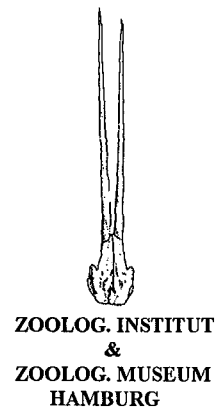




# LEMUR NEWS

*The Newsletter of the Madagascar Section  
of the I.U.C.N./S.S.C. Primate Specialist Group*

**NUMBER 4, MAY 1999**



**Cover photo:** *Propithecus diadema diadema* in the area between Andranomay and Mantadia;  
photo taken by Harald Schütz

## **LEMUR NEWS**

The Newsletter of the Madagascar Section of the IUCN/SSC Primate Specialist Group

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## EDITORIAL

The time since publication of *Lemur News* Vol. 3 has seen many important events and activities in Madagascar. Most prominent among those was the XVII<sup>th</sup> Congress of the International Primatological Society, held in Antananarivo in August 1998. The congress represented a milestone in the history of modern primatology and conservation in Madagascar with a number of participants much higher than expected. A summary of activities of and around the congress is given below by B. Rakotosamimanana.

The second phase of Madagascar's Environmental Action Plan has now started. In the wake of the PRIF-FEM/GEF, ONE,DEF,ANGAP/UNDP/CI workshop setting conservation and research priorities in Madagascar in 1995, protection of areas is being reinforced and surveys within but also outside the protected area system have been intensified. One particular focus of research on lemurs in Madagascar now concentrates on the role of corridors which might link the remaining tracts of primary forest. These aspects are covered by a variety of contributions in the present issue of *Lemur News*.

As of issue number 5 of *Lemur News*, Dr. Ken Glander, Director of the Duke University Primate Center, Durham, USA will join us in our efforts to produce *Lemur News* on a regular basis. Ken certainly does not need an introduction to the readers of *Lemur News*. Apart from his own research on lemurs he has been instrumental and supportive of lemur (and other primate) studies for decades. We look forward to collaborating with him even closer in the future.

Last, but not least we would like to apologize to Rodric Mast from Conservation International. Rod had been instrumental in getting *Lemur News* off the ground and producing the first issues. Yet, we did not mention his important contribution in our previous editorial.

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## NEWS and ANNOUNCEMENTS

### Le XVII<sup>ème</sup> Congrès de l'IPS

Le XVII<sup>ème</sup> Congrès de l'IPS (International Primatological Society), qui a pour thème: "Prenons la Responsabilité de notre Avenir pour la Conservation de notre Biodiversité telle que les Primates", s'est tenu à Antananarivo en Août 1998. Ce congrès s'est déroulé en quatre étapes bien distinctes:

Le pré-congrès: 04 au 08 août 1998: C'est l'I.C.T.E. (Institute for the Conservation of Tropical Environments) qui a pris en main toute son organisation, animé par sa coordinatrice internationale: Dr. Patricia C. Wright et son Directeur Général: Dr. Benjamin Andriamihaja. Il a eu lieu dans le Parc National de Ranomafana et y ont pris part 30 congressistes des pays en voie de développement aussi bien que des représen-

tants des pays autour du monde (Argentine, Brazil, China, Colombia, Ghana, India, Indonesia, Japan, Madagascar, Mexico, Nepal, Nigeria, Uganda, Etats-Unis, le Royaume-Uni et Vietnam). L'objectif du pré-congrès fut de montrer les réalités malgaches en matière de conservation des Lémuriens ainsi que les problèmes qui peuvent surgir sur le terrain et les méthodologies utilisées à Ranomafana même pour y apporter des solutions avec l'aide des structures décentralisées de la région qui travaillent de pair avec l'I.C.T.E.

L'exposition sur les Lémuriens: 08 au 14 août 1998: Ce fut une exposition destinée au grand public tananarivien qui n'a donc pas été oublié au cours de ce congrès. Elle a pour thème: "Les Lémuriens, richesse inestimable à conserver". Elle a eu lieu à la Maison de la Communication des Universités à Ankaditapaka-Ankadifotsy (Antananarivo) et la cérémonie d'ouverture fut présidée par le Président de l'Assemblée Nationale, Pr. Ange Andrianarisoa, sous le Haut Patronage du Président de la République de Madagascar. Elle a été organisée, dans le cadre du XVII<sup>ème</sup> Congrès de l'I.P.S. par les étudiants du D.E.A. d'Anthropologie Biologique de la Faculté des Sciences sous la conduite du Dr. Lucien Rakotozafy. Cette exposition a drainé 1425 personnes à raison de 300 visiteurs par jour du 10 au 14 août 1998 et un nombre plus élevé de jeunes que d'adultes. Ce public a formulé le désir de faire de l'exposition une exposition itinérante en vue de l'information et la conscientisation de tous à Madagascar dans la conservation de la biodiversité en général à Madagascar et des Lémuriens en particulier.

Le congrès: 10 au 14 août 1998: Il s'est tenu au Campus Universitaire d'Ambohitsaina à Antananarivo. La cérémonie d'ouverture présidée par le Premier Ministre, Mr. Tantely Andrianarivo, le 10 août 1998 à 16 h 30 et la cérémonie de clôture présidée par le Ministre de l'Enseignement Supérieur, Mr. Joseph Sydson, le 14 août 1998, étaient sous le Haut Patronage du Président de la République de Madagascar, son Excellence l'Admiral Didier Ratsiraka.

Les tours post-congrès: à partir du 15 août 1998: Ce sont les tours-opérateurs qui les ont organisés. Les congressistes ont ainsi eu la possibilité de visiter différentes aires protégées à travers l'île. Et au début du mois de Septembre, les derniers congressistes se sont encore trouvés sur le terrain pour admirer in-situ les différentes espèces de Lémuriens dans leurs niches écologiques réparties à travers l'île.

Concernant le congrès proprement dit, 550 primatologues représentés par une cinquantaine de pays dont 100 chercheurs malgaches et 60 personnels d'appui y participent. Le nombre total des présentations étaient de 422 réparties comme suit: 22 symposia, 16 communications orales, 3 grandes conférences, 108 posters, 1 session vidéo avec 8 thèmes et 3 ateliers. Les communications ont concerné tous les Primates non-humains du monde entier depuis les Petits Prosimiens d'Asie, d'Afrique et de Madagascar jusqu'aux grands Singes Anthroïdes d'Asie et d'Afrique en passant par les petits Singes d'Amérique du Sud et d'Asie. Toutes les disciplines ont été abordées depuis la Morphologie, l'Anatomie et le Comportement jusqu'à la Psycho-Biologie, la Croissance, la Nutrition, la Santé et la Reproduction en passant par la Systématique, la Paléontologie, la Biologie moléculaire et la Phylogénie pour aboutir à la Conservation des Primates à travers le monde. Les 22 symposia ont concerné notamment les Primates nocturnes, les Primates herbivores, les Primates subfossiles, les Primates âgés, les Primates comme fléaux, les effets de la fragmentation des forêts et la turbulence exercée sur l'habitat sur les populations de Primates à travers le monde, l'utilisation des techniques de Biologie moléculaire pour l'étude de la Systématique et de la Phylogénie des Primates et les Primates les plus en danger à travers le monde et leur statut global de conservation à l'aube du 21<sup>ème</sup> siècle.

Concernant Madagascar, les Lémuriens ont été à l'honneur notamment *Microcebus*, *Haplemur*, *Lepilemur*, *Varecia*, *Lemur catta*, *Cheirogaleus* pour les formes actuelles et les grandes formes disparues subfossiles.

L'éducation des populations en vue de la conservation des Primates n'a pas été oubliée et la session vidéo sur le FE-TIN'NY ZETRA ainsi que les sketches présentés par les enfants d'Ivoina et d'Ambatondrazaka et par JWPT ont constitué le sommet de cette éducation environnementale.

Au cours de ce congrès, des manifestations culturelles malgaches ont été organisées à la fin de ces journées si chargées pour permettre aux congressistes de se reposer et de se détendre un peu. Ce fut au cours de la cérémonie de clôture que l'on a procédé à des distinctions honorifiques et des distributions de prix aux participants du Grand Concours de Jardins organisé en vue de l'embellissement du Campus Universitaire d'Ambohitsaina.

Last but not least: Cinq chercheurs de renom international ont été reconnus avoir aidé l'Université d'Antananarivo dans la formation des étudiants malgaches de 3<sup>e</sup> cycle dans le domaine de la Primatologie. Il s'agit de:

Mme Alison Jolly, de Princeton University (New Jersey, USA) qui a été élevée au grade d'Officier de l'Ordre National de la République,

Pr. Elwyn L. Simons, Directeur Scientifique de Duke University Primate Center (Caroline du Nord, USA),

Pr. Yves Rumpler, Directeur de l'Institut d'Embryologie de la Faculté de Médecine de l'Université de Louis Pasteur de Strasbourg (France),

Mr. Chatrath Sing Pritijith, Duke University Primate Center (Caroline du Nord, USA).

Les trois derniers ont été élevés au grade de Chevalier de l'Ordre National de la République,

Pr. Jean-Jacques Petter qui a été élevé au grade de Professeur Emérite des Universités de Madagascar.

Que peut-on tirer de ce congrès ?

#### 1) Pour les Primates:

Les présentations en matière de recherche fondamentale ont bien sûr primé sur le reste, mais les chercheurs ont toujours su montrer l'étroite relation entre les résultats de leurs recherches et la survie des Primates qui aboutit toujours à la nécessité de leur conservation.

Les Lémuriens à Madagascar constituent un thème privilégié et ont été qualifiés de "porte - fanion" (=flagship) parmi la biodiversité de l'Ile car ils permettent de s'étendre dans tous les domaines du développement. Ce congrès a permis au monde scientifique international d'apprécier les potentialités des institutions nationales et des chercheurs malgaches. En effet, de telles potentialités existent réellement, ce qui permettra de tisser des accords de collaboration inter-institutions pour exploiter scientifiquement ce terrain si riche en biodiversité. Au niveau national, il existe enfin des possibilités d'extension de la collaboration en matière écotouristique entre les Primatologues et Conservationnistes de l'Université et des institutions comme la Maison du Tourisme.

#### 2) Pour l'Université d'Antananarivo:

La tenue de ce XVII<sup>e</sup> Congrès de l'I.P.S. a apporté enfin un plus à l'Université d'Antananarivo en permettant la réhabilitation d'une part des infrastructures au niveau des huit amphithéâtres de trois Facultés et des deux salles de lecture de la Bibliothèque Universitaire, lesquels avaient besoin d'un sérieux coup de pinceau, et d'autre part l'embellissement de l'environnement même au sein du Campus Universitaire d'Ambohitsaina lui-même grâce au Grand Concours de jardin organisé par le Secrétariat du XVII<sup>e</sup> Congrès et à l'implantation de panneaux et plaques indicateurs à tous les

points stratégiques du Campus pour le visiteur non averti. Et tous les équipements audio - visuels, les équipements informatiques et de reprographie acquis en vue de la bonne marche du congrès soit par achat soit par donation de la part de généreux sponsors vont rester dans les Départements et Instituts de l'Université en vue de l'amélioration de l'enseignement et de la recherche en général et de la Primatologie en particulier. Et nous remercions ici ces sponsors avisés qui ont fait don de ces équipements au Secrétariat du Congrès, nous citons notamment la Fondation Margot Marsh des Etats - Unis, la Société Moritani du Japon, Duke University en Caroline du Nord aux Etats - Unis, et nous n'oublions pas le Gouvernement malgache dans la liste. Les noms de tous ces généreux donateurs sont d'ailleurs consignés dans la petite brochure intitulée "Programme" éditée par le Secrétariat du XVII<sup>e</sup> Congrès et qui est actuellement entre les mains de tous les congressistes présents à cette grande manifestation du XVII<sup>e</sup> Congrès de l'I.P.S.

#### Berthe Rakotosamimanana

Secrétaire Général du XVII<sup>e</sup> Congrès de l'I.P.S.

Secrétaire Général du Groupe d'Etude et de Recherche sur les Primates de Madagascar (G.E.R.P.)

Département de Paléontologie et d'Anthropologie Biologique, Faculté des Sciences, B.P. 906, Université d'Antananarivo, Antananarivo (101), Madagascar

### The Center for Applied Biodiversity Science - Conservation International

Intel Corporation's co-founder and Chairman Emeritus Gordon Moore and his wife Betty are contributing US\$35 million to Conservation International (CI) to establish a research center - The Center for Applied Biodiversity Science - with the mission of identifying emerging threats to biodiversity to allow for swift action for the protection of the planet's most biologically valuable ecosystems. The creation of this Center was announced by Peter Seligmann, Chairman and Chief Executive Officer of CI on 2 October 1998. The Center will take on world leaders in science, technology, economics and conservation to develop action plans to counter imminent global threats. It will work closely with partnership organizations worldwide to tackle, in the field, some of the most pressing threats to biologically rich natural habitats. According to Russell A. Mittermeier, President of CI, "This is the largest, single private gift in the history of international biodiversity conservation and hopefully marks the start of a new era of environmentally-focused philanthropy commensurate with the scale and importance of the biodiversity crisis."

PSG Member, conservation biologist, Professor of Vertebrate Zoology at the Federal University of Minas Gerais, and CI Vice President for the Brazil Program, Gustavo A. B. da Fonseca has been appointed Executive Director. The Center's management will be based within Conservation International's headquarters, Washington, D. C., but will carry out its mandate throughout the world with a network of global experts and partnership organizations. It will also set up an Advisory Council consisting of outside experts and representatives of partnership organizations. A key aspect of the Center's operations will be the creation of a number of fellowships as well as a strong network of institutional partners. Fellows will be recruited from leaders in many different fields, from industry, universities, and other conservation groups. The Center will provide action plan blueprints for field-testing conservation strategies. It will also organize conferences and workshops to bring together top experts to explore trends and opportunities in biodiversity conserva-

tion. The Center's efforts will parallel Conservation International's strategic focus of targeting the world's highest priority regions in terms of biodiversity - megadiversity countries, hot spots, tropical wilderness areas and key marine ecosystems. An example of one issue which will be tackled is predatory logging in tropical forests. This threat has escalated rapidly in the recent past, with international logging conglomerates targeting tropical developing nations for huge tracts of pristine forests. In most cases, massive environmental degradation occurs as a result, with little economic return for the developing countries involved. Among other issues the center will also address the interface between conservation biology as a science and field-based conservation, mining and other extractive industries within biologically sensitive regions, as well as the devastating impact of invasive species on natural ecosystems.

#### **Lisa Bowen**

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e-mail: <l.bowen@conservation.org>.

### **Ecotourism helps fund village conservation programs**

Nearly 10,000 tourists visited Ranomafana National Park in 1998 [French (3726), Malagasy (2882), Italian (1128), German (606), USA (517), British (444), Swiss (282)]. The park was created in May 1991, and previous to that time there were virtually no tourists. Local villagers directly benefit from tourism at the park because half of the park entrance fees paid by international tourists is returned to the local villages in the form of grants for conservation and economic development projects. In addition, the local economy of the Ranomafana area is benefiting from this tourism as new restaurants, small hotels, and other tourism-related businesses are created or expanded.

#### **Patricia C. Wright, Fredrika H. van Berkum, Suzanne Zeeve and Benjamin Andriamihaja**

Institute for the Conservation of Tropical Environments, State University of New York at Stony Brook, Stony Brook, NY 11794-4364, USA

### **Experiences from Primate tourism**

Ecotourism in Madagascar has high potential and arose substantial expectations from the Malagasy people. Despite some promising starts (see above), attempts to establish primate tourism programs in Madagascar are in their infancy. In contrast, gorilla tourism in Africa can look back on two decades of experience. In recent articles, T. Butynski and J. Kalina summarize some of the experiences. They conclude, that primate tourism is likely to be sustainable only: (1) where gorilla conservation is given priority over economic and political concerns, (2) where decisions affecting gorilla tourism are based on sound and objective science, (3) where the scientifically formulated regulations governing this activity are rigorously controlled, and (4) where the conservation benefits from gorilla tourism monies are considerably greater than at present. Probably not all of the experiences with gorilla tourism apply to the situation of lemur tourism in Madagascar. Yet where lemur tourism has been developed, it is not without problems (e.g., Hawkins, this vol.). Researchers as well as tourist operators and guides can learn from the gorilla experience and should consult Butynski's and Kalina's papers for stimulating insights.

#### **References**

- Butynski, T.M.; Kalina, J. 1998. Gorilla tourism: a critical look. Pp. 294-313 in E.J. Milner-Gulland; R. Mace (eds.). Conservation of biological resources. Blackwell Scientific, Oxford.
- Butynski, T.M.; Kalina, J. 1998. Is gorilla tourism sustainable? *Gorilla Journal* 16: 15-19.

### **Update on the IUCN/SSC Wildlife Trade Programme**

The goal of the IUCN/SSC Wildlife Trade Programme is to promote the conservation of wild species subject to trade by assessing the effect of trade on the status of species and generating appropriate recommendations and conservation strategies.

The work of IUCN's Species Survival Commission (SSC) on the status of wild species in trade started over 10 years ago. The programme ran initially under the auspices of the Trade Specialist Group, established to enhance the SSC's scientific input to CITES (Convention on International Trade in Wild Fauna and Flora), and later as the Wildlife Trade Programme, co-ordinated by the SSC Secretariat. Gradually, the focus has broadened to encompass a wide range of trade issues. A major focus has been to identify species threatened by trade and to recommend actions to address these threats. This has involved working with Specialist Groups to monitor the status of species in trade and prioritise species for conservation action. Information is then relayed to decision makers within the international conservation community. The programme has, therefore, acted as a two-way process, encouraging the exchange of information between scientists and policy-makers.

The Wildlife Trade Programme works in collaboration with its partner organisations, the TRAFFIC Network and WCMC (World Conservation Monitoring Centre). SSC formally recognises TRAFFIC as its primary source of expertise on trade data, and TRAFFIC recognises SSC as its primary source of expertise on the biological status of species in trade. By combining the data produced by the two organisations, the impact of trade on wild species can be assessed. The programmes' objectives are as follows: 1) To identify situations where trade in wild species appears unsustainable or detrimentally affects the status of non target species; 2) To focus on gaps in knowledge of the biology and status of species in trade; 3) To develop and promote those actions and/or mechanisms necessary to ensure the conservation of species detrimentally affected by trade; 4) To ensure that the SSC's expertise is used to influence the decisions of CITES and other relevant agreements; 5) To provide scientific support and capacity building to the Parties to CITES (and other relevant international agreements) in implementing conventions at national and regional levels and; 6) To increase understanding about CITES and other relevant agreements within the SSC network.

Priority actions are: 1) Identify a focal point for trade issues in each taxonomic Specialist Group to ensure that SSC can provide high-quality information to policy makers; 2) Support for Specialist Group Action Planning to identify species affected by trade which may be of conservation concern; 3) Determine where further information is needed on these species and stimulate the information collection; 4) Work with interested parties to promote appropriate conservation action for species identified; 5) Provide general assistance to the CITES Secretariat and Parties between the meetings of the Conference of Parties (COP); 6) Provide specific assistance to the Parties for the meetings of the COP by publishing: CITES: A Conservation Tool, A Guide to Amending the Appendices to CITES. This publication provides guidan-

ce through the Convention's articles and resolutions governing the submission, presentation and adoption of proposals to amend the appendices. The analyses of proposals to amend the CITES Appendices, produced in collaboration with the TRAFFIC Network, providing an independent assessment of the information provided in the proposals. 7) Support the CITES Significant Trade process by identifying species subject to "significant" levels of trade and development of conservation and management programmes for species in trade in their country of origin; 8) Assist CITES Parties to review and, where it is necessary, to strengthen the capacities of their Scientific Authorities to undertake the monitoring and assessment procedures for wild species in trade; 9) Contribute to policy documents, e.g., CITES Guidelines for the Disposition of Confiscated Specimens, IUCN Re-introduction Guidelines and IUCN Guidelines for the Prevention of Biodiversity Loss due to Biological Invasion. The Wildlife Trade Programme aims to expand its work in three theme areas of particular conservation concern: trees, marine organisms, and medicinal plants and animals. The SSC tree networks are being further developed in conjunction with WCMC. Further emphasis is being placed on marine organisms. The Medicinal Plant Specialist Group is very active and a number of medicinal issues are of concern to animal Specialist Groups as well.

Further information is available from:  
IUCN The World Conservation Union: <www.iucn.org>;  
IUCN Species Survival Commission:  
<www.iucn.org/themes/ssc>;  
IUCN/SSC Wildlife Trade Programme:  
<www.iucn.org/themes/ssc/programs>;  
TRAFFIC Network: <www.traffic.org>;  
Convention on International Trade in Endangered Species of Wild Fauna and Flora: <www.wcmc.org.uk/CITES>. Information on CITES, list of Parties, information on the meetings of the Conference of the Parties, Text of the Convention, Appendices, Reservations, Resolutions and information on publications available at the World Conservation Monitoring Centre: <www.wcmc.org.uk>, or contact the Wildlife Trade Programme directly: IUCN/SSC Wildlife Trade Programme, 219c Huntingdon Road, Cambridge CB3 0DL, UK, Tel: +44 1223 277966, Fax: +44 1223 277845, e-mail: <iucn-ssc@wcmc.org.uk>.

## The PSG (Primate Specialist Group) and the International Primatological Society

The International Primatological Society (IPS) is affiliated to the World Conservation Union (IUCN). For this reason, as well as the fact that many of the IUCN/SSC Primate Specialist Group (PSG) members also belong to IPS, at a meeting held during the XVIIth IPS Congress, hosted by the University of Antananarivo, Madagascar, 10-14th August 1998, the IPS Council voted to include a representative of PSG on the Council in a non-voting capacity. This measure is intended to increase the joint effectiveness of IPS and PSG in IUCN matters. The PSG Deputy Chairman, Anthony B. Rylands, subsequently attended the Council meeting on August 13 1998 as PSG representative. At that meeting Anthony Rylands was appointed Meeting Secretary, to participate in the Organizing Committee of the XVIIIth Congress of the International Primatological Society to be held in Adelaide, Australia, 7-12 January 2001.

## Officers of the International Primatological Society

Two important changes were made concerning the Officers of the Council of the International Primatological Society (IPS). A new standing committee for Education was created, and Dr. Sian Evans, Dumond Conservancy, Miami, Florida, was appointed the first Chair. First Vice-President for Education. Dr. Hilary O. Box, Reading University, Reading, UK, was appointed Interim Vice President and Chair of the Captive Care Committee, replacing Dr. Cobie Brinkman, Australian National University, Canberra, Australia.

The officers (1996-2000) are currently as follows:

President - Prof. Toshishada Nishida, Department of Anthropology, Graduate School of Science, Kyoto University, Sakyo-ku, Kyoto-shi 606, Japan,

Tel: 81-75-753-4084, Fax: 81-75-751-6149,

e-mail: <nishida@jinrui.zool.kyoto-u.ac.jp>;

Secretary General - Dr. Dorothy Fragaszy, Department of Psychology, University of Georgia, Athens, Georgia 30602, USA, Tel: 1-706-542-3036, Fax: 1-706-542-3275,

e-mail: <doree@archer.uga.edu>;

Vice President for Membership - Dr. Richard W. Byrne, Department of Psychology, University of St. Andrews, St. Andrews, Fife KY16 9JU, Scotland, Tel: 44 334-62051,

Fax: 44-334-63042, e-mail: <rwby@st.andrews.ac.uk>;

Vice President for Captive Care - Dr. Hilary O. Box, Department of Psychology, University of Reading, Reading RG6 2AL, UK, Tel: 44 1734 318523 x 6668, Fax: 44 1734 316604,

e-mail: <h.box@reading.ac.uk>;

Vice President for Conservation - Dr. Ernesto Rodríguez-Luna, Instituto de Neuroetología, Universidad Veracruzana, Veracruz 91000, México, Tel: 52-28-12-57-48,

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e-mail: <saragat@speedy.coacade.uv.mx>;

Vice President for Education - Dr. Sian Evans, Dumond Conservancy, 14805 S. W. 216 Street, Miami, FL 33170, USA, Tel: +1 305 238 9981, Fax: +1 305 235 4253,

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Treasurer - Dr. William Roudebush, Department of Obstetrics and Gynecology, Medical University of SC, Charleston, SC 29425-2233, USA, Tel: 1-803-792-8348,

Fax: 1-803-792-0533, e-mail: <roudebwe@lp.musc.edu>.

## Awards 1998

### International Primatological Society

The Martha J. Galante Award is given each year by the International Primatological Society for the conservation training of professionals of primate habitat countries. Candidates are reviewed by the IPS Conservation Committee, currently chaired by Ernesto Rodríguez-Luna, Universidad Veracruzana, México. This year it was most deservedly presented to Dr. Mukesh Kumar Chalise of the Kathmandu University, Dhulikhel, Nepal. Dr. Chalise is one of very few primatologists in Nepal, and is currently studying *Macaca assamensis* in the Makalu-Barun Conservation Area. For more information on this award, please write to Dr. Ernesto Rodríguez-Luna, Vice President for Conservation, International Primatological Society, c/o Instituto de Neuroetología, Universidad Veracruzana, Veracruz 91000, México, Tel: 52-28-12-57-48, Fax: 52-28-17-65-39 or 52-28-12-57-46, e-mail: <saragat@speedy.coacade.uv.mx>.

### American Society of Primatologists

The Conservation Committee of the American Society of Primatologists (ASP), Chair Randall Kyes, University of Washington, Seattle, made the following awards during the Society's 1998 Annual Meeting:

Rebeca Araya, New York University, "Genetic structure in two sympatric and behaviorally diverse saki monkeys *Pithecia pithecia* and *Chiropotes satanas*";  
 Lucy Beresford-Stooke, UK, "Primate population densities after pitsawing in Budongo Forest, Uganda";  
 Mukesh K. Chalise, Nepal, "Environmental protection in Makalu-Barun Conservation Area through conservation education";  
 Mugambi Karere, Kenya, "Pre-translocation ecological study of DeBrazza's monkeys (*Cercopithecus neglectus* Schegel) in western Kenya";  
 Christian Mokal, Indonesia, "Population survey of the Sulawesi black macaque (*Macaca nigra*) at the Tangkoko-Duasudara Nature Reserve, North Sulawesi, Indonesia";  
 Erwin Palacios, Colombia, "Density of the red howler monkey (*Alouatta seniculus*) in south-eastern Colombia";  
 Jill Pruetz, University of Illinois, "Forest characteristics and spider monkey (*Ateles geoffroyi*) densities in forest fragments at La Suerte Biological Field Station, Costa Rica";  
 Juan Carlos Serio Silva, Mexico, "The primates of the peninsular of Yucatan: Current state and strategies for their conservation";  
 Kimberly Williams-Guillen, New York University, "The behavioral ecology of mantled howling monkeys living in Nicaraguan coffee plantations".  
 The Awards and Recognition Committee, chaired by Gerry Ruppenthal, University of Washington, Seattle, gave the 1998 Distinguished Primatologist Award to W. Richard Dukelow, of Michigan State University, in honor of outstanding achievements in primate research. Dr. Dukelow was a former President of ASP, and has been a major influence in shaping the direction of the Society and is, besides, a world-renowned leader in the field of primate reproductive biology. For further information on these awards: Dr. Randall Kyes, Chair, Conservation Committee, University of Washington, Regional Primate Research Center, Health Sciences Center, Box 357330, Seattle, WA 98195, USA, e-mail: <rkyes@u.washington.edu>;  
 Dr. Gerry Ruppenthal, Chair, Awards and Recognition Committee, Center on Human Development and Disability, University of Washington, Box 357920, Seattle, WA 98195, USA, e-mail: <gerry@u.washington.edu>.  
 From ASP Bulletin 22(3), September 1998.

