
Nycticebus coucang	Slow loris
Nycticebus pygmaeus	Pygmy loris
Family Tarsiidae	
Tarsius bancanus	Western or Horsfield's tarsier
Tarsius pumilus	Lesser spectral tarsier
Tarsius spectrum	Spectral or Sulawesi tarsier
Tarsius syrichta	Philippine tarsier
Family Cercopithecidae	
Subfamily Cercopithecinae	
Papio hamadryas	Hamadryas baboon
silenus-sylvanus group	
Macaca silenus	Lion-tailed macaque
Macaca nemestrina	Pigtail macaque
Macaca maura	Moor macaque
Macaca nigra	Celebes black macaque
Macaca nigrescens	Gorontalo macaque
Macaca ochreata	Booted macaque
Macaca brunnescens	Muna-butung macaque
Macaca tonkeana	Tonkean macaque
Macaca hecki	Heck's macaque
Macaca pagensis	Mentawai macaque
sinica group	
Macaca sinica	Toque macaque
Macaca radiata	Bonnet macaque
Macaca assamensis	Assamese macaque
Macaca thibetana	Tibetan macaque
fascicularis group	
Macaca fascicularis	Long-tailed or crab-eating macaque
Macaca mulatta	Rhesus macaque
Macaca cyclopis	Formosan rock or Taiwan macaque
Macaca fuscata	Japanese macaque
arctoides group	
Macaca arctoides	Stumptail or bear macaque
Subfamily Colobinae	
Semnopithecus entellus	Common, Hanuman or Himalayan langur
Presbytis comata	Grizzled leaf monkey
Presbytis femoralis	Banded leaf monkey
Presbytis frontata	White-fronted leaf monkey
Presbytis hosei	Hose's leaf monkey
Presbytis melalophos	Mitred leaf monkey
Presbytis potenziani	Mentawai leaf monkey
Presbytis rubicunda	Maroon leaf monkey
Presbytis thomasi	Thomas' leaf monkey
Kasi	
Trachypithecus vetulus	Purple-faced leaf monkey
Trachypithecus johnii	Nilgiri or John's leaf monkey
Trachypithecus	
Trachypithecus auratus	Ebony leaf monkey
Trachypithecus cristatus	Silvered leaf monkey
Trachypithecus francoisi	Francois' or Tonkin leaf monkey
Trachypithecus geei	Golden leaf monkey
Trachypithecus obscurus	Dusky or spectacled leaf monkey
Trachypithecus phayrei	Phayre's leaf monkey
Trachypithecus pileatus	Capped leaf monkey
"Odd-nosed" colobines	
Nasalis larvatus	Proboscis monkey
Simias concolor	Pig-tailed snub-nosed monkey
Pygathrix nemaeus	Red-shanked Douc monkey
Pygathrix nigripes	Black-shanked or black-footed Douc monkey
Rhinopithecus avunculus	Tonkin snub-nosed monkey
Rhinopithecus roxellana[1]	Sichuan golden snub-nosed monkey
Rhinopithecus bieti	Black or Yunnan snub-nosed monkey
Rhinopithecus brelichi	Gray or Guizhou snub-nosed monkey
Family Hylobatidae	
Nomascus	
Hylobates concolor	Black, crested or light-cheeked gibbon
Symphalangus	
Hylobates syndactylus	Siamang
Bunopithecus	
Hylobates hoolock	Hoolock or white-browed gibbon
Hylobates	
Hylobates klossii	Kloss's gibbon
Hylobates moloch	Silvery or moloch gibbon
Hylobates pileatus	Pileated or capped gibbon
Hylobates agilis	Agile gibbon
Hylobates lar	Lar gibbon
Hylobates muelleri	Müller's, Bornean or gray gibbon
Family Pongidae	
Pongo pygmaeus	Orang-utan

1. The addition of the "e" to the species-group name *"roxellana"* is an unjustified emendation not present in the original spelling (D. Brandon-Jones, pers. comm. 1986).

Table 2. Asian Species with High Conservation Priority Ratings

Highest Priority Rating

Simias concolor
Rhinopithecus avunculus
Rhinopithecus bieti
Rhinopithecus brelichi

Pygathrix nemaeus
Pygathrix nigripes
Hylobates moloch

Very High Conservation Rating

Nycticebus pygmaeus
Macaca silenus
Macaca pagensis
Presbytis comata
Trachypithecus francoisi
Nasalis larvatus
Rhinopithecus roxellana
Hylobates concolor
Hylobates klossii
Pongo pygmaeus

High Priority Rating

Tarsius pumilus
Tarsius spectrum
Tarsius syrichta
Macaca maura
Macaca ochreata
Macaca brunnescens
Macaca tonkeana
Macaca hecki
Macaca thibetana
Presbytis potenziani
Trachypithecus johnii
Hylobates hoolock
Hylobates pileatus

Priority Rating

Loris tardigradus
Macaca nigra
Macaca nigrescens
Macaca cyclopis
Macaca fuscata
Macaca arctoides
Trachypithecus vetulus

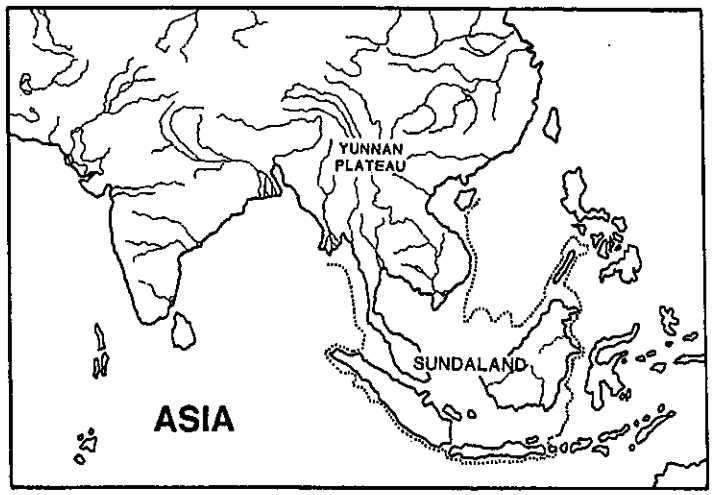

Fig. 1. Equatorial Sundaland and the mountain chains and rivers of continental southeast Asia emanating from the Yunnan Plateau (map by S.D. Nash from author's original).

Conservation Action

Four kinds of projects have been identified as necessary for conservation action for Asian primates: (1) countrywide surveys to determine potential reserve areas, (2) regional and species-oriented surveys to determine potential reserve areas, (3) reserve development and management projects, and (4) special projects, such as monitoring the effects of trapping for trade, translocation, and developing alternative methods to pest control. The projects in each category have been prioritized relative to one another. The goal of primate conservation in Asia, as elsewhere, should be to establish and effectively manage reserves to promote the long-term survival of endangered populations and communities, especially those with high levels of species diversity or species endemism. Surveys are still needed in some Asian countries to determine where such reserves should be declared.

The long-term success of any conservation efforts for primates in Asia will depend on the extent to which nationals are involved as investigators and implementors and, likewise, the extent to which local people benefit directly (e.g., monetarily) or indirectly (e.g., watershed protection) from specific actions. Those projects that offer an opportunity for the in-country training of primatologists and wildlife biologists, especially those that include field research programs affiliated with local universities and/or wildlife conservation agencies, should receive special attention.

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Conservation Status of Primates in Malesia, with Special Reference to Indonesia

by Kathy MacKinnon

There are at least 31 species of primates in the Sundaic and Wallacean Subregions of the IndoMalayan Realm, and 34 species if we give specific status to all the Sulawesi macaques (Fooden, 1969). Of these, 24 are endemic to the Malesian Region. The distributions of the various species throughout Malesia are shown in Figure 1 (see end of article for all figures and tables).

All but two of the Malesian primates are found in Indonesia, which has the richest primate fauna of any Asian country. Only two species, the dusky leaf monkey *(Presbytis obscura)* and the endemic Philippine tarsier *(Tarsius syrichta)*, do not occur in the Indonesian archipelago. Within Indonesia, primates are found as far east as Sulawesi and Timor, the easternmost island of the Lesser Sundas (Nusa Tenggara), though the long-tailed macaques which occur there are believed to have been introduced originally by people. Sixteen of the Indonesian primates (or 19 if we accept the higher number) are island endemics.

Apart from these non-human primates, Indonesia has a large and rapidly expanding human population, estimated to be over 150 million in the 1982 census and expected to reach 200 million by the year 2000. These people need land and every year vast tracts of forest are destroyed for timber and to make way for agriculture and transmigration schemes. Inevitably, loss of forest means loss of wildlife and the problems facing primates in Indonesia are typical of the pattern found throughout the whole of Southeast Asia. One way of assessing the status of primate populations is to determine how much of their natural habitat remains and how much is protected. From this, we can estimate likely numbers remaining and numbers protected for each species.

Tables 1 and 2 show the areas of original and remaining natural habitat within each species' range for Indonesia, including all of Borneo, and the rest of the Malesian Region. Since primate distributions rarely coincide with political boundaries and five species of primates are endemic to Borneo, information on primate status and habitats have been included for the whole of Borneo, not just Indonesian Kalimanatan. More detailed information on primate status in Sarawak and Sabah is presented by Bennett *et al.* (1986, and this issue) and Davies and Payne (1982).

Habitat areas for Indonesia are derived from the National Conservation Plan for Indonesia (FAO/MacKinnon, 1981/1982). Data for the rest of Malesia have been derived from the Review of the Protected Areas System in the Indo-Malayan Realm (IUCN, 1986). Some measure of the ongoing threat to each species is given by comparing areas of original with remaining habitat to estimate percentage loss of habitat. It is worth noting here that while the figures for remaining areas of forest are based on the latest available LANDSAT imagery and forestry maps, these sources are often several years old and deforestation is continuing all the while, so even these figures will tend to be overestimates.

From Tables 1 and 2, it can be seen that all species of the region have suffered considerable reduction in habitat. Within Indonesia all but nine out of 29 species have already lost half or more of their original habitat and four endemics, the Moor macaque, Javan gibbon, Javan leaf monkey and Javan lutong, have all lost more than 85% of their original habitat. For the Javan gibbon and Javan leaf monkey, species with very limited distributions in lowland rainforest, habitat loss is a drastic 96%. Elsewhere in Malesia the pattern is similar, with all species already having lost 50% or more of their original habitats. Even species which are common at present will not be so for much longer if the present rate of deforestation continues; the ubiquitous long-tailed macaque, for instance, has already lost a startling 90% of its habitat on Java. The message is clear: to safeguard future primate populations, action must be taken now.

A species' long-term security is reflected by the areas of protected habitat found within its range. In this context primates are useful indicator species for the adequacy of protected area coverage within the region. Tables 1 and 2 show that all primate species have some areas of protected habitat within their range, and list the protected areas where the various species are known to occur. With the possible exception of the Philippine tarsier, which may occur in the Leyte mountains, populations of all Malesian primates are protected within the existing reserve network of the region.

If we consider that ideally we need 10% of most habitats protected for adequate protection, then few primate species meet this criterion. In Indonesia, the only species with more than 10% of their original habitat protected are the Mentawai primates. In the Malay Peninsula, the situation is better with only the agile gibbon and silvered leaf monkey having less than 5% of their original habitats protected. Overall, the species for gravest concern is again the Philippine tarsier with only 0.8% of its traditional lowland rainforest habitat protected; this species is obviously a conservation priority.

Several species have less than 10% of their remaining habitat within protected areas, but some have large healthy populations outside reserves. Both on the Asian mainland and the Indonesian islands, the long-tailed macaque and silvered leaf monkey have relatively small areas of their original habitat protected. These species are common in secondary habitats outside protected areas, where they reach even higher densities than in primary forest. These species require no special conservation action; there are healthy populations both within and outside the existing reserve system. The status of the long-tailed macaque in the Philippines may, however, be a matter for concern. There are at least two, and perhaps three, distinct races of long-tailed macaques in the Philippines, and considerable numbers of these monkeys are exported for biomedical research. A survey to determine the status of long-tailed macaques in the Philippines would be useful.

The Status of Indonesian Primates

With the help of FAO, the Indonesian Department of Conservation (PHPA) has prepared a Conservation Master Plan for the whole of Indonesia, reviewing the conservation priorities of each reserve on an island by island basis. Some 299 conservation areas have already been declared, including sixteen national parks. From the point of view of primate protection, the country's reserve systems must fulfill certain criteria. Geneticists believe that breeding populations of at least 5,000 individuals are necessary to maintain genetic diversity. The FAO/PHPA team planning the reserve system in Indonesia has tried to protect at least 10% of all major habitats, and larger areas where the population size of a certain animal or plant species is critically small (FAO/MacKinnon, 1981/1982). To determine how adequate the protected area system of Indonesia is for ensuring the survival of primate species we have attempted to determine the numbers for each species of Indonesian primate, both for remaining habitat and for protected populations within reserves. The results are presented in Table 3.

Total population estimates are calculated by multiplying the remaining areas of habitat by a conservative working density estimate for each species. The conservative density estimates are derived from published estimates of intensive field studies, amended to give a figure applicable to the species' whole range and not just most favored habitats (see MacKinnon, 1983, 1986). These estimates (or 'guesstimates') are inevitably crude. However, they do give a working figure on which to base some conclusions about a species' status. At the crudest level, these figures give some idea of which species are common, which rare, which endangered. Any primate that does not have at least 10% of its remaining habitat protected or a freely-interbreeding population of at least 5,000 animals should be considered endangered.

Twelve species have an estimated 10,000 animals or less in reserves or less than 10% of their remaining habitat protected. Species of special concern with rather limited distributions include: the orang-utan, Bornean and Javan gibbons, four Mentawai primates, Sulawesi macaques *Macaca tonkeana/hecki* and *M. maura*, Javan leaf monkey, Javan lutong, white-fronted leaf monkey and proboscis monkey. *Macaca ochreata/brunnescens* can also be considered vulnerable.

Three species, the Javan gibbon *(H. moloch)*, Javan leaf monkey *(P. comata (=aygula))* and the Mentawai macaque *(Macaca pagensis)* have total population estimates of less than 10,000 animals with less than 5,000 in reserves. In all cases, more than one third of their remaining habitat

lies within reserves, but their populations are so small that these species must be regarded as seriously threatened. For the Javan gibbon and leaf monkey, although the area protected seems inadequate, there is no further room for reserve expansion on crowded Java. It is therefore inexcusable that such a valuable reserve as Gn. Halimun (40,000 ha), which probably harbors the largest populations of these endemic species, has as yet no permanent guard force.

The Mentawai monkeys, like the Kloss'gibbon, are all endemic to the Mentawai islands and their status must be regarded as precarious, even though 33% of their remaining habitat is protected in the Taitaibatti Reserve. It is essential that PHPA go ahead with the proposed extension of this reserve, the only protected area for these species.

Of the Sulawesi macaques, *M. maura* is probably the most threatened. Current proposals to extend Karaenta to join Bantinmurung to form a national park, and proposals for a new reserve, Gn. Lompobatang, should receive immediate attention. For *M. tonkeana/hecki*, the picture is confused by the fact that there appears to be a large population outside the reserve system. Several large reserves have been established in central Sulawesi (e.g. Morowali, Lore Kalamanta), but much of the habitat included within their boundaries is unsuitable for *tonkeana*. Moreover, even if *tonkeana* and *hecki* are the same species, as Groves (1980) suggests, they are strikingly different in appearance and *hecki* is worth protecting as a distinct form. *M. hecki* is found only on the northern peninsula and much of its habitat is being destroyed by land clearance for transmigration schemes, e.g. at Paguyaman. *M. hecki* from this area are common pets even 100 km to the east at Gorontalo; this is some reflection of the number of animals being displaced. *M. hecki* is protected only in very small reserves such as Tangale, Panua, and Tanjung Panjang, and the very western part of Dumoga National Park; this species requires greater protection. Although the crested macaque *(Macaca nigra/nigrescens)* has a very limited distribution, it is one of the best protected of the Sulawesi macaques. It occurs at high densities in Dumoga and Tangkoko-Dua Saudara, two areas where World Wildlife Fund has been very active.

Little is known about the leaf-monkey *Presbytis frontata*, so it is impossible to determine whether it is adequately protected within the existing reserve system until further population data are collected. Although this species is legally protected in Indonesia, in Sarawak it is not and is regularly hunted for food. Together with *Presbytis hosei* and *P. rubicunda*, two other Bornean endemics, it accounts for 1% of all mammals hunted in Sarawak (which may amount to 20,000 monkeys annually) (Bennett, *et al.*; 1986).

In a previous review (MacKinnon, 1986), the Javan lutong was included with *Presbytis cristata*. Weitzel and Groves (1985) have now declared this race to be a separate species, *Trachypithecus auratus*. Whether we regard the Javan lutong as race or full species, it is worth pointing out that while it has a very limited distribution, mainly on Java and Bali which it shares with 90 million people, this animal is still adequately protected by the existing reserve system and healthy populations are found in many of Java's main reserves (see Table 1).

For the proboscis monkey *(N. larvatus)* the main threat is habitat loss. Where proboscis monkeys do occur they are conspicuous, occurring at high densities and in large troops. However, like long-tailed macaques, they frequent some of the riverine habitats most favored by people for logging, village settlement and agriculture, so much of their lowland forest habitat is threatened. In Indonesia, less than 10% of this species' remaining habitat is secure in reserves; if possible more areas should be set aside to protect this unique species. This is particularly important, since this Bornean endemic is not well-protected outside Indonesia. The animal's habit of sleeping in riverside trees makes it particularly vulnerable to hunters. Bennett, *et al.* (1986) estimate there may be as few as 1,000 of these spectacular animals left in Sarawak.

The orang-utan deserves special attention. Total estimates for this species presented in Table 3 may be an overestimate, since the species has a patchy occurrence in Kalimantan and an equally fragmented distribution in Sarawak and Sabah; (for instance, it does not occur in the Tawau Hills or Tabin area; Davies and Payne, 1982). There are probably about 180,000 orang-utans in Sumatra and Kalimantan (Rijksen, 1978; MacKinnon, 1983, 1986) and another 4,000 or so in Sabah and Sarawak (Davies and Payne, 1982). While these figures are at least thirty times greater than estimates publicized by WWF twenty years ago, they do not mean that the species' status has improved, nor is there any cause for optimism. Orang-utans are particularly vulnerable to habitat destruction and hunting pressure and the wild population is probably declining by several thousand animals each year. This vulnerability was well illustrated when fires swept through Kutai Reserve in 1983, destroying much of the forest and depleting the resident wildlife. The only orang-utans that can be regarded as secure are those in reserves. The existing reserve system protects healthy populations. Known densities of this ape are considerably higher in Gn. Leuser, Kutai and Tanjung Puting than the conservative density estimate of 1 animal/km² used in Table 3 so that the protected population can be considered to be at least 20,000 animals. Nevertheless safeguarding this ape will require higher standards of reserve protection and management than exist at present.

Is the Reserve System of the Malesian Region Adequate to Protect and Maintain Primate Populations?

Since pressures on forest for both agricultural land and timber are unlikely to abate in the forseeable future, it is vital to determine if the primates of the Malesian Region are adequately represented in the system of national parks and other protected areas. Ultimately, these may be the only areas where certain species will survive.

Over the last ten years Indonesia has been the focus of a long-term FAO National Parks Development Program and World Wildlife Fund Program. The existing and proposed system of national parks and protected areas affords comprehensive coverage to all major habitat types (see FAO National Conservation Plan). Figure 2 shows existing and proposed major reserves within Indonesia. Indonesian Government policy to set aside some 10% of all habitats as reserves is highly commendable and should be adequate to protect most primate species, apart from those which are already seriously reduced in numbers and/or confined to very small areas.

In Malaysia, a national conservation strategy is being prepared and implemented on a state by-state basis (Kahn, 1985; Kavanagh, 1985). On the whole, Malaysia, including Sabah and Sarawak, has a good system of reserves, especially if existing proposals to extend the reserve system and enlarge existing reserves are implemented. The creation of the Lanjak Entimau Reserve in Sarawak on the border with Indonesia was particularly useful as it connects with the large Gn. Bentuang and Karimun Reserves to create an extensive transfrontier reserve protecting a valuable block of primate habitat.

Peninsular Thailand, although densely populated, also has an extensive system of small reserves, and if protection and management in these areas can be improved primates will be relatively safe in the Malay Peninsula.

Primate populations within reserves are only secure if they are adequately protected. Although the list of nature reserves in Indonesia, Malaysia and Thailand is impressive and most primates seem to have adequate areas of habitat included within the existing reserve system, not all of these areas can be considered secure or well-protected. Many have suffered considerable abuse in the past, e.g. logging, collecting of forest products, extensive burning, and many areas still lack an adequate or well-trained guard force so that abuses still occur. Management problems are especially serious in regions of high human population density, e.g. in Way Kambas Reserve in Lampung poachers still enter to hunt, fish and steal timber in spite of the presence of a large guard force.

The main area of concern for conservation in the Malesian Region today must be the Philippines. The existing system of reserves, with the exception of Palawan, is inadequate in both coverage and quality of management. For political reasons, extensive tracts of one of the finest national parks, Mt. Apo, were degazetted in 1985 to allow more land clearance for agricultural settlement. In many of the existing reserves protection and management are virtually non-existent. It is essential that

more habitat be protected in the Philippines, particularly as large areas of the central islands are now totally deforested. The endemic Philippine tarsier is particularly at risk.

Threats to Malesian Primates Outside Reserves

While viable populations of most primate species seem to be protected within the region's reserve network, at present far larger numbers of primates are found outside reserves. The main threat facing these primates, as elsewhere in the tropics, is the loss of habitat due to forest clearance. (In Sarawak and Sabah, hunting may also have a drastic impact on some primate populations leading to local extinctions).

Forest clearance for agriculture has continued for centuries throughout Southeast Asia but deforestation is now occurring at an alarming rate, with no chance for abandoned farmlands to regenerate natural forest cover. In Indonesia alone, every year approximately 500,000 ha of forest are cleared for government-sponsored transmigration schemes, and individual farmers working independently probably clear as much again. As the forest is lost, the primates are lost. Some species move to adjacent forest and raid crops, another source of conflict between man and wildlife which leads to further killing. The macaques, *M. fascicularis, M. nemestrina, M. nigra* and *M. maura* in certain areas, are particularly serious agricultural pests.

Logging is a major industry throughout Southeast Asia, in Indonesia the second most important revenue earner after oil. There are two main logging procedures:

(1) clear cutting where all trees of a suitable size are taken, with consequent complete destruction of the habitat and disastrous consequences for the resident primates, and

(2) selective logging (8-12 trees removed/ha) where only certain species of a certain size are taken.

Even with selective logging there is serious disturbance and destruction of the forest (up to 65% of the canopy is often destroyed) due to falling trees dragging down their neighbors, construction of logging roads, etc. Selective logging does have one major benefit over clear-felling; the fruit trees important to primates are usually not good timber trees and are often left standing.

In Malaya, Marsh & Wilson (1981) found that logging reduced primate densities at all the sites studied, but the effects differed with the age of the secondary stand and also between primate species. After a lapse of five years or so, certain primate species may make a comeback and achieve higher population densitites in the disturbed secondary forest (which, because of its open nature, has a high level of new leaf growth) than in primary forest. The long-tailed macaque *(M. fascicularis)*, an adaptable opportunist, is one such species. Nevertheless, for most primate species logging means a reduction in habitat, a drop in population numbers, and reduced breeding activity due to overcrowding. Whenever possible timber companies should be encouraged to follow those logging regimes shown to have the least deleterious effects on resident primate populations.

Primate Trade

Illegal trade in some endangered and protected animals is common within the region, with species such as the slow loris and some monkeys openly offered for sale or kept as pets (even, as in Indonesia, where they are legally protected). There are probably 100 crested macaques *(Macaca nigra/nigrescens)* held as household pets in the Dumoga valley (North Sulawesi) alone.

If the national Conservation or Game Departments confiscate these illegal pets, they are faced with the problem of what to do with them. The internal illegal trade in orang-utans in Indonesia and Sabah has been almost completely stopped, partly by developing orang-utan rehabilitation centers where the confiscated animals are trained to return to the wild. Such schemes are costly in terms of money and effort, however, and contribute little to the species' overall chances of survival when the main threat is habitat loss. Their most useful function is to serve as centers for conservation education, as at Bohorok, North Sumatra and Sepilok, Sabah.

The main primate trade in the region involves the provision of live animals for biomedical and other research laboratories, most of which are in Europe, North America and Japan. Since 1978, when India imposed an outright ban on exports of rhesus macaques, Indonesia has been the biggest primate supplier. Long-tailed macaques *(M. fascicularis)* account for most of the exports, but some trade in pig-tailed macaques *(M. nemestrina)* and silvered leaf monkeys *(P. cristata)* occurs as well. In 1984, Malaysia also placed a total ban on all primate exports, including *M. fascicularis*. Both Indonesia and the Philippines are still exporting *M. fascicularis*, and breeding stations have been established in both countries to supply animals for biomedical research.

However one feels about the primate trade, the demand for live animals for biomedical research is unlikely to disappear in the near future, particularly while live monkeys are still used for testing batches of vaccine prior to its release for mass immunization programs. In fact, there is a world-wide trend of diminishing primate exports which is reflected by exports from Indonesia. Whereas in both 1972 and 1973 Indonesia exported 14,000 long-tailed macaques to Japan alone (Kavanagh, 1984), by 1982 the total export of long-tailed macaques was less than 15,000 and the quota for 1983 was reduced to 13,000 animals.

There are still substantial wild populations of long-tailed macaques in Indonesia and there is no evidence that the species cannot sustain the present level of harvesting. The situation in the Philippines is not well-known and there is an urgent need for surveys to determine the current status and trends of wild macaque populations and the effects of the primate trade on them. The situation for pig-tailed macaques in Indonesia should also be reviewed, since pig-tailed macaques are probably much less common than is widely believed and may even be threatened in some places within their range.

A further cause for concern is the considerable numbers of monkeys 'wasted' during forest clearance schemes and in the trapping programs themselves. Loss of animals due to death, injury or unsuitability (wrong age/sex class) varies between 32% and 71% (Darsono, pers. comm.). Primates for trade are derived mainly from wild populations with the main dealers employing their own teams of highly skilled trappers. They should be encouraged to trap and trade animals displaced by land clearance schemes (or in forest about to be logged), thus reducing the pressure on healthy wild populations in undisturbed habitat.

Live-caught, long-tailed macaques currently fetch ridiculously low prices, US$50-100 an animal to the main dealer and as little as US$1-5 per suitable animal to the actual trapper. So long as the price per wild-caught animal remains at the current low level, wastage is likely to remain high. The higher the price a monkey fetches for the trapper or dealer, the more valuable it becomes and the better the treatment it will receive. By increasing demand for 'cleaner', healthier animals, overseas buyers could encourage responsible dealers to establish alternative supply sources for long-tailed macaques, either by ranching animals on a semi-wild basis in previously logged forest (see MacKinnon, 1983) or by maintaining captive breeding colonies.

Conservation Action Needed for Indonesian Primates

1. Further surveys should be carried out to monitor certain primate populations, especially for proboscis monkeys (over all of Borneo), Sulawesi macaques, white-fronted leaf monkey *Presbytis frontata* (all Borneo), Philippine tarsier.
2. Comprehensive surveys should be carried out to census and monitor wild populations of the two races of *M. fascicularis* in the Philippines. These are particularly urgent in view of the decline in these populations and the species' importance for trade.
3. There should be no trading in the 14 primate species identified as endangered or threatened, with an estimated population of 10,000 or less animals in reserves or less than 10% of their habitat protected. These 14 species are orang-utan, proboscis monkey, the Mentawai primates, white-fronted leaf monkey, Javan gibbon, Javan leaf monkey, Javan lutong, Philippine tarsier and three of the Sulawesi macaques - *M. maura, M. tonkeana/hecki* and *M. ochreata/brunnescens*. Populations of

these species in reserves should be monitored, and active management implemented if necessary to maintain adequate populations.

4. Improved management and guarding of all reserves, with first priority given to:
   a) implementation of a management plan and establishment of a guard force in Gn. Halimun *(H. moloch* and *P. aygula),*
   b) improved guarding in Gn. Honje *(H. moloch* and *P. aygula),*
   c) improved protection and management of reserves in peninsular Thailand,
   d) improved protection and management of existing reserves in the Philippines.
5. Extension of existing reserves and establishment of new reserves within a threatened species' range whenever possible including:
   a) extension of the Taitaibatti Reserve (Mentawai primates) as in process;
   b) establishment of Gn. Lompobatang Reserve *(M. maura)* as proposed;
   c) establishment of a new, preferably large, reserve to protect habitat of *M. tonkeana/hecki* (the rejected proposal for Randangan should be reconsidered);
   d) extension of existing reserves and establishment of new reserves as proposed by the State Conservation Strategies for Sabah and Sarawak;
   e) identification of key areas for conservation and establishment of new reserves in the Philippines, with no further excisions from important reserves.
6. For species with a wide geographical range, several reserves should be established to maintain regional variation. For instance, some of the island forms of *M. fascicularis* are quite distinct and well worth special protection. To be specific, the proposed Simeulue Island Reserve in Aceh is a high priority.
7. Improved law enforcement to prevent hunting of threatened and protected species or their capture for pets, especially relevant to Mentawai primates, orang-utan, *M. hecki, Presbytis frontata,* and proboscis monkey.
8. So long as Indonesia and the Philippines maintain a trade in wild-caught primates, primarily long-tailed macaques, supplies should, whenever possible, be drawn from animals displaced when their forest habitat is converted to agricultural land, in accordance with IUCN and WHO guidelines (1981). Procedures for the control of trade and export of primates need tightening up. Capture permits granted should not exceed the quota for each species. Captive breeding colonies of much used species, e.g. *Macaca fascicularis,* should be established in both user and source countries.
9. A survey to assess the distribution and status of the Philippine tarsier and to propose measures for its protection must be one of the top conservation priorities for the whole Asian Region. A better reserve network in the Philippines is essential to protect not only this rare animal but also many of the country's other endemic mammals and birds, which have evolved during the Philippines' long isolation from mainland Asia.