## BBC Primate Series

At long last the BBC Natural History Unit, in conjunction with the Discovery Channel, is to make a major series devoted to the primates. The series, called "Cousins", will consist of three one hour films focussing, respectively, on the prosimians, monkeys, and apes (including man). Filming will take place throughout 1999 and early 2000.

At this early stage of research we are anxious to cast our net as wide as possible in the search for exciting or interesting behaviours or spectacles from the primate world. We would like to ask for the help of the Lemur News readers in this search.

One of our aims initially is to compile a list of all habituated primate groups in the World. Obviously, not all such groups are study groups – they could be self-habituated or habituated for tourist purposes or habituated by association with a study group. We'd be very grateful if, as well as telling us about your study group, you could let us know of any other habituated groups you might know.

Our other main aim is finding behaviours that have never been filmed before. If there is anything that you think we should feature then we'd be very grateful if you could tell us about it. Equally, we would love to hear about different settings for better-known behaviours.

We are, as ever, entirely in the debt of the scientists working in the field for the most up-to-date information on the current state of knowledge about the primates. If there's anything in this subject area you think we should be committing to film, please get in touch.

Please contact: Dan Rees, Bernard Walton or Miles Barton; BBC Natural History Unit; Whiteladies Road; Bristol BS8 2LR; UK; Tel: +44 117 9732211; e-mail: <Bernard.Walton@bbc.co.uk>

## The Jersey Wildlife Preservation Trust changed its name

In honour of Gerald Durrell the Jersey Wildlife Preservation Trust has been renamed to Durrell Wildlife Conservation Trust. The name "Jersey Zoo" will not be changed. Also, the address remains the same at: Les Augres Manor, Trinity, Jersey, Channel Islands, JE3 5BP.

## Research opportunities

Azafady is embarking on a project through which they hope to coordinate the biological mapping of the forest of Lokara (Fort Dauphin) in great detail. Azafady is offering the use of their facilities in Madagascar to those who do the research. More details can be found at <http://77easyweb.easynet.co.uk/~azafady/> or obtained from Azafady, 306a Portobello Road, London W10 5TA, UK.

## A new Primate List-server - Primfocus

A new Primate List-server "Primfocus" was announced on "Primate-talk" by Rick Bogle. The purpose of primfocus is to:

1. Provide an open forum for discussions about protecting of primates;
2. Provide a bulletin board for posting news items regarding primates; and
3. Share information relating to primates. Primfocus is an unmoderated open list. The list owners request that discussions remain civil and germane to primate protection and other primate issues. The list owners reserve the right to remove anyone from the list who repeatedly fails to honor the above statements. To subscribe to PrimFocus, send a message to <waste@waste.org> with the following message (and no subject line): subscribe primfocus. For the digest version, use the following text: subscribe primfocus-digest. To post messages to PrimFocus send your news item or discussion topic to e-mail: <primfocus@waste.org>.

## ARTICLES

### Situation actuelle des aires protégées à Madagascar.

### Plan stratégique de l'ANGAP (Association Nationale pour la Gestion des Aires Protégées) de 1998 à 2000

Actuellement, Madagascar possède 44 aires protégées qui couvrent, au total, une superficie de 1.730.603 ha, soit envi-



ron les 3% du territoire malgache. Le programme de conservation du patrimoine naturel atteint son rythme de croisière à Madagascar. Après la création du plus grand parc national malgache: Le Parc National de Masoala, en mars 1997, dix autres Réserves ont été transformées en parc nationaux:

- création du Parc National n°7 du Tsingy de Bemaraha dans la Province de Mahajanga en Août 1997,
- création du Parc National n°9 de Befotaka Midongy dans la Province de Fianarantsoa en Décembre 1997,
- création du Parc National n°10 de Baie de Baly dans la Province de Mahajanga en Décembre 1997,
- création du complexe Parc National n°11 de Kirindy/Mikea dans le Province de Toliara en Décembre 1997,
- création du Parc National n°13 de Marojejy dans la Province d'Antsiranana en Mai 1998,
- création du Parc National n°14 d'Andringitra dans la Province de Fianarantsoa en Octobre 1998.

Les quatre aires protégées suivantes sont déjà appelées parcs nationaux mais les décrets les créant, ne sont pas encore sortis:

- Parc National d'Andohahela dans la Province de Toliara,
- Parc National d'Ankarafantsika dans la Province de Mahajanga,
- Parc National de Zahamena dans la Province de Toamasina,
- Parc National de Zombitse/Vohibasia dans la Province de Toliara.

Tableau 1: Liste des aires protégées selon leur mode de gestion.

|    | Aires protégées       | Surface (ha) | Statut                                     | Opérateur   |
|----|-----------------------|--------------|--|-------------|
| 1  | Andohahela            | 76 020       | Parc National                              | ANGAP       |
| 2  | Isalo                 | 81 540       | Parc National                              | ANGAP       |
| 3  | Mantadia              | 10 000       | Parc National                              | ANGAP       |
| 4  | Montagne d'Ambre      | 18 220       | Parc National                              | ANGAP       |
| 5  | Ranomafana            | 41 600       | Parc National                              | ANGAP       |
| 6  | Bemaraha              | 152 000      | Parc National/ Réserve Naturelle Intégrale | ANGAP       |
| 7  | Zombitse et Vohibasia | 36 803       | Parc National                              | WWF         |
| 8  | Marojejy              | 60 150       | Parc National                              | WWF         |
| 9  | Andringitra           | 31 160       | Parc National                              | WWF         |
| 10 | Ankarafantsika        | 60 520       | Parc National                              | CI          |
| 11 | Zahamena              | 73 160       | Parc National                              | CI          |
| 12 | Mananara Nord         | 23 000       | Parc National                              | UNESCO      |
| 13 | Masoala               | 230 000      | Parc National                              | CARE        |
| 14 | Baie de Baly          | 69 350       | Parc National                              | Contractant |
| 15 | Kirindy - Mikea       | 72 200       | Parc National                              | Contractant |
| 16 | Midongy du Sud        | 197 900      | Parc National                              | Contractant |
| 17 | Betampona             | 2 228        | Réserve Naturelle Intégrale                | ANGAP       |
| 18 | Lokobe                | 740          | Réserve Naturelle Intégrale                | ANGAP       |
| 19 | Tsaratanana           | 48 622       | Réserve Naturelle Intégrale                | ANGAP       |
| 20 | Tsimanampetsotsa      | 43 200       | Réserve Naturelle Intégrale                | Contractant |
| 21 | Tsingy de Namoroka    | 21 742       | Réserve Naturelle Intégrale                | Contractant |
| 22 | Ambohitantely         | 5 600        | Réserve Spéciale                           | ANGAP       |
| 23 | Analamazaotra         | 1 180        | Réserve Spéciale                           | ANGAP       |
| 24 | Analamerana           | 34 700       | Réserve Spéciale                           | ANGAP       |
| 25 | Andranomena           | 6 420        | Réserve Spéciale                           | ANGAP       |
| 26 | Ankara                | 18 225       | Réserve Spéciale                           | ANGAP       |
| 27 | Cap Ste Marie         | 1 750        | Réserve Spéciale                           | ANGAP       |
| 28 | Forêt d'Ambre         | 4 810        | Réserve Spéciale                           | ANGAP       |
| 29 | Manombo               | 5 320        | Réserve Spéciale                           | ANGAP       |
| 30 | Manongarivo           | 35 250       | Réserve Spéciale                           | ANGAP       |
| 31 | Anjanaharibe-Sud      | 32 090       | Réserve Spéciale                           | WWF         |
| 32 | Pic d'Ivohibe         | 3 453        | Réserve Spéciale                           | WWF         |
| 33 | Nosy Mangabe          | 520          | Réserve Spéciale                           | CARE        |
| 34 | Bezaha Mahafaly       | 600          | Réserve Spéciale                           | ESSA        |
| 35 | Ambatovaky            | 60 030       | Réserve Spéciale                           | Contractant |

|    | Aires protégées        | Surface (ha) | Statut           | Opérateur   |
|----|------------------------|--------------|------------------|-------------|
| 36 | Ambohijanahary         | 24 750       | Réserve Spéciale | Contractant |
| 37 | Bemarivo               | 11 570       | Réserve Spéciale | Contractant |
| 38 | Bora                   | 8 380        | Réserve Spéciale | Contractant |
| 39 | Kalambatritra          | 28 250       | Réserve Spéciale | Contractant |
| 40 | Kasijy                 | 18 800       | Réserve Spéciale | Contractant |
| 41 | Mangerivola            | 11 900       | Réserve Spéciale | Contractant |
| 42 | Maningoza              | 7 500        | Réserve Spéciale | Contractant |
| 43 | Marotandrano           | 42 200       | Réserve Spéciale | Contractant |
| 44 | Tampoketsa Analamaitso | 17 150       | Réserve Spéciale | Contractant |

Les activités de l'ANGAP pour les années 1998 à 2000 ont pour objectif de maintenir en bon état, dans le cadre d'une gestion durable, des zones prioritaires de conservation des écosystèmes naturels représentatifs des unités biogéographiques de Madagascar. Les résultats attendus sont les suivants:

Renforcement du réseau national d'aires protégées et l'institution en charge de sa gestion par:

- la création des aires protégées,
- le changement du statut des Réserves Naturelles Intégrales en Parcs Nationaux,
- la mise en place des bases de financement durable du réseau,
- l'amélioration des capacités techniques des responsables,
- la multiplication du partenariat institutionnel,
- l'élaboration du code de gestion des aires protégées,
- la mise en place des structures décentralisées,
- la mise en place d'un système efficace de gestion du réseau,
- l'acquisition des matériels adéquats.

Connaissance et valorisation des éléments relatifs à la biodiversité des aires protégées et leur équilibre et assurance de leur suivi écologique par:

- l'élaboration des procédures pour les inventaires et la constitution de base de données de gestion du réseau,
- l'élaboration des documents spécifiques sur la biodiversité,
- l'élaboration d'une "monographie" de chaque aire protégée,
- la mise en place d'un dispositif de suivi écologique,
- l'élaboration des documents sur les potentialités scientifiques des différents sites,
- l'élaboration et le suivi de la mise en oeuvre des conventions de recherche.

Fonctionnement d'un système de conservation et de gestion approprié au niveau des aires protégées par:

- l'élaboration des documents concernant la stratégie de conservation et de gestion des aires protégées,
- l'élaboration, le cas échéant, du plan de gestion de chaque aire protégée,
- la mise en oeuvre du système de conservation défini dans le plan de gestion,
- l'élaboration des procédures en vue de la structuration des aires protégées de catégorie B2 et C,
- la redélimitation, le bornage et la matérialisation des limites des aires protégées.

Adoption d'un changement de comportement positif vis-à-vis des ressources naturelles renouvelables par les populations riveraines des aires protégées et des sites urbains de proximité par:

- l'élaboration et la diffusion de la stratégie de communication du réseau,
- l'élaboration des produits de communication,
- le développement du partenariat local, régional, national et international,



- la gérance des manifestations liées à la gestion du réseau,
- la mise en place de la stratégie du réseau dans la politique nationale d'éducation environnementale,
- la poursuite des campagnes d'éducation environnementale par sites, la dynamisation des groupements en matière d'éducation environnementale.

Développement et rentabilisation des potentialités écotouristiques de certaines aires protégées et les données y relatives par:

- la finition du plan marketing,
- la concrétisation du plan d'actions commerciales du réseau des parcs et réserves,
- la mise en oeuvre du plan marketing,
- la poursuite de l'aménagement spatial et la mise en place d'infrastructures spécifiques,
- la rentabilisation des données sur la biodiversité du réseau des parcs et réserves,
- le développement des partenariats avec les secteurs privés au niveau des aires protégées cibles.

Proposition et soutenance dans la dynamique de l'approche régionale des mini-projets alternatifs aux pression par:

- le renforcement des structures de gestion DEAP (COGES),
- le financement, appui et suivi de la mise en oeuvre des micro-projets DEAP,
- le financement et appui de la mise en oeuvre de mini-projets alternatifs,
- le financement et encadrement du développement des zones périphériques des PCDI,
- l'intégration dans le processus de l'approche régionale.

L'ANGAP publiera de Code de Gestion des Aires Protégées (COGAP) pour être présenté au gouvernement malgache. Le COGAP est un ensemble de texte de nature différente: des énoncés de politique, le code constitué d'une loi posant les principes fondamentaux de gestion des Aires Protégées et des éléments constitutifs des futures textes d'application.

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### Contribution à l'étude du genre *Archaeolemur* SP (*Archaeolemuridae*): Un Lémurien subfossile provenant de la région de l'Ankarana. Essai de reconstitution du paléoenvironnement de la région de l'Ankarana

Des ossements de Vertébrés incluant des Lémuriens disparus ont été découverts et récoltés dans des dépôts de grotte, dans la région de l'Ankarana; ceci, grâce à des expéditions effectuées par l'équipe universitaire de Duke (USA), en collaboration avec le Département de Paléontologie et d'Anthropologie Biologique de l'Université d'Antananarivo, de 1986 à 1993. Dans ce travail, nous allons étudier particulièrement le genre *Archaeolemur* sp. provenant de la grande forme et *A. majori*, la petite forme.

Nous avons fait ainsi des mensurations ostéométriques et par la suite une étude statistique, dont l'objectif est de dégager les caractères qui différencient l'*Archaeolemur* de l'Ankarana des autres *Archaeolemurs* provenant d'autres sites situés plus au Sud (Fig. 1), et de pouvoir extrapoler le régime alimentaire ainsi que le mode de locomotion de l'animal. Enfin, à partir de ces études, et avec l'appui des références bibliographiques, nous allons essayer de reconstituer le paléoenvironnement de la région de l'Ankarana.

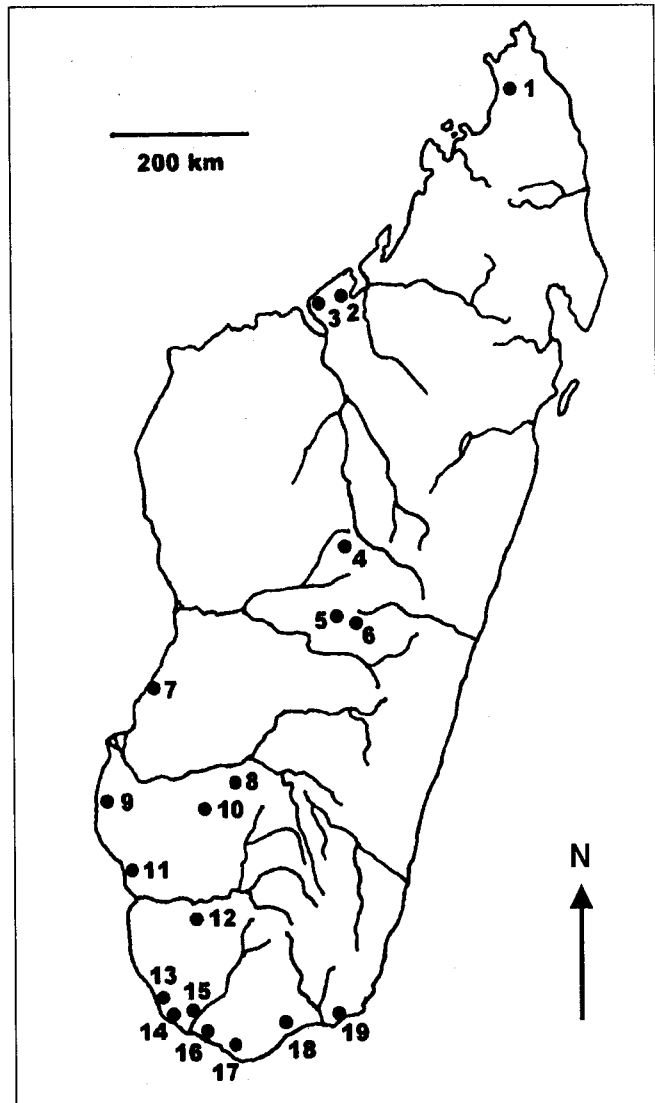


Fig. 1: Répartition géographique du genre *Archeolemur* (d'après Godfrey *et al.* 1990).

1 Ankarana, 2 Anjohibe, 3 Amparihingidro, 4 Ampasambazimba, 5 Morarano-Betafo, 6 Antsirabe, 7 Belo-sur-Mer, 8 Tsirave, 9 Lamboharana, 10 Ampoza-Ankazoabo, 11 Ambolisatra, 12 Taolambiby, 13 Tsiandroina, 14 Bemafandry, 15 Bevoha, 16 Anavoaha, 17 Beloha, 18 Amboyombe, 19 Andrahomana

#### Methodologie

##### Site d'études

L'affleurement de l'Ankarana est situé dans l'extrême Nord de Madagascar (12°-13°S, 49°E). C'est un plateau calcaire du Jurassique moyen, profondément érodé et bordé au Nord Ouest par une falaise qui domine à plus de 250 m les plaines basaltiques environnantes (Simons *et al.* 1990, 1995; Wilson 1987). Sur toute son étendue, il présente un relief karstique impressionnant, prenant souvent la forme de "Tsingy", produit de l'érosion du calcaire par les pluies (Wil-

son 1987). Plus de 110 km de grottes parcourent le massif, et il y existe plusieurs douzaines de grottes fossilifères (Simons *et al.* 1992). Ce sont les planchers des grottes qui contiennent d'épais dépôts d'argiles ou de vases, dûs à l'effondrement des toits de grottes, et les ossements s'y trouvent (Wilson 1987).

#### Études bibliographiques

D'après la bibliographie, nous avons pu dégager que: (1) les espèces du genre *Archaeolemur* sont all'opatriques (Godfrey *et al.* 1990), (2) il n'y a pas de variation sexuelle chez les autres Lémuriens vivants actuels (Godfrey 1977; Albrecht *et al.* 1990), (3) la petite forme *A. majori* se rencontre dans le Sud de Madagascar et (4) la grande forme *A. edwardsi* se rencontre dans le centre et le Nord (Randriamanantena-Vuillaume 1982; Godfrey *et al.* 1990). A partir de ces quelques idées, nous avons choisi Ampasambazimba au centre pour *A. edwardsi* et Beloha à l'extrême Sud pour *A. majori* pour les échantillons de référence; et Ankarana au Nord pour les échantillons d'étude.

**Mensurations ostéométriques et les indices caractéristiques**  
Après avoir fait des triages préalables en éliminant les jeunes individus, nous avons mesuré au total 227 os, entiers ou fragmentaires dont 41 os crâniens, 30 mandibules, 35 humérus, 23 radius, 23 ulnas, 33 fémurs et 42 tibias.

Les mesures ostéométriques que nous avons effectuées sont, soit des mesures anthropométriques simples, soit des mesures déjà utilisés par d'autres auteurs tels que Lamberton (1934), Godfrey (1977) et Randriamanantena-Vuillaume (1982). Pour le crâne, on a 5 variables; pour la mandibule: 5 variables; pour l'humérus: 5 variables; pour le radius: 4 variables; pour l'ulna: 2 variables; pour le fémur: 5 variables; pour le tibia: 6 variables. Nous avons calculé quelques indices tels que: indice de robustesse de la mandibule, indice brachial, indice intermembral, indice crural, indice huméro-fémoral, indice de robustesse de l'humérus, indice de robustesse du fémur. Les indices de robustesse sont calculés un à un pour chaque individu.

#### Méthode statistique

La méthode de comparaison des moyennes a été appliquée pour tester si les échantillons appartiennent ou non à une même population. Pour cela, nous avons appliqué le test-T de Student-Fischer dans le cas des petits échantillons, avec une condition préalable: il faut que les deux populations à comparer aient des variances égales pour que la comparaison des moyennes puissent se faire. Pour cela, nous avons utilisé le test F de Snedecor-Fischer (Lamotte 1962; Documenta Geigy 1963).

#### Estimations de la taille et de la masse

Pour l'estimation de la taille (=longueur du rachis précaudal), nous avons utilisé les équations allométriques de Randriamanantena-Vuillaume (1982). Par l'épaisseur de l'humérus, l'équation est:  $x=25,4813y^{0,9580}$ , avec  $x$ =longueur du rachis précaudal, et  $y=DH+dH$  (épaisseur de l'humérus). Par la longueur humérale, l'équation est:  $x=5,1988y^{0,8122}$ , avec  $x$ =longueur du rachis précaudal et  $y$ =longueur de l'humérus. Toutes les mesures effectuées sont en millimètres; l'estimation finale de la longueur du rachis précaudal est obtenue à partir de la moyenne entre l'estimation par l'épaisseur et l'estimation par la longueur humérale.

Pour l'estimation de la masse, nous avons pris l'équation allométrique de Mac Neill (1985) à partir de l'épaisseur du fémur. L'équation est:  $m=0,0102d^{2,7778}$ , avec  $m$ = masse corporelle (en kg),  $d$ =diamètre du fémur (en mm). L'estimation finale de la masse est obtenue par la moyenne des deux diamètres du fémur tels que le diamètre antéro-postérieur et le diamètre interne-externe de la diaphyse.

## Résultats et Interprétations

#### Entre les formes de Beloha et d'Ampasambazimba

Les différences sont toutes hautement significatives sauf pour quelques caractères. Donc, les deux espèces *A. edwardsi* et *A. majori* sont confirmés par les études statistiques.

#### Entre les formes de Beloha et de l'Ankarana

Toutes les différences sont hautement significatives, sauf pour la longueur humérale. Les moyennes pour la longueur maximale sont respectivement de 136,57 mm pour la forme de Beloha et de 137,56 mm pour la forme de l'Ankarana. ( $t=0,37$ ;  $t_0=2,13$  valeur du tableau indiquant  $p < 0,05$ ). Conclusion: la proportion de longueur de l'humérus est donc la même chez les deux formes.

#### Entre les formes d'Ampasambazimba et de l'Ankarana

Pour la mandibule: Les différences sont significatives pour les caractères suivants: La hauteur molaire de la mandibule ( $t=6,34$ ;  $t_0=2,10$ ; les moyennes sont de 30,91 mm, pour la forme de l'Ankarana, et de 25,90 mm pour la forme d'Ampasambazimba); l'indice de robustesse de la mandibule ( $t=3,50$ ;  $t_0=2,10$ ; les moyennes sont des 57,87 mm pour Ankarana et de 65,40 mm pour Ampasambazimba). Conclusion: Le corps de la mandibule d'*Archaeolemur* de l'Ankarana est plus haute mais il est moins robuste.

Pour l'humérus: Les différences sont significatives pour les caractères suivants: La longueur maximale: la forme d'Ampasambazimba a l'humérus très long (moyenne=155,96 mm), par rapport à la forme de l'Ankarana (moyenne=137,56 mm),  $t=11,29$ ;  $t_0=2,26$ ; le diamètre antéro-postérieur de la diaphyse: les individus de l'Ankarana ont ce diamètre plus grand (moyenne=17,46 mm) par rapport aux échantillons provenant d'Ampasambazimba (moyenne=15,46 mm),  $t=3,57$ ;  $t_0=2,14$ . L'indice de robustesse de l'humérus:  $t=6,89$ ;  $t_0=2,31$ . Les humérus des individus provenant de l'Ankarana sont très robustes (moyenne=23,17 mm); pour les individus provenant d'Ampasambazimba la moyenne est de 18,48 mm. Conclusion: L'humérus de la forme d'Ampasambazimba est très long par rapport à celui de l'Ankarana, mais les diamètres transversaux sont les mêmes sauf pour le diamètre antéro-postérieur où la forme l'Ankarana a ce diamètre plus large. De ce fait, l'humérus de la forme de l'Ankarana est très robuste.

Pour les autres types d'os tels que, le radius, l'ulna et le tibia, les différences sont non significatives pour les longueurs maximales tandis qu'elles sont significatives pour les diamètres transversaux tels que: le diamètre maximum distal du radius dont les moyennes sont respectivement de 22,9 mm pour Ampasambazimba, et de 24,17 mm pour Ankarana ( $t=7,47$ ;  $t_0=3,18$ ); le diamètre interne-externe de la diaphyse de l'ulna dont les moyennes sont respectivement de 9,54 mm pour Ampasambazimba et de 11,62 mm pour Ankarana ( $t=5,55$ ;  $t_0=2,14$ ); le diamètre interne-externe de la diaphyse du tibia dont les moyennes sont de 12,11 mm pour Ampasambazimba et de 13,43 mm pour Ankarana ( $t=2,16$ ;  $t_0=2,09$ ); le diamètre interne-externe de l'épiphyse distal du tibia dont les moyennes sont de 24,07 mm pour Ampasambazimba et de 26,50 mm pour Ankarana ( $t=2,76$ ;  $t_0=2,18$ ). Pour le fémur, les différences sont non significatives pour toutes les variables mesurées.

Pour la masse et la taille: les deux formes ont statistiquement la même taille et la même masse; elles sont respectivement de 553,18 mm et 27,90 kg pour la forme d'Ampasambazimba, et de 561,49 mm et 27,47 kg pour la forme d'Ankarana.

Pour l'indice inter-membral: en regardant l'indice inter-membral de chaque forme d'*Archaeolemur*, nous avons constaté que cet indice décroît du Sud au Nord en passant par le Centre. La forme de Beloha possède le plus fort indice in-

ter-membral qui est de 91,4 mm, vient ensuite la forme d'Ampasambazimba, et enfin celle de l'Ankarana avec un indice de 85,8 mm. Conclusion: Selon ses résultats, nous pouvons conclure que *Archaeolemur* de l'Ankarana aurait les membres antérieurs les plus courts par rapport à longueur du rachis précaudal.

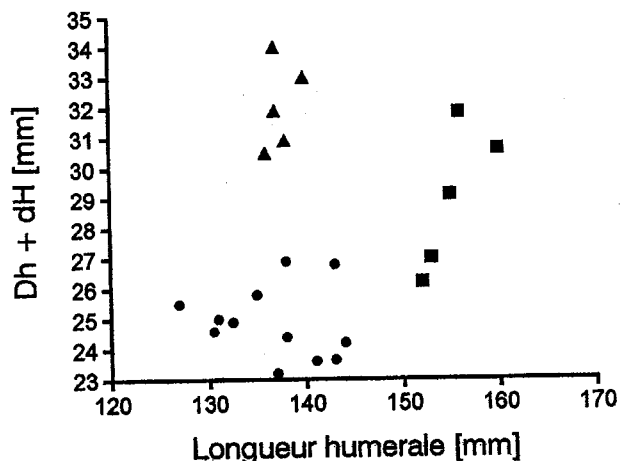


Fig. 2: Séparation des espèces par des méthodes ostéométriques simples: l'humérus. Ordonné: somme des diamètres antéro-postérieur et interne-externe de la diaphyse; Abscisse: longueur de l'humérus. Points: Beloha; Carrées: Ampasambazimba; Triangles: Ankarana

### Discussions

Compte-tenu des résultats de notre étude, nous avons constaté que la forme d'*Archaeolemur* de l'Ankarana possède des caractères intermédiaires entre les formes de Beloha et d'Ampasambazimba pour l'humérus, la ressemblance avec *A. edwardsi* au niveau du crâne, de la taille et de la masse, une forte robusticité des os longs, et elle possède une mandibule particulière.