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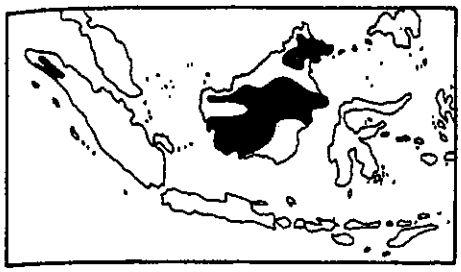
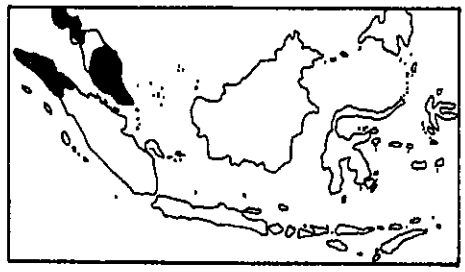
On following pages: Figs. 1a,1b,1c. The distributions of all primate species within Malesia (maps by S.D. Nash from author's originals).

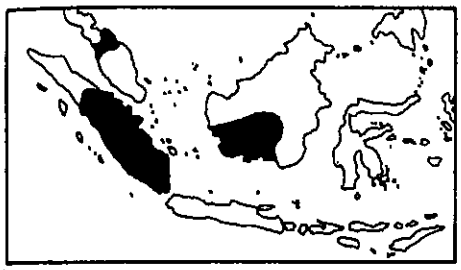


Pongo pygmaeus

Hylobates syndactylus



Hylobates lar



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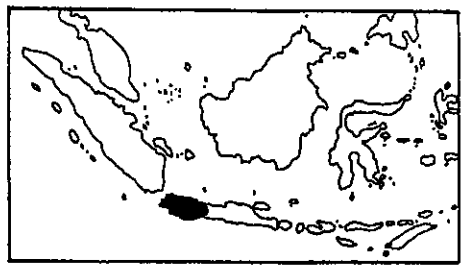
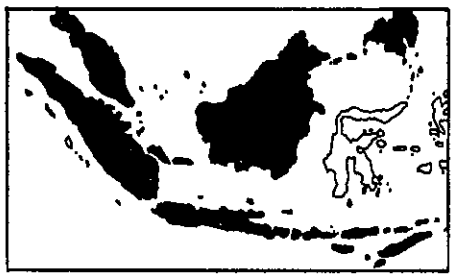
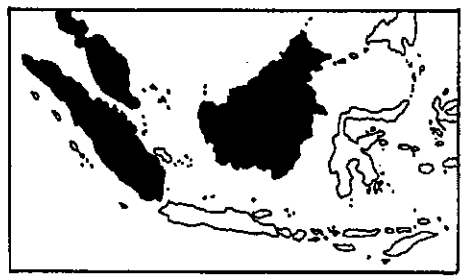


Hylobates moloch

Hylobates klossi



Macaca fascicularis



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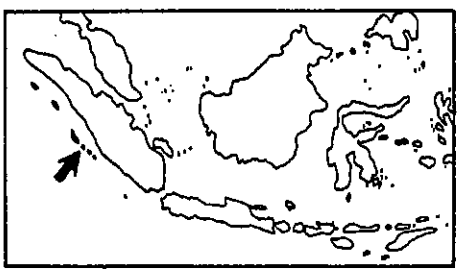
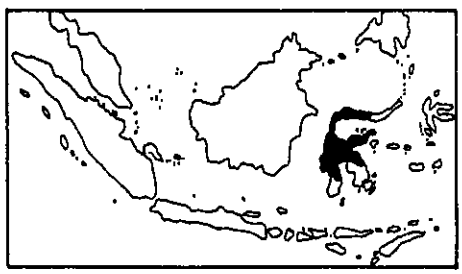


Macaca pagensis

Macaca nigra/nigrescens



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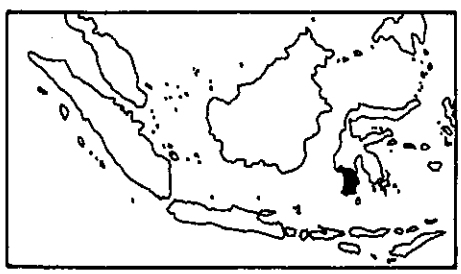
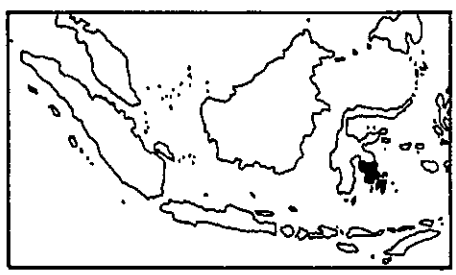


Macaca maura



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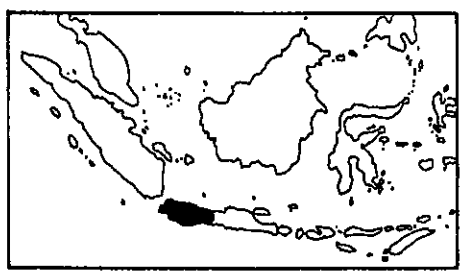
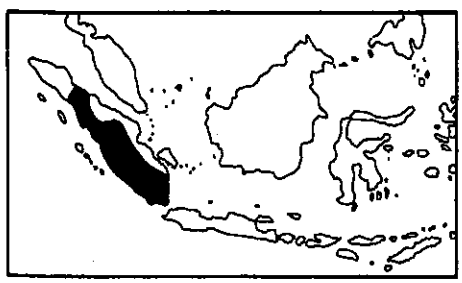
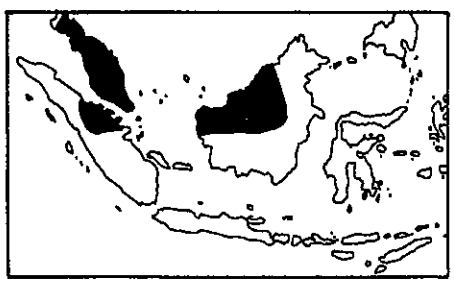


Presbytis aygula



Presbytis melalophos



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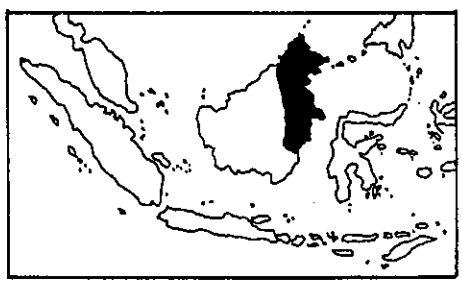
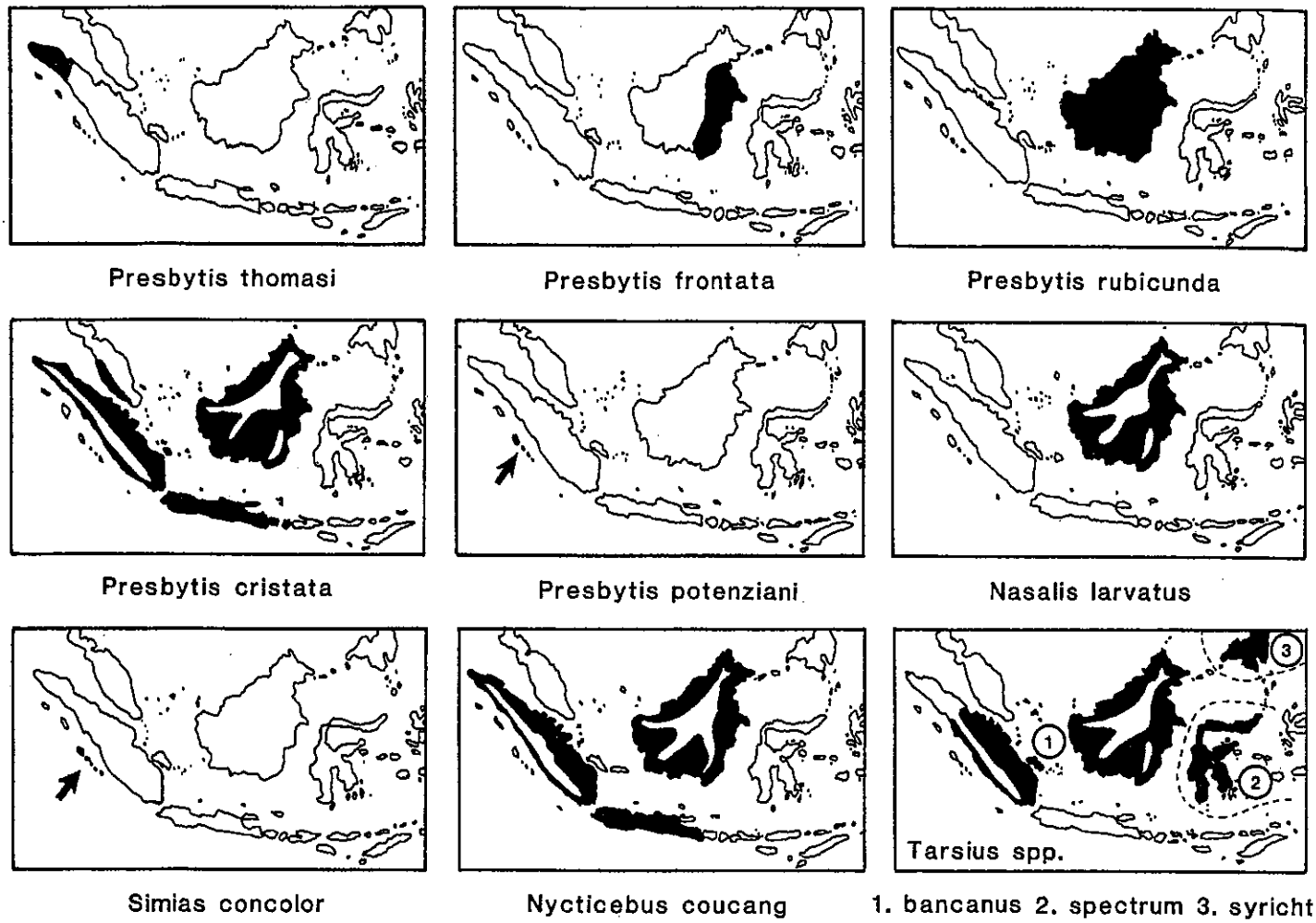


Presbytis hosei



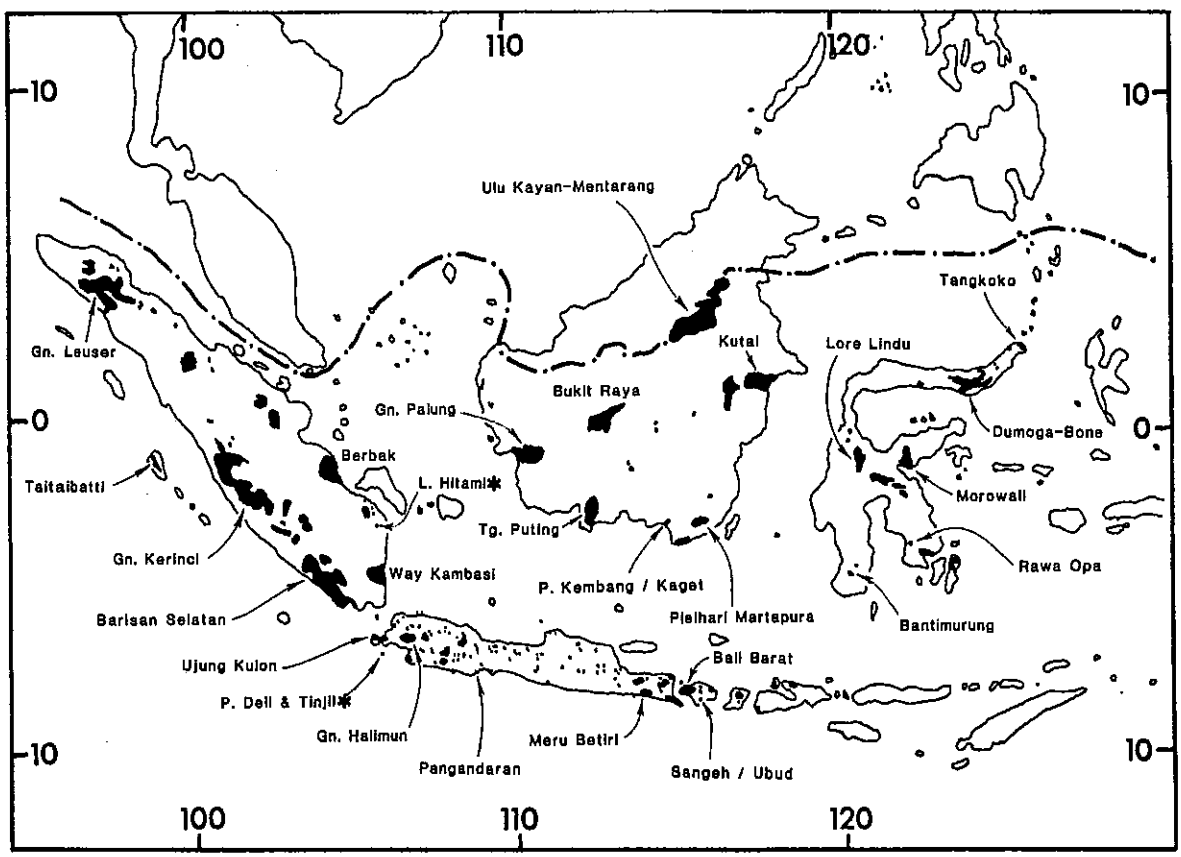


Fig. 2. Major reserves (black) harboring primate populations in Indonesia and proposed locations for pilot primate ranching projects (*) (map by S.D. Nash from author's original).

Table 1. Areas of Original, Remaining and Protected Habitat for Primates of Indonesia and North Borneo

Species	Islands	Habitat type	Original Habitat (km²)	Habitat Remaining (km²)				Reserves within Species Range
Orang utan *Pongo pygmaeus*	Borneo	Lowland & hill forest, swamp &	B) 464,000	B) 184,000	63	8,185	2.1	Kutai, Tanjung Puting, Gn. Palung, Bukit Raya, Gn. Leuser, Bukit Baka, Lanjak Entimau, Danum Valley,
	N. Sumatra	health forest	S) 89,000	S) 23,000		3,500		
			553,000	207,000		11,685		
Siamang *Hylobates syndactylus*	Sumatra	All forests up to 1,500 m excluding mangrove and peat swamp	340,000	120,000	66	20,000	5.8	Way Kambas, Barisan Selatan (SS1), Kerinci, Gn. Leuser
Agile-gibbon, dark-handed gibbon *Hylobates agilis*	C. & S. Sumatra S.W. Kalimantan	Lowland forest excluding mangrove	500,000	170,000	66	19,700	3.9	Way Kambas, Barisan Selatan (SS1), Kerinci, Kerumutan, Gn. Palung, Kendawangan, Karimun, Gn. Bentuang
White-handed gibbon *Hylobates lar*	N. Sumatra	Lowland forests up to 1,000 m excluding mangrove	68,000	30,800	55	4,000	5.8	Gn. Leuser
Bornean gibbon *Hylobates muelleri*	N.E. & S. Borneo	Lowland forest, excluding mangrove & kerangas	395,000	253,000	36	20,385	5.1	Kutai, Ulu Kayan, Gn. Becapa, Gn. Mulu, Lanjak Entimau, Danum Valley, Kinabalu
Kloss gibbon *Hylobates klossi*	Mentawai Is.	All forests excluding mangrove	6,500	4,500	31	1,490	22.9	Taitaibatti
Javan gibbon, grey gibbon *Hylobates moloch*	West Java Gn. Slamet	Lowland & hill forests to 1,500 m	43,274	1,608	96	600	1.3	Ujung Kulon, Gn. Halimun
Long-tailed macaque *Macaca fascicularis*	Sumatra, Java, Borneo, Bali, Lesser Sundas east to Timor	Coastal and riverine forest up to 1,000 m, disturbed forest	S) 87,644	S) 29,906	66	3,542	3.3	Gn. Leuser, Kerinci, Way Kambas, Kutai, Tanjung Puting, Ujung Kulon, Pangandaran, Baluran, Bali Barat, Samunsam, Danum Valley, Klias
			Bo) 100,380	Bo) 52,660	48	3,837		
			Ja) 17,177	Ja) 758	96	179		
			NT) 32,519	NT) 5,900	82	330		
			237,720	89,224	63	7,888		
Pig-tailed macaque *Macaca nemestrina*	Sumatra Borneo	Primary and secondary lowland & hill forest, raid farmland	396,200	208,200	48	30,620	7.7	Gn. Leuser, Kerinci, Way Kambas, Kutai, Tanjung Puting, Danum Valley, Gn. Mulu
Mentawai macaque *Macaca pagensis*	Mentawai Is.	Lowland forest	6,500	4,500	31	1,490	22.9	Taitaibatti
Crested macaque *Macaca nigra/ nigrescens*	N. Sulawesi	Lowland & hill forests	12,000	4,800	60	2,750	22.9	Tangkoko-Dua Saudara, Gn. Ambang, Dumoga-Bone
Celebes macaque *Macaca tonkeana/ hecki*	Central Sulawesi	Lowland & hill forests	67,000	38,500	33	1,055	1.5	Lore Kalamanta, Morowali, Panua, Lempako Mampie
Moor macaque *Macaca maura*	SW Sulawesi	Lowland & hill forests	23,000	2,800	88	495	2.1	Bantimurung, Karaenta
Ochreate black ape *Macaca ochreata/ brunnescens*	SE Sulawesi	Lowland & hill	29,500	18,500	37	1,420	4.8	Rawa Opa
Proboscis monkey *Nasalis larvatus*	Borneo	Estuarine and riverine forest, often far inland	29,496	17,750	40	1,225	4.1	Tanjung Puting, Kutai, Gn. Palung, Samunsam, Klias
Pig-tailed langur, snub-nosed langur, *Simias concolor*	Mentawai Is.	Lowland rainforest below 450 m	6,500	4,500	31	1,490	22.9	Taitaibatti
Javan leaf monkey *Presbytis comata (=aygula)*	W. Java, Gn. Slamet	Lowland & hill forest to 1,500 m	43,274	1,608	96	730	1.6	Ujung Kulon, Gn. Halimun
Silvered leaf monkey *Presbytis cristata*	Sumatra, Borneo	Coastal & riverine forest	316,630	156,900	52	12,900	4.0	Kutai, Gn. Palung, Gn. Leuser, SS1, Way Kambas, Berbak, Klias, Samunsam

Javan lutong *Trachypithecus auratus*	Java, Bali Lombok	Coastal & riverine forest, lowland & hill forests	46,890	6,898	86	814	1.7	Ujung Kulon, Gn. Gede-Pangrango, Baluran, Meru Betiri Pangandaran, Gn. Halimun, Bali
White-fronted leaf monkey *Presbytis frontata*	Borneo, R. Kayan south to R. Barito	Primary forest up to 300 m, excluding swamp forest	12,500	61,500	51	7,260	5.8	Kutai, Pleihari Martapura, Lanjak Entimau
Bornean or grey leaf monkey *Presbytis hosei*	Borneo, north of R. Mahakam	Primary lowland & lower montane forest up to 1,000 m	104,000	54,000	48	7,120	6.8	Ulu Kayan, Mentarang Kutai, Gn. Mulu, Pulong Tau
Banded leaf monkey *Presbytis melalophos*	S. Sumatra to north of Lake Toba	Primary & lower montane forest up to 1,500 m	174,340	50,960	71	11,120	6.3	Kerinci, Way Kambas, Barisan Selatan
Mentawai langur *Presbytis potenziani*	Mentawai Is.	Primary lowland rainforest	6,500	4,500	31	1,490	22.9	Taitaibatti
Maroon leaf monkey *Presbytis rubicunda*	Borneo	Dry lowland & montane forest up to 1,500 m, secondary forest	415,000	266,000	36	19,670	4.7	Kutai, Tanjung Puting, Gn. Palung, Pleihari Martapura Lanjak Entimau, Gn. Mulu
Thomas'leaf monkey *Presbytis thomasi*	Sumatra n. of Lake Toba	Lowland rainforest, lower montane forest	68,000	30,800	55	4,000	5.8	Gn. Leuser
Presbytis femoralis	E. Central Sumatra & N.W. Borneo	Swamp forest & lowland forest	121,000	60,500	50	2,576	2.6	Samunsam, Gn. Becapa, Sambas, Danau Sentarum, Gn. Bentuang/Karimun
Western tarsier *Tarsius bancanus*	Sumatra Borneo	Lowland primary & secondary rainforests	609,000	305,000	50	33,165	5.4	Kutai, SS1, Kerinci Kerumutan, Lanjak Entimau, Danum Valley
Eastern or spectral tarsier *Tarsius spectrum*	Sulawesi & offshore islands	Lowland & secondary rainforests, agricultural land	154,400	70,730	54	5,852	3.8	Tangkoko-Dua, Saudara, Dumoga Bone, Panua, Lore Kalamanta
Slow loris *Nycticebus coucang*	Sumatra, Java, Borneo	Primary & secondary rainforest	769,000	334,000	57	38,481	5.0	Gn. Leuser, Kutai, Lanjak Entimau, Niah

Data on habitat areas from "National Conservation Plan for Indonesia", FAO-INS/78/061, and "Review of the Protected Areas Systems in the IndoMalayan Realm".

Table 2. Original, Remaining and Protected Primate Habitats in the Malay Peninsula and Philippines

Species	Distribution	Habitat Type	Original Habitat (km²)	Habitat Remaining (km²)				Reserves within Species Range
Siamang *Hylobates syndactylus*	Malay Peninsula	Forests up to 1,500 m, excluding mangrove & peat swamp	125,110	49,800	61	11,887	9.5	Krau, Taman Negara, Cameron Highlands
Agile gibbon *Hylobates agilis*	Malay/Thai border	Lowland forests	32,270	14,345	56	489	1.5	Ulu Muda, Sungai Dal FR
White-handed gibbon *Hylobates lar*	Malay Peninsula	Lowland forests up to 1,000m	117,700	42,540	66	18,658	15.8	Krau, Taman Negara, Endau Rompin, Khao Luang
Long-tailed macaque *Macaca fascicularis*	Malay Peninsula, Philippines	Coastal and riverine forest	M) 21,876 Ph) 16,982	9,649 8,974	56 48	1,164 275	5.3 1.6	Krau, Taman Negara, Endau Kota Tinggi, Bataan, Canlaon, Mt. Isarog, St. Paul's
Pig-tailed macaque *Macaca nemestrina*	Malay Peninsula	Lowland & hill forests	31,000	14,673	53	2,750	8.8	Krau, Taman Negara
Silvered leaf monkey *Presbytis cristata*	Malay Peninsula	Coastal and swamp forest	4,231	1,311	70	150	3.5	Kuala Selangor, Kinta
Banded leaf monkey *Presbytis melalophos (=femoralis)*	Malay Peninsula	Lowland forest	155,494	56,767	64	23,585	15.1	Krau, Khao Luang, Khao Bhantad, Taman Negara
Dusky leaf monkey *Presbytis obscura*	Malay Peninsula	Lowland forest	155,494	56,767	64	23,585	15.1	Khao Luang, Krau, Khlong Saeng
Philippine tarsier *Tarsius syrichta*	Samar, Leyte, Dinargat, Siargao, Bohol, Mindanao	Lowland forest	60,248	13,050	79	500	0.8	Leyte Mountains ? Mt. Apo ?
Slow loris *Nycticebus coucang*	Malay Peninsula, Mindanao	Lowland rainforest	M) 117,200 Ph) 20,600	7,038 4,728	94 77	3,098 500	2.6 2.4	Krau, Taman Negara, Endau Rompin, Khao Bhankad, Mt. Apo.

Table 3. Conservative Population Estimates for all Primates Within Indonesia

Species	Area of Suitable Habitats Remaining (km^2)	% Habitat Protected	Conservative Working Density animals / km^2	Total Population Estimate	Estimated Protected Population in Reserves
P. pygmaeus	179,000	5.2	1	179,000	9,300 ++
H. syndactylus	120,000	16.7	3	360,000	60,000
H. agilis	170,000	11.6	5	850,000	98,500
H. lar	30,800	13.0	5	154,000	20,000
H. muelleri	146,000	9.2	8	1,168,000	108,000
H. klossi	4,500	33.1	8	36,000	11,920 ++
H. moloch	1,608	37.3	3	4,824	1,800 *
M. fascicularis:					
Primary habitat	73,371	10.2	30	2,176,860	220,040
Secondary forest	38,750	5.8	40	1,550,000	90,000
M. nemestrina	179,140	15.1	5	895,700	135,475
M. pagensis	4,500	33.1	2	9,000	2,980 *
M. nigra / nigrescens	4,800	57.3	30	144,000	82,500
M. tonkeana / hecki	38,500	2.7	10	385,000	10,550 ++
M. maura	2,800	17.7	20	56,000	9,900 ++
M. ochreata / brunnescens	18,500	7.7	15	277,500	21,300
N. larvatus	10,438	9.8	25	260,950	25,625
S. concolor	4,500	33.1	7	31,500	10,430 ++
P. comata (=aygula)	1,608	45.5	5	8,040	3,650 *
P. cristata#	133,167	9.5	15	1,997,505	188,775
P. frontata	35,000	15.2	2	70,000	10,660 ++
P. hosei	29,000	14.6	10	290,000	42,200
P. melalophos	50,960	21.8	20	1,019,200	222,400
P. potenziani	4,500	33.1	10	45,000	14,900 ++
P. rubicunda	266,000	7.4	10	2,660,000	196,700
P. thomasi	30,800	13.0	30	924,000	120,000
P. femoralis	42,700	5.2	20	854,000	44,408
T. bancanus	198,250	13.3	50	9,912,500	1,314,000
T. spectrum	70,730	8.3	200	14,146,000	1,170,400
N. coucang	227,883	13.9	5	1,139,415	157,980

Key:

*Estimated total populations of less than 10,000 animals

++Species of vulnerable status

#Includes estimates for the Javan lutong *Trachypithecus auratus*

Current Status of Primates in Sarawak

by Elizabeth L. Bennett, Julian O. Caldecott, Michael Kavanagh, and Anthony C. Sebastian

Introduction

The Malaysian state of Sarawak on the island of Borneo has twelve species of native, nonhuman primates, comprised of one great and one lesser ape, six colobines, two macaques and two prosimians. Of these, five species are endemic to Borneo: the Bornean gibbon *(Hylobates muelleri)*, the proboscis monkey (*Nasalis larvatus*), the white-fronted langur *(Presbytis frontata)*, Hose's langur *(P. hosei)* and the red or maroon langur *(P. rubicunda)*. Five subspecies are also endemic to Borneo: the Bornean orang-utan *(Pongo pygmaeus pygmaeus)*, two banded langurs *(Presbytis melalophos chrysomelas* and *P. m. cruciger)*, the Bornean slow loris *(Nycticebus coucang borneanus)*, and the western tarsier *(Tarsius bancanus borneanus)*.

All of Sarawak's primates are threatened to some extent by habitat destruction and/or hunting. Following the definitions of the IUCN Mammal Red Data Book, we have assigned each threatened species to a category that reflects its status in Sarawak. "Endangered" species are those that are in danger of extinction in Sarawak, if the causal factors continue operating. "Vulnerable" species are those that are believed to be moving into the "endangered" category in the near future, if the causal factors continue operating. In practice, these categories include species for which remedial action has been or is being undertaken and whose populations may be expected to recover, but whose recovery is currently insufficient to justify their transfer to another category.

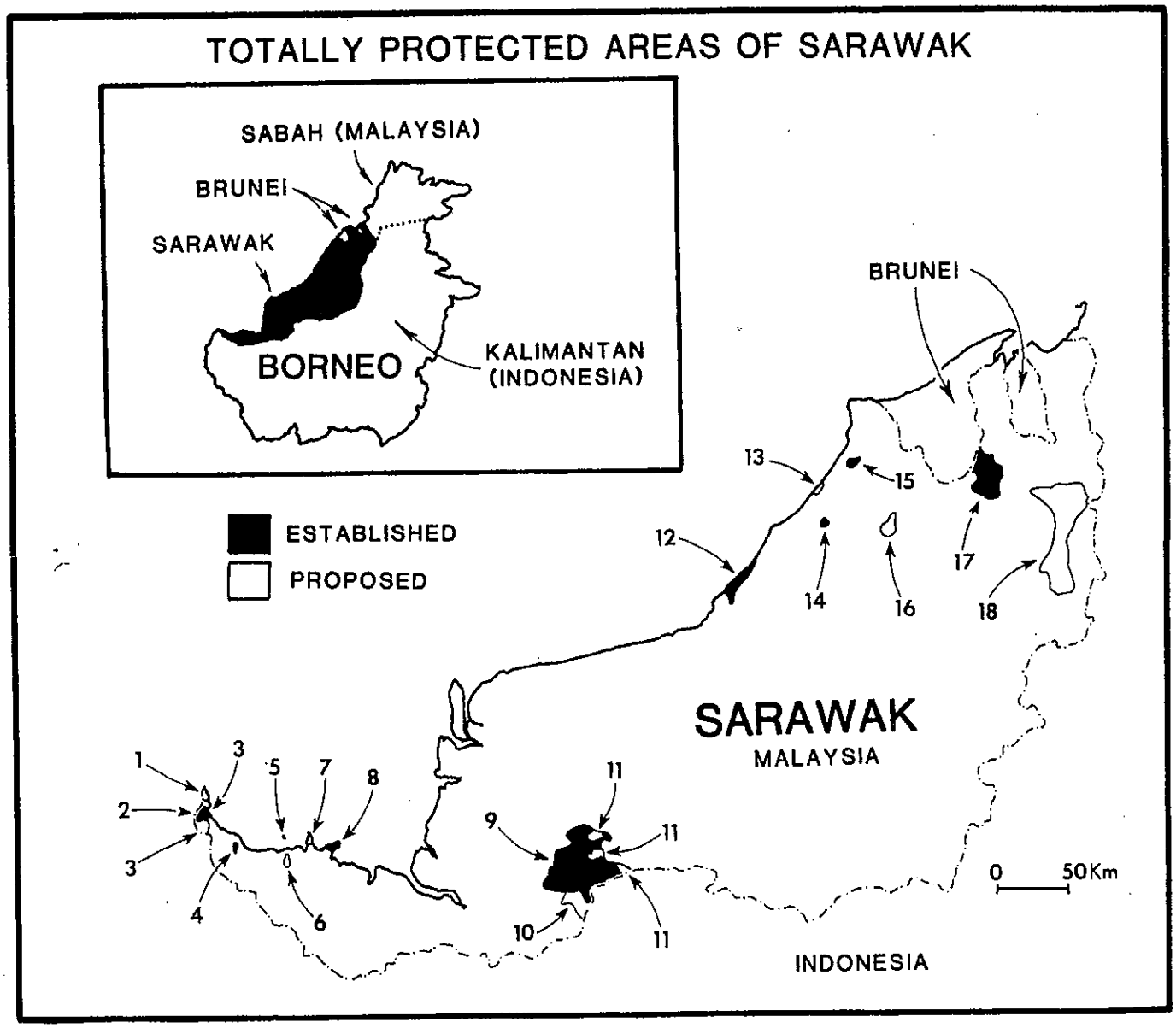


Fig. 1. National Parks (NP) and Wildlife Sanctuaries (WS) within the Malaysian state of Sarawak (map by S. D. Nash based on authors' original).