Ainsi, nous avons avancé que la forme de l'Ankarana est une nouvelle espèce d'*Archaeolemur* provenant des sites situés plus au Sud. Pour le mode de locomotion, le genre *Archaeolemur* est plutôt quadrupède terrestre. Mais la différence de proportion de longueur ainsi que la forte robusticité des os longs du membre antérieur de la forme de l'Ankarana suggèrent que cet *Archaeolemur* serait capable de grimper les "Tsingy" pour passer d'une poche de forêt à une autre. Il pourrait passer la plupart du temps à grimper et monter sous les arbres sous les "Tsingy" pour se nourrir.

Pour le régime alimentaire, le genre *Archaeolemur* est avancé comme plutôt folivore que frugivore. Mais l'indice de robustesse faible de la mandibule de la forme de l'Ankarana suggère des nourritures moins coriaces que les deux autres formes situées plus au Sud (*A. majori* et *A. edwardsi*).

Un essai de séparation des espèces selon la robustesse des os et la taille a été effectué. Sur le graphique, nous avons porté la somme des diamètres diaphysaires de l'humérus en ordonné, et la longueur maximale en abscisse. Cette méthode sépare bien les trois espèces d'*Archaeolemur* au niveau de l'humérus.

### Essai de reconstitution du paléoenvironnement de la région de l'Ankarana

Les forêts qui entourent couramment et qui pénètrent dans les canyons du massif de l'Ankarana ont été décrites comme de poches de forêt tropicale sèche semi-caducifoliée qui sont en transition avec des broussailles cassées (Wilson *et al.* sous-pressé, in Godfrey *et al.* 1990).

Les grands Lémuriens ont autrefois occupés les forêts insolées des puisards qui bordent les entrées des grottes, aussi

bien que ceux qui ont vécu dans les canyons, portant des forêts qui coupent en deux les ruelles souterraines (Simons *et al.* 1990). Parmi les Lémuriens disparus qui ont été déjà découverts dans d'autres sites, et qui ont été trouvés dans la région de l'Ankarana, de nouveaux genres et espèces ont été décrits. Il s'agit de *Babakotia radofilai* (Godfrey *et al.* 1990; Jungers *et al.* 1991; Simons *et al.* 1992), et des *Mesopropithecus dolichobrachion* (Simons *et al.* 1995).

Il y avait aussi des Lémuriens subfossiles qui avait perduré jusqu'à nos jours: ce sont: *Indri indri*, *Hapalemur simus*, *Eulemur spp.*, et *Propithecus spp.* Si nous prenons le cas de *Indri indri* et *Hapalemur simus*, ils sont cantonnés actuellement dans la forêt humide de l'Est de Madagascar. De même pour le rongeur *Nesomys* qui a été trouvé à l'état subfossile dans la région de l'Ankarana. Ces trois espèces sont donc, à notre avis, de bons indicateurs de climat. Si nous prenons le cas de *Hapalemur simus*, il est cantonné actuellement dans la région de Ranomafana, et a une nourriture hautement spécialisée, avec une dépendance apparente vis-à-vis du bambou géant (Simons *et al.* 1990). *Hapalemur simus* a colonisé autrefois la région de l'Ankarana car 50,96 % des os de Lémuriens recoltés lors des expéditions lui appartiennent. Il y avait eu probablement un couloir de forêt qui reliait la région de l'Ankarana à celle de l'Est à partir duquel, les espèces ont pu migrer vers l'Est lorsque le climat était devenu défavorable à leur survie (Rakotosamimanana *et al.* en prép.). D'après ces idées, nous avons avancé que: "la présence des espèces *Hapalemur simus*, *Indri indri*, le genre *Nesomys* ainsi que du bambou géant dans la région nous permettent de dire que le paléoclimat de la région était identique au climat de la région Est auparavant: c'était un climat humide et la forêt était dense et sempervirente."

D'après cette étude, nous avons constaté que *Archaeolemur* de l'Ankarana était vraiment différent des autres *Archaeolemur*s. A partir de cette étude de *Archaeolemur* et de ses faunes associées, nous avons pu reconstituer le paléoenvironnement de la région. Toutefois, ce travail est actuellement mené en collaboration avec L. Godfrey et E.L. Simons de l'Université de Duke, en Caroline du Nord (USA), pour une étude beaucoup plus approfondie. En effet, ils existent encore beaucoup d'ossements appartenant à ce genre dans leur laboratoire, et un peu partout dans les différents musées de l'Europe.

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## The Primates of Isalo National Park, Madagascar

This paper reports on the results of a study of the primates of Isalo National Park, Madagascar, undertaken in February 1995. Goals of the study were: (1) to identify all species of primate at the sites visited; (2) to make population estimates of all diurnal species in each site visited, in such a way as to permit subsequent repeated surveys for the purposes of management evaluation; and (3) to establish the habitat relationships of primate species in order to make recommendations about management for their benefit.

### Study site: location and character

Isalo National Park, situated between 22°10'-22°40'S and 45°11'-45°23'E in the south-western corner of the Province of Fianarantsoa, Madagascar, is a rocky massif characterised by deep canyons and extensive plateaux. It covers an area of 81,540 ha, and is thus the forth-largest protected area in Madagascar (Ramarokoto *et al.* this vol.). The bedrock is a sandstone, probably aeolian in origin, from the Jurassic. The quality of this rock varies widely over the massif, and this has resulted in large differences in relief and erosion. The elevation varies between 510 and 1268 m, and canyons of up to 200 m depth cut in particular the eastern and north-western sectors.

The climate in the area is of a dry tropical character, but the site itself is on the limit of the humid eastern and dry western biomes (White 1983). Around 850-1200 mm of rain falls per annum, with 90% occurring between November and March; rainfall is higher in the Park than outside, owing to the greater elevation. Many of the rivers that run through the canyons are permanent, and there are several seasonal lakes and many seasonal streams in the Park. Temperatures vary between monthly means of 17° in June and 25° in February.

More than 50% of the surface area of the National Park of Isalo is covered either by bare rock or grass savanna. It appears that this situation has been created by annual grassfires which prevent woody regrowth over most of the Park. These fires are set for the principal benefit of cattle which graze during certain seasons in the Park.

Grass savanna is interspersed with a tree savanna, composed mostly of fire-resistant tree species. The most important of these is *Tapia* (*Uapaca bajeri*), present in monospecific stands in many areas, and which covers an area in excess of 2,500 ha in the south. Amongst other species present in

tree-savanna are *Asteropeia rhopaloides*, *Stereospermum euphorioides* and *Acridocarpus excelsus*, all of which are somewhat resistant to fire.

In open rocky areas, in particular on steep slopes or exposed ridges, vegetation is dwarfed and xerophytic. Species such as *Pachypodium rosulatum* and *Aloe isaloensis* are characteristic of such habitats, and are both endemic to the massif. This form of vegetation only persists in areas insulated from fire by bare rock.

In valley bottoms along permanent watercourses, dense secondary gallery forest has grown since the Park was established in 1962. The principal tree species concerned are *Eugenia* sp., *Tamarindus indica* and *Mangifera indica*. In some areas dense stands of *Blechnum* sp., and two species of palm endemic to the massif occur. In permanently humid areas where the forest is very degraded or frequently burned, *Pandanus pulcher* may be very common.

Along seasonal streams, mostly in the lower parts of valleys, relict patches of heavily degraded western Malagasy deciduous forest occur. These are often no more than 10-30 m in diameter but may be up to 1 km long. Species characteristic of this formation include *Commiphora* sp., and *Dalbergia* sp. Between the villages of Tanambao and Beraketa, to the west of the Park, lies the forest of Analalava. This is a single large block of degraded primary western Malagasy deciduous forest, 460 ha in extent. In the northern part of the Park, but not visited during the current study, is another area of western deciduous forest (Andranofotsy) approximately 240 ha in area, although much of this is already degraded.

Table 1: Presence of primate species in sites visited around the Park; p = present.

1= Sahanafa; 2= Ankademoky; 3= Sakamalio; 4= Canyon des Rats and Canyon des Singes; 5= Analalava, Tanambao (outside reserve to West); 6= Oasis, Tsiranoambolala, river Mariany, (outside reserve to south).

| Species                         | Sites    |          |          |          |          |          |
|---------------------------------|----------|----------|----------|----------|----------|----------|
|                                 | 1        | 2        | 3        | 4        | 5        | 6        |
| <i>Cheirogaleus medius</i>      |          |          |          | p        | p        |          |
| <i>Microcebus murinus</i>       | p        | p        |          |          | p        |          |
| <i>Mirza coquereli</i>          |          |          |          |          | p        |          |
| <i>Propithecus v. verreauxi</i> | p        | p        | p        | p        | p        |          |
| <i>Lepilemur ruficaudatus</i>   |          |          |          |          | p        |          |
| <i>Lemur catta</i>              | p        | p        | p        | p        |          | p        |
| <i>Eulemur fulvus rufus</i>     | p        | p        | p        | p        | p        |          |
| <b>Total number of species</b>  | <b>4</b> | <b>4</b> | <b>3</b> | <b>4</b> | <b>6</b> | <b>1</b> |

In the bottoms of many deep canyons are narrow ribbons of primary evergreen forest. Characteristic tree taxa of these situations are *Voacanga* sp., *Nuxia* sp., *Weinmannia* sp., and *Tambourissa* sp. Dense stands of ferns *Blechnum* sp. are present in the understory. These are species usually found in east Malagasy rainforest.

There are no ecological texts relating specifically to the Park. A number of publications contain references to the fauna of the Park, most notably Nicoll and Langrand (1989) which contains lists of four species of reptile, 55 species of bird and nine species of mammal. Goodman and Langrand (1994) and Langrand and Goodman (1997) report on the fauna of Zombitse and Vohibasia forests, 110 km to the southwest.

### Methods

From 1 February -2 March 1995 30 days were spent conducting fieldwork in or around the National Park of Isalo. All research sites and routes taken between them are shown on

Figure 1. Four sites (Ankelivozo, Ankalilana, Antanile, Antambonoo) were visited briefly (less than one day), so that no surface area estimates could be calculated. Analalava was an irregular block of forest, about half of which was surveyed over several visits. The other survey sites comprised single gallery forest strips or small blocks, which were visited in their entirety several times during surveys. Surface area was calculated from maps, with estimates refined from field data.

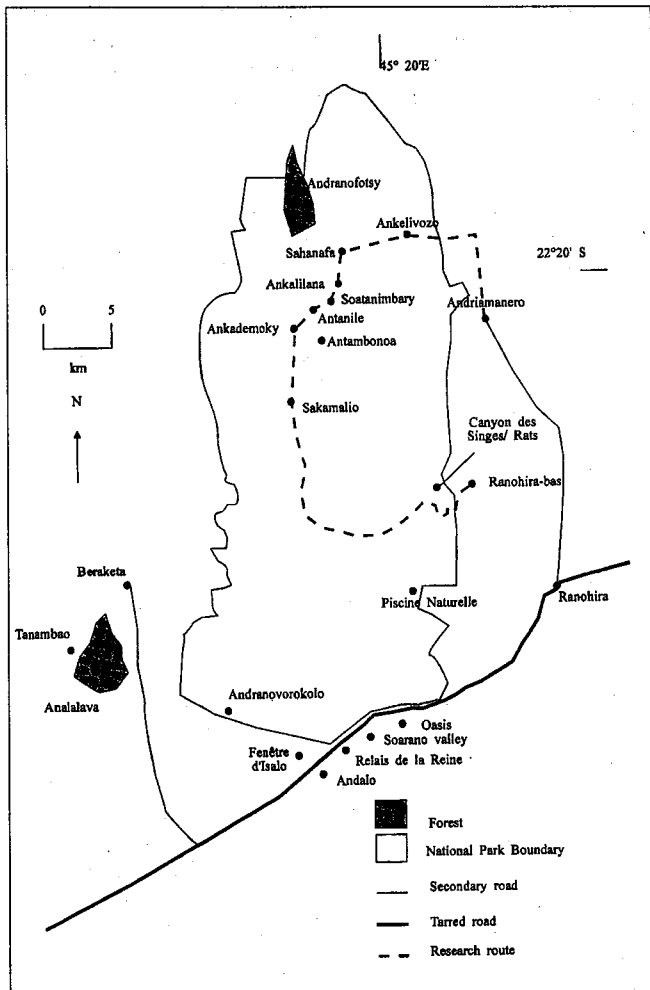


Fig. 1: Location of survey sites.

2-9 February: Sahanafo (Camp at 22°19.14'S, 45°17.52'E): Habitats studied: Secondary gallery forest with *Eugenia* sp., *Tamarindus indica* and *Mangifera indica* (approximately 60 ha), degraded western deciduous forest remnants in gullies, *Tapia (Uapaca bojeri)* forest, open rocky hillsides, grass savanna.

10-15 February: Ankademoky (Camp at 22°22.4'S, 45°15.7'E): Habitats studied: Secondary gallery forest with *Eugenia* sp., *Tamarindus indica* and *Mangifera indica* (approximately 28 ha), *Tapia (Uapaca bojeri)* tree-savanna, open rocky hillsides, grass savanna.

16-21 February: Canyon des Singes/Canyon des Rats (Camp at 22°29'S, 45°23'E): Habitats studied: Primary native gallery forest along canyon beds (approximately 5 ha); degraded primary western deciduous forest on slopes (approximately 20 ha); secondary gallery forest along rivers (approximately 16 ha); rocky and muddy riverine habitats.

21-28 February: Analalava (Camp at 22°35.04'S, 45°07.61'E): Habitats studied: Degraded primary western deciduous forest (460 ha, about 200 ha of which was inventoried) on sand; degraded primary central domain forest in humid valley bottom; open tree savanna with *Acridocarpus ex-*

*celsus*; *Tapia (Uapaca bojeri)* tree-savanna on open hillsides; open rocky hillsides; edges of ricefields.

28 February-2 March Oasis (Camp at 22°37.5'S, 45°22.0'E): Habitats studied; *Tapia (Uapaca bojeri)* tree-savanna; humid valleys with *Pandanus*; open grass savanna with rocky outcrops; small permanent lake at Andranovorokolo, 22°39.2'S, 45°12.5'E; open rocky hillsides.

In all sectors visited, flagged transects were established, of varying length according to the extent of habitat. These transect were walked four (Sahanafa, Ankademoky, Canyon des Singes and Canyon des Rats, Analalava 1 and 2) or two (Analalava 3 and 4) times each during the day, and twice (all except Analalava 3 and 4, walked once only) at night. One observer worked alone during the day and two observers worked at night. Trails were walked at about 0.5-1 km/hr, slowly and silently, and all contacts with primates noted. The group size of group-living primates was established by walking slowly around the area the group occupied; this sometimes took 30 minutes or more for large groups of *Eulemur fulvus rufus*.

The distance to the nearest group member when detected, height in vegetation, time and (for *Eulemur fulvus rufus*) sexual composition of the group was noted for each contact. Nocturnal lemurs were detected by reflected eyeshine from a Petzl headlamp, and illuminated with a powerful lamp for specific identification.

Transect surveys were conducted between 06h00 and 09h00 and 15h30 and 18h00, the peak activity periods for most diurnal species, and between 19h30 and 23h00 for nocturnal species. Outside these time periods, non-quantified searches were made for primates in all types of habitat present in the vicinity of the study areas. All sightings of all groups were plotted on sketch maps of the study sites. Comparison of group size and (for *Eulemur fulvus rufus*) sexual composition were used to define group boundaries, permitting estimates of population.

## Results

Seven species of primate were located in and around the Park (Table 1). Of these, only three had been recorded in the Park previously (*Propithecus v. verreauxi*, *Eulemur fulvus rufus*, and *Lemur catta*: Nicoll and Langrand 1989). Four nocturnal species (*Mirza coquereli*, *Lepilemur ruficaudatus*, *Cheirogaleus medius* and *Microcebus murinus*) were recorded in the vicinity of the Park for the first time.

Table 1 shows that Analalava is the most species-rich site visited for primates, with two nocturnal species present that were not found elsewhere in the Park. The three diurnal species were the most widespread, being found at five of the six sites sampled each. *Microcebus murinus* was the only nocturnal species found within the Park, although *Cheirogaleus medius* was seen just outside near the Canyons. From Table 1 it is clear that primate communities of sites studied fall into two groups; those within the reserve (Sahanafa, Ankademoky, Sakamalio and the Canyons) and Analalava. It is the presence of nocturnal lemurs that distinguishes Analalava from the other sites.

Ganzhorn (1994) describes the lemur community of Zombitse forest, 100 km SW of Isalo, the nearest site to Isalo to have been inventoried. Only one species of lemur is present at Zombitse and absent from Isalo: *Phaner furcifer*. This species feeds on gum (Mittermeier *et al.* 1994) and has possibly been eliminated from Analalava in particular by extraction of gum-yielding trees. Ganzhorn (1994) notes that the (single) Zombitse record of *Mirza coquereli* is the first for the area, so the presence of *M. coquereli* at Analalava is also a range extension. Other nocturnal species (except *Microcebus murinus*) were noted at Isalo in even lower frequency than at Zombitse, where frequencies are already considered to be atypically low (Ganzhorn 1994).

**Population size**

At each site sampled, careful note was made of the relative locations of groups of diurnal primates in order that population estimates could be made. Table 2 shows the number and sizes of groups of diurnal primates seen at each site. In isolated forests such as Ankademoky and Sahanafa, it is considered likely that all groups of diurnal primates present at the site were encountered, as the whole sample area was covered several times during surveys.

Table 2: Group size (and for *Eulemur fulvus rufus* sexual composition) of diurnal primates at sites visited in and around the Park. An asterisk indicate that the group size count was probably incomplete.

| Site                   | <i>Lemur catta</i> |      | <i>Propithecus verreauxi</i> |      | <i>Eulemur fulvus rufus</i> |            |
|------------------------|--------------------|------|------------------------------|------|-----------------------------|------------|
|                        | Group              | size | Group                        | size | Group                       | size       |
| Ankelivozo             |                    |      | A                            | 5    |                             |            |
| Sahanafa               | i                  | 6    | B                            | 10   | 1                           | 4* (?)     |
|                        | ii                 | 7    | C                            | 5    | 2                           | 9 (6m,3f)  |
|                        | iii                | 10   | D                            | 4    | 3                           | 5* (?)     |
|                        | iv                 | 6    | E                            | 5    | 4                           | 9 (6m,3f)  |
|                        | v                  | 4    | F                            | 4    | 5                           | 12 (6m,6f) |
|                        | vi                 | 8    | G                            | 6    | 6                           | 10 (6m,4f) |
|                        | vii                | 8    | H/I                          | 12   | 7                           | 13 (8m,5f) |
|                        |                    |      | J                            | 8    | 8                           | 3* (?)     |
| Ankalilana             | viii               | 5*   |                              |      |                             |            |
| Antanile               |                    |      |                              |      | 9                           | 3* (2m,1f) |
| Soatanimbary           |                    |      |                              |      | 10                          | 8 (4m,4f)  |
| Ankademoky             | ix                 | 12   | L                            | 5    | 11                          | 6 (3m,3f)  |
|                        | x                  | 9    | M                            | 5    | 12/13                       | 12 (7m,5f) |
|                        | xi                 | 5*   | N                            | 5    |                             |            |
|                        | xii                | 10   |                              |      |                             |            |
| Antamboona             |                    |      | O                            | 3    |                             |            |
|                        |                    |      | P                            | 7    |                             |            |
| Sakamalio              |                    |      | Q                            | 5    |                             |            |
| Canyon des Singes/Rats | xiii               | 8*   | R                            | 5    | 14                          | 5 (2m,3f)  |
|                        | xiv                | 20   | S                            | 5    | 15                          | 5 (3m,2f)  |
|                        |                    |      | T                            | 6    | 16                          | 5 (2m,3f)  |
| Analalava              |                    |      | U                            | 5    | 17                          | 6(?)       |
|                        |                    |      |                              |      | 18                          | 5*(?)      |

Table 3 shows that overall numbers and densities of diurnal lemurs were very high in Sahanafa, similar in Ankademoky and the Canyon des Singes/Rats, but much lower in Analalava. Other sites within the Park held about the numbers of diurnal lemurs that might be predicted by their surface areas, which were all much smaller than those at Sahanafa, Ankademoky, and in the Canyons.

Table 3: Minimum total number of individuals of diurnal primates in sites in and around the Park. Numbers in brackets are densities (ind./km<sup>2</sup>) calculated as numbers of individuals divided by surface area of forest, and thus refer only to densities within forest, not over the Park as a whole. Only the 20 ha of degraded deciduous forest in the Canyon des Singes/Rats held any primates. Densities were calculated only for *Propithecus v. verreauxi* and *Eulemur fulvus rufus* as *Lemur catta* ranged widely outside forest areas.

| Site                           | <i>Lemur catta</i> | <i>Propithecus verreauxi</i> | <i>Eulemur fulvus rufus</i> |
|--------------------------------|--------------------|------------------------------|-----------------------------|
| Ankelivozo                     |                    | 5                            |                             |
| Sahanafa (60 ha)               | 49                 | 60 (100)                     | 64 (106)                    |
| Ankalilana                     | 5                  |                              |                             |
| Antanile                       |                    |                              | 3                           |
| Soatanimbary                   |                    |                              | 8                           |
| Ankademoky (28 ha)             | 36                 | 15 (54)                      | 18 (64)                     |
| Antamboona                     |                    | 10                           |                             |
| Sakamalio                      |                    | 5                            |                             |
| Canyon des Singes/Rats (20 ha) | 28                 | 16 (80)                      | 15 (75)                     |
| Analalava (200 ha)             |                    | 5 (2.5)                      | 11 (5.5)                    |
| Totals                         | 118                | 116                          | 119                         |

In contrast, Table 4 shows that nocturnal lemurs were absent in all sites examined within the Park, including the two Canyons, but were comparatively abundant and species-rich in Analalava. A possible reason for the low numbers of nocturnal lemurs in sites within the Park is that most of the gallery forests examined were secondary in nature. Before the Park was established in 1962, the areas of forest at Sahanafa and Ankademoky were very small (G. Rabeony pers. comm. 1995). Since the establishment of the Park, larger, mobile lemurs such as the diurnal *Propithecus v. verreauxi*, *Eulemur fulvus rufus* and *Lemur catta* were able to move from source populations into the gallery forest. However the smaller nocturnal lemurs, being very vulnerable to predators such as owls and carnivores, would not have been able to invade the gallery forest.

Table 4: Sighting frequencies of nocturnal primate species on transects in and around the Park. All transects were walked twice. Numbers refer to individuals seen more than 2 m apart except where stated.

| Site (hrs spent searching; m of transect) | <i>Cheirogaleus medius</i> | <i>Microcebus murinus</i> | <i>Mirza coquereli</i> | <i>Lepilemur ruficaudatus</i> |
|---|----------------------------|---------------------------|------------------------|-------------------------------|
| Sahanafa (7; 2000 m)                      |                            | 3                         |                        |                               |
| Ankademoky (5.5; 1350 m)                  |                            | 1                         |                        |                               |
| Canyon des Singes/Rats (7.5; 2100 m)      | 1 (3 ind.)                 |                           |                        |                               |
| Analalava (7.5; 2200 m)                   | 5                          | 44                        | 1 (2 ind.)             | 2                             |

**Habitat utilisation of primates, and implications for conservation**

Diurnal primates showed marked differences in habitat utilisation. Verreaux's Sifakas *Propithecus v. verreauxi* were only found in gallery forest along permanent rivers, where there were large trees. They were not present in forest blocks smaller than approximately 5 ha. However their apparent home ranges were relatively small and in areas of extensive habitat such as Sahanafa they were abundant. Mean group size in the Park (5.8 ± 2.1, n=18) is very high for this species (Mittermeier *et al.* 1994).

Brown lemurs *Eulemur fulvus rufus* were commonest in gallery forest along permanent rivers, but were also found in degraded deciduous western forest on hill-sides. However they were only found in this habitat type when it adjoined gallery forest on rivers, and it seems very likely that food availability in gallery forest was the critical factor affecting their distribution. Occasionally they were seen moving across areas of open savanna when returning to gallery forest to sleep. They were never seen in Tapia forest. Mean group size near villages was about average for the species all over Madagascar (5.3 ± 0.5, n=4) but group size far from villages (9.9 ± 2.4, n=8) is very large (Hawkins *et al.* 1990, Harcourt and Thornback 1990, Mittermeier *et al.* 1994).

Ring-tailed lemurs *Lemur catta* were found in all habitats except grass savanna. However their distribution was very patchy, and in all instances except one (near the Fenêtre d'Isalo), groups were seen in areas that had a combination of gallery forest, open rocky areas and Tapia forest. Their absence from large areas of Tapia forest (some of which was adjacent to rocky areas) in the centre of the Park where gallery forest was absent suggests that, as is the case with *Eulemur fulvus rufus*, in Isalo *Lemur catta* require gallery forest. The single exception to this rule was a group seen near the Fenêtre d'Isalo, which is about 2 km from the nearest gallery forest.



*Lemur catta* were conspicuously absent from the deciduous western forest at Analalava, where these three habitat types were present, possibly owing to hunting pressure. Both other species of diurnal lemur were rare in this area too, and *L. catta* are often present in areas with few trees. They are very vulnerable to hunting by dogs, particularly in areas such as Analalava where there are few steep cliffs that would provide refuge in the absence of trees.

Table 5: Mean group sizes (from Table 2) of two diurnal lemur species in sites near and far from villages. Sites far from villages are Ankelivozo, Sahanafa, Antanile, Soatanimbary, Ankademoky, Antambonao and Sakamalio. Sites near villages are Canyon des Rats/Canyon des Singes, Analalava and Oasis. Only data from groups counted completely are shown (those marked with an asterisk in Table 2 are incomplete counts). Differences were tested with a two-way t-test. The sample size of complete counts of *Lemur catta* groups was too small to permit testing.

| Species                      | Mean group size $\pm$ SD  |                         |
|------------------------------|---------------------------|-------------------------|
|                              | Far from villages         | Near villages           |
| <i>Propithecus verreauxi</i> | 6.14 $\pm$ 2.41<br>(N=14) | 5.25 $\pm$ 0.5<br>(N=4) |
| <i>Eulemur fulvus rufus</i>  | 9.87 $\pm$ 2.36<br>(N=8)  | 5.25 $\pm$ 0.5<br>(N=4) |

Group size and density of Malagasy primates may be related to hunting pressure (Harcourt and Thornback 1990). Figures 2a,b show the relationships of group size and density of diurnal primates to distance from nearest village. Group size of *Eulemur fulvus rufus* is smaller in areas near villages, whereas group size of *Propithecus verreauxi* is about the same near and far from village (Fig. 2a, Table 5). Density of both species was much lower at Analalava than elsewhere (Fig. 2b). Thus group size and density did not follow identical patterns.