1. Tanjung Datu NP (1,214 ha)
2. Samunsam WS (6,092 ha)
3. Samunsam WS extensions (14,810 ha)
4. Gunung Gading NP (5,430 ha)
5. Pulau Tukong Ara-Banun WS (1 ha)
6. Matang NP (2,363 ha)
7. Santubong NP (2,363 ha)
8. Bako NP (2,728 ha)
9. Lanjak-Entimau WS (168,755 ha)
10. Batang Ai NP (27,060 ha)
11. Lanjak Entimau WS extensions (18,414 ha)
12. Similajau NP (7,067 ha)
13. Sibuti WS (1,212 ha)
14. Niah NP (3,140 ha)
15. Lambir Hills NP (6,952 ha)
16. Loagan Bunut NP (10,740 ha)
17. Gunung Mulu NP (52,887 ha)
18. Pulong Tau NP (164,500 ha)

Orang-utan: Vulnerable

The indigenous subspecies, *Pongo pygmaeus pygmaeus*, is endemic to Borneo and totally protected in Sarawak under the Wild Life Protection Ordinance of 1958. There are two main population centers. The first is in the lowland swamp forests between the Sadong and Lupar Rivers (Fig. 1). This population is already fragmented and continuing to decline because of habitat destruction and hunting. The second population is in the Lanjak-Entimau Wildlife Sanctuary (WS), which was gazetted primarily for orang-utan protection in 1983. The government is considering extending this sanctuary in three areas. In addition, it is planning to create Batang Ai National Park (NP), contiguous with the sanctuary's southern boundary. Lanjak-Entimau is also continguous with the large Indonesian Gunung Betung dan Karimun Nature Reserve. These existing and proposed Totally Protected Areas (TPAs) together encompass more than 8,000 km² of mostly intact habitat. Recent aerial surveys of the Sarawak component indicate a population sufficient to be viable in the long-term and, if the additional TPA proposals are successful, the species' future in Sarawak should be assured.

In addition to the two main populations, there are known to be individuals scattered in the most remote interior part of the state, along the Indonesian frontier area extending almost as far north as the proposed Pulong Tau NP. It is unlikely, however, that these are anywhere present in sufficient numbers to form another viable population.

Bornean gibbon: Vulnerable

Sarawak's only lesser ape is totally protected in the State; however, it is incorrectly named in the Ordinance, which could make the law difficult to enforce. Bornean gibbons are generally present wherever lowland or hill dipterocarp forest is intact. Numbers are declining overall, however, because of habitat disturbance, and populations in some areas have been reduced or eliminated by hunting. Hunting is for food or sport, and local populations are easy to exterminate because of the species' loud songs which attract attention, monogamy which means breeding is easily disrupted, and strong site attachment which inhibits both the evasion of hunters and recolonization of depopulated areas.

Presumably substantial populations exist in Gunung Mulu NP and Lanjak-Entimau WS, and if Samunsam WS is extended as proposed by the Forest Department, this population should also be viable. Small numbers of gibbons occur in Niah NP and Lambir Hills NP, and the species is present at low density in parts of the proposed Pulong Tau NP. Successful establishment of Pulong Tau NP and Batang Ai NP, and the extensions to Lanjak-Entimau WS and Samunsam WS should ensure the species' survival in Sarawak. Populations outside the system of TPAs would benefit from taxonomic correction of the Wild Life Protection Ordinance, public education as to its provisions, and vigorous enforcement.

Proboscis monkey: Endangered

Proboscis monkeys are almost entirely restricted to a few small patches of mangrove, riverine and peat swamp forest close to the coast, mainly outside the TPA system. The species was formerly widespread but has become extinct in many areas due to habitat clearance by logging and agricultural conversion. Intense, mainly recreational, illegal hunting has greatly reduced the populations in some remaining areas of habitat. The species' habit of sleeping conspicuously by rivers makes these animals particularly vulnerable.

Since groups are very wide ranging, the minimum effective TPA size is large. Sarawak's total population may be as low as 1,000 individuals. These animals occur in several isolated localities, including two TPAs. One of these is Bako NP where, however, the population may be too small to continue being viable in the future. The other is Samunsam WS, which was gazetted in 1979 mainly to protect the state's largest known population of about 160 individuals. However, this population uses areas outside the sanctuary, making the proposed extension an urgent necessity.

Effective protection from hunting is also crucial to the species' survival in the state, and additional areas need to be established as parks or sanctuaries where viable populations exist. Current survey work (by the Forest Department with ELB and ACS) suggests that TPAs could usefully be established for this and other species in the Triso and Maludam Peat Swamp Forests to the north of the Lupar River, and in the Limbang Mangroves that lie between the two parts of Brunei Darussalam. Transfrontier cooperation with Brunei Darussalam is a possibility that is being investigated. Another very important area for the proboscis monkey is the extensive, mangrove-covered delta of the Sarawak River. Surveys (by the Forest Department with ELB) indicate that this area would be suitable for development as a biosphere reserve, since existing traditional human use of the area does not conflict with the forest's important role in fisheries and wildlife protection.

Silvered langur: Endangered

Small populations of *Presbytis cristata* occur in Samunsam WS, Bako NP, Niah NP and in the proposed Sibuti WS. This species is not widespread in the state, being restricted to a few localities in mangrove and riverine forests close to the coast. Habitat clearance is taking its toll, and the species is also not protected by law and is heavily hunted in some areas. Legal protection is urgently needed. The animals at Samunsam use areas outside the sanctuary, further justifying its extension.

Banded langur: Endangered

There are two subspecies in Sarawak, *Presbytis melalophos chrysomelas* and *P. m. cruciger*, both of which are endemic to northwestern Borneo and neither of which is protected in Sarawak. Both are restricted to patches of low and medium elevation forest, *P. m. chrysomelas* in the west (where it occurs in Samunsam WS and Gunung Gading NP) and *P. m. cruciger* in the north (where a small population may exist in Lambir Hills NP but this is unconfirmed). The species is declining due to habitat clearance and hunting for food and sport associated with settlements and the timber industry. Hunting pressures are aggravated by a demand for bezoar stones (visceral concretions used in traditional medicine and sometimes found in this and other *Presbytis* species). Conservation priorities include total legal protection, the extension of Samunsam WS, and additional TPA protection for *P. m. cruciger*.

Other langurs: Vulnerable

White-fronted, Hose's and red langurs are all unprotected in Sarawak. They are found throughout the interior of the state, *P. frontata* in the south-center, *P. hosei* in the north, and *P. rubicunda* patchily across all inland areas. Recent research (Forest Department with JOC) shows that these species together account for at least one percent of all mammals hunted in Sarawak (which may amount to roughly 20,000 monkeys annually), such hunting being associated with inland settlements, the timber industry, and the demand for bezoar stones.

The population of *P. frontata* in and around Lanjak-Entimau WS should be viable if the proposed extensions and Batang Ai NP are gazetted. The same TPA complex could sustain a population of *P. rubicunda* which also occurs in Gunung Mulu NP and the proposed Pulong Tau NP. These last two parks will be responsible for sheltering the state's *P. hosei* populations. As well as consolidating the TPA system, priorities include protection of these and other *Presbytis* species under the Wild Life Protection Ordinance.

Macaques: Not Threatened

Neither the long-tailed macaque (*Macaca fascicularis*) nor the pig-tailed macaque (*M. nemestrina*) is protected by law. They are found throughout the state and in all or most existing and proposed TPAs. (*M. nemestrina* may be absent from the smaller ones.) Both species can survive in logged forest, and *M. fascicularis* may also establish itself in agricultural mosaics. In many areas, however, both species are intensely hunted for food, sport and especially as crop pests. Together they account for more that two percent of the mammals hunted in Sarawak,

and they both appear to be held at low density. In particular, *M. nemestrina* is naturally rare and its groups are highly mobile, so local populations are vulnerable to extinction by hunting around farms. Nevertheless, both species should survive indefinitely within the TPA system.

Prosimians: Insufficiently Known

Both of Sarawak's prosimians are endemic Bornean subspecies: the slow loris (*Nycticebus coucang borneanus*) and the western tarsier (*Tarsius bancanus borneanus*). Both are totally protected by law and distributed throughout the state at low to medium elevations and in at least some existing or proposed TPAs. There is no information on population density in relation to human land use or natural habitat variation. Individuals are kept and traded as pets, but neither species is systematically hunted, and both are indeed protected by traditional beliefs among the Iban (Sarawak's largest native racial group).

Conclusions

Sarawak's primates are all variously affected by one or some combination of the following factors: habitat clearance (agricultural and other land developments, intense logging, or settled cultivation) and hunting (for food, sport, crop protection or trade). Not all species and populations are affected equally, however, and the three most endangered species (*Nasalis larvatus, Presbytis cristata* and *Presbytis melalophos*) are those with limited distributions in the coastal lowlands where humans have long been active. Of these, the proboscis monkey is most in need of attention, but the single most urgent conservation priority — extension of Samunsam WS — would also benefit silvered and banded langurs. This should certainly be backed up by full legal protection and the establishment of additional TPAs for all three species.

The other primates all occur in at least one sizeable TPA, and if the system is consolidated and defended effectively, as has been proposed by the National Parks and Wildlife Office of the Forest Department, populations should be maintained indefinitely. The outlook is bleak, however, for primates living in many areas outside the parks and sanctuaries. Without legal protection and the enforced regulation of hunting, most such local populations are likely to become extinct.

The main hope for all of Sarawak's primates lies in the substantial level of interest in wildlife amongst all levels of the public. This is quickly apparent in conversation with Sarawakians or when reading the local press, and it means that there is at least potential popular support for any initiative towards wildlife conservation in the state. One manifestation of this was the formation in late 1984, of a Special Select Committee of the State Legislative Assembly on the Conservation of Flora and Fauna. It will report to the Assembly with detailed findings and recommendations on all aspects of wildlife conservation. A similarly important aspect has been the State Government's current support for the production of a Conservation Strategy for Sarawak (by World Wildlife Fund Malaysia, in collaboration with the State Planning Unit of the Chief Minister's Department). These moves indicate that there are grounds for optimism for the future of the diverse wild species and natural systems of this part of Borneo.

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Conservation Status of the Primates of the Indo-Chinese Subregion

by John and Kathy MacKinnon

Eighteen species of primates are found in the Indo-Chinese Subregion of the Indo-Malayan Realm (see Fig. 1). These include four gibbons, six macaques, six leaf monkeys and two lorises. Another four species are marginal intruders to the region. The dusky leaf monkey *(Presbytis obscura)* and banded leaf monkey *(Presbytis melalophos)* are both found in the lowland rainforests of peninsular Thailand. The very rare Biet's and Brelich's snub-nosed monkeys *(Pygathrix bieti* and *P. brelichi)* are found on the northern margins of the region, *P. bieti* along the northern Burmese border in the Yun-ling mountain range and *P. brelichi* in the Fan-jin Mountains of Kweichan Province, China. Distribution maps of all species are presented in Figure 2. Seven of the species considered here are endemic to the region. Others are more widespread in adjacent biogeographical regions.

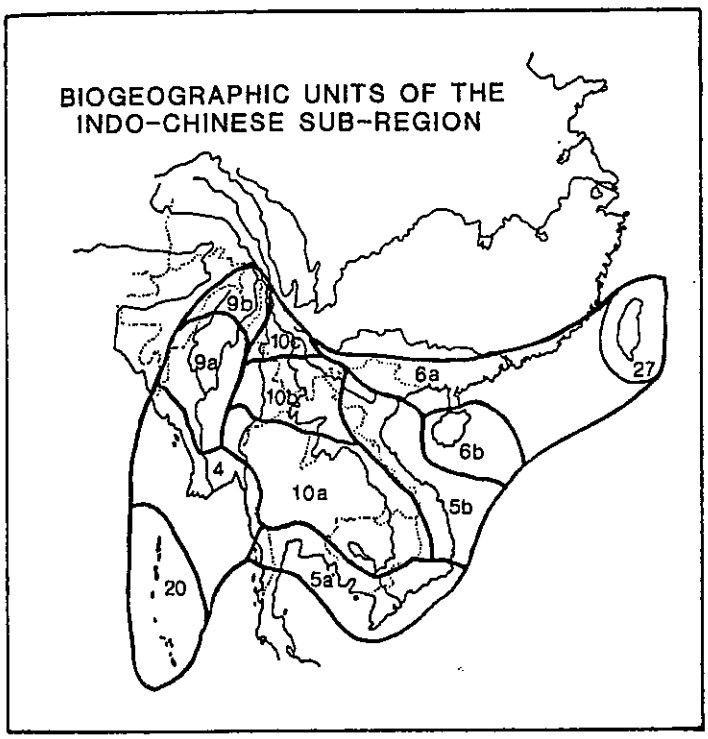

Fig. 1. Biogeographic units of the Indo-Chinese sub-region (map provided by authors; from MacKinnon and MacKinnon, 1986).

To estimate the total numbers of each primate species remaining and the degree to which species are threatened, the following data have been collected for each species: (1) areas of original and remaining habitat, (2) the total area of species' habitat protected within the existing and proposed protected areas of the region, and (3) average population densities. Table 1 shows the areas of original and remaining natural habitats within each species' range. The data for original habitat has been calculated from vegetation maps prepared for the Review of the Protected Areas Systems in the IndoMalayan Realm (MacKinnon and MacKinnon, 1986) based on a variety of sources. Remaining forest was mapped after consultation of the latest forestry maps and satellite photos available for the region. Nevertheless as many of these sources are already out of date and deforestation is proceeding apace, these figures will tend to overestimate areas of remaining forest.

Some measure of the ongoing threat to each species is given by comparing areas of original with remaining habitat to estimate percentage loss of habitat. As Table 1 shows, some species have already suffered dramatic loss of habitat. Half the species (9) already have lost 70% or more of their original habitat area and all except for the capped langur *(P. pileata)* have lost more than half of their original habitat.

A species' long-term security is reflected by the area of protected habitat found within its range. The total protected area for each species is the sum of the species' habitat protected within the existing and proposed protected area systems of the region. For all species we have determined the percentage of a species' original habitat which is now protected; for all species this is very small. Table 1 lists areas of primate habitat protected within the region and those reserves where species are known or are likely to occur.

To determine the existing status of the Indo-Chinese primates we have attempted to give total population estimates for each species. Population density estimates of forest primates are usually derived from intensive field surveys and broad surveys in the area concerned. Density estimates for the primates of Indochina are sparse in the literature. To determine a conservative density estimate, we have used figures derived from Chivers (1977) and Brockelman (1975) (gibbons), from Wolfheim (1983), and from densities estimated for the same species elsewhere in Asia, e.g. Gittins (1980). Each estimate is qualified by subjective judgements based on a knowledge of the species' biology and distribution. These conservative working density estimates (Table 2) are meant to give a 'safe' figure applicable throughout the whole of the species' range, regardless of habitat type.

Density Estimates for Indo-Chinese Primates

To calculate a total population for each primate species within the Indo-Chinese Region, we have multiplied the area of habitat remaining by a conservative density estimate for each primate species. Total population estimates for each species occurring in the Indo-Chinese Biogeographic Region are presented in Table 2. These estimates are crude and best described as "guesstimates". They do, however, give a working figure on which to base some conclusions about a species' status - which species are common, which rare, and which endangered - and the adequacy of protection afforded by the regional network of national parks and protected areas.

Table 1 shows that all primate species of the region have at least some areas of suitable habitat protected within the reserve system. Only two species, *Hylobates lar* and *H. pileatus*, have approximately 10% or more of their original habitat protected within reserves. This reflects the very good coverage of gibbon habitat within the Thai National Park and Protected Area system. All other species except *Hylobates hoolock* and *Presbytis pileata* have less than 5% of their original habitat protected within the reserve system and two species, *Pygathrix avunculus* and *Presbytis francoisi*, both with very limited distributions, have less than 2% of their habitat protected.

Table 2 lists the number of primates likely to survive in the suitable habitat remaining for each species if not otherwise disturbed. This is a big 'if'. During the thirty years of warfare in Indochina, primate populations and other wildlife suffered drastically and many populations have been hunted to extinction. Today, therefore, not all areas of remaining habitat support primate populations — in fact the majority do not. Elsewhere in the region, increasing population pressure has led not only to forest clearance but to animals being hunted for food or exterminated as crop raiders. Again many remaining areas of natural habitat no longer support primate populations. Thus, although the distribution maps for *Macaca assamensis* and *M. arctoides* show these species widely dispersed across the region, in Thailand — one of the only countries of the region where good data are available — these species are now reduced to relict populations in montane habitats. These factors have been taken into partial account when estimating remaining populations.

Table 1 also lists areas of primate habitat protected within the region. Again these figures must be viewed with caution. Many of the protected areas of the Indo-Chinese Subregion exist only on paper or are still at the proposal stage. Protection and management is minimal or non-existent in most of the listed reserves of the region. Only the Thai national parks can be described as being well-managed, but many of these have suffered past agricultural incursions and hunting disturbance. Many other Thai reserves still suffer from poor management and abuse from neighboring agricultural settlements. Thus, although habitat is indeed

protected many of these protected areas no longer contain their original complement of wildlife. Throughout the region primates have suffered from hunting for food, medicine and as agricultural pests. In protected areas where populations are known to still occur they may be at relatively low densities because of past hunting pressure. Therefore, the compensated figure listed for protected population may be a considerable overestimate for some species.

Table 1 indicates that many species have considerable areas of their remaining habitat protected within the reserve system. Only six species have 10% or less of their remaining habitat protected within the existing reserve system. These include three of the macaques; *M. arctoides, M. assamensis,* and *M. mulatta. M. mulatta* is, however, well protected outside the region in India and although their natural habitat has been much reduced there, rhesus macaques achieve high densities in urban situations.

The other three species with about 10% or less of their remaining habitat protected are *Presbytis francoisi, Presbytis pileata* and *Pygathrix avunculus. P. pileata* is also found outside the Indo-Malayan Realm in neighboring Bangladesh and Assam so it is not a species of special concern. *Presbytis melalophos* and *P. obscura* are marginal intruders into the Realm but both are well-protected in the reserves of the Malay Peninsula.

Although they are marginal to the region, it is worth looking at the status of China's snub-nosed monkeys. There are three *Pygathrix* species in mainland China and all three are classed as rare in the IUCN Red Data Book. The most endangered is the black or Biet's snub-nosed golden monkey *(P. bieti)* found on the Yunnan—Tibet border where it is estimated at only 200 animals. Brelich's snub-nosed monkey found only in the Fan-jin Mountains of Kweichow is believed to total only 500 animals. The golden monkey *(P. roxellanae)* is more widely distributed and numerous with a population believed to total between 3,500 and 5,000 animals. The Chinese government has taken some steps to conserve these rare *Pygathrix* species although there are, as yet, no reserves for Biet's snub-nosed monkey, the most endangered species (Tan Bangjie, 1985). Although hunting of monkeys is now banned and forest destruction has stopped, we still require surveys and long-term studies to determine the status of the Chinese snub-nosed monkeys, especially the two rarer species.

Table 1. Distribution, Habitat Loss and Habitat Protection for Primates of IndoChina

Species	Biounits	Habitats	Original area/km²	Remaining/ km²	% loss	Protected/ km²	% original protected	% remaining protected	Reserves
Hylobates concolor	5, 10	evergreen forest up to 1,500 m.	349,330	87,532	75	10,918	3.1	12.5	Xishuangbanna (CH) Nam Cat Tien, Cuc Phuong (VN)
H. lar	4, 10a, 5a	evergreen forest up to 1,000 m. excluding mangrove	95,000	26,900	72	15,080	15.8	56.0	Pakchan (BU) Khao Yai, Huai Khae Khaeng, Doi Inthanon, Phu Khieo (TH)
H. hoolock	4, 9, 10	evergreen forest up to 1,500 m.	168,353	56,378	67	8,554	5.1	15.2	Tanlwe/Ma-e Chung Tamanthi (BU)
H. pileatus	5a, 10a	lowland forest up to 1,000 m. not mangrove	70,000	11,200	84	6,963	9.9	62.1	Khao Khitchakut Khao Yai, Khao Soi Dao (TH)
Macaca arctoides	5, 10, 4 6a, 9b	upland forest	1,546,964	556,466	64	57,971	3.7	10.4	Salak Phra, Nam Nao (TH) Kon Ha Nang, Cuc Phuong (VN)
M. assamensis	4, 10, 5b, 9b	upland forest	802,193	335,002	59	20,323	2.5	6.1	Salak Phra, Huai Kha Khaeng (TH)
M. cyclopis	27	lowland and upland forest	37,281	11,556	69	1,450	3.9	12.5	Yu-Shan (TW) Taroga (TW)
M. fascicularis	5, 10a	coastal and riverine forest up to 1,000 m. disturbed forest	106,603	15,468	86	4,169	3.9	26.9	Salak Phra, Huai Kha Khaeng (TH), Nam Cat Tien (VN)
M. nemestrina	5, 10, 9	primary and secondary lowland and hill forest	1,537,623	467,012	70	61,882	4.0	13.2	Pidaung (BU) Khao Yai, Nam Nao Huai Kha Khaeng (TH) Nam Cat Tien, Cuc Phuong (VN)
M. mulatta	6, 9, 10 5b	evergreen and dry deciduous forest up to 3,000 m.	1,732,270	568,638	67	49,019	2.8	8.6	Pidaung (BU) Salak Phra, Huai Kha Khaeng, Doi Chieng Dao (TH) Cuc Phuong, Kon Cha Rang (VN)

Table 1 (continued)

Species	Biounits	Habitats	Original area/km²	Remaining/ km²	% loss	Protected/ km²	% original protected	% remaining protected	Reserves
Pygathrix avunculus	6a	limestone forest	29,688	9,060	70	440	1.5	4.8	Ba Bé (VN)
P. nemaeus	5b, 10a	evergreen forest up to 1,500 m.	296,000	72,720	76	9,155	3.1	12.6	Nam Cat Tien, Kon Ka Kinh (VN)
Presbytis cristata	5, 10a	coastal and riverine forest	91,309	11,759	88	3,028	3.3	25.8	Nam Nao, Khao Khieo (TH)
P. francoisi	5b, 6a	semi-evergreen forest	97,400	14,106	86	1,140	1.2	8.0	Cuc Phuong (VN)
P. phayrei	4, 9, 10 5b	lowland evergreen forests	708,572	193,172	73	27,337	3.8	14.1	Huai Kha Khaeng (TH) Pidaung, Pegu Yoma (BU)
P. pileata	9	wet deciduous and tropical evergreen forest	65,868	34,622	48	3,717	5.6	10.7	Xishuangbanna (CH) Tamanthi (BU) Pidaung (BU) Nam Lang (BU) Natma Taung (BU)
Nycticebus coucang	4, 5, 9, 10	primary and secondary rainforest	1,202,912	307,779	75	52,282	4.3	17.0	Khao Yai (TH) Xishuangbanna (CH) Nam Cat Tien, Cuc Phuong (VN)
N. pygmaeus	10a, 5b	evergreen up to 1,500 m.	296,000	72,720	76	9,155	3.1	12.6	Nam Theun (LA) Cuc Phuong, Vu Quang (VN) Lomphat (KA)

Table 2. Population Estimates for Indo-Chinese Primates

Species	Working Density Animals/km²	Total Population Estimate	Protected Population Estimate
Hylobates concolor	3.0	131,000	16,300 #
Hylobates hoolock	3.0	169,134	25,662
Hylobates lar	3.0	79,700	45,240
Hylobates pileatus	3.0	33,600	20,889
Macaca arctoides	2.0	556,000	57,900 #
Macaca assamensis	2.0	335,000	20,300 #
Macaca cyclopis	5.0	57,780	7,250 *
Macaca fascicularis	20.0	309,360	83,380
Macaca mulatta	10.0	3,790,000	320,600 #
Macaca nemestrina	5.0	1,200,000	60,000 #
Presbytis cristata	10.0	784,000	20,000 #
Presbytis francoisi	3.0	42,318	4,560 *
Presbytis phayrei	4.0	515,000	72,900 #
Presbytis pileata	10.0	230,800	24,400 #
Pygathrix avunculus	2.0	18,120	880 *
Pygathrix nemaeus	2.0	72,200	9,150 *#
Nycticebus coucang	3.0	923,337	156,846
Nycticebus pygmaeus	1.0	72,720	9,155 *

\# species heavily hunted for food or as agricultural pests
* species with less than 10,000 protected in reserves

Concolor Gibbon

H. concolor is endemic to the Indo-Chinese Region being found only from South China to South Vietnam, and on the offshore island of Hainan where small populations still exist in the Wuz Hishan Mountains and Bawa Ling (J. Thornback, pers. comm.). Within its range, it has already suffered 75% loss of habitat. This species is listed as endangered in the IUCN Red Data Book. Protected areas lying within the species' range total 10,918 km², and include Xishuangbanna Conservation Area (China) and Nam Cat Tien and Cuc Phuong in Vietnam. With an estimated density of 3.0 animals/km², the total area of remaining habitat would support about 260,000 individuals if gibbons were present in all remaining forest. Chivers (1977) suggested a figure of 228,000 concolor gibbons for Laos and Vietnam. In fact, the remaining population of concolor gibbons in Indochina is likely to be considerably less (see Table 2). For the last 30 years the whole Indo-Chinese Region has been wracked by warfare which has destroyed natural habitat, accelerated the rate of forest clearance and led to the killing of much local wildlife for food. Gibbons are now extremely rare in Vietnam at least (Constable, 1982; Westing and Westing, 1981). On several field trips in various parts of Vietnam, J. MacKinnon reports that he never heard a gibbon call, even on four visits to Cuc Phuong National Park where this species is listed as present.

Hoolock Gibbon

Hylobates hoolock occurs from eastern India and Bangladesh through Burma into southern China; the eastern limit of its distribution is the Salween River. At a density of 3 animals/km² we can expect a population of 169,000 in areas of remaining suitable habitat. Chivers (1977) estimated some 452,000 gibbons for Burma alone, a figure almost three times as great as that in Table 2, which we regard as optimistic. Chinese scientists estimate no more than 50 animals remain in southwest China (Tan Bangjie, 1985).

Lar Gibbon

Hylobates lar is found in southern Burma and Thailand within the region, but also occurs throughout peninsular Malaya and into Sundaland to North Sumatra. Chivers (working on figures supplied from detailed studies by Brockelman) suggests a figure of 60,000 for Thailand. This figure accords closely with our estimate of 79,700 for the whole region. Lar gibbons are well-protected within the Thai reserve network.

Pileated Gibbon

Hylobates pileatus is endemic to the Indo-Chinese Region occurring in southern Thailand and Kampuchea west of the Mekong. It is difficult to assess the animal's status in war-torn Kampuchea but it seems likely that with a much smaller human population, primates have suffered much less from hunting in Kampuchea than in neighboring Vietnam. With a remaining habitat of about 11,200 km² and a density of 3 animals/km², expected gibbon populations may be in the region of 33,000 or so animals, with some 20,000 protected within reserves. Chivers (1977) estimated a total population of pileated gibbons of 100,000 and predicted a likely decline to about 22,500 animals by 1980. Many of the southern Thai national parks, where pileated gibbons occur, are well-protected. Although the Kampuchean parks have no management infrastructure, human population levels are lower in Kampuchea than elsewhere so destruction of forests and wildlife has been less severe until recently. However, since pileated gibbons occur in the border zones where the Khmer Rouge are still fighting with Kampuchean Government forces supported by the Vietnamese army, the status of primates in these areas can only be regarded as seriously threatened.

Stump-tailed Macaque

Although the distribution map shows *M. arctoides* with a very wide distribution extending beyond the region's boundaries into Assam, southern China and even into northern Malaya, the species is by no means common within that range. Remaining populations within Thailand, for instance, are distinct, montane relicts of a once much wider range (Eudey, 1980). Bain and Humphrey (1982) map this species in Thailand with a very limited distribution in western Thailand along part of the Burmese border in the Huai Khae Khaeng area. Thus, total areas of remaining suitable habitat for this species distort the true picture. The species has suffered in Thailand due to habitat loss and trapping for export (now banned), and populations are also likely to be much reduced elsewhere within the species' range by killing for food and as agricultural pests. The species also shares its range with *M. assamensis* and *M. mulatta*, and is likely to be replaced by the latter in any competitive situation.

Assam Macaque

The Assam macaque is found from northern India and Nepal to Vietnam. Although this species is considered abundant in India (Wolfheim, 1983), very little information is available for the rest of its range. Nevertheless we estimate a total population of more than 300,000 with 20,300 animals in reserves, figures which may be overly optimistic. *M. assamensis* is a forest monkey which utilizes many types of evergreen and dry forest within its range over a wide range of altitudes. Throughout its range this macaque has been killed for food and as a crop raider. In North Vietnam it is also trapped for biomedical research and exported to the U.S.S.R. (Wolfheim, 1983). Military activity in Laos and Vietnam has undoubtedly destroyed some of the species' habitat and increased hunting of this primate for food.