Density of *Eulemur fulvus rufus* in the area of the Canyons was as high as at sites far from villages, whereas group size was smaller at this site than in sites far from villages. Local people reported that hunting of *Eulemur* had stopped in the last few years in the region of the Canyons, in response to the near-continuous presence of tourists. This suggests strongly that *E. f. rufus* is hunted near Analalava, where both group size and density were very low.

Group size of *Propithecus verreauxi* at Analalava did not differ from that elsewhere, whereas its density at this site was very low (Tables 2, 5). Conversations with local people suggest that *Eulemur fulvus rufus* is preferred prey, as *P. verreauxi* is taboo (fady) for some local villagers. The very low density at this site suggests either that they do not have small group sizes in hunted areas, or that hunting pressure was not the same all over the site.

Densities of the two species are remarkably similar in all sites where density was calculated (Fig. 2b). This pattern is difficult to explain. Ganzhorn (1994) report densities of diurnal lemurs in Zombitse well below those found in most of Isalo except at Analalava; he comments that those seen were very wild and probably heavily hunted. The same situation seems to apply in Isalo only at Analalava.

#### Assessment of human impact on habitats important for primates

No detailed assessment of the human use of the reserve was made during this study. However, it is clear that certain practices will have profound effects on the habitats present in the Park. Table 6 shows that the most pressured habitat, and by far the most important for conservation action is the

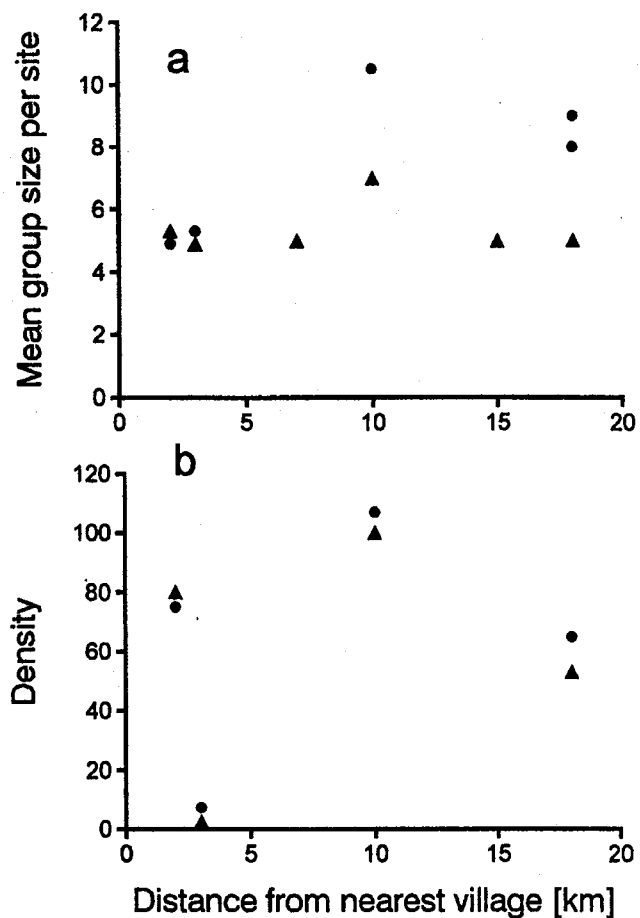


Fig. 2: Relationships of group size (a) and density ((b) individuals per km<sup>2</sup>) of diurnal primates to distance from the nearest village. Dots = *Eulemur fulvus rufus*, Triangles = *Propithecus verreauxi*.

western deciduous forest of Analalava. Hunting and extraction of wood for local construction needs were both occurring at high levels. The people of the village of Tanambao expressed discontent with outsiders (from more distant villages) who cut wood for building materials in what the people of Tanambao regarded as their forest. However the people of Tanambao were undoubtedly hunting the lemurs that occurred in the forest. Hunting appears to have materially reduced the density (and changed the behaviour) of diurnal primates in the habitat, compared to for instance gallery forest, where they are little hunted and abundant, and live in large groups (Tables 3, 5).

Bush-fires regularly burn the grass immediately adjacent to the forest at Analalava, but there is no evidence that fires penetrate western deciduous forest unless the forests are already considerably degraded (SAF-CO 1992, J. Durbin pers. comm. 1995). The boundaries of Analalava appear not to have changed in the last 50 years. Thus at Analalava, human activity is likely to have a negative long-term effect on the biodiversity importance of the habitat, which is the highest of any studied.

The remoteness of most gallery forest from human habitation means that human pressure is low, but seasonal use of this habitat for cattle grazing (reportedly in large numbers) has an unknown but presumably negative effect on the regenerative capacity of the forest. Guides and porters for tourists collect firewood in these areas and hunt lemurs occasionally. However the very high biodiversity importance and the very small surface area of this habitat means that care-



ful management of tourism and local exploitation are vital to ensure that the habitat retains its biodiversity value. Tapia forest is under almost as much pressure as western deciduous forest at Analalava (Table 6), particularly for commercial exploitation (of Tapia fruits), for wood and by fire. However the biodiversity importance of this habitat is low; no primates were seen in this habitat. This is probably because Tapia forest is a fire-maintained habitat. The degraded western forests found in association with gallery forests are much more likely to be negatively affected by bushfires than the relatively intact forest at Analalava. Regeneration of these forests outside their current limited area is unlikely as seedlings are killed by fire. The biodiversity value of this habitat is rather low, but could be substantially improved if regeneration was encouraged. Restocking of western deciduous tree species might be an option in some areas.

Table 6: Human pressures affecting habitats in and around the Park. \*\*\*= high level of pressure \*\*= moderate level of pressure \*= low level of pressure 0= no pressure.

| Habitat                            | Burning for pasture | Wood | Hunting | Commercial exploitation | Total Stars |
|------------------------------------|---------------------|------|---------|-------------------------|-------------|
| Gallery Forest                     | 0                   | *    | **      | 0                       | 3           |
| Degraded western Forest            | ***                 | *    | **      | 0                       | 6           |
| Bare rocky massifs                 | ***                 | 0    | 0       | **                      | 5           |
| Canyon forest                      | 0                   | *    | **      | ***                     | 6           |
| Primary western forest (Analalava) | **                  | ***  | ***     | **                      | 10          |
| Savanna                            | ***                 | 0    | 0       | 0                       | 3           |
| Tapia Forest                       | *                   | **   | *       | ***                     | 9           |

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## Observations of lemurs in the forest east of Tsinjoarivo, Ambatolampy

Major river systems have been classically cited as important barriers for dispersal for various primate species. This geographically limiting aspect is often evident in the distributions of closely related species or subspecies. Numerous lemurs appear to show a similar pattern, and in the central portion of the eastern humid forest the Mangoro River is often cited as the southern limit of several forms such as *Indri indri*, *Propithecus diadema diadema*, and *Eulemur fulvus fulvus* (Tattersall 1982; Mittermeier *et al.* 1994). In the first case the Mangoro River forms the southern limit of this species' range and for the latter two taxa the geographic division between different subspecies.

In a broad sense information on the distribution of lemurs is remarkably sparse and little fine-scale data are available. The Mangoro River basin is a case in point. We strongly suspect that few records of the lemur community of this basin have actually been published. As a result, maps of lemur geographic ranges are often generalized and broad extrapolations presented. This case is further complicated by the fact that the Mangoro River basin drains a vast area of eastern central Madagascar, and several large tributaries feed into the main river. One of these affluents is the Onive River, which has its origin in the Ankaratra Mountains west of Ambatolampy and then descends to the east through the Tsinjoarivo forest block to its junction with the main Mangoro River further to the east. Extensive areas of forest still exist in this region and apparently the Tsinjoarivo forest still has unbroken connections to the Anosibe An'ala region. Thus, an understanding of the primate communities occurring in the Tsinjoarivo forest might be useful for resolving some of the issues associated with the Mangoro River basin as a major geographical barrier for lemurs.

### Sites and Methodology

Between 6 and 22 Jan. 1999 we conducted biological inventories in two different forested sites in the Tsinjoarivo area. This work is part of a larger project associated with the bio-

geography of plants and various land vertebrate groups across the Central High Plateau of Madagascar.

The different study sites, both in the Province of Antananarivo, were:

1) Mahatsinjo Forest, 10.0 km SE Tsinjoarivo, near Andasi-vodihazo 19°40.8'S, 47°46.2'E, 1475-1625 m. This forest block has been completely isolated from other forest zones for at least 15-20 years and comprises a region of approximately 220-260 ha.

2) Ankilahila Forest, 16.2 km SE Tsinjoarivo, along the Andrindrimbolo River 19°42.4'S, 47° 50.1'E, 1400-1550 m. An area that is part of the large forest block between the regions of Tsinjoarivo and Anosibe An'ala. Over the past decade this region has been heavily encroached upon by slash-and-burn agriculturalists resulting in a patch work of degraded zones. As far as we can determine this site is still part of the greater forest block.

During the course of these inventories no primatologist *per se* was part of the research group, but many of the members have considerable knowledge of Malagasy lemurs. The group of researchers spent portions of the day and time virtually each night in the forest. No quantitative survey or transect techniques were used during this project for primates, but rather all of the researchers reported their observations to SMG, who in turn compiled the records.

### Previous work in the region

Little inventory work has been conducted in the area to the east of Tsinjoarivo. In May 1929 the Mission Zoologique Franco-Anglo-Américaine made a quick visit the Tsinjoarivo largely for ornithological collections (Rand 1936). We are unaware of any primate information resulting from this trip. Subsequently in the context of a project entitled, "Projet de Développement Forestier Intégré dans la région du Vakinankaratra" organized by GZT, several inventories have been conducted in the Tsinjoarivo area. The results of one of these inventories with information on lemurs are presented in the report by Rakotondraparany (1997).

### Results

Nine species of lemur were recorded in the Tsinjoarivo Forest by our group, including five nocturnal and four diurnal species (Table 1). Specific notes and observations on the various species are given below. Local names are from the Vakinankaratra dialect and are based on discussions with people living in tavys close to the forest edge.

*Microcebus rufus*: In the Mahatsinjo Forest this species was common and numerous individuals were observed each night. This is in contrast to the Ankilahila Forest where this species was distinctly less common. One individual captured and released in the Mahatsinjo Forest fit the description and measurements of *M. rufus* (Tattersall 1982; Mittermeier *et al.* 1994).

*Cheirogaleus major*: This species was common at both sites. Individuals were observed nearly each night.

*Lepilemur mustelinus*: One or two individuals of this species were observed during most nightly walks in the Ankilahila Forest. In comparison it was only observed once in the Mahatsinjo Forest. The pelage coloration, including tail and dorsum, fit the characters used to defined *L. mustelinus* (*sensu* Mittermeier *et al.* 1994). Locally this species is called *tsisy* or *sisy*.

*Hapalemur griseus griseus*: This species was present at both sites, often in forested areas with climbing bamboo. A group of 12 individuals was observed in the Mahatsinjo Forest. This species is locally called *kotrika*.

*Eulemur fulvus fulvus*: In the Mahatsinjo Forest this species was observed once - a group of three individuals. While

in the Ankilahila Forest it was observed on several occasions in troops of up to seven individuals. In all cases when we were able to carefully examine the coloration of adults, they precisely matched the description of *E. f. fulvus*. This is in contrast to the records of Rakotondraparany (1997) who reported observations of a group in the same general area as our sites that possessed phenotypic characters of *E. f. rufus*, the form signaled as occurring south of the Mangoro River. The local name for this species is *varikabe*.

*Eulemur rubriventer*: A male and female were observed together on a ridge (about 1550 m) above the Ankilahila site. This is the only record we have of this species in the Tsinjoarivo Forest. Local people living in a tavy close to our camp know this species as *varika masofotsy* or *varika mena*.

*Avahi laniger*: This species was observed during most of the night walks in the Mahatsinjo Forest, while in the Ankilahila Forest it was not observed or heard calling on a single occasion. We assume that it occurs at the second site but is rare. The local name for this species was *vahana*.

*Propithecus diadema diadema*: This species was observed nearly daily in the Mahatsinjo forest, but was distinctly rarer in the Ankilahila Forest. All of our observations of this species at both sites were unquestionably of the nominate form. We found no evidence of *P. d. edwardsi* or intermediate individuals between this form and nominate *diadema*.

*Daubentonia madagascariensis*: This species was observed on one occasion at night in the Ankilahila Forest. Workings of this species were found at this site in a dense stand of bamboo above the Andrindrimbolo River that were identical to those reported for this species by Duckworth (1993). No sign of this species was observed in the Mahatsinjo Forest. Two local people from Mahatsinjo and another from Ankilahila living in tavys at the forest edge were shown a illustration of this species and they were not familiar with it.

Table 1: Lemur species identified during the January 1999 survey of two sites in the Tsinjoarivo Forest and compared to other sites at nearly equivalent elevations.

| Species<br>Elevation   | Mahatsinjo <sup>1</sup><br>1475-1625 m | Ankilahila <sup>1</sup><br>1400-1550 m | Andringitra <sup>2</sup><br>1210-1625 m |
|--|--|--|---|
| <i>Microcebus rufus</i>  | +                                      | +                                      | +                                       |
| <i>Cheirogaleus major</i>  | +                                      | +                                      | +                                       |
| <i>Lepilemur mustelinus</i>  | +                                      | +                                      | +                                       |
| <i>Hapalemur aureus</i>  | -                                      | -                                      | +                                       |
| <i>Hapalemur griseus griseus</i>   | +                                      | +                                      | +                                       |
| <i>Hapalemur simus</i>   | -                                      | -                                      | +                                       |
| <i>Eulemur fulvus</i><br>subspp.   | +                                      | +                                      | +                                       |
| <i>Eulemur rubriventer</i>   | -                                      | +                                      | +                                       |
| <i>Avahi laniger</i>   | +                                      | -                                      | +                                       |
| <i>Propithecus diadema diadema</i>   | +                                      | +                                      | -                                       |
| <i>Daubentonia madagascariensis</i>  | -                                      | +                                      | +                                       |
| Total number of species  | 7                                      | 8                                      | 10                                      |
| Sources of information: <sup>1</sup> this study, <sup>2</sup> Sterling & Ramarosoan (1996) |  |  |   |

### Discussion

To a large degree, the lemur survey conducted in the Tsinjoarivo Forest did not yield any surprises. All of the species found occur across much of the central portion of the eastern humid forest and fringing portions of the Central High Plateau. When the lemur fauna of the Tsinjoarivo Forest is compared with that of the Parc National d'Andringitra, slightly less than 300 km further south, the two sites have similar primate communities occurring in montane forest (Table 1). The major difference is the presence of two other species of *Hapalemur* at Andringitra.

The absence during our survey of the Tsinjoarivo Forest of two species, *Indri indri* and *Varecia variegata*, are note

worthy. For the former species this may be related to the elevation of the sites, which were higher than that typical for the geographical range of this species. Apparently, *Varecia* is known to local people who mentioned that it is rare in the area and referred to this animal as *sadabe* or *babakoto*. These people were unfamiliar with a *babakoto* lacking a tail, and thus it appears that these two local names are used for *Varecia*. Rakotondraparany (1997) reported that near Ankazomena, in the same forest block as our Ankilahila site and 5.5 km to the northeast, they heard the vocalization of *Varecia* on one occasion.

The source of the Onive River is the eastern slopes of the Ankaratra Massif, where little forest remains. A survey of this site in 1929 in the vicinity of the Manjakatampo Forestry Station at about 1720 m and in forest at a slightly higher elevation (about 1800 m), failed to find evidence of any lemur species in the area (Delacour 1932; Rand 1936). Further, no lemur species was recorded during an inventory of the Nosiarivo Forest (2000 m) on the same massif and just above Manjakatampo (Goodman *et al.* 1996). Given that the Manjakatampo Station is in the same watershed as the Tsinjoarivo Forest, although at a slightly higher elevation, and that numerous species of lemurs occur at the latter site, we conclude that primates once occurred on the Ankaratra Massif and only recently have gone extinct. On the basis of reports from travelers, extensive areas of natural forest occurred on the Ankaratra Massif until around the 1860s (Mayeur 1913, Parrott 1924, cited in Gade 1996). The slopes of Ankaratra at the headwaters of the Onive River was the site of a massive commercial lumbering operation in the 19th-century (Bonnemaison 1969). We strongly suspect that this forest destruction led to the local extinction of lemur species on the Ankaratra Massif.

On the basis of this survey of the forest east of Tsinjoarivo, little resolution can be provided as to the southern limit of the *Indri*. Our study sites were probably in elevational zones above the upper limit of this species. Further work needs to be conducted at lower-lying sites along the Onive or Mangoro rivers to establish this species' southern limit. With regards to shifts in the subspecies of *Eulemur fulvus* and *Propithecus diadema* along the northern and southern sides of the Mangoro River, we can simply state at the upper portions of this basin, on the northern side of the Onive River, there is not evidence of intermediates between *E. f. fulvus*/*E. f. rufus* or *P. d. diadema*/*P. d. edwardsi*. More extensive survey work combined with genetic studies along both sides of the Mangoro watershed are needed to establish the geographic ranges of these forms and if intermediate individuals occur.

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### A Visit to the Strict Nature Reserve Tsingy de Namoroka (NW Madagascar)

The Strict Nature Reserve of Namoroka (RNI No. 8; Fig. 1) is one of three reserves in Madagascar (along with Ankarana and Bemaraha) that includes "Tsingy", spectacularly eroded limestone formations with caves (Paulian and Grjebine 1954; Nicoll and Langrand 1989; Laumanns and Gebauer 1993). These emergent, mostly uncovered formations account for 28% of the reserve's total area (21,742 ha). The reserve has been designated as a "highest priority region" for conservation in Madagascar (Mittermeier *et al.* 1992). The climate is seasonal with heavy rain from December to April. Vegetation varies from subhumid semi-evergreen to dry deciduous forest; xerophytic plants and baobab trees are present. Most of the reserve is savannah with few trees and temporary lakes. Until recently only four lemur species (*Eulemur fulvus rufus*, *Propithecus verreauxi deakeni*, *Lepilemur edwardsi*, *Microcebus murinus*) had been reported from the area (Tattersall 1982; Nicoll and Langrand 1989; Harcourt and Thornback 1990; Mittermeier *et al.* 1992 1994; Ganzhorn *et al.* 1996/97). Museum specimens indicate the presence of *Haplemur griseus occidentalis* (Tattersall 1982), *Phaner furcifer pallescens* (Groves and Tattersall 1991), and two *Microcebus* species (Martin 1995). Lambertson (1934) mentions Hourcq as having found a dead *Daubentonia* near Andranomavo, close to the reserve (Fig. 1). Hawkins *et al.* (1998) sighted five lemur species within the reserve in 1993 (*Lepilemur* sp., *M. murinus*, *P. furcifer*, *P. v. deakeni*, *E. f. rufus*), and a total of eight within the Baly Bay region (Fig. 1).

Between Sept. 26 and Oct. 3 1997, an excursion was made to improve knowledge on (1) access and research conditions, (2) actual lemur diversity, and (3) current state of the reserve.

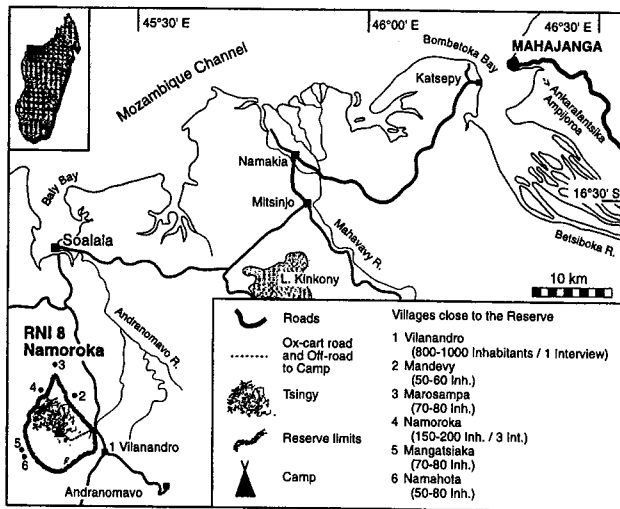


Fig. 1: Map of the region with the Strict Nature Reserve of Namoroka. RNI = Réserve Naturelle Intégrale. Insert map: Madagascar.

## Material and Methods

The reserve was accessed by car from Mahajanga. The camp was established close to the caves of Ambovonomy (16°28.1'S, 45°20.9'E, Fig. 1) due to the availability of water and the proximity to forests. Survey walks were made by day and after dusk (Sept. 28 – 30, 1997). Three of us (AM, AZ, UT) were experienced in locating and identifying lemurs at night. Head lamps were used to locate the animals with their reflecting eyes. They were then identified with a strong flash light and binoculars. Additional information (vocalizations, interviews) helped to confirm the presence of certain species. Four interviews were conducted with local villagers on the use of the reserve, lemur diversity and local traditions.

## Results

Access by car is tedious even during the dry season, and can not be recommended before the end of August. Two ferries have to be used (Mahajanga, Soalala) and the journey from Mahajanga to the camp site takes about one or two days. The most difficult sections are after Soalala. Final access to the camp (3 km) is through open savannah. A well equipped four wheel drive car with a winch is indispensable. Experience in off-road driving and mechanical skills are advantageous. Enough fuel should be brought from Mahajanga; only very basic provisions may be bought in Vilanandro.

**Lemurs:** Seven species representing five families were sighted in the reserve. The presence of an eighth species was suggested by the interviews (Tab. 1).

*Daubentonia madagascariensis:* An animal was seen for a short time on the ground and a possible nest was detected near the camp. Interviews revealed that in December 1996, an Aye-aye was killed in the village of Vilanandro (Fig. 1). We substantiated this information: (1) The villager said the animals' name is "Hay-hay" in the east (from where he once emigrated), but "Karakapaka" in the Namoroka region. This matches closely the name "Bekapaka" used in the Bemaraha region further south (Bousquet and Rabetaliana 1992; Thalmann 1992; Rakotoarison *et al.* 1993). (2) Asked for a description, the villager readily pointed out the strange

overall appearance, the big ears, the strange teeth and the special digits (with the thin third finger). (3) The chief of the reserve identified the animal based on a picture in "Torolalana momban'ny biby voaro" by Ramilirimanana (no print date in book: p.24) which definitely shows *Daubentonia*. (4) Out of curiosity, the villager later cut down a tree to investigate a sphere made up of leaves in the crown. A "Karakapaka" emerged from the nest (it was allowed to escape).

All *Eulemur fulvus rufus* seen were shy. Males and females were clearly dimorphic in pelage coloration. Hawkins *et al.* (1998) have already reported an unusually large extension of the white pelage around the face in females.

*Hapalemur griseus* ssp.: One group of three animals was seen. Interviews confirmed our observation of no important bamboo vegetation, a food item often used by *Hapalemur* spp.

*Lepilemur* is common. The systematic status of the species present is impossible to assess, from sightings alone. According to distribution maps it should be *Lepilemur edwardsi*, but it could be also *L. ruficaudatus* or even an as yet undefined species (Petter pers. com.)

*Microcebus* of the western grey form classifiable as *M. murinus* was seen. Trapping of animals would be necessary to check for the presence of two distinct species.

*Phaner furcifer* ssp. *Phaner furcifer* is common judged from vocalizations and sightings. It was impossible to make any reliable decision about the sub-specific status of the animals.

The *Propithecus verreauxi* individuals observed clearly show the coloration of the *P.v. deckeni* subspecies. No variation in pelage coloration was observed.

Table 1. Lemur species in the Strict Nature Reserve of Namoroka (RNI Nr. 8) as indicated by sightings (S) and interviews (I). CR = Conservation Rating (Harcourt and Thornback 1990).

| Species                                     | Vernacular name        | S | I | CR |
|---|------------------------|---|---|----|
| <i>Cheirogaleus medius</i>                  |                        |   | + | LR |
| <i>Daubentonia madagascariensis</i>         | Karakapaka             | + | + | E  |
| <i>Eulemur fulvus rufus</i>                 | Gidro                  | + | + | LR |
| <i>Hapalemur griseus</i> ssp.               |                        | + |   | V  |
| <i>Lepilemur</i> sp.                        | Kitrontro (or Kitanta) | + | + | LR |
| <i>Microcebus</i> sp. ( <i>M. murinus</i> ) | Tilintilivaha          | + | + | LR |
| <i>Phaner furcifer</i> ssp.                 | Kitanta (or Kitrontro) | + | + | V  |
| <i>Propithecus verreauxi deckeni</i>        | Tsibahaka              | + | + | V  |

+ = indicated. E = Endangered, LR = Low risk, V = Vulnerable

**State of the reserve:** Degradation of the forests continues due to deliberately set and uncontrolled savannah bush fires to promote grass regrowth for cattle. Fires heavily damage forest edges and cause destruction within forests that are not protected by Tsingys. Emergent Tsingys shelter only a small proportion of the forest. The reserve is not permanently inhabited. It is used for uncontrolled cattle pasture, limited hunting, and collection of other products (honey, medical plants). The human population surrounding the reserve about 1200-1500, living in six villages (Fig. 1). The limits of the reserve are mainly in savannah. Some border stones are still visible (Fig. 2).

## Discussion

**Lemurs:** Combined sources (Hawkins *et al.* 1998; Tab. 1) indicate the presence of at least nine lemur taxa in the region. Seven were seen in the reserve. Most *Cheirogaleus medius* individuals would be in torpor in September (A. Müller unpubl. data). This species would therefore not be sighted. The presence of *Hapalemur griseus* ssp. is surprising, since bam-



Fig. 2: A reserve border-stone in the savannah (with M. Rakoto, Guide); in the background dry deciduous forest on rocky soil.

boo is not abundant in the area, but Hawkins *et al.* (1998) have been told by locals that this sub-species does not feed preferentially on bamboo. A recent hypothesis proposes that even more taxa may be present in the reserve (Thalmann and Rakotoarison 1994) but more intense work is needed to confirm or reject this hypothesis. For example, the *Eulemur mongoz* population occurring on the south-western riverside of the Mahavavy (Tattersall and Sussman 1975; Curtis 1997; U. Thalmann unpubl. data) is not separated from the Namoroka region by efficient geographical barriers. However, it can be very difficult to detect this catemeral and behaviourally cryptic species in certain regions (e.g., Reserves of Ankarafantsika/Ampijoroa), especially during the dry season when *E. mongoz* is almost entirely night-active (Rasmussen 1995). Petter *et al.* (1977) indicated the presence of *Mirza* in the region (but see Tattersall 1982). The taxonomic status of several taxa is unclear at the species level as in *Lepilemur* sp. (Hawkins *et al.* 1998) or at the sub-species level (*Phaner furcifer* ssp.). The single museum specimen of *Phaner furcifer* from Namoroka was only assigned to *P. f. pallescens* "with some misgivings" (Groves and Tattersall 1991). The case of *Microcebus* is even more puzzling. Hawkins *et al.* (1998) spotted a second form that resembled *M. myoxinus* in mangrove vegetation near Soalala. From museum specimens, Martin (1995) identified distinct grey and western rufous forms in Namoroka. The description of *M. ravelobensis* (Zimmermann *et al.* 1998) from Ampijoroa confirms earlier observations of two sympatric forms in the West by Petter (1962). If *M. myoxinus* occurs in the region, it means that efficient geographical barriers (Thalmann and Rakotoarison 1994) did not prevent it from occurring as far north as Baly Bay (Hawkins *et al.* 1998) or perhaps even Bombetoka Bay (Schmid and Kappeler 1994). The biogeography of western Madagascar remains enigmatic. Comparative morphological and genetic studies of easily trapped species (e.g. *Microcebus* sp.) and capture of other lemurs in certain western regions would help clarify this unsatisfying but challenging situation.

**Conservation:** Even though it was described as a "highest priority region" for conservation (Mittermeier *et al.* 1992), degradation of the Strict Nature Reserve Namoroka continues dramatically. Uncontrolled bush-fires are the major threat. The question must be raised whether this reserve deserves special attention despite difficult access and logistics. Tsingy regions, spectacular and attractive as they are *per se* (Jolly and Lanting 1987, 1988; Wilson 1990), also show high levels of biodiversity and endemism, as well as rich lemur faunas, worthy of special attention. Eleven species are present in Ankarana (Mittermeier *et al.* 1994), and at least 12 in Bemaraha (Thalmann and Rakotoarison 1994). Facilita-

ting factors for implementation of a conservation program in Namoroka are that the reserve boundaries are in savannah and that border-stones are still visible (Fig. 2). Demarcation (green fence, fire protecting girdles), surveying and patrolling the limits could be relatively easy. The reserve is not inhabited and the surrounding human population is small. Due to the limited resources and isolation of the local population, an appropriate development program may quickly attract the interest of local people and produce positive results. Improvements would be directly associated with the value of the reserve and its protection. However, a program may also have negative impacts such as the disturbance of local traditions and the attraction of more people. Economic and health service improvements could lead to a rapid population increase since birth control appears to be prohibited by local tradition. The strict protection-status of the reserve precludes virtually any access; some possible measures (e.g. eco-tourism) would therefore be difficult to implement.

**Recommendation:** In the short term, and despite the notorious problems with access and logistics, we recommend an urgent assessment of the reserve's biodiversity, and emphasize the necessity for and feasibility of a conservation program in the Strict Nature Reserve Namoroka.

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## Les Lémuriens de la région de Daraina: Forêt d'Analamazava, forêt de Bekaraoka et forêt de Sahaka

Du 25 juillet au 24 août 1998, un inventaire de population de Lémuriens a été effectué dans la région de Daraina, située dans le Nord Est malgache par une équipe pluridisciplinaire du Cabinet Conseil BIODÉV Madagascar. La zone d'étude

se trouve dans les communes rurales de Daraina et de Nossy-be, située dans la sous-préfecture de Voahemmar, appartenant à la province d'Antsiranana.

Notre étude faisait suite à quelques prospections effectuées dans la région (Meyers and Ratsirarson 1989; Mittermeier *et al.* 1992). La présente étude rend compte également au résultat de ces prospections. Les trois massifs forestiers que nous avons visités sont les suivants: la forêt d'Analamazava, la forêt de Bekaraoka et la forêt littorale de Sahaka. La forêt d'Analamazava (Site 1: 13°15'25"S, 49°36'38"E, Fig. 1) fait partie de la Réserve Spéciale de Daraina (30.000 ha). La vue globale de la physionomie de la forêt montre l'aspect général d'une végétation mosaïque. Cela provient du facteur édaphique qui détermine l'instauration de la forêt sur le substrat rocheux ainsi que l'influence du facteur microclimatique engendré surtout par le vent asséchant "Varatraza". Malgré la présence de la végétation rupicole form la pelouse xérophytique à unités d'*Aloe* sp. et d'*Euphorbia* sp. et de la forêt rupicole à affinité sèche s'installant sur la station substrat rocheuse escarpée, la végétation climacique caractéristique de ces écosystèmes forestiers d'Analamazava est une forêt dense humide. La forêt de Bekaraoka (Site 2: 13°06'38"S, 49°41'55"E) d'une superficie de 10.800 ha possède le statut d'une forêt classée. Il s'agit d'une végétation climacique caractéristique du domaine phytogéographique de l'Ouest selon Humbert (1955). Elle présente des caractères particuliers comme la caducité du feuillage pendant la saison sèche et l'aptitude des espèces à survivre dans des conditions écologiques très sévères (déficit hydrique). Les espèces végétales présentent en effet des adaptations poussées à la sécheresse et offrent des spectacles majestueux: pachycaulie (ex: *Adansonia za*), la spinescence (ex: *Pachypodium rutenbergianum*), la microphylie (ex: *Diospyros* sp.) et la présence des contreforts (ex: *Hildegardia erythrosiphon*). La forêt littorale de Sahaka (Site 3: 13°05'55"S, 49°54'44"E) longe entre le lac Sahaka et l'Océan Indien. C'est une formation végétale sous pressions humaines par ses rôles multiples. Ceci pourrait être dû à l'accès facile favorisant le vol des bois utiles dont les espèces les plus exploitées sont *Dalbergia* sp., *Dypsis* sp. et *Pandanus* sp. La situation actuelle de cette forêt est aussi en danger à cause de l'envahissement des espèces colonisatrices comme *Lantana camara* (Verbenaceae). Comme la forêt littorale est une variante de la forêt dense humide sempervirente (Koechlin *et al.* 1971), elle est plus ou moins fermée et la canopée se situe entre 10 et 15 m de haut avec trois strates. Le but principal de notre étude était d'obtenir des informations sur la présence et l'absence d'espèces de Lémuriens dans les différents types de formations végétales de cette région de Daraina. En effet, à chaque site, dans différents types de forêts, des pistes extensives ont été lentement parcourues, deux fois au cours de la journée, de 6 h 30 à 11 h 30 le matin, et de 15 h 00 à 17 h 30 l'après-midi, pour détecter la présence des Lémuriens diurnes soit par observation directe, soit par vocalisation ou mouvement dans les arbres. Les observations nocturnes ont été effectuées entre 19 h 00 et 23 h 00 en utilisant des lampes frontales de faible intensité pour repérer les espèces nocturnes par reflet lumineux de leurs yeux. Une fois repérés, des lampes beaucoup plus puissantes ont été utilisées afin d'identifier l'espèce. Toutes les espèces observées le long des transects diurnes et nocturnes ont été répertoriées. En plus de ces observations, des interviews auprès des populations locales ont également été réalisées pour savoir les types de Lémuriens qui existent dans les différents sites.

Cette étude a mis en évidence la présence des huit espèces de Lémuriens suivantes dans la région de Daraina.

*Propithecus tattersalli*: Cette espèce strictement diurne a une distribution très limitée, dans les forêts entre Loky et la rivière de Manambato dans la partie Nord Est de Madagascar (Mittermeier *et al.* 1994). En effet, Daraina est l'endroit

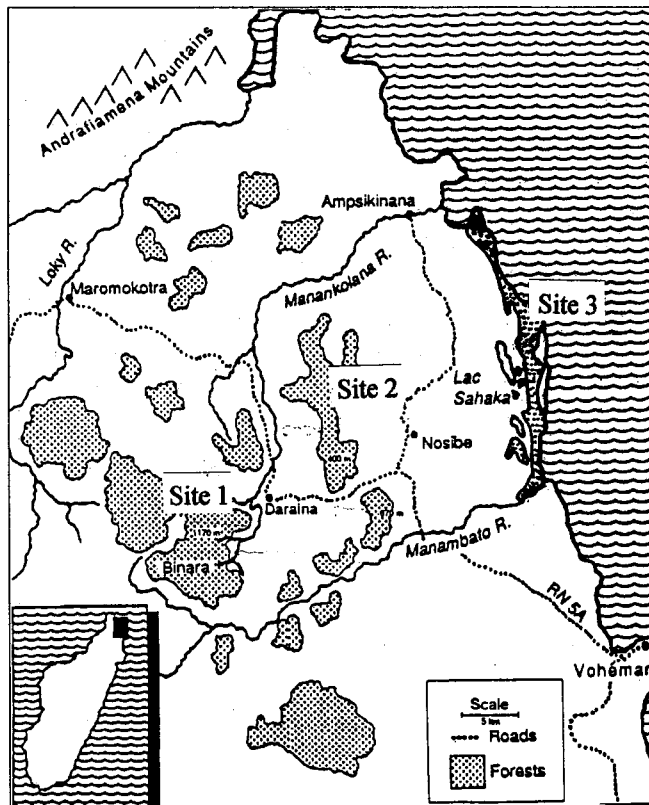


Fig. 1: Sites inventoriés par BIODÉV en 1998; carte d'après D. Meyers.

idéal où on peut le rencontrer naturellement. Plusieurs groupes de cette espèce ont été observés aussi bien dans la forêt humide que dans la forêt sèche. Par contre, elle n'a pas été répertoriée dans la forêt littorale. La faible densité voire l'absence de cet animal dans la forêt de Sahaka peut être due à la forte dégradation de cette dernière. Les "Simpona" vivent en groupe d'environ cinq individus en moyenne. Le prédateur comme le Fosa (*Cryptoprocta ferox*) est son ennemi naturel. La plupart des habitants originaires de cette région considèrent cet animal comme "fady", mais l'arrivée massive des migrants venant des autres régions de l'île à la conquête de l'or commence à changer cette coutume. La destruction de son habitat constitue donc la principale menace pour la survie de cette espèce. Basée sur la découverte de *Propithecus tattersalli*, une recommandation a été faite pour créer un parc national de 20.000 ha dans cette région de Daraina (Meyers and Ratsirarson 1989; Harcourt and Thornback 1990; Mittermeier et al. 1992).

*Eulemur coronatus*: Cette espèce semble avoir un rythme d'activité principalement diurne, mais a été aussi souvent observée en activité pendant la nuit. Son aire de distribution se limite à l'extrême Nord de l'île (Mittermeier et al. 1994). Elle a été recensée dans les trois sites d'étude mais semble être plus abondante dans la forêt de Sahaka. En effet, elle se rencontre dans tous les types de forêt dans son aire de distribution. Ils vivent en groupe de six individus en moyenne. Ce nombre peut aller jusqu'à 15. La destruction de la forêt et la pression de chasse constituent les principales menaces pour la survie de cette espèce. Il faut noter que cet animal est très méfiant de l'homme. En effet, presque immédiatement après être observés, les groupes s'enfuient rapidement dans la forêt.

*Eulemur fulvus sanfordi*: Cette sous-espèce semble être surtout active le matin mais a été aussi observée en activité la nuit. Elle vit en sympatrie avec *Eulemur coronatus* dans son aire de distribution (Mittermeier et al. 1994). En effet, il n'était pas rare de les trouver ensemble dans la forêt humide. Elle est par contre absente dans les deux autres sites. Le

nombre moyen d'individus dans un groupe est de cinq à six. Son aire de distribution est limitée dans le Nord de Madagascar. La destruction de l'habitat et la pression de chasse par les populations locales constituent les principales menaces pour sa survie.

*Lepilemur* sp: Cette espèce nocturne a été recensée dans les trois sites d'études. La détermination de cette espèce nous a posé un certain nombre de problèmes. Néanmoins, les observations de plusieurs individus de cette espèce semblent confirmer la présence de *Lepilemur septentrionalis* dans ces forêts. En effet, cette espèce est présente à Daraina selon Mittermeier et al. (1992). La couleur de son corps est grise, certains individus semblent être un peu plus bruns. La queue est plus foncée. La face est marron noir. Une ligne médiane noire se trouve le long de son dos. Cet animal a une assez grande taille. En plus de la déforestation, la chasse constitue une grande menace pour la survie de cette espèce.

*Phaner furcifer*: Cette espèce nocturne a été rencontrée à Analamazava et à Bekaraoka. Mais, aucun individu n'a été observé dans la forêt de Sahaka. Cette espèce est très facile à reconnaître grâce à ses cris aigus et par la présence de la ligne médiane noire le long du dos et de la tête où elle se bifurque en deux pour atteindre les yeux. Il faut noter que le genre *Phaner* contient une seule espèce avec quatre sous-espèces identifiées jusqu'à ce jour, et les populations de *Phaner* trouvées dans cette région ne sont pas encore nommées ou bien identifiées (Mittermeier et al. 1994). Les observations de quelques individus au cours de cet inventaire ne nous ont pas encore permis de déterminer sa position taxonomique exacte. Toutes ces sous-espèces de *Phaner* ont chacune une distribution très limitée le long des côtes de Madagascar.

*Microcebus rufus*: Cette espèce nocturne a été observée dans les forêts d'Analamazava et de Sahaka. Aucun individu n'a été observé dans la forêt sèche de Bekaraoka. Néanmoins, les guides nous ont signalé sa présence dans ce deuxième site. Il faut noter que les Microcèbes se rencontrent dans une grande variété d'habitats et supportent un degré variable de dérangements humains. Sa rareté dans le Site 2 peut être due à la saison. En effet, les nourritures dans ces forêts sèches commencent à devenir rares et les Microcèbes deviennent ainsi moins actifs.

*Daubentonia madagascariensis*: Le Aye-Aye est un animal strictement nocturne. Un individu de cette espèce a été observé à Analamazava durant cette expédition. Sa présence dans la forêt de Bekaraoka a été signalée par les guides et les villageois. Par contre, sa présence n'a été ni prouvée ni signalée par les guides et les villageois dans la forêt littorale de Sahaka. Il faut noter que cette espèce est harcelée par les populations locales comme un animal "porte malheur". Les guides nous ont raconté que plusieurs Ayes-Ayes ont été déjà tués par les gens dans cette région. Cette tuerie constitue en effet la principale menace pour la survie de cette espèce, en plus de la destruction de son habitat par la déforestation.

*Cheirogaleus medius*: Ces espèces nocturnes hibernent pendant les saisons sèches. C'est pourquoi, elle n'a pas pu être inventoriée durant cette étude. Néanmoins, selon Mittermeier et al. (1994), cet animal est abondant dans les forêts sèches de Daraina. *C. medius* est présente dans presque toutes les forêts sèches de l'île.

En plus de ces huit espèces, la présence de *Cheirogaleus major* est aussi soupçonnée dans les forêts humides de Daraina (Site 1). En effet, l'aire de distribution de cette espèce se trouve à travers toutes les forêts humides de l'Est, dans le massif de Tsaratanana et dans la région de Sambirano, dans la Montagne d'Ambre et près de Vohémar (Mittermeier et al. 1994). Néanmoins, elle aussi est moins active durant l'hiver (juillet à septembre), donc beaucoup plus difficile à trouver (Petter et al. 1977).

Le nombre des espèces de Lémuriens de la région de Daraina est donc élevée puisque l'on y trouve au moins huit espè-



Tableau 1. Les espèces de Lémuriens de la région de Daraina.

| Nom scientifique                    | Nom vernaculaire       | Forêt humide d'Analamazava (Site 1) | Forêt sèche de Bekaraoka (Site 2) | Forêt littorale de Sahaka (Site 3) | Statut *   |
|-------------------------------------|------------------------|-------------------------------------|-----------------------------------|------------------------------------|------------|
| Espèces confirmées                  |                        |                                     |                                   |                                    |            |
| <i>Microcebus rufus</i>             | Tsidy                  | Présent                             | ?                                 | Présent                            | Abondant   |
| <i>Cheirogaleus medius</i>          | ?                      | ?                                   | Présent                           | ?                                  | Abondant   |
| <i>Phaner furcifer</i>              | Tanta                  | Présent                             | Présent                           |                                    | Vulnérable |
| <i>Lepilemur sp.</i>                | Fitsidika              | Présent                             | Présent                           | Présent                            | ?          |
| <i>Eulemur coronatus</i>            | Akomba                 | Présent                             | Présent                           | Présent                            | En danger  |
| <i>Eulemur fulvus sanfordi</i>      | Akomba                 | Présent                             |                                   |                                    | Vulnérable |
| <i>Daubentonia madagascariensis</i> | Haihay                 | Présent                             | Présent                           |                                    | En danger  |
| <i>Propithecus tattersalli</i>      | Simpona Akomba malandy | Présent                             | Présent                           | ? Gravement en danger              |            |
| Espèce soupçonnée                   |                        |                                     |                                   |                                    |            |
| <i>Cheirogaleus major</i>           | ?                      | Présent?                            |                                   | Présent ? Abondant                 |            |
| * d'après Mittermeier et al. (1994) |                        |                                     |                                   |                                    |            |

ces dont *Daubentonia madagascariensis*. Néanmoins, il faut toujours penser aux menaces qui pèsent sur cette faune lémurienne, d'une part à cause de la destruction de leur milieu de vie, et d'autre part à cause de la chasse. La forêt littorale de Sahaka est sillonnée de pistes et de layons créés par les forestiers. Ils permettent une pénétration aisée de la forêt pour les cultivateurs, les braconniers et les voleurs de bois. Dans toutes les forêts visitées, nous avons constaté l'existence d'une exploitation illégale de bois précieux concernant des arbres de faible diamètre, ce qui compromet la régénération. De plus, le bois est utilisé d'une manière traditionnelle notamment pour la construction des habitations et des pirogues à proximité du lac, pour le chauffage, pour la confection de liens à partir d'écorce des jeunes arbres, pour la confection des vannes (tamis d'or), etc.

Les défrichements au profit des cultures sur brûlis ont été constatés dans plusieurs blocs forestiers. Ces défrichements sont causés principalement par des populations de migrants venant du Sud. Les feux de brousse permettant de reverdir les pâturages grignotent peu à peu les lisières et de nombreux zébus broutent dans les forêts, ce qui peut compromettre leur régénération. Il faut aussi noter que l'exploitation aurifère dans cette région de Daraina constitue la principale menace pour ces forêts. En effet, plusieurs blocs forestiers sont déjà touchés par cette exploitation actuellement envahissante. Enfin, la chasse des Lémuriens pour l'alimentation est amplement pratiquée dans toute la région. Les espèces les plus chassées sont *Eulemur coronatus*, *Eulemur fulvus sanfordi* et *Lepilemur sp.* Les techniques de chasse sont surtout les pièges traditionnels et la capture au trou pour les *Lepilemurs*.

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#### Conservation of Perrier's Sifaka (*Propithecus diadema perrieri*) in Analamera Special Reserve, Madagascar

Perrier's sifaka (*Propithecus diadema perrieri*) is considered to be the rarest *Propithecus diadema* subspecies, and it has one of the smallest distributions of any lemur species (Tattersall 1982; Mittermeier et al. 1994). This sifaka is found only in the forests just south and east of Anivorano Nord in northern Madagascar. However, the precise limits of its range are not known because *P. d. perrieri* is among the least studied of all prosimians. One protected area, Analamera Special Reserve (Fig. 1), is thought to contain most of the remaining population of *P. d. perrieri* (Ganzhorn et al. 1996/1997). Brief surveys of *P. d. perrieri* have been conducted in northern Madagascar (Petter et al. 1977; Meyers and Ratsirarson 1989; Hawkins et al. 1990). Petter et al. (1977) estimated a density of only 3-4 animals/km<sup>2</sup> in the region. Meyers and Ratsirarson (1989) conducted a brief study of *P. d. perrieri* in Analamera and found that group size was small (1-6 individuals) and composed of adult animals and one infant. The home range was estimated to be 28 ha. Hawkins and co-workers (1990) observed *P. d. perrieri* in the NW and NE sections of Ankarana Special Reserve. Population estimates vary widely from 100 to 2000 individuals (Petter et al. 1977; Richard and Sussman 1987; Meyers and Ratsirarson 1988). Based on the extremely restricted geographic range of *P. d. perrieri* and the paucity of field data on its population size and behavioral ecology, the IUCN/SSC Primate Specialist Group has given this lemur its highest priority for con-

ervation (Mittermeier *et al.* 1992). The IUCN has classified *P. d. perrieri* as critically endangered (Baillie and Groombridge 1996).

In order to update the conservation status of this sifaka, we conducted a pilot study of the distribution and behavioral ecology of *P. d. perrieri* in Analamera Special Reserve, Madagascar from June 7 to August 4, 1998. This 34,700 ha reserve is located 42 km east of Antivorano Nord on the Indian Ocean coast of Madagascar, at 12° 44' S and 49° 44' E (Nicoll and Langrand 1989). Analamera contains dry deciduous forest, and the canopy is 15-20 meters tall, closed, and discontinuous.

Three groups of *P. d. perrieri* were located and two groups were habituated (group 1 and group 2) near Camp Antobiratsy. This camp is located at 12° 48' 26" S, 49° 32' 04" E along the banks of the Andampy River in the southern section of the Reserve (Fig. 1). Focal animal instantaneous sampling was used to collect more than 600 hours of data on one randomly selected individual each day. Every 5 minutes a record was made of the following: (1) activity [feeding, resting, traveling, etc.], (2) food item, (3) distribution of the animal in the forest canopy by height above ground in meters, and (4) nearest neighbor [ID or age and sex class]. Fecal samples were collected from individuals. Detailed *ad libitum* notes were kept on interspecific and intergroup associations, rare behaviors, and demographic changes.

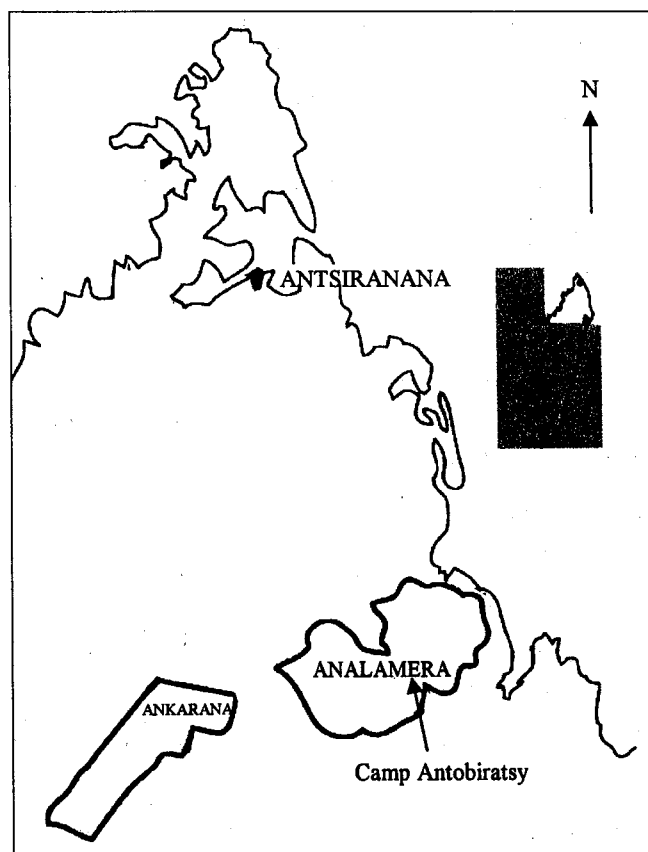


Fig. 1: Locations of protected areas where *Propithecus diademata perrieri* are known to occur and location of study site in Analamera Special Reserve.

Group composition was roughly similar among the three groups seen at Camp Antobiratsy. At the beginning of our study, Group 1 was comprised of three animals (2 adult males and 1 adult female). One of the adult males in group 1 disappeared sometime during the night of July 7. The male's remains were found three days later spread over a 25 m<sup>2</sup> area near what our guides informed us was the den of a fossa (*Cryptoprocta ferox*). Although an infant was born into group 1 on June 27, it also disappeared overnight approxi-

mately one week after the male was lost. The baby appeared healthy and it was observed moving and vocalizing on the day before it disappeared. There were four animals in group 2 (one adult male and three adult females) and in group 3 (two adult males, one adult female, and a juvenile).

The areas where the two study groups were located were composed of highly fragmented forest patches, as was much of the reserve. Unlike the other *diademata* subspecies (Wright 1987; Powzyk 1997), Perrier's sifakas regularly come down to the ground to cross large savannas between forest patches and to drink water from river beds. In one case, animals in group 2 traveled more than 600 m across a hillside savanna to reach a forest patch we had not seen them enter previously. This behavior may expose them to greater threats of predation because they are more visible to predators.

Local people reported that it is *fady* (taboo) to hunt Perrier's sifaka. However, elders we interviewed informed us that this taboo is breaking down among younger hunters and is absent among newcomers to the area. For example, we met a Malagasy man with a sling shot walking through the forest near our study groups. Although he said the sling shot was for protection from bandits, our guides from Ranomafana National Park told us that this weapon was used principally for hunting lemurs. This cultural change is critical for the survival of the sifakas because the home ranges of three groups we studied were located along a busy travel route for people moving between markets and villages. In another example, we located a snare trap for wild pig within the home range of group 1. Because Perrier's sifakas travel and feed near the ground, they could be caught in this type of trap. Habitat disturbance within the reserve continues to seriously threaten Perrier's sifakas. We were approached by a local man to see if we had seen or obtained any precious stones (e.g., sapphires), and if so, would we be willing to sell them to him. Illegal logging and mining for sapphires has had a deleterious effect on lemur habitats and populations in nearby Ankarana Special Reserve (Hawkins *et al.* 1990). Conservation authorities in northern Madagascar are aware of the serious threat that human activities hold for local habitats. For example, we passed a large, heavily armed patrol from Association Nationale pour la Gestion des Aires Protégées looking for illegal miners as we left Analamera. Zebus were located in most regions of the reserve we visited, and regularly moved through the area inhabited by our study groups. The conservation status of the study animals near Camp Antobiratsy is particularly precarious because this camp is used regularly by local people to mourn their dead. Therefore, education of local people about the role of lemurs in tropical ecosystems and the importance of community-based conservation must be a critical component of any future research projects in Analamera Special Reserve.

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## Inventaire biologique dans le Sud malgache en vue d'une conservation pour l'écorégion de la forêt sèche de Madagascar: volet Primatologie

Dans le cadre de la campagne Planète Vivante 2000 du WWF, 200 écorégions ont été identifiées dans le monde (Global 200) pour être l'objet d'initiatives de conservation. Les forêts tropicales sèches et les forêts épineuses de l'Ouest et du Sud de Madagascar ont été incluses dans les écorégions prioritaires de la région africaine et feront l'objet d'initiatives de conservation présentes et futures. Le programme du WWF à Madagascar a ensuite préparé une série d'évaluations et d'analyses visant à développer des stratégies de conservation écorégionales de ces deux écosystèmes forestiers

en un tout. Pour cela le WWF travaille en collaboration et sous la direction de la Cellule Technique Régionale du Programme AGERAS de la seconde phase du Plan d'Action Environnemental (PE 2).

Les premiers objectifs de ce programme de conservation écorégionale sera d'achever une phase de reconnaissance et de collecte d'informations, d'analyses biologiques et socio-économique de toute l'écorégion et d'analyses situationnelles du potentiel et des opportunités de conservation. Ces études aboutiront à un processus participatif pour développer un Plan de Conservation écorégionale et appuieront le processus de planification régionale catalysé par le Programme AGERAS de PE 2.

Concernant le contexte biologique proprement dit, les forêts tropicales et les forêts épineuses de l'Ouest et du Sud de Madagascar sont parmi les forêts sèches les plus riches du monde, avec des degrés d'endémicité locale et nationale extrêmement élevés, que ce soit au niveau des espèces, des genres et familles. De vastes étendues de forêts intactes se trouvent à l'extérieur des aires protégées actuelles. A peu près 21% des 13.763 km<sup>2</sup> de forêts tropicales sèches primaires de l'Ouest de Madagascar sont protégées ou gérées. Par contre, les forêts épineuses et la brousse du Sud couvrent 14.115 km<sup>2</sup> dont seulement 3,2% sont protégées (Faramalala 1995). Ce type de forêt se limite au Sud et au Sud-Ouest de Madagascar. Les informations scientifiques disponibles sur ces écosystèmes sont relativement peu nombreuses.

L'objectif de la phase initiale (mars-novembre 1998) du Projet Ecorégion de Forêt Sèche de Madagascar est de développer des stratégies de conservation des parties Sud de l'écorégion (principalement au sud, à l'est de Morombe, au nord et à l'ouest d'Amboasary). Pendant cette première phase, les activités suivantes ont été réalisées: cartographie par base de données d'un Système d'Information Géographique (SIG), évaluation biologique, identification des zones prioritaires de conservation de la biodiversité, évaluation socio-économique et analyse des opportunités de conservation, analyse situationnelle pour inclure l'identification des intervenants locaux, autorités régionales et acteurs de développement et les contacts et visites des zones prioritaires par les représentants des villages. Une équipe de primatologues a participé à l'inventaire des Lémuriens dans cette phase initiale. Pour cela, la méthode standard pour l'inventaire de la faune Lémurienne a été utilisée: le "Transsect-sampling" ou méthodes d'échantillonnage par transect et on a aussi procédé à des enquêtes auprès de la population locale à titre de complémentarité d'informations. Nous avons pu faire l'inventaire dans six sites: Ankoba, Ankodida, Mahazoarivo, Masiabiby, Anjatsikolo et Bereny.

Ankoba (25°10'14"S, 46°38'53"E): En général, la forêt est du type fourré xérophytique avec une strate supérieure ne dépassant pas les 6 m. La strate moyenne n'existe pratiquement pas. La densité du sous-bois varie suivant le support: moyennement dense et épineux sur le sol et clair sur le rocher. On a noté une variation de la structure de la végétation dans une vallée: il s'agit d'une forêt dense, verdoyante avec absence totale des espèces épineuses et une hauteur moyenne de la canopée atteignant 12 à 13 m. Le sous-bois est dense.

Ankodida (25°03'14"S, 46°30'54"E): La végétation est sèche et épineuse marquée par les Didiereaceae, le sous-bois est entremêlé et la strate moyenne est de 2 à 3 m. La hauteur de la canopée atteint environ 7 m caractérisée par l'abondance des palmiers triède dans certains endroits.

Mahazoarivo: La forêt est du type sèche, dense, dont la strate supérieure est dominée par *Alluaudia*. La strate moyenne est constituée par différentes espèces de plantes épineuses. Il n'y a pas de sous-bois. Le type du sol est très rocailleux.

Masiabiby: La forêt est constituée d'*Alluaudia* et des Euphorbiaceae avec quelques grands arbres à 40 cm de diamè-

tre. La canopée est presque ouverte avec une hauteur de 7 à 8 m. Le sous-bois est clair avec des touffes d'herbacées et de lianes. La nature du sol est sableuse.

Anjatsikolo (24°45'43"S, 46°10'14"E): La forêt est généralement dense, sèche et épineuse à Didieraceae. Elle est caractérisée par l'abondance d'*Alluaudia procera*, un sous-bois plus ou moins dense, l'absence de la strate herbacée et la présence de deux strates: la strate arbustive (4-6 m) et la strate arborée (6-12 m). Le sol est très rocailleux.

Bereny (25°27'18"S, 45°21'44"E): La végétation est un bas fourré xérophyle. Elle est constituée de courts arbres de 4 à 7 m de hauteur et généralement de petite taille. Le sous-bois est plus ou moins clair du fait du pâturage intensif des troupeaux de bovins et d'ovins, et il n'a pas de strate herbacée. L'*Alluaudia procera* est très rare. L'*Alluaudia dimosa*, qui est fréquemment observée dans cette forêt, peut atteindre une hauteur de 8 m. Le sol est sableux (sable rouge) et le terrain est plus ou moins plat.

Dans ces six sites, quatre espèces de Lémuriens appartenant à quatre familles ont été recensées: *Propithecus verreauxi verreauxi* (Indridae), *Lemur catta* (Lemuridae), *Lepilemur leucopus* (Megaladapidae) et *Microcebus murinus* (Cheirogaleidae).

*Propithecus v. verreauxi*: A Ankoba, un groupe de *Propithecus v. verreauxi* est composé de trois individus, de pelages différents: un individu typiquement *P. v. verreauxi*; un autre probablement la variante *P. v. majori* appelée communément par les villageois "Sifakavahy", décrite par Mittermeier *et al.* (1994) avec un pelage marron de la tête jusqu'au milieu du dos, fesse blanche, partie ventrale marron foncée, faces externes des membres marrons. Le troisième individu a un pelage beaucoup plus clair que ce dernier. A Anjatsikolo, on a aussi constaté une légère variation de la couleur du pelage au sein d'un même groupe: les uns ont un dos uniformément blanc, tandis que les autres ont le bas du dos et flancs un peu plus grisâtre. *P. v. verreauxi* ne vocalise que très rarement. On peut observer leurs groupe à moins de 6 m car ils sont très peu sauvages. Ce comportement pourrait être dû à l'inexistence de pressions anthropiques qui s'exercent sur cette espèce. C'est un tabou pour les villageois de chasser les Lémuriens, à l'exception de la population de Mahazoarivo qui le pratique. Dans ce dernier site, quatre couples différents ont été observés dans des endroits intacts. La petite taille pourrait être le résultat de la dissociation des groupes à cause de la chasse. Cependant, leur association par couple semble être inhabituelle. La taille des groupes de cette espèce est moindre que dans les autres parties Sud et Ouest de l'île. A Kirindy, les groupes de *P. v. verreauxi* varient en général entre cinq à huit individus. Par contre, dans ces différents sites, les groupes de *P. v. verreauxi* sont généralement formés de quatre individus; mais on a vu quand même quelques-uns formés de quatre à neuf individus. L'absence des Sifaka dans la forêt de Bereny pourrait avoir une relation avec la structure de la végétation (bas fourré), qui n'est pas du tout leur type d'habitat. En effet, dans les autres sites, cette espèce habite les forêts à grands arbres ou à *Alluaudia procera* (Fantiolitse).

*Lemur catta*: Dans les quatre premiers sites, *Lemur catta* semblent plus nombreux que *Propithecus v. verreauxi*. Pour la plupart, les groupes de *L. catta* sont répertoriés par leurs cris et les empreintes de leurs pas. Ils sont difficiles à dénombrer car ils s'enfuient dès la première rencontre. A Anjatsikolo, on les a surtout rencontré au niveau des points d'eau et sur des montagnes rocheuses et un groupe était formé d'une quinzaine d'individus. Il semble qu'ils sont sauvages. Ceci pourrait être dû à leur vigilance. Cette espèce n'est pas nombreuse dans la forêt de Bereny; ce qui pourrait être expliqué par la perte de leur habitat due au défrichement. Pas mal de déboisements existent dans cette forêt.

*Lepilemur leucopus*: Cette espèce peut vivre en groupe (deux individus) et aussi solitairement. A Anjatsikolo, une étude beaucoup plus approfondie de cette espèce serait nécessaire, car on a constaté une nette différence dans la coloration du pelage et de la taille entre deux individus. L'un est plutôt gris et de petite taille, alors que l'autre a un dos plus roux, une queue plus sombre et de taille plus grande que le premier.

*Microcebus murinus* et *Cheirogaleus medius*: Ils n'étaient pas abondants, voire absents dans certains sites. Ceci pourrait être dû au fait que l'inventaire a été fait durant la saison pendant laquelle cette espèce est moins active. Il est fort probable que *Cheirogaleus medius* existe dans ces forêts. Cependant, nous ne les avons pas répertoriés car la période d'inventaire coïncide avec leur hibernation.

Dans certains sites, les Lémuriens et autres espèces faunistiques de la forêt sont à l'abri de la perturbation pour l'une ou l'autre des raisons suivantes: soit à la croyance des habitants à l'existence de "kokolampy" (démon de la forêt ou mauvais esprit) et ils ne touchent pas la forêt, soit à la coutume villageoise qui interdit les coupes de bois aux alentours des tombeaux, soit au tabou de manger les Lémuriens, ou à l'état du sol rocailleux qui ne permet aucun défrichement de la forêt pour faire de la culture. Néanmoins, on a constaté quelques petits défrichements de la forêt pour faire de la culture, ou genre de chasse mais ceux-ci ne semblent pas trop perturber la forêt. Par contre, dans d'autres sites, la perturbation de la forêt est très poussée à cause du développement intense des défrichements. Aussi, les troupeaux de bovins et d'ovins dispersés dans la forêt menacent la régénération naturelle de cette dernière car ils broutent à la fois les feuilles et les jeunes pousses de plantes, entraînant ainsi le déséquilibre de l'écosystème.

En général, l'intégrité écologique de l'Ecorégion de Forêt Sèche est menacée par plusieurs facteurs anthropogéniques. Les habitats intacts sont dégradés et fragmentés par les pratiques agro-pastorales, le pillage des bois précieux, la croissance des besoins en bois de chauffe et de construction. L'invasion des plantes exotiques et grimpantes: des *Opuntia* et sisal constituent l'une des menaces les plus sérieuses pesant sur la zone aride Sud et Ouest de l'écorégion. Le cactus rivalise avec la végétation naturelle et finit par la dominer. Les graines de sisal, qui proviennent des plantations situées à proximité de certaines forêts, colonisent progressivement ces dernières, et de ce fait entraîne un impact sur la biodiversité.

Tableau 1: Les espèces des Lémuriens inventoriées dans les forêts d'Ankoba, Ankodida, Mahazoarivo, Masiabiby, Anjatsikolo et Bereny.

| Nom scientifique                | Nom vernaculaire | Ankoba | Ankodida | Mahazoarivo | Masiabiby | Anjatsikolo | Bereny |
|---------------------------------|------------------|--------|----------|-------------|-----------|-------------|--------|
| <i>Propithecus v. verreauxi</i> | Sifaka           | +      | +        | +           | +         | +           | -      |
| <i>Lemur catta</i>              | Maki, Hira       | +      | +        | +           | +         | +           | +      |
| <i>Lepilemur leucopus</i>       | Songiky          | -      | -        | +           | +         | +           | -      |
| <i>Microcebus murinus</i>       | ?                | -      | +        | -           | +         | -           | +      |

Si les menaces pesant sur la biodiversité de l'ecorégion sont nombreuses, les opportunités le sont aussi. L'accès à la conservation de certains forêts semble être facile et dû à certains facteurs bloquants de la perturbation de l'écosystème (différents tabous, terrain inexploitable pour faire de la culture,...). Plusieurs groupes ethniques et communautés ont exprimé leur intérêt à participer à la gestion zones forestières qui les entourent afin de les protéger des pressions extérieures. Ces opportunités de conservation doivent être développées et des stratégies seront élaborés pour aider les communautés locales à assumer les responsabilités de gestion et de conservation des forêts.

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## Brief surveys of two classified forests in Toamasina Province, eastern Madagascar

Madagascar's classified forests (Forêts classées) are administered by provincial offices of the Ministère des Eaux et Forêts. In theory exploitation of these forests is illegal, with the exception that local people may make use of traditional forest products and apply for permission to cut timber for house construction. In practice protection of these areas is non-existent. The network of classified forests covers an area of 4,000,000 ha (Mittermeier *et al.* 1994), however it is likely that only a fraction of this area still retains forest cover. The status of lemur populations in the classified forests is unknown, but their importance for the continued survival of many lemur species should not be underestimated.

One-day surveys of the Antanamalaza and Sahivo classified forests, in Toamasina province, were carried out in January 1998 to record lemur and bird species present and to assess the state of forest cover. In addition Antanamalaza was re-surveyed in January 1999. Both of these lowland rainforests are situated to the north-west of the 2,228 ha Betampona Natural Reserve (17°15' - 17°55'S, 49°12' - 49°15'E; Fig. 1). It is currently estimated that only 50% of Betampona (i.e., 1,114 ha) is relatively undisturbed primary rain forest. Eleven species of lemur occur at Betampona (see Table 1) and 80 bird species have been recorded in the reserve and its environs.

### Antanamalaza

On paper Antanamalaza forest (17°50' S; 49°11' E) covers an area of 231 ha and lies approximately 5 km directly north-west of Betampona. Within the past 20 years the forest was continuous with the Sahivo forest to the south.

On 21 January 1998 three lemur species were sighted: *Indri indri*; *Varecia variegata variegata*; *Eulemur fulvus albifrons*. Local villagers also reported the presence of *Daubentonia madagascariensis*. Four *Indri* were sighted in a thin

Table 1: Lemur species at Betampona Natural Reserve.

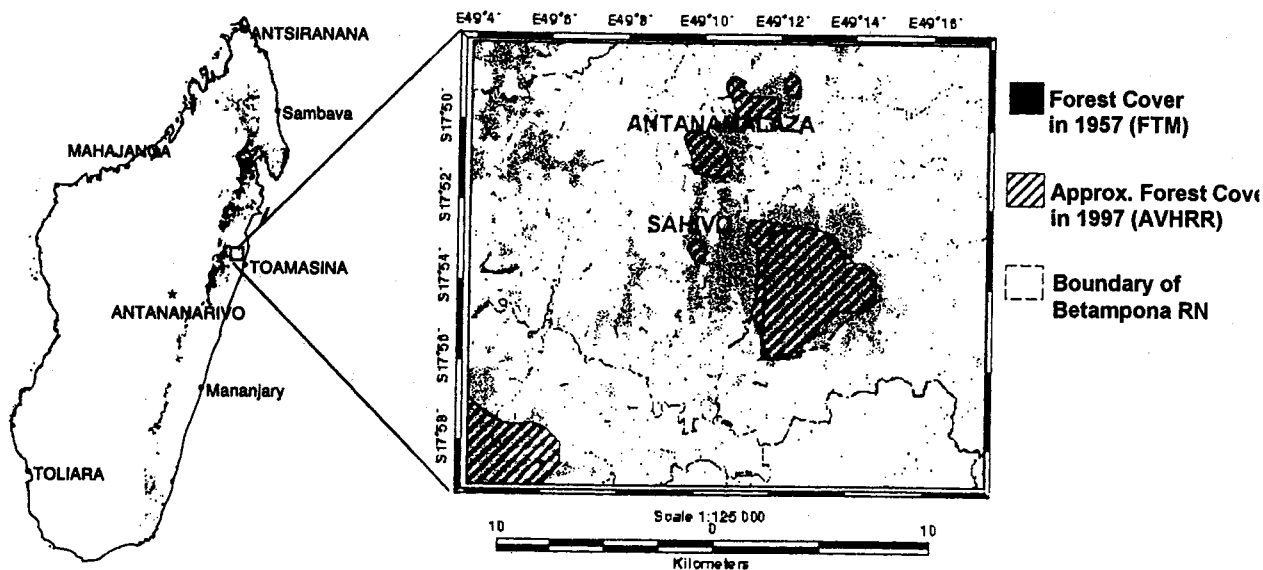
| Family         | Species                             | Local name   |
|----------------|-------------------------------------|--------------|
| Cheirogaleidae | <i>Microcebus rufus</i>             | Tsidy        |
|                | <i>Cheirogaleus major</i>           | Tsitsihy     |
|                | <i>Phaner f. furcifer</i>           | Tantana      |
| Megaladapidae  | <i>Lepilemur mustelinus</i>         | Trangalavaka |
| Lemuridae      | <i>Haplemur g. griseus</i>          | Bokombolo    |
|                | <i>Eulemur fulvus albifrons</i>     | Alokosy      |
|                | <i>Varecia v. variegata</i>         | Varikandana  |
| Indridae       | <i>Avahi laniger</i>                | Fotsiafaka   |
|                | <i>Propithecus d. diadema</i>       | Simpona      |
|                | <i>Indri indri</i>                  | Babakoto     |
| Daubentoniidae | <i>Daubentonia madagascariensis</i> | Hay hay      |

corridor of forest within a highly degraded area, characterised by open secondary forest to the east and recent "Tavy" (slash-and-burn cultivation) plots to the west and south. The group comprised two adults, one juvenile and one infant (carried by mother). Inter-individual variation in pelage was apparent. The adult male was markedly lighter in coloration than the others, with white face and neck, white patches on lower back, flanks, rump and thighs, while shoulders, arms and ears were black. The other individuals had black face, neck, back and arms, grey thighs and only a small v-shaped patch of white on the lower back.

The group was encountered at a height of 10–15 m in a Rara tree (Myristicaceae: *Bronchoneura* sp.). The *Indri* at Betampona have been observed to feed on the fruit and leaves of this species. Other tree species present, upon which the *Indri* at Betampona have been observed to feed included: *Menahihy* (Ochnaceae: *Campylospermum* sp.), *Voapaka* (Euphorbiaceae: *Uapaca* sp.), *Hazinina* (Clusiaceae: *Symphonia* sp.), *Molopangady* (Rubiaceae: *Alberta* sp.) and *Zanamalotra* (Cesalpiniaceae: *Dialium* sp.). Calls of three groups of *Indri* were heard from this region. A further light-coloured adult was sighted (white face, neck, chest, flanks and lower back; black ears, legs and shoulders) in an area characterised by a low and discontinuous canopy (~ 10 m). *Menahihy*, *Molopangady* and *Voapaka* trees were present in the vicinity and other species upon which *Indri* have been observed to feed included *Tarantana* (Anacardiaceae: *Rhus tarantana*), *Mampay* (Cesalpiniaceae: *Cynometra* sp.), *Sadodok'ala* (Rubiaceae: *Gaertnera* sp.) and *Ramy* (Burseraceae: *Canarium madagascariensis*). A group of six adult *Varecia* was sighted in a patch of forest bordering a large tavy clearing and calls were heard from two other groups. The pelage of these individuals was identical to those at Betampona—i.e., corresponding to the *variegata* group (Tattersall 1982). A group of three adult *Eulemur f. albifrons* was also sighted.

On 17 January 1999 four lemur species were sighted, the addition being a single adult *Avahi laniger*. Villagers also reported the presence of *Microcebus rufus* and *Phaner furcifer*. It is also likely that *Haplemur griseus griseus* and *Cheirogaleus major* occur within the forest. Four adult *Indri* were sighted in the same region as 1998. However no calls were heard from other groups. Four adult *Varecia* (one female, three sex unknown) were sighted in the south of the forest. A local woman working on her tavy claimed to have seen five individuals that morning. This is likely the same group observed in 1998, then numbering six. Calls were heard from a further two groups in the north and west. Two groups of *E. f. albifrons* were sighted: a group of four adults in the north (one male, one female, two sex unknown) and a group of two adults in the south (male and female). Unlike the *E. f. albifrons* at Betampona, the two groups were completely silent and moved very quietly through the canopy. Thirty-eight bird species were recorded in the forest and surrounding area, including 17 species that occur only in primary or secondary forest. Of note is the presence of the Brown Mesite (*Mesitornis unicolor*) and the Red-fronted

## Forest Change in the region of Betampona RN, 1957-1997



1997 Eastern Rainforest Map (AVHRR)

Fig. 1: Map of survey areas.

*Coua* (*Coua reynaudii*). It is likely that further species would be added if a longer period were spent in the forest. It is certain, from discussions with villagers, that the Madagascar Crested Ibis (*Lophotibis cristata*) no longer occurs at Antanamalaza. Similarly it is unlikely that certain rare species present at Betampona, e.g., Pollen's Vanga (*Xenopirostris polleni*) and Dusky Greenbul (*Phyllastrephus tenebrosus*) will exist due to the level of habitat disturbance.

### Sahivo

On 18 January 1998 four lemur species were sighted in the 225 ha Sahivo forest (17° 53' S; 49° 10' E): *Indri indri*; *Eulemur fulvus albifrons*; *Haplemur griseus griseus*; and *Avahi laniger*. One adult, dark-coloured *Indri* was sighted in primary forest at an elevation of 465 m. Arms and upper back were black, face was black with a white band above the eyes, flanks were white, and there was a v-shaped white patch on the lower back. Calls of further *Indri* were heard and estimated to be 2 km from our location. Villagers report two groups of three individuals exist in the forest. A group of seven *E. f. albifrons* was sighted, comprising six adults and one infant being carried by a male. Three *H. g. griseus* were sighted, two adults and one infant, and three *Avahi*, two adults and one infant. *Daubentonia* also occurs in the forest as evidenced by the presence of Ramy nuts bearing the characteristic incisor marks made by this species to obtain the seed inside.

### The status of lemurs in Antanamalaza and Sahivo

The Simpona or Diademed Sifaka (*Propithecus d. diadema*) which still occurs in small numbers at Betampona (estimated 10 - 15 individuals, density: 0.9 - 1.3 animals/km<sup>2</sup>) is absent from both of these forests. Villagers report that the last Simpona were seen in Antanamalaza during the mid 1970's. Their absence in the two forests is most likely due to a lack of sufficient resources to support a population. Simpona require a significantly richer diet than the sympatric *Indri*. As frugivores, they consume a large diversity of plant species and exhibit seasonal variation in the emphasis of plant parts in their diet (Powzyk 1997). For these reasons they typically maintain large territories and travel long distances to locate resources. Groups at Betampona are estimated to

have territories of 100+ ha. There is probably simply insufficient forest remaining in Antanamalaza and Sahivo to support this species. Simpona are also vulnerable to hunting, being extremely curious and relatively unafraid of humans. It is therefore no great surprise that this species was the first of the current lemur community to disappear from these forests.

*Varecia* are absent from Sahivo, although they are reported to have occurred there up to about ten years ago. It appears that three groups exist at Antanamalaza and a reasonable estimate would be 10 - 15 individuals. Villagers report that the *Varecia* are mainly observed feeding on leaves. Data from Betampona indicate that the *Varecia* there are highly frugivorous spending 92% of feeding time consuming fruits (Britt 1996). This is supported by studies at other sites (e.g., Morland 1991; White 1991; Rigamonti 1993; Vasey 1996; Balko 1998). If the villager's observation is correct this suggests that the *Varecia* are existing in a sub-optimal environment. This is further supported by the report that infants have not been observed in living memory. The villagers suggested that the *Varecia* population had increased in recent years and inferred that individuals had moved there from Betampona. This would involve an extremely hazardous journey across 10 km of cultivated land. It seems more likely that what the villagers are seeing is the squeezing of the existing population into a smaller and smaller area of primary forest. Estimates of primary forest cover from a September 1997 AVHRR image indicate that less than 121 ha (1 pixel) remained at that time. Green and Sussman (1990) calculated a deforestation rate of 1.4% per year over a 35 year period; preliminary results of current deforestation rates range from 2% to 10% per year depending on the region (Young and Axel, unpublished). Given that those forests most at risk are low elevation, low slope patches in areas of relatively high human population density (Green and Sussman 1990), it is reasonable to assume that less than 100 ha of forest now exists in Sahivo. Thus the density of *Varecia* at Antanamalaza is between 10 - 15 animals/km<sup>2</sup>, considerably higher than the estimate of 2.5 - 3.1 animals/km<sup>2</sup> at Betampona.

*Indri* still occur in both forests probably due in large part to the generally observed "fady" (taboo) against eating this



species. At Sahivo 3 - 6 individuals exist in approximately 100 ha of forest (density: 3 - 6 animals/km<sup>2</sup>). At Antanamalaza 4 - 12 individuals exist also in approximately 100 ha of forest (density: 4 - 12 animals/km<sup>2</sup>). The population estimate at Betampona is 50 - 75 individuals giving a density estimate of 4.5 - 6.7 animals/km<sup>2</sup>. Pollock (1975) recorded a population density of 8 - 16 animals/km<sup>2</sup> at Analamazoatra. As in Betampona the *Indri* exhibit inter-individual variation in pelage markings, ranging from very light coloured to very dark individuals.

*Eulemur f. albifrons* occurs in both forests. It is unlikely that any more than 20 individuals exist in each forest (maximum density: 20 animals/km<sup>2</sup>). A conservative estimate of the population at Betampona would be within the region of 250 individuals (density: 11.2 animals/km<sup>2</sup>, if one assumes that this species can make use of most of the 2,228 ha of the reserve). This species is likely to be the major target of hunting activities.

*Hapalemur g. griseus* occurs definitely in Sahivo and is likely also to occur at Antanamalaza. It is impossible to provide population estimates at present. However, we have observed this species in highly degraded areas around Betampona. It is probably the least threatened of the diurnal lemurs by the destruction of these two forests.

It is not possible at this time to present population estimates for the nocturnal lemur species.

### Conclusion

The future looks bleak for the lemur communities of Antanamalaza and Sahivo. One species has already gone from Antanamalaza and two from Sahivo. Both forests have reduced lemur species diversity compared to the nearby Betampona reserve. The remaining lemurs exist at high densities compared to those recorded at Betampona and are being rapidly squeezed into smaller, fragmented patches of forest. Lemur snares were discovered in Antanamalaza, despite assurances by local villagers that they observed a fady against eating any lemur species. The main threat to these forests is clear-felling for tavy, which is eating away at the edges of the forests and being carried out in the middle, creating a mosaic of small isolated forest patches. Additionally there is evidence of extraction of precious hardwoods such as Ebony and Palissandre. In the surrounding area many rice paddies lie fallow as local people can obtain higher yields from clearing and burning primary forest. There is a real need to discourage this practice. It may already be too late to save these forests and it would certainly require immediate and effective intervention by agents of the Ministère des Eaux et Forêts.

The tragedy is that if well managed, these forests could probably still meet the timber needs of the local community and continue to support the current lemur and bird populations. If felling continues at the present rate it is likely that only a few small patches of forest will remain in 2 - 3 years and the majority of lemur species will disappear. The only remaining forest in the local area will be the Betampona reserve. It is feared that the ever-increasing human population will then turn its attention towards this last refuge for lemurs in the region.

### Acknowledgements

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## A biological assessment of the Zahamena-Mantadia corridor, Madagascar

The priority setting workshop held in April 1995 in Madagascar (Priorities for Biodiversity Conservation in Madagascar, Primate Report 48-1, 1997) demonstrated that a significant portion of the conservation and research priorities are located outside of the protected areas network in Madagascar, and thus reinforced the need to address eco-region-based conservation rather than exclusively biodiversity conservation in protected areas. In 1997, a five-year strategic objective grant agreement was signed between Malagasy governmental agencies and the United States Agency for International Development (USAID) to develop the regional landscape approach in order to conserve biologically diverse ecosystems in five priority zones in Madagascar. Conservation International (CI) is the lead organization for conservation planning in two of the five priority zones, the Mantadia-Zahamena corridor and the Bealanana-Mahajanga region.



Successful conservation planning must be based on solid basic information of the biological resources existing in the region. One way to obtain this is through "rapid assessments". Conservation International's Rapid Assessment Program (RAP) was established in 1990 to meet the critical need for rapid identification of priority areas and to improve biodiversity protection. The RAP methodology is not designed as a more in-depth inventory or monitoring but to provide information of regional biodiversity quickly. This methodology helps to set priorities for conservation activity worldwide and provides countries with the information and technical assistance needed for the development of national biodiversity strategies.

CI conducted a RAP of the biodiversity of humid forests within the Mantadia-Zahamena corridor, financed by Netherlands Committee for IUCN, Netherland, and the Wolfensohn Family Foundation, USA. This eastern mountain range corridor links the protected areas of Andasibe-Mantadia National Park and the Zahamena Strict Nature Reserve, and it contains commercial forestry zones, numerous local forest exploitation and two other reserves, Mangerivola and Betampona. The corridor covers a total of approximately 830 hectares and is extremely important for biodiversity conservation purposes. The highland rainforest of Andasibe-Mantadia, for instance, is home to Madagascar's largest lemur species (*Indri*) and Zahamena National Park is considered to be among the richest forests in the world in terms of primate diversity (14 species).

Survey work was divided into two expeditions (expedition 1: November 7 - December 14 1998; expedition 2: January 15 - 28 1999). Four camps were placed in different classified forests, and one site was placed in Mantadia National Park. Transects were centered around these sites within a radius of approximately one kilometer. The study sites were determined with the help of an overflight video, geographical and vegetational maps, and consultations with local people and national stakeholders. Sampling lasted 6-7 days at each site. The position and altitude of each site are presented in Table 1. Malagasy and international scientists surveyed following taxonomic groups: Small mammals - Lemurs - Birds - Reptiles - Amphibians - Insects - Plants and Vegetation. Each taxonomic group used established scientific methodologies.

Table 1: Names and positions of sites surveyed during the RAP.

| Site                       | Location             | Altitude | Status | Time period   |
|----------------------------|----------------------|----------|--------|---------------|
| Iofa (site no 1)           | 18°42.1'S, 48°28.0'E | 835 m    | FC     | 07-13 Nov     |
| Didy (site no 2)           | 18°11.9'S, 48°34.7'E | 960 m    | FC     | 16-22 Nov     |
| Mantadia (site no 3)       | 18°47.5'S, 48°25.6'E | 895 m    | PN     | 25 Nov-01 Dec |
| Andriantantely (site no 4) | 18°41.7'S, 48°48.8'E | 530 m    | FC     | 04-10 Dec     |
| Sandranantitra (site no 5) | 18°02.9'S, 49°05.5'E | 450 m    | FC     | 18-24 Jan     |

FC = Classified forest; PN = National Park

Preliminary results for each taxonomic group are presented in the written report (Rapport préliminaire 1998: D'un programme d'inventaire biologique rapide (RAP). Corridor Mantadia-Zahamena). Final report editing and publishing, as well as distributing will be completed by August 1999. The final results of the biological inventory are needed for successful conservation planning and development actions for the region of the Mantadia-Zahamena corridor.

Following this biological inventory, a "Madagascar Biodiversity Corridor Planning Workshop" was held in Andasibe, Madagascar (9-11 February 1999), which was organized by CI Washington and CI Madagascar. Government representatives (Association Nationale pour la Gestion des Aires

Protégées [ANGAP], Direction des Eaux et Forêts [DEF], Office National pour l'Environnement [ONE]), USAID and NGOs attended the workshop. Divided into working groups, participants analysed corridor data and current land-use and developed designs and management strategies for the Mantadia-Zahamena corridor.

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### Biological inventories of forest fragments and forest corridors in eastern and central Madagascar.

The problem of habitat fragmentation in the remaining forest blocks of Madagascar is a serious problem that readers of this newsletter are certainly aware of. However, one of the difficulties in addressing this issue is the lack of comparable data from eastern Madagascar on the effects of habitat isolation on different aspects of the natural biological communities. The corollary of this point is to assess the importance of existing forested corridors that link large remaining blocks of natural habitat.

In order to address these issues a research program has been developed by the WWF-Madagascar program to study the effects of forest fragmentation in the remaining forest blocks on the Central High Plateau. It is planned that over the next three years approximately 20 different sites will be inventoried.

Research teams organized by WWF are also working on corridor issues. These studies involve field surveys and subsequent taxonomic and genetic studies of a variety of organisms. In the latter portion of 1996 a multidisciplinary group of biologists spent nearly two months in the field conducting an elevational inventory of the plants and animals (including lemurs) in the Réserve Spéciale (RS) d'Ivohibe and the unbroken forested corridor that links this reserve to the Parc National (PN) d'Andringitra. This latter area, which was formerly a Réserve Naturelle Intégrale but its status was recently changed to a national park, was the site of several intensive biological inventories starting in 1993, and is among the best known areas of forest in the humid portion of the island. We are currently finishing a monograph presenting the results of this survey which is edited by S. M. Goodman and B. Rasolonandrasana and will be published in Recherches pour le Développement, Série Sciences Biologiques, Antananarivo.

Largely the same research group responsible for the Ivohibe/Andringitra corridor project is currently organizing two other parallel studies in forested corridors for the period between September and December 1999. The first project will examine in detail the forested corridor of Betaolona, connecting the PN de Marojeje and the RS d'Anjanaharibe-Sud. These two reserves have been the subject of intensive biological inventories, the results of which have or soon will be published in monographic form. This new study will focus on

the importance of the Betaolona Forest for maintaining the biological diversity in the two adjacent reserves. Further, other surveys will be conducted on the western slopes of the Anjanaharibe-Sud massif, outside of the protected area, with the idea of possibly extended the western limit of this reserve.

The second project for late in 1999, in collaboration with colleagues from MICET, is to conduct extensive inventories in the corridor linking the PN de Ranomafana and the PN d'Andringitra. Once this project is completed, detailed comparable information will be available from the continuous swath of forest from Ranomafana to Ivohibe, an area over 150 km in length.

These field surveys, in combination with parallel projects being conducted by other conservation and scientific organizations on Madagascar, should begin to address the issues of the effects of habitat isolation and the importance of maintaining forested corridors. The largest existing forest block on the island, running from the Tsaratanana/Manongarivo massifs, east and south through the areas ringing Andapa, and then southeast to the Masoala Peninsula, remains to a large extent poorly known. This region should be given high priority for inventory work.

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### Lemurs can't do it all by themselves anymore

Rainforest in Madagascar is exceptional in the degree to which seed dispersal is conducted by highly arboreal mammals. Particular lemur species such as the obligately frugivorous *Varecia variegata variegata*, may be critically important for forest maintenance (Dew and Wright 1998). It follows that we need to maintain viable populations of these seed dispersers in remaining forest if integrity and dynamics of the ecosystem is to be maintained. The problem is that, like frugivores worldwide which have large area requirements, these species are exceptionally vulnerable to forest fragmentation. Enhanced human access and hunting levels in fragmented forest, and sensitivity of key seed dispersers such as *V.v. variegata*, to human disturbance (Morland 1991), compound the risks of local extinction. In addition to disturbance, selective logging can have a serious negative impact on highly frugivorous lemurs (White *et al.* 1995). Not only are the large trees, favoured by *V.v. variegata*, removed, but there is a large overlap in the tree species that people harvest and those that are an important food resource for lemurs (Merenlender *et al.* 1998).

A further concern results from observations I have made in Masoala where seasonal altitudinal movements of *Varecia variegata rubra* are very evident. In the central area of Masoala National Park, this species congregates at relatively low elevations (below 550 metres) during October and November, feeding on the fruits of a limited number of tree species. The most regularly visited fruiting tree, *Sideroxylon betsimisarakum*, Sapotaceae, was not found above 550 m. In fact, three species of lemur were observed (*Eulemur fulvus albifrons*, *Haplemur griseus griseus*, and *Varecia variegata rubra*) feeding together in this tree species on two occasions. Local people stated that this migration is a regular annual occurrence. Annual migration may seem surprising considering it has often been reported that Malagasy rainforest trees exhibit notable lack of predictability in fruiting periods within and between years (Morland 1991, Pollock 1975). In-



Fig. 1: "Where are you going?"; painting by L. Holloway, used for public awareness campaigns.

cidental observations in Zahamena RNI during June 1994 (Holloway 1994), also suggest seasonal elevational movements of *Varecia v. variegata* during periods of fruit scarcity. In this case it appeared that fruiting phenology may have been disrupted by the devastating cyclone Giralda. At 800 m there were virtually no trees with ripe fruit in June and there were no observations of *V.v. variegata* throughout May and June, although local people stated that this species was normally present at this elevation. At 400 m, in contrast, several tree species bore ripe fruit and *V.v. variegata* was abundant. Some tree species, such as *Chrysophyllum boivinianum* were in fruit at both elevations but were only ripe at lower elevations. These observations are worrying because they suggest that for this lemur genus, it may be irrelevant how much high elevation forest remains if the amount of lower elevation forest is limited, inaccessible, or destroyed. A search of published literature found no reference to seasonal elevational migrations of highly frugivorous lemurs. However, *Eulemur fulvus rufus* was observed to migrate out of the study area between April and mid-May when fruit was most scarce at Ranomafana (Overdorff 1993, 1996). Overdorff also found that *E. rubriventer*, also highly frugivorous, did not migrate, revealing that species vary in their dietary requirements and behavioural strategies according to their reproductive ecology in particular. Perhaps *Varecia*, being obligately frugivorous, needs to track suitable fruiting trees more closely than other species. Further research in this area is necessary.

It is clear that if we are to be confident that we can actually maintain populations of these important seed dispersers,

habitat area, habitat quality, disturbance levels, metapopulation structure, and elevational range must all be considered. Since many sites of conservation importance already face degradation or disruption of one or several of the above factors, an essential consideration must be the maintenance or restoration of habitat continuity. This requires conservation planning on a larger spatial scale than has been practised until recently. This is now widely recognised and has been incorporated into Madagascar's environmental action plan (PE2: see Ganzhorn *et al.* 1997; Hannah *et al.* 1998). It also implies that we need to direct our attention towards conserving ecosystem processes (such as forest regeneration), in addition to the traditional species-based approaches.

When considering habitat continuity, protection of extant natural habitat is obviously a priority. Important corridors such as between Zahamena and Mantadia have already been identified and measures to protect these are in place. However, many protected areas as well as unprotected areas of conservation importance are now isolated and too small to remain viable for all biota that live there. Restoration of connectivity will be necessary to conserve the biodiversity quality of such areas (Ganzhorn *et al.* 1997). Périnet-Analamazaotra Special Reserve, Betampona, the forests of Daraina, Manombo, Ankazomivady, Ambohitantely, and even increasingly isolated fragments within Mananara Nord PN, are a few examples.

We need to help the lemurs to help themselves and ultimately the forest itself. The importance of arboreal seed dispersers in forest regeneration, and the need for our intervention in catalysing forest restoration has been re-enforced by recent research on forest regeneration in Madagascar (Holloway 1994, 1999): indications are that germination and establishment requirements and competition are not major inhibitory factors to the establishment of forest trees outside

of forest, since trees grow well when sown outside (Holloway 1999). Restoration of forest corridors has been initiated in Masoala in collaboration with Projet Masoala. This involves planting forest trees highly favoured by frugivorous lemurs in linked clusters between forest blocks. Once the trees are mature enough to entice lemurs to forage, the lemurs themselves will be able to continue the process of forest restoration. This approach to forest restoration demands less human effort than conventional blanket planting, with a diverse age structure and resulting in more species than were initially planted.

A similar approach is anticipated to commence on a large scale in the Andasibe-Mantadia area. In addition to lemurs, essential participants in the project are local people. A series of measures, including the restoration of degraded land for more sustainable cultivation, are an integral part of the programme. Restoration is a slow but necessary process. We are beginning to understand what is required to catalyse forest restoration in Madagascar. We need to apply these insights now and on a wide scale.

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Fig. 2: Catalysing Rainforest Restoration in Madagascar; painting by L. Holloway, used for public awareness campaigns.

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## *Eulemur* is a phylogenetically-defensible taxon (but species relationships within the genus are problematic)

Over the past decade, the Malagasy primate family Lemuridae has been the object of intense systematic scrutiny. In 1988, three papers were published, nearly simultaneously, that questioned previously-accepted ideas both of phylogeny and taxonomy (Groves and Eaglen 1988; Simons and Rumpler 1988; Tattersall 1988). In particular, the authors of these papers were interested in clarifying the relationship of *Lemur catta* (the ring-tailed lemur) to other lemurid species. Following decades of reports of special similarities between *L. catta* and the genus *Hapalemur* (bamboo lemurs), the three papers independently recommended new genus-level taxonomy for *Lemur* species other than *L. catta*. *Prosimia* (Tattersall 1988), *Petterus* (Groves and Eaglen 1988), and *Eulemur* (Simons and Rumpler 1988) were the suggested alternatives. As reviewed by Groves and Trueman (1995), the genus *Eulemur* was ruled by the International Commission on Zoological Nomenclature to be the valid taxon. *Eulemur* has been widely accepted even though the phylogenetic basis for the new taxonomy requires further investigation. The taxonomy was originally proposed more as a repository for those species orphaned by the recognition of *L. catta*/*Hapalemur* affinities than as a distinct phylogenetic unit (Simons and Rumpler 1988). In other words, these authors did not explicitly address the issue of *Eulemur* monophyly. Subsequently, numerous studies employing a variety of character sets have investigated the question directly and have found support for a *Eulemur* clade, though ironically, the relatedness of *L. catta* to *Hapalemur* has proven to be questionable. Our study (Yoder and Irwin in press) joins others in attempting to unambiguously resolve lemurid phylogeny as a first step towards establishing a phylogenetic taxonomy for this group of primates. We employed a variety of genetic markers to assess the relative placement of the genera *Eulemur*, *Lemur*, *Hapalemur*, and *Varecia*.

### Materials and Methods

Tissues (liver, spleen, kidney, muscle) for all study samples were acquired from animals that died of natural causes at the Duke University Primate Center (DUPC). Taxon sampling at the genus level within the Lemuridae is exhaustive. Species-level sampling is nearly complete except for the omission of two of three *Hapalemur* species, *H. simus* and *H. aureus*, and one *Eulemur* species, *E. coronatus*. DNA sequences for four genetic markers were generated for all samples. These are the entire 1140 bp cytochrome *b* gene, a portion of the mitochondrial control region (D-loop) homologous with the hypervariable 1 (HV1) region found in humans, the entire cytochrome oxidase subunit II gene (COII), and a 1067 bp fragment of exon 1 of the interphotoreceptor retinoid binding protein (IRBP). The sequences were analyzed with a variety of phylogenetic algorithms including maximum parsimony, maximum likelihood, and least-squares regression. For the parsimony analyses, a variety of character-weighting schemes were investigated. Bootstrap analysis was employed to estimate statistical support for clades yielded by the analyses.

### Results and Discussion

The questions that motivated this study — is *Eulemur* monophyletic? do *L. catta* and *Hapalemur* form a clade? what is the relative position of *Varecia*? — are clearly and consistently resolved in the parsimony analyses of the individual genes (Fig. 1). Repeatedly, the answers are: *Eulemur* is monophyletic, *L. catta* and *Hapalemur* do form a clade, and *Varecia* is basal to a *Eulemur* plus *L. catta*/*Hapalemur* clade.

As indicated by the bootstrap values, support for these results is typically robust. The only exception to these results is seen in the IRBP tree which does not resolve the relative placement of the three primary lineages. Although the overall observed congruence among data sets is gratifying, one still hopes to find a single fully-resolved tree that is supported by all of the data. Such is not the case for this study with respect to branching patterns within *Eulemur*. Specifically, the placement of the species *E. mongoz* and *E. rubriventer* varies not only from one data set to another (Fig. 1) but also within data sets depending on the weighting scheme employed (not shown).

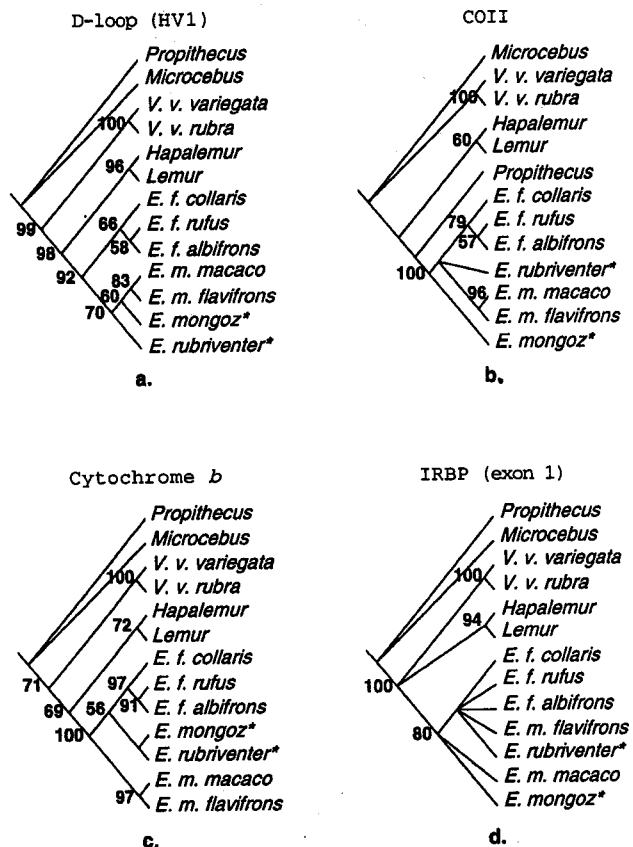


Fig. 1: Maximum parsimony trees for individual genes in which all characters were equally-weighted. Numbers indicate bootstrap values greater than 50%. a) D-loop, b) COII, c) cytochrome b, d) IRBP. *E. mongoz* and *E. rubriventer* are highlighted with asterisk (\*) to draw attention to their problematic placement relative to other *Eulemur* taxa.

A variety of solutions have been proposed for overcoming difficult phylogenetic problems. Many authors have suggested that phylogenetic algorithms that incorporate a model of character-state change can accurately resolve short internal branches. Others have suggested that increased sampling, either of characters or taxa, can improve accuracy. As mentioned in the Materials and Methods section of this article, we have sampled all but one of the extant *Eulemur* species. Although it is conceivable that the addition of this single taxon could improve resolution, it is doubtful that the effects would be significant. Accordingly, to increase the character sample, we combined the four gene-specific data sets into a single data set for parsimony analysis. The results are illustrated in Figure 2. When characters are equally-weighted, bootstrap support for virtually every lemurid node is 98%, except for those nodes resolving the placement of *E. rubriventer* and *E. mongoz*. On the other hand, when characters are differentially weighted according to *a priori* notions of character consistency and informativeness, bootstrap valu-

es for the placement of these taxa go up to 75%, though their relative placement is different than with the equally-weighted analysis of the same data set. The power of differential character weighting in parsimony analysis has been frequently demonstrated, though arguments for equal weighting are also compelling. Thus, it is difficult to choose *a priori* between the two phylogenies illustrated in Fig. 2.

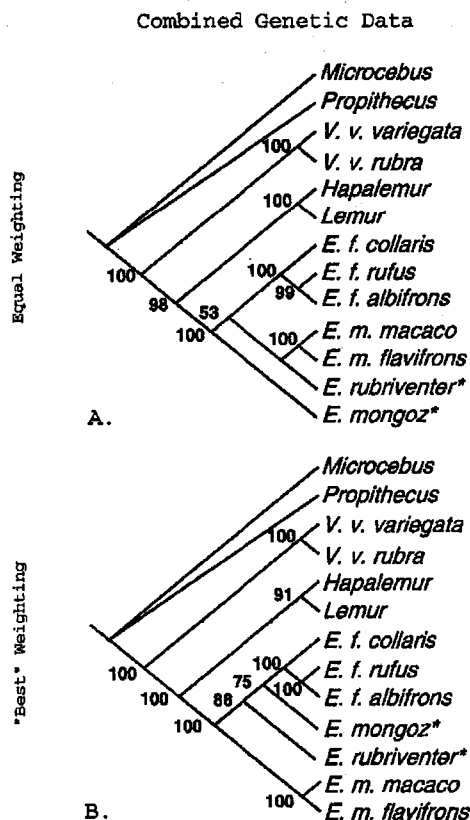


Fig. 2: Parsimony trees for combined mitochondrial and nuclear data set. A. = Analysis in which all characters were equally-weighted. B. = Analysis in which characters were differentially-weighted (transversions only for D-loop, transversions weighted 10 times more than transitions for COII and cytochrome b, and third positions only for IRBP).

Despite the problematic nature of the species interrelationships within the genus *Eulemur*, all of the questions that originally motivated this study have been answered consistently and with robust support: *Eulemur* describes a clade, *L. catta* and *Hapalemur* form a clade that is sister to *Eulemur*, and *Varecia* is basal to both. The results have been confirmed with mitochondrial and nuclear DNA data, as well as with a select set of morphological and behavioral characters taken from the literature (not shown). Given the strength of the results, the diverse character support, and nearly complete taxon sampling, we believe that the lemuriids are good candidates for the derivation of a stable phylogenetic taxonomy.

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## *Lemur catta* from the Andringitra Massif are *Lemur catta*

The ring-tailed lemur (*Lemur catta*) is the best known member of the family Lemuridae, and for many people, is the embodiment of "lemur" in the generic sense. Typically, the species is characterized as inhabiting areas of dry deciduous forest, gallery forest, and spiny thorn scrub in southern and southwestern Madagascar. In 1995, however, investigators discovered an apparently isolated troop of *L. catta* in the remote and climatically-severe region of the Parc National (PN) d'Andringitra. Goodman and Langrand (1996) noted that the animals exhibited phenotypic variation unusual for the species, including thicker and distinctly darker fur and fewer rings on the tail. On the basis of these morphological, geographic, and ecological distinctions, the authors raised the question as to whether this population might represent a previously undescribed species of *Lemur*. To investigate the question, we have sequenced two mitochondrial markers (HV1 of the control region and cytochrome *b*) for two individuals from the Andringitra population, six from the Duke University Primate Center (DUPC), one from Beza Mahafaly, and one from Ambohimahavelona. These data were analyzed with phylogenetic and genetic distance methods to determine if patterns of genetic variation and allele distributions are consistent with the hypothesis that the Andringitra population and lowland populations represent two species. Support for this hypothesis would be derived from a result in which the DUPC individuals (which, although without ancestral-female locality data, are putative lowland representatives), the Beza Mahafaly individual, and the Ambohimahavelona individual together form a clade that excludes the Andringitra specimens. Results derived from both data sets falsify the different-species hypothesis, with the Andringitra individuals nesting securely among the lowland representatives. These and other results suggest that genetic exchange throughout *L. catta*'s geographic range has been persistent and pervasive. We conclude therefore that the Andringitra population, although interesting in its ecological specializations, should not be elevated to a distinct species. A more detailed description of this study is currently in review.

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## Survey of *Hapalemur griseus* subspecies and study of mitochondrial DNA variations

The genus *Hapalemur* comprises three species; *Hapalemur aureus*, *Hapalemur simus* and *Hapalemur griseus*. The latter one contains several subspecies. Four of them; *H. g. griseus*, *H. g. alaotrensis*, *H. g. meridionalis* and *H. g. occidentalis*, have been characterised on the basis of morphological and karyotype differences (Petter *et al.* 1977; Tattersall 1982; Warter *et al.* 1987). Two others, *H. g. ssp1* and *H. g. ssp2* have only been characterised on the basis of cytogenetic data, among some *H. griseus* of unknown origin living in the Park of Tsimbazaza.

In order to detect the location of these putative new subspecies, a systematic survey of the *H. griseus* has been started, and 45 animals coming from different eastern areas of Madagascar were studied. Three populations of *H. g. griseus* were caught in Maromiza, Ranomafana and Anjozorobe, two groups of *H. g. occidentalis* came from Analamera and Ambakoany and one population of *H. g. meridionalis* from Andohahela. Ear biopsies and blood samples were collected, and a cytogenetic study was performed on these different samples. In addition to this necessary inventory, a study of the relationships between *H. g.* subspecies has been started using the comparison of cytochrome b, D-loop and 12S mitochondrial DNA sequences.

Preliminary results, using a 357 base pair sequence of the cytochrome b, indicate that each subspecies possesses characteristic single nucleotide patterns which have been observed in all the animals studied. Moreover, when different populations of the same subspecies are compared, each population possesses individualities which may be related to its capture site. Finally, the distances observed inside the subspecies are smaller than those observed between the subspecies, and the distances between *H. g. occidentalis* and *H. g. griseus* are smaller than those observed between *H. g. meridionalis* and *H. g. occidentalis* or *H. g. griseus*. Work is now in progress to get more information using D-loop and 12S sequences. Attempts are also made to include comparisons with *H. g. alaotrensis* and *H. aureus*.

The study is supported by the Association Européenne pour l'Etude et la Conservation des Lémuriens (Consortium Université Louis Pasteur de Strasbourg/Zoos of Mulhouse/Köln/Saarbrücken).

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## Genetic and cytogenetic studies in speciation of *Lepilemur septentrionalis*

*Lepilemur septentrionalis* includes four subspecies characterized by different karyotypes: one with 34 chromosomes, two with 36 chromosomes, and one with 38 chromosomes (Petter *et al.* 1977). Numerous fertile natural hybrids with 35 and 37 chromosomes occurred indicating the absence of reproductive barriers between these subspecies. Furthermore, no morphological differences between these subspecies were noticed leading to the conclusion that this group is still evolving.

In our study, we combine molecular genetic and cytogenetic analyses to understand their respective roles in *L. septentrionalis* speciation. Our objective is to evaluate the genetic distances between these subspecies and point out the genetic relationship between animals karyotypically different. In order to evaluate the genetic distances between these subspecies, it appeared to be interesting to know as a reference the genetic distances between *L. septentrionalis* and another *Lepilemur* species. In this study we choose the *L. dorsalis* which is geographically adjacent distributed to the *L. septentrionalis*. Samples of *L. dorsalis* came from two areas, Nosy Be (island) and Befotaka Maromandia (mainland), and those of *L. septentrionalis* from the sites of Andrafiameana, Analamera and Ankarana. All these samples belong to animals with 36, 37 and 38 chromosomes. Samples from *L. septentrionalis* with 34 chromosomes are planned to be taken from animals in the relict forest of Sahafary. The animals were caught by trap and immediately released at their capture site after the sampling. The cytogenetic study as well as mtDNA sequences are in progress. Preliminary result shows a relatively larger differences between *L. septentrionalis* and *L. dorsalis* than between different populations of *L. septentrionalis* (Ravaoarimanana *et al.*, submitted). Study supported by the Association Européenne pour l'Etude et la Conservation des Lémuriens (Consortium Université Louis Pasteur de Strasbourg/Zoos of Mulhouse/Köln/Saarbrücken).

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Ravaoarimanana, B.; Fausser J.L.; Rumpler Y. Genetic comparison of wild populations of *Lepilemur septentrionalis* and *Lepilemur dorsalis* using RAPD markers. Int. J. Primatol. (submitted).

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## Phylogeny of Lepilemuridae

The taxonomy as well as the phylogeny of the lepilemurs was essentially based on cytogenetic criteria. They allowed to distinguish six different species (Petter *et al.* 1977). In the last decade the discrimination of species on the basis of molecular biology data has been successful and in the case of Primates they gave reliable results when distant species were compared. For the lepilemurs, in a previous work the



use of an unique specimen for each species showed that the interspecific genetic distance was very low and did not allow to discriminate clearly the different species. For this reason we decided to start a new study on the lepilemurs using at least ten different samples for each species. Till now we could perform this study on *L. septentrionalis*, *L. dorsalis*, *L. leucopus* and *L. ruficaudatus*, and we plan to take samples from *L. mustelinus* and *L. edwardsi*. Two different regions of the mitochondrial genome were chosen for this study: a part of the cytochrome b gene (357 bp) and a part of the 12 S RNA gene (373 bp). Each amplified fragment was directly sequenced after agarose extraction (using freeze-squeeze method). Alignments of nucleotide sequences were performed using appropriate software (i.e. CLUSTAL W.). The last problem is the choice of the software to be used to perform phylogenetic reconstructions. As described by several authors, the same set of data may give different results according to the software, or the options in the software, used. Work supported by the Association Européenne pour l'Etude et la Conservation des Lémuriens (Consortium Université Louis Pasteur de Strasbourg/Zoos of Mulhouse/ Köln/Saarbrücken).

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### Census of *Haplemur griseus alaotrensis*

A census of the Alaotran gentle lemur *Haplemur griseus alaotrensis* has just been carried out (Jan-Mar 1999) at Lac Alaotra by the Durrell Wildlife Conservation Trust. It is five years since the last census. The census was carried out by Thomas Mutschler and Andrianirina Jeannicq Randrianarisoa. Preliminary information is worrying. Overall, encounter rates had dropped markedly and reports of hunting were rife. However, lemurs, sometimes the same individuals, in a previous long-term study site were still persisting. The data are currently being analysed.

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### Predation on *Eulemur fulvus* by *Accipiter henstii* (Henst's Goshawk)

While for some years Madagascar was thought to be void of predators, at least for the larger lemur species, recent discoveries of bones from large eagles and carnivores along with analyses of scats and owl pellets of extant predators changed our view (review Goodman *et al.* 1993, 1998). Here, I

would like to add an observation that extends our knowledge of the range of predation on lemurs. The incident was observed in the "Forêt de Kirindy/CFPF" (20°04'S, 44°39'E) a dry deciduous forest on the west coast of Madagascar, about 60 km north of Morondava. On August 18, 1998 an *Accipiter henstii* flew about 10 m above the canopy with a seemingly dead *Eulemur fulvus* in its claws, grasping the prey around the shoulder-blades. The lemur might not have been full-grown. Since birth season of *E. fulvus* is around October, the animal caught by *A. henstii* must have been at least 10 months old. This observation confirms previous reports of large diurnal raptors (probably *A. henstii*) preying on *E. fulvus* (D. Overdorff, in Goodman *et al.* 1993).

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## FUNDING AND TRAINING

### Training at the Durrell Wildlife Conservation Trust

#### Summer School

The Summer School of the Training Centre of the Durrell Wildlife Conservation Trust is based at the Trust's headquarters in Jersey and consists of morning and afternoon lectures, discussion sessions and individually supervised research exercises. It offers: An overview of how the DWCT and other organisations have integrated conservation in captivity and the wild, and what future strategies could be: Lectures which are a mixture of fundamentals and provocative appraisals encouraging the formulation of views on the conservation role of zoos based on an understanding of the issues involved; Study projects which provide an opportunity to gain first-hand experience of carrying out research and analysing data, projects tailored to suit the capabilities, background and types of investigation of interest to each student; Practical instruction/workshop sessions, with demonstrations of systematic data collection, based on appropriate experimental design, showing how to analyse the information obtained, and other demonstration sessions in which zoo staff and invited experts explain some of the practicalities of captive and field management. The Course Directors are the Trust Department Head of Training, Dr. John E. Fa, and two internationally recognised scientists. The Course Tutor is Dr. Anna T. C. Feistner, Trust Department Head of Research. The Course Co-ordinator is Mr. Chris Clark, Assistant Deputy Head of Training at the Trust. The fee per person is £1,095 (in 1999; includes 1999 fee membership of the Trust, hotel accommodation, all meals, and course expenses). Participation is limited to approximately 24 students, with selection based on merit and suitability. Early application is essential.



### Zoo Conservation Biology

This is an integrated training programme linking an intensive coverage of the theoretical aspects of Conservation and Zoo biology with more practical aspects of research and animal management. The course is run as many as three times a year and is offered at two levels, one for Managers, Directors & Senior Curators and one for Senior or Head Keepers and Supervisors. We have a link with the University of Kent who award participants of our course who are successful in the assessments with a Diploma in Endangered Species Management.

### The PHVA Facilitators Skills Workshop

The Population and Habitat Viability Analysis (PHVA) Facilitators Skills Workshop is an intensive seven day course run in conjunction with the Conservation Breeding Specialist Group (CBSG). It is an introduction to the PHVA and other CBSG programmes and covers the theory associated with group dynamics and the facilitation of group performance.

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## MEETINGS

### III Congreso de la Asociación Primatológica Española (APE), 20-22 September 1999, Universidad Autónoma de Barcelona, Spain.

Inaugural lecture to be given by Professor Adriaan Kortlandt "Protohominid behaviour in primates". Plenary lectures include: Montse Garcia "Aplicación de los estudios citogenéticos en primates a la patología genética humana"; Dr. R. Stanyon "Evolución genética y especiación en primates"; Dr. J. Sabater Pi "La cultura en los primates no humanos"; Dr. Turbón "Adaptación y comportamiento de los primeros homínidos". Contact: Secretaria del Departamento de Biología Celular e Fisiología, Facultad de Ciencias, Universidad Autónoma de Barcelona, 08193 Barcelona, Spain, Fax: 93 581 2295, e-mail: <jvea@psi.ub.es>.

### Primate Society of Great Britain Winter Meeting 1999, 1 December 1999, Institute of Zoology, London.

The theme will be "Mating and Social Systems of Old World Monkeys". Suggestions for speakers and offers of posters are very welcome. Contact: Dr. Caroline Ross or Mairi Macleod, School of Life Sciences, Roehampton Institute London, West Hill, London SW15 3SN, UK, Tel.: +44 181 392 3561, Fax: +44 181 392 3527, e-mail: <c.ross@roehampton.ac.uk> or <m.macleod@roehampton.ac.uk>.

### XVIIIth Congress of the International Primatological Society, 7-12 January 2001, Adelaide, Australia.

Australasian Primate Society, President Mr. John Lemon, Western Plains Zoo, Dubbo, NSW. Mr. Graeme Crook is Chairman of the Organizing Committee. For more information, and to be put onto the Congress Organizer's mailing list, write to: Conventions Worldwide, PO Box 44, Rundle Mall, SA 5000, Australia, Tel: +61 8 8363 0068, Fax: +61 8 8363 0354, e-mail: <satconv@camtech.net.au>, sending your postal address, telephone, fax and e-mail address.

### Call for papers:

Held at the outset of the new millennium, the XVIIIth Congress of the International Primatological Society will provide opportunities to reflect on past achievements, current projects, but most importantly on the future of primate conservation and research.

*Primates in the new millenium* will be promoted as the congress theme, and it is dedicated to the survival of all primates. Research papers and short videos related to specific symposia topics are encouraged.

Globally, wild populations continue to decline and threats to habitat and survival increase. However, improvements in conservation management and captive care combined with the development of new sanctuaries and tourism projects that share profits with local communities provide hope for the future.

It is hoped that a variety of symposia will emerge, along with individual papers and posters that address a broad range of topics related to the understanding of the behavioural diversity and survival of the primate species that share our planet with us.

Appropriate topics and papers will be selected by the committee, and the decision of the committee is final and no correspondence will be entered into.

### Calls for symposium titles:

Participants wishing to register a symposium title would need to submit a 200 word abstract. Titles of accepted Symposia will be published on the webpage from August 1999. E-mail to: Carla Litchfield at <aclitch@terra.net.au> Closing date for submissions: 31 July 1999

### Call for papers:

Once symposia are selected and announced, then papers will need to be submitted to the committee. An abstract of 100 words will need to be submitted, and those selected will be published on the webpage. E-mail to Carla Litchfield at <aclitch@terra.net.au>

Closing date for first call for papers: 31 January 2000

Closing date for second call for papers: 31 May 2000

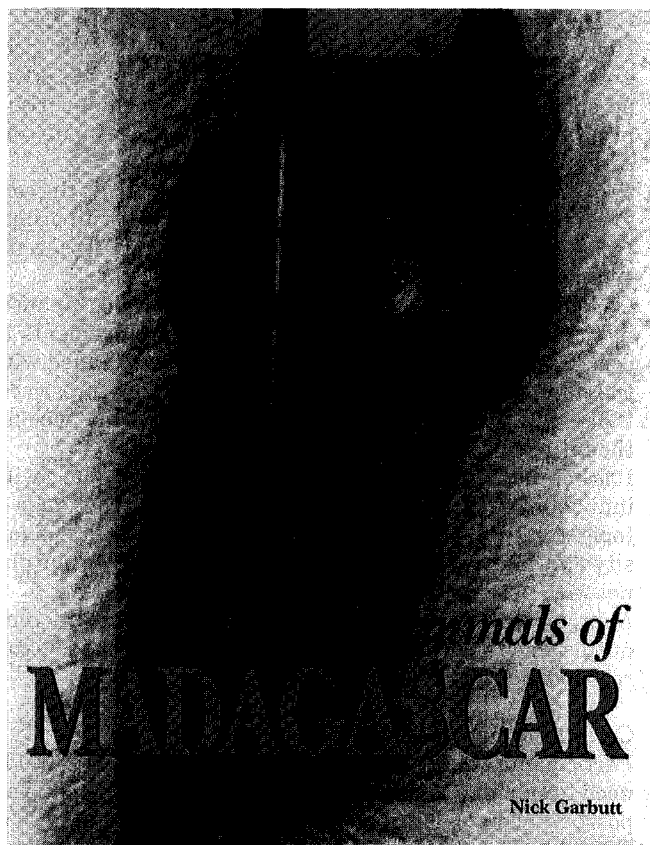
A final list of papers will be published on the Internet by 30 June 2000.

## RECENT PUBLICATIONS

### Books

**Mammals of Madagascar.** Garbutt, N. 1999. Pica Press, Sussex. ISBN 1-873403-52-6. Price: hardcover £ 30.-;

In his book "Mammals of Madagascar" Nick Garbutt provides a comprehensive and concise review of the information necessary to come to some understanding of what Madagascar and its unique mammalian fauna are like. He starts out with a few paragraphs on the biogeography of Madagascar. Then he moves on to a presentation of Madagascar's different habitats and some of the threats pending on the island. In this part of the book the text is minimal, but the pictures tell you more than words could ever do. The reader dwells in pictures of lush green rain forest, flips the page and, unexpectedly, is confronted with a shocking black and white photograph of the aftermath of slash-and-burn cultivation. This sequence of pictures and the utilization of colored versus black and white photographs leaves a lasting impression.



After the general introduction, Nick Garbutt moves on to a presentation of the species of mammals known from the island. He closely follows, and for lemurs, provides an update of Harcourt and Thornback's (1990) IUCN Red Data Book "Lemurs of Madagascar and the Comoros". Each species description includes "Measurements", "Description", "Distribution", "Behaviour", and a recommendation where the species can be seen. For lemurs he adds brief accounts on habitat requirements, population figures and threats. Each species account is accompanied by an updated distribution map that shows the state of the art as of 1997/98. This is most convenient as there is no need to search for the corresponding map hidden somewhere else. In view of the current surge of inventories, taxonomic revisions and the discoveries of new species, especially the maps for small rodents and insectivores will change. His compilation of pictures and skillful artwork is beyond anything that has been published on Madagascar's mammals yet. Except for bats and some of the most secretive species, each species description is illustrated with stunning photographs. The book ends with a brief sketch of conservation needs and up-to-date recommendations for ecotourism. This is the book I always wanted to have. It qualifies as a book for the coffee table as well as a textbook and a field guide. Nick Garbutt and the publisher did an excellent job.

Reviewed by Jörg U. Ganzhorn.

**Lemurs of the Lost World: Exploring the Forests and Crocodile Caves of Madagascar.** 2<sup>nd</sup> edition by J. Wilson. 1996. Available in US from PO Box 287, Great Falls, VA 22066 and in the UK from 22 Glen Dale, Rowlands castle, Hants., PO9 6EP. Profits on sales of the book are donated to the Durrell Wildlife Conservation Trust (formerly JWPT).

**1997 IUCN Red List of Threatened Plants.** Worldwide more than 12.5% of the 270 000 species of vascular plants are at risk of extinction, according to the most comprehensive scientific assessment, ever assembled on the status of the world's plants: the 1997 IUCN Red List of Threatened Plants. The IUCN Red List reveals that 12.5%, or 34,000, of

the world's vascular plant species are threatened with extinction. The Red List is the result of a 20-year effort by a unique coalition of scientists, conservation organizations, botanical gardens and The World Conservation Union (IUCN), and compiled by the World Conservation Monitoring Centre (WCMC), Cambridge, UK. Conservation assessments were provided by numerous scientists and conservationists with major input from the Smithsonian Institution's Department of Botany, The Nature Conservancy, Environment Australia and CSIRO, The National Botanical Institute (South Africa), The Royal Botanical Gardens, Kew and Edinburgh, and the New York Botanical Garden. The 1997 IUCN Red List of Threatened Plants is available for US\$ 45 (plus shipping and handling) from the New York Botanical Garden, Scientific Publications, Bronx, NY 10458-5126, USA, Tel: +1 (718) 817-8721;

Fax: +1 (718) 817-8842; e-mail: <scipubls@nybg.org> (from Biological Conservation Newsletter, Smithsonian Institution, Department of Botany. April/May 1998, No. 178).

**L'Alimentation en Forêt Tropicale: Interactions Bioculturelles et Perspectives de Développement,** edited by C.M. Hladik; Haldik, A.; Pagezy, H.; Linares, O.F.; Koppert, G.J.J.; Froment, A. 1996. Éditions UNESCO, Man and the Biosphere (MAB), Paris. ISBN 92 3 203381 X. Editions in French (1996) and English (1993). Volume I. Les ressources alimentaires: production et consommation. Volume II. Bases culturelles des choix alimentaires et stratégies de développement. The English language edition - Tropical Forests, People and Food. Biocultural Interactions and Applications to Development, C. M. Hladik, Hladik, A.; Linares, O.F.; Pagezy, H.; Semple, A.; Hadley, H. (eds.) 1993, Vol. 13. Man and the Biosphere (Series editor J. N. R. Jeffers), UNESCO, Paris, and The Parthenon Publishing Group, Carnforth, UK. Available from: The Parthenon Publishing Group, UK Office, Casterton Hall, Carnforth, Lancashire LA6 2LA, UK, Tel: +44 15242 72084, Fax: +44 15242 71587; USA Office, One Blue Hill Plaza, P.O.Box 1564, Pearl River, New York 10965, USA, Tel: +1 (914) 73 9363, Fax: +1 (914) 735 1385. Web site: <<http://www.parthpub.com>>.

**Timber Production and Biodiversity Conservation in Tropical Rain Forest,** by Andrew G. Johns 1997, xxi + 225pp. Cambridge University Press, Cambridge, UK. ISBN 0 521 57282 7. Price: Hardback £40.00. Timber production is often the most economic form of land use in areas of tropical forest. The area of tropical forest reserved for timber production exceeds that of National Parks and other preserved areas by a ratio of at least 8:1. Although often poorly managed to date, production forests have the potential to support a high percentage of natural forest biodiversity. They have a vital role to play in conservation strategies. This book attempts to bridge the current gap between conservation requirements and commercial interests, indicating the possibilities for integrated management of tropical forests. The aim is to develop a justification and practical approach for the management of production forest as a supplement to totally-protected forest in the conservation of tropical biodiversity.

**Primate Adaptation and Evolution,** by John G. Fleagle 1999, 596pp. Academic Press, San Diego. 2<sup>nd</sup> edition. ISBN 0 122 60341 9. Price US\$55.00.

**Molecular Biology and Evolution of Blood Group and MHC Antigens in Primates,** edited by A. Blancher, J. Kellin and W. W. Socha 1997, 570pp. Springer Verlag, New York. ISBN 3 540 61636 5. Price: US\$149.00. Available from: Springer Verlag New York, Inc., 44 Hartz Way, Secaucus, NJ 07094, USA, Tel: +1 800-SPRINGER., Fax: 212 533 3503.

**Primate Locomotion: Recent Advances**, edited by Elizabeth Strasser, John Fleagle, Alfred Rosenberger, and Henry McHenry 1998. Plenum Press, New York and London. ISBN: 0 306 46022 X. Price: US\$110 (USA and Canada), other countries add 20%.

**Introduction to the Primates**, by Daris R. Swindler, illustrated by Linda E. Curtis. University of Washington Press, Seattle. 1998. Price: Paperback US\$22.00. A comprehensive but compact guide to the long evolutionary history of the world's prosimians, monkeys and apes, and to the much shorter history of humankind's interactions with them.

**Cognitive Ecology: The Evolutionary Ecology of Information Processing and Decision Making**, edited by Reuven Dukas. The University of Chicago Press, Chicago. 1998, 420pp. Price: Paperback US\$30.00. This book maps out a new field in the intersection between cognitive psychology and behavioral ecology. The chapters provide up-to-date reviews of current research, including topics as diverse as neural networks, recognition of bird song, spatial memory and foraging decisions. Available from: The University of Chicago Press, 5801 South Ellis Avenue, Chicago, IL 60637. Web site: <www.press.uchicago.edu>.

**Proceedings: International Symposium on Assessment and Monitoring of Forests in Tropical Dry Regions with Special Reference to Gallery Forests**, edited by José Imaña-Encinas (University of Brasília) and Christoph Klein (University of Freiburg) 1997, 378pp. University of Brasília, Brasília. Proceedings of a symposium held in Brasília from 4-7 November 1996. Thirty-three contributions. For more information: Editora Universidade de Brasília, SCS Q.02, Bloco C, No. 78, Edifício Ok, 2o. andar, 70300-500, Brasília, D. F., Brazil.

**Dynamics of Tropical Forest Communities**, edited by David M. Newbery, N. Brown and H. H. T. Prins, 648pp., March 1998. Blackwell Scientific Publications, Oxford, UK. ISBN 0 6320 4944 8. Price: Hardback £60.00 + p&p (half-price to members of the British Ecological Society). The proceedings of the 37th Symposium of the British Ecological Society. The book includes 22 in-depth reviews of important areas in tropical ecology. It challenges the dynamic equilibrium idea by arguing for thinking on a timescale of decades to centuries: finding new ways to handle unpredictability and uniqueness; and evaluating species diversity and community change at different scales more critically. The difficult search for more robust generalizations and rules in tropical communities is partly answered by the realization that a new framework and perspective is required for the tropics. There are strong implications for the enhanced conservation and wiser management of tropical resources at both regional and global levels. For more information: Anna Rivers, Blackwell Science, Osney Mead, Oxford OX2 0EL, UK, Tel: +44 1865 206206, Fax: +44 1865 721205.

**A stereotaxic atlas of the Grey Lesser Mouse Lemur brain (*Microcebus murinus*)** edited by N. Bons, S. Silhol, V. Barbie, N. Mestre-Frances, D. Albe-Fessard 1998. Elsevier Sciences. Hardbound 184 pp. Price: US\$ 100.50. The discovery of age-related changes in the *Microcebus murinus* brain rendered the compilation of an atlas essential. Recent results obtained concerning the evolution of the brain structures and cellular elements during the life of this prosimian have shown numerous similarities to the ageing human brain. The nature of these led to the conclusion that the species could constitute a valuable tool for fundamental and experimental studies into human cerebral ageing and neurodegenerative diseases, particularly those of the Alzheimer

type. The importance of this lies in the fact that, currently, no model of human cerebral ageing, related to associated disability or not, exists. Clearly there is a great need for investigations into *Microcebus murinus* in numerous domains. Some are being undertaken by various international scientific teams but substantial areas of great interest remain so far untouched. The likelihood of *Microcebus murinus* becoming a model for human brain studies and therapy, means that use of the animal will expand widely in cerebral research, in physiological, clinical and pharmacological experiments, psychological studies, etc. In this context a stereotaxic atlas of its brain must be considered essential. It provides a tool to locate modified brain structures and lesions, to evaluate the activity of the different cerebral areas by imaging, to record the electric activity of single neurons, nuclei and fibres and to correlate functions and structures involved in behavioural changes related to age or neurodegenerative pathologies.

**Les Zones d'Importance pour la Conservation des Oiseaux a Madagascar**. 1999. Projet ZICOMA (Zones d'Importance pour la Conservation des Oiseaux à Madagascar) has just completed two years of fieldwork aimed at identifying the important bird areas of Madagascar. This project, funded by the European Commission, collected data on and visited 128 sites in Madagascar. Many of these sites were previously unsurveyed for birds. The field teams also collected data on lemurs, principally diurnal species. The results of these surveys are published in a book. The book will include a list of priority sites for bird conservation. This is compared with a similar analysis for primates made on the basis of published information updated with Projet ZICOMA survey results. Copies of the book are obtainable through Projet ZICOMA, B.P. 1074, Antananarivo (101), Madagascar.

#### Journals and Book chapters (without abstracts)

Primate Conservation, the journal of the IUCN/SSC Primate Specialist Group has published the volume N° 17 (1996/1997). The issue include the papers given at a special conservation symposium at the 16<sup>th</sup> Congress of the International Primatological Society in Madison 1996, supplemented by reviews on "Primate conservation and Key organizations" and some case studies. It includes the following papers: Primate conservation: a retrospective and a look into the 21<sup>st</sup> century – R.A. Mittermeier and W.R. Konstant; The role of IPS and National Park societies in global primate conservation – D.J. Chivers; Conservation efforts of the American Society of Primatologists – R.C. Kyes and S.M. Howell; Funding for primate conservation – where has it originated? W.R. Konstant; The role of zoos in primate conservation - A. Baker; Primate conservation and the IUCN/SSC conservation breeding specialist group: tools, models, and processes – S. Ellis; Neotropical primate conservation – the species and the IUCN/SSC Primate Specialist Group Network – A.B. Rylands, E. Rodriguez-Luna and L. Cortés-Ortiz; The state of lemur conservation in Madagascar – J.U. Ganzhorn, O. Langrand, P.C. Wright, S. O'Connor, B. Rakotosamimanana, A.T.C. Feistner and Y. Rumpler; African primate conservation - the species and the IUCN/SSC Primate Specialist Group Network – T.M. Butynski; Asian primate conservation - the species and the IUCN/SSC Primate Specialist Group Network – A.A. Eudey; Current status and future viability for the Mentawai primates – A. Fuentes; Endangered primate species in Vietnam – Le Xuan Canh; Proyecto Tití: developing alternatives to forest destruction – A. Savage, L.H. Soto and L.H. Giraldo; The endangered Muiriquis in Brazil's Atlantic forest – K.B. Striere, G.A.B. Fonseca; Extinction faces Ghana's Red Colobus Monkey and other local-

ly endemic subspecies – J.F. Oates, T.T. Struhsaker and G.H. Whitesides; The Mountain Gorilla – conserving an endangered primate in conditions of extreme political instability – H.D. Steklis, C.N. Gerald and S. Madry; Conservation status and prospects of the Snub-Nosed Langurs (Colobinae: *Rhinopithecus*) – R.M. Ren, R.C. Kirkpatrick, N.G. Jablonski, W.V. Bleisch and X.C. Le; Conservation of Japanese Macaques in Yakushima: the effectiveness of UNESCO's Natural World Heritage Designation – D.A. Hill and T. Maruhashi.

Special Editions of the American Journal of Primatology: The American Journal of Primatology has produced a special issue on "Primate Seed Dispersal" (Volume 45, number 1 1998). The Guest Editors were Joanna E. Lambert, University of California - Los Angeles, and Paul A. Garber, University of Illinois - Urbana. It is based on a symposium "Primates as Seed Dispersers and Seed Predators in Tropical Forests", presented at the Joint Congress of the International Primatological Society and the American Society of Primatologists held in Madison, Wisconsin, in August 1996. It includes the following papers: Primates as seed dispersers: Ecological processes and directions for future research - P.A. Garber and Lambert, J.E.; Evolutionary and ecological implications of primate seed dispersal - J.E. Lambert and Garber, P.A.; Seed dispersal by long-tailed macaques – P.W. Lucas and Corlett, R.T.; Lowland gorillas and seed dispersal: The importance of nest sites - M.E. Rogers; Voysey, B.C.; McDonald, K.E.; Parnell, R.J., and Tutin C.E.G.; Seed handling by three prosimian primates in southeastern Madagascar: Implications for seed dispersal – D.J. Overdorff and Strait, S.G.; Variation in seed handling by two species of forest monkeys in Rwanda – B.A. Kaplin and Moermond, T.C.; Seed dispersal by Neotropical seed predators – M.A. Norconk, Grafton, B.W., and Conklin-Brittain, N.L.; Forests without primates: Primate/Plant codependency – C.A. Chapman and Onderdonk, D.A.

Volume 46, number 1 1998, of the American Journal of Primatology is dedicated to "Nesting and Resting in Primates: Behavioral Ecology of Inactivity". The Guest Editors were William C. McGrew, Miami University, Oxford, Ohio, and Barbara Fruth, Max Planck Institut für Verhaltensphysiologie, Seewiesen, Germany. The papers result from a symposium held during the Joint Congress of the International Primatological Society and the American Society of Primatologists in Madison, Wisconsin, in August 1996. Contents: Introduction to nesting and resting in primates: Behavioral ecology of inactivity – B. Fruth and McGrew, W.C.; Nests, tree holes and the evolution of primate life histories – P.M. Kappeler; Sleeping sites, sleeping places, and presleep behavior of gibbons (*Hylobates lar*) – U. Reichard; Sleep, sleeping sites, and sleep-related activities: Awakening to their significance – J.R. Anderson; Sex-specific usage patterns of sleeping sites in grey mouse lemurs (*Microcebus murinus*) in northwestern Madagascar – U. Radespiel; Cepok, S.; Zietemann, V., and Zimmermann, E.; Shadows on a changing landscape: Comparing nesting patterns of hominids and chimpanzees since their last common ancestor – J. Sept.

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### Ongoing lemur studies

In Lemur News Vol. 3 we had solicited information on ongoing field studies on lemurs. The feedback was marginal and the present list is utterly incomplete. Nevertheless we consider this a start that might help to plan and coordinate future studies and stimulate synergistic processes by in-



creased collaboration. More ongoing studies are described in the sections of "Articles" and "Notes" in this issue of *Lemur News*. They are no reiterated here.

- Arrigo-Nelson, S. (SUNY-Stony Brook graduate student): Ontogeny of social structure and dominance acquisition in *Propithecus d. edwardsi*.
- Britt, A.; Welch, C.; Katz, A.: c/o SPEF, Tamatave): Reintroduction of *Varecia variegata*.
- Carraï, V. (Univ. Pisa graduate student): Seasonal and sex-specific variation in *Propithecus v. verreauxi*.
- Dausmann, K. (Univ. Hamburg graduate student): *Cheirogaleus medius*: Population dynamics and energetics of hibernation