Formosan Rock Macaque

Macaca cyclopis is endemic to the island of Taiwan. Here it occurs in a wide range of habitats from forest to open rocky hills at altitudes varying from sea level to 1,800 m (although it has been recorded higher; Wolfheim, 1983). Many of the lowland forests and other natural vegetation types have been cleared for human habitation and agricultural lands, and only some 30% of the species' original habitat remains. Of this 12.5% lies within protected areas. With an estimated density of 5 animals/km², there could be as many as 57,000 Formosan rock macaques in the wild but this figure is probably far too high. Past hunting levels have probably reduced the population to half this number. Macaques are hunted for food and as crop raiders and animals are also trapped for biomedical research. Some 7,250 Formosan macaques are estimated to exist within the island's existing network of protected areas. These reserves are reasonably well protected and the species is probably secure in these areas. However, because of the low protected population this species should be monitored for long-term population trends.

Long-tailed Macaque

Macaca fascicularis occurs only in the southern half of the Indo-Chinese Region but is also common in the neighboring Sundaic Biogeographic Realm. This species is a native of riverine, swamp and coastal forests but also achieves high densities in secondary habitats such as plantations and ricefields where it is a serious crop raider (MacKinnon, 1983). This monkey must be regarded as one of the most opportunistic and successful of all the Old World monkeys. The long-tailed macaque is well-protected in several reserves both in Indochina and adjacent Sundaland (MacKinnon, 1986) and its overall population numbers give no cause for concern. It is worth noting, however, that this macaque's riverine and swamp forest habitat is also the habitat most favored by man for agriculture, and this species has already lost some 86% of its natural habitat within the region. Similarly in Indonesia it has lost 66% of its habitat overall and a startling 96% in Java and Bali (MacKinnon, 1986).

Rhesus Macaque

The rhesus macaque enjoys a wide distribution both within the Indo-Chinese Region and, outside the region, in India. Rhesus macaques can achieve very high densities in some habitats, and population densities cited in the literature range from less than 1 to 1,000 animals/km² (Wolfheim, 1983). Little information is available on the animal's abundance over most of its range. Although rhesus macaques live naturally in a wide variety of habitats and even urban environments, the species has been eliminated throughout much of its former range in Thailand (Fooden, 1971) and probably also in Indochina. Widespread bombing, defoliation and hunting of monkeys for food during the war have certainly reduced numbers of these macaques. Rhesus macaques are also killed as crop raiders. Some animals were exported from Thailand for biomedical research in the past; this trade is now banned. Vietnam supplies *M. mulatta* to the Soviet Union for biomedical research (Constable, 1982). Although large areas of rhesus macaque habitat remain we have no information on how many viable populations of this species occur outside reserves. The estimated protected population may also be an overestimate. Many of the "reserves" of the area have been seriously disturbed in the past and still have little effective protection.

Pig-tailed Macaque

Macaca nemestrina is very widely distributed throughout the region. Outside the region it extends into Assam and Sundaland, reaching Sumatra and Borneo. Pig-tailed macaques are found in both lowland and hill forest but do not utilize all the available habitat. Although this macaque's range extends well into Indochina, the species is absent or hunted to extinction throughout much of its range. The estimate of over 60,000 pig-tailed macaques in protected areas may still be too high even though this estimate was reduced to account for the species being actively hunted and destroyed as a crop raider.

Silvered Leaf Monkey

Presbytis cristata is found from southern Burma through Indochina. Outside the region, populations are found in Malaysia and Indonesia as far east as Borneo and Lombok. This species inhabits riverine, swamp and coastal forests throughout its range. It can occur at relatively high densities, but throughout much of Indochina this leaf monkey has been hunted to extinction. Although the total remaining population estimate is high, only about 20,000 animals are believed to be protected.

Francois' Leaf Monkey

Presbytis francoisi has a very limited distribution, occurring only from southeastern China south through northern Vietnam and part of central Laos west to the Mekong. This species seems to inhabit semi-evergreen forest and rocky areas. Very little is known apart from the fact that part of its range was heavily damaged by bombing during the Vietnam conflict (Pfeiffer, 1973). With a working density of 3 animals/km², the remaining habitat could support a population of some 42,000 animals. Almost certainly the true remaining population is much lower than this — perhaps a tenth. An estimated 4,500 animals protected within reserves is an optimistic figure. This species must be considered seriously endangered.

Phayre's Leaf Monkey

Presbytis phayrei is found throughout the region from Burma through southern China and Thailand to Vietnam and outside the region in Bangladesh. It occurs in evergreen forest and even secondary forest where it often achieves higher densities than in primary growth. It has been hunted to extinction in some parts of Burma around salt springs to obtain its lime-induced gallstones (bezoar stones) for medicinal purposes (Lekagul and McNeely, 1977) and, like the other primates in Indochina, has declined during the war years due both to direct military activity (spraying of defoliants, etc.) and to an increased number of monkeys being killed for food or as crop raiders.

Capped Langur

Presbytis pileata is found from eastern Bangladesh and Assam to northern Burma, and only just extends into the northwest of the Indo-Chinese Subregion. Capped langurs occur in tropical wet deciduous forest and tropical evergreen rainforest (Wolfheim, 1983) and where they occur achieve densities often exceeding 10 animals/km^2. Numbers likely to remain within Burma are high with a good population protected within reserves. Although little information is available on the species' distribution in Burma (Salter, 1983), it is likely that capped langurs occur in Tamanthi, Pidaung, Nam Lang and Nakma Taung.

Douc Langur

Douc langurs are found only on the Indochinese Peninsula. Some authorities separate douc langurs into two species: the red-shanked douc langur *(Pygathrix nemaeus)* of central Vietnam and east central Laos, and the black-shanked douc langur *(P. nigripes)* of South Vietnam, South Laos and East Kampuchea. Douc langurs are listed as endangered in the IUCN Red Data Book. Although considerable areas of douc langur habitat remain and are protected, few of these areas still support douc langur populations. In Vietnam especially, the recent military activities have had a serious effect on langur populations; heavy bombing and the use of defoliants have destroyed habitat, and monkeys and many other animals have also been killed for food. Though douc langurs are still believed to occur in the reserves of Nam Cat Tien and Kon Ka Kinh, douc langurs are now extinct on Mt. Sontra where they were studied by Lippold (1977). Although there is no information available on the status of doucs in Laos and Kampuchea, there are probably no more than 9,000 of these langurs in proposed protected areas, and perhaps many less.

Tonkin Snub-Nosed Langur

Pygathrix avunculus is found only in a small area of North Vietnam, north of the Red River. It is found in forests on the limestone hills of the region. Because of its very limited distribution and the small area of its habitat protected, this langur must be regarded as seriously endangered. This species probably still occurs in Ba Bé National Park in Vietnam, but with an estimated protected population of only 880 animals must be considered seriously endangered.

Slow Loris

Nycticebus coucang is widely distributed throughout the region and extends extralimitally from Assam to Mindanao and onto the islands of the Sunda Shelf. Although it has suffered from habitat destruction, the slow loris is relatively numerous and is further protected by its nocturnal way of life.

Pygmy Loris

Nycticebus pygmaeus has a much more limited distribution being confined to the Indochinese Peninsula east of the Mekong River. Within this region all primate populations have suffered drastically over the last few decades from prolonged military activities, bombing, defoliant spraying and hunting for meat and medicinal properties. Both pygmy and slow lorises are sometimes offered for sale as food at the bird and animal market in Saigon.

The main threat to the primates of Indochina, as elsewhere in tropical Asia, is forest clearance for agriculture, timber and, in parts of Indo-China, as a deliberate act of war. Vietnam alone has lost more than half its forest cover in the last 40 years due to forest clearance and war damage; now only 24% of the country's land surface remains forested. Locally primate populations are also threatened by hunting and extermination as crop raiders. Although large populations of many primate species still remain outside the existing reserve systems of the Indo-Chinese Subregion, it is only in protected areas that a long-term future can be assured and only if these areas are large enough to maintain viable populations and are well protected and managed. It is therefore a cause for optimism that the other countries of the region are following Thailand's lead and are attempting to establish networks of parks and protected areas to protect a comprehensive range of habitats and their associated wildlife. As yet, only Thailand has an adequate protected area system which offers good protection to all the country's primates. However, protection and management of many of the smaller reserves in Thailand needs to be improved. Neighboring Burma still has extensive forest covering a wide range of habitats from wet evergreen forests to coastal mangroves and temperate forests in the north. Although Burma's human population is not high by Asian standards, it is increasing steadily. Recently the Burmese government, in cooperation with F.A.O., has begun to develop a national parks and protected areas program, and many of the proposed conservation areas will give much-needed protection to the primates of the region.

Priority conservation action for the Indo-Chinese Region now needs to be concentrated on Laos, Kampuchea and Vietnam. All three countries already have a proposed network of reserves and have expressed their desire for international cooperation to develop them. After forty years of warfare and subsequent rebuilding, these governments are now focusing their attention on wildlife conservation. As a mark of their concern, Vietnam, Laos and Kampuchea recently signed an international agreement to cooperate on the conservation of kouprey and waterbirds.

The facts presented in this paper highlight our ignorance of the status of primates and other wildlife in Laos, Kampuchea and Vietnam, and emphasize the need for conservation action now. Of the five species identified as having less than 10,000 animals protected within existing or proposed reserves, four are confined to these three countries. These countries must be regarded as key countries for primate conservation in Asia.

There is little available information on the status of primates within Laos and Kampuchea. Surveys of primate distribution, densities and status should be a priority in these countries as soon as the political climate allows. Similarly, information for Vietnam is sparse and out-of-date. The situation in Vietnam is probably more serious than even recent literature suggests, as a burgeoning human population makes ever-increasing demands on the now limited and depleted wildlife resources. Vietnam has all the problems of any other densely-populated Asian country struggling to feed an expanding population, problems exacerbated by the long years of warfare. The Vietnamese govenment, concerned with the country's environmental problems, has prepared a National Conservation Strategy which is now being implemented. A national system of reserves is being established and probably populations of all the country's primates are protected within this reserve network but nowhere are populations very large. Several species including pygmy loris, douc langurs, Tonkin snub-nosed langur and Francois' leaf monkey, must still be considered under-protected. These species will require adequate protection and good habitat management if they are not to become extinct.

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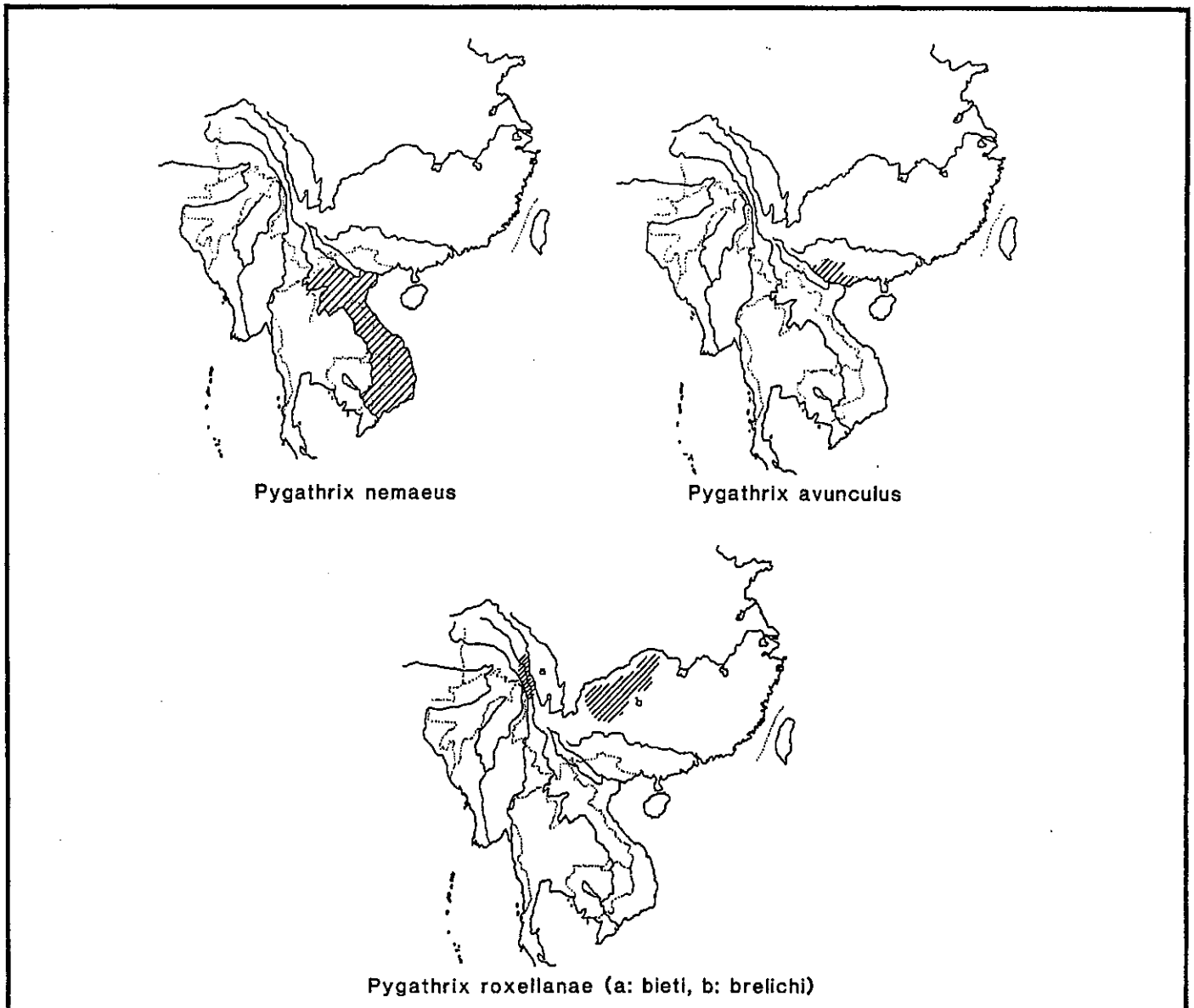
Fig. 2. Distribution maps of primate species in the Indo-China Subregion (maps provided by authors).



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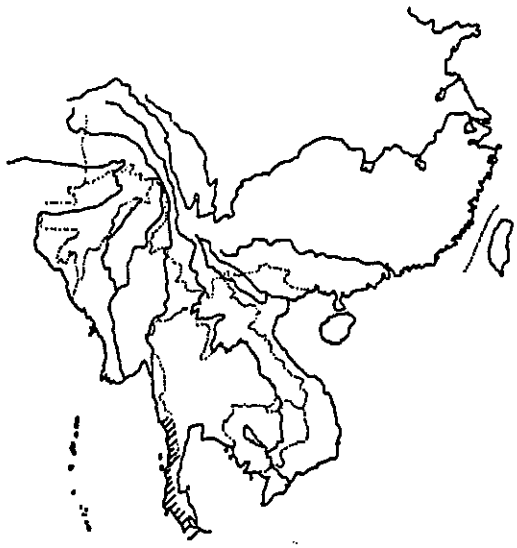
Presbytis francoisi



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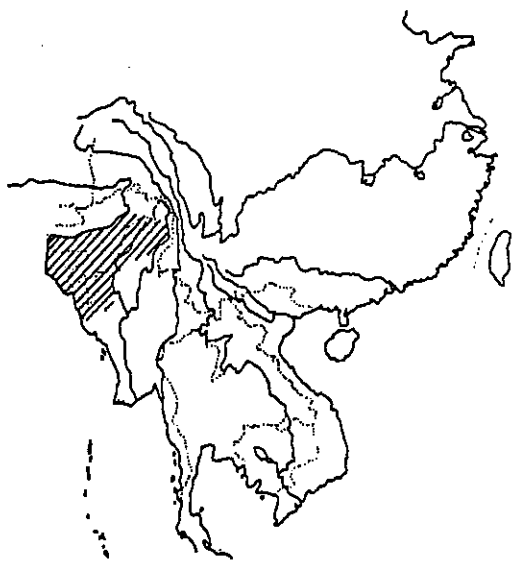
Presbytis obscura

Presbytis phayrei



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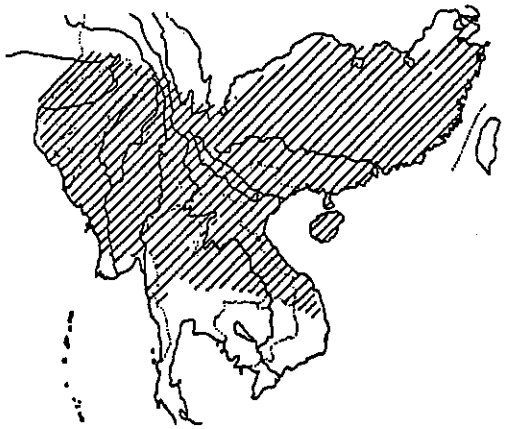
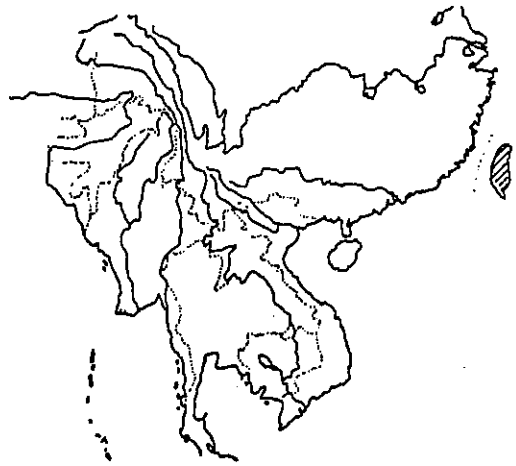


Macaca mulatta



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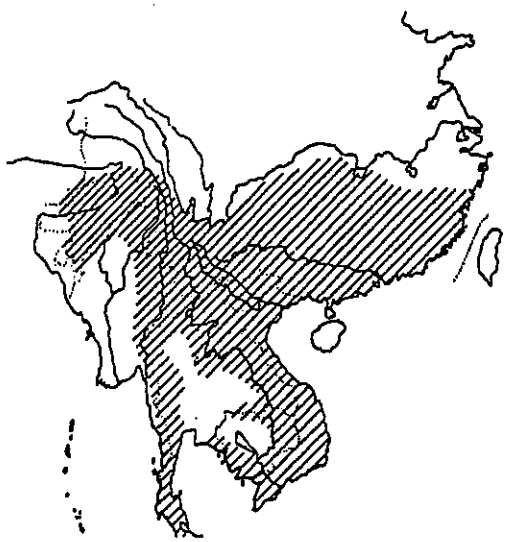
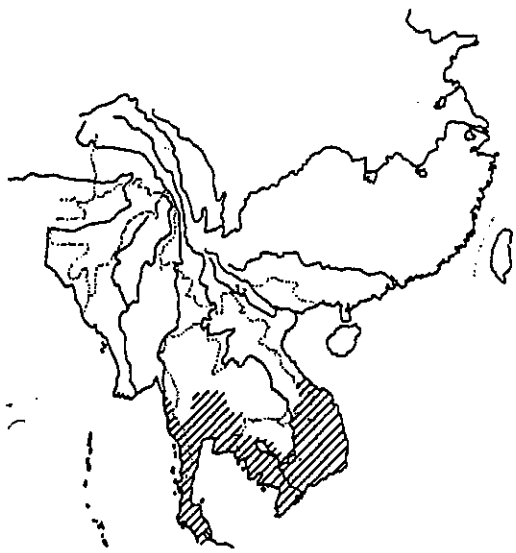
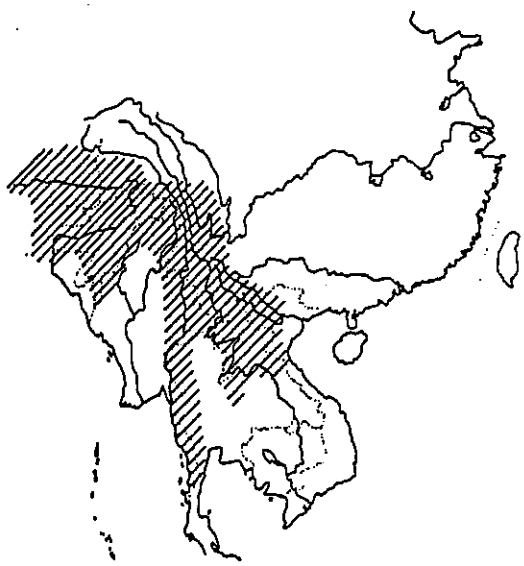


Macaca arctoides



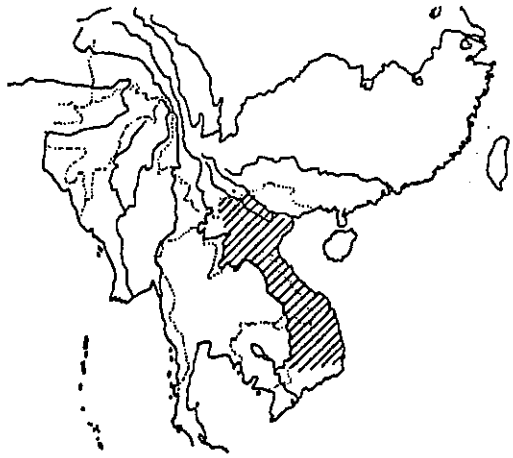
Macaca fascicularis

Macaca nemestrina



Macaca assamensis

Nycticebus coucang



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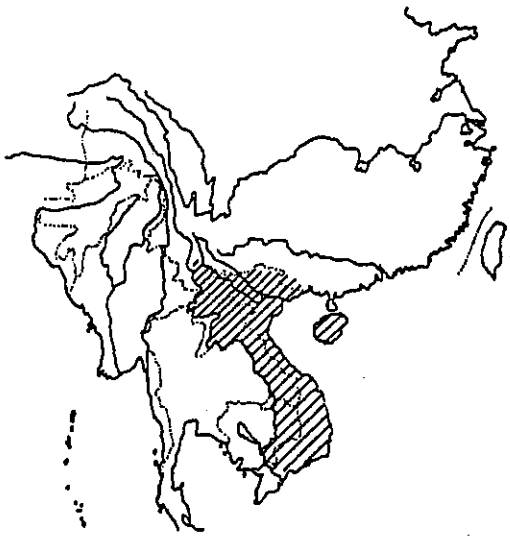
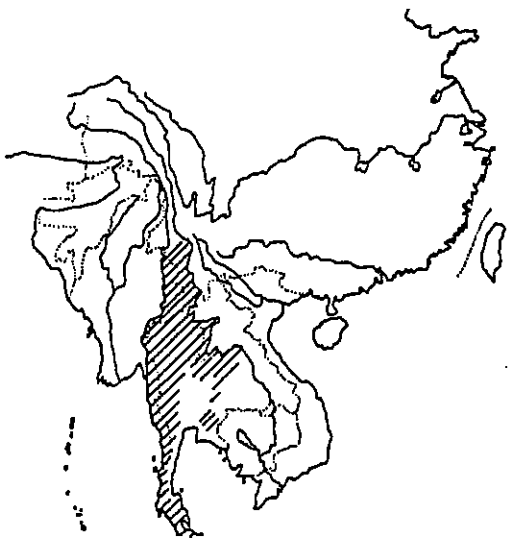


Hylobates concolor

Hylobates hoolock



Hylobates lar

Hylobates pileatus

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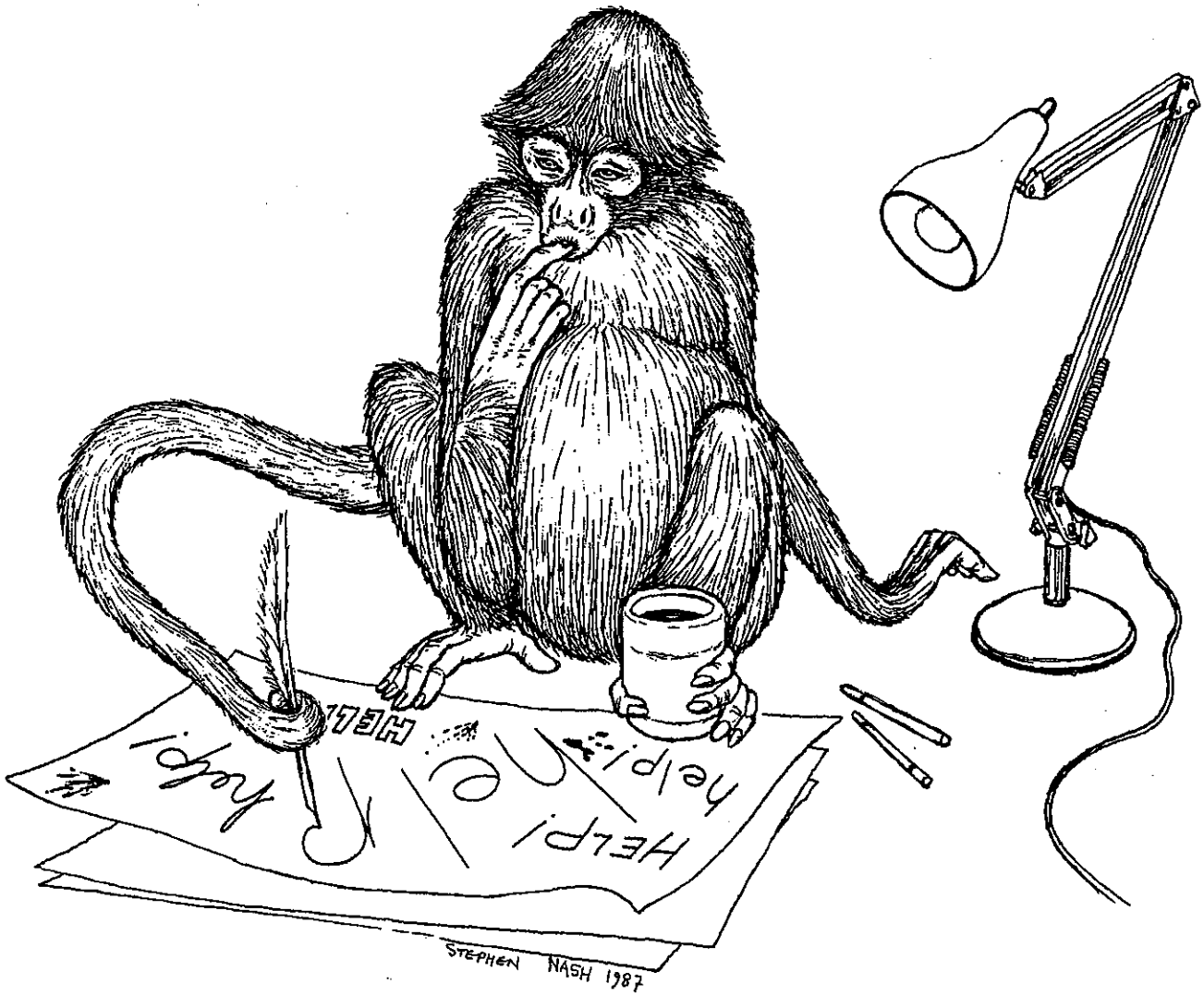

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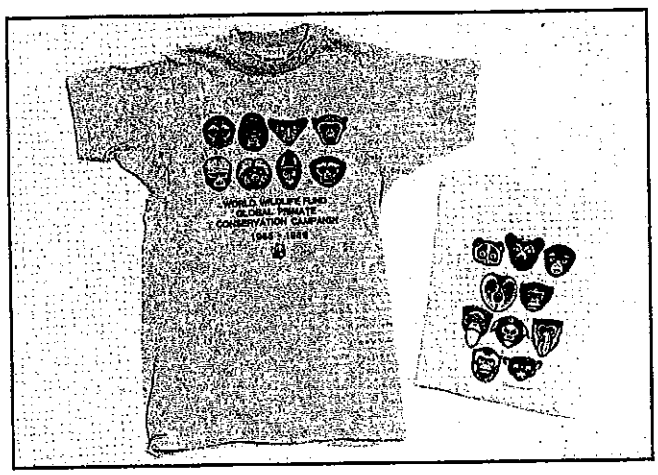

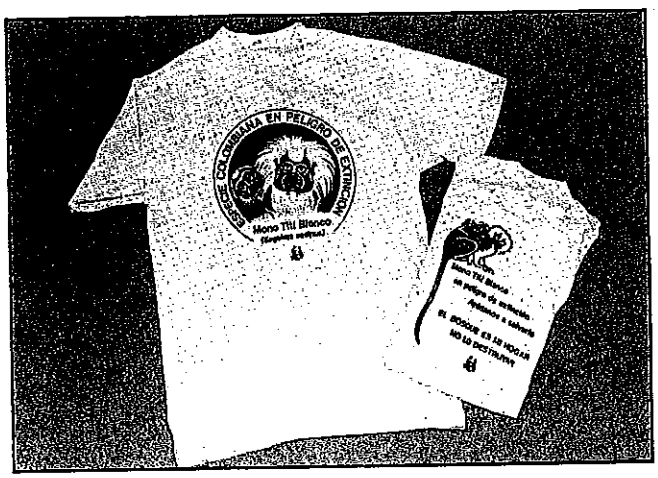

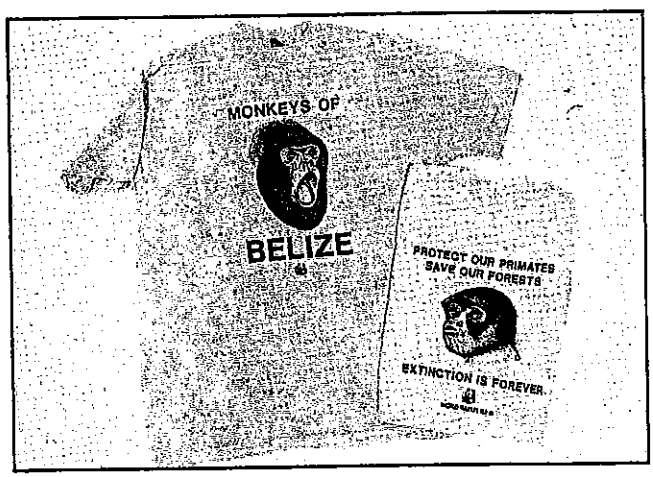

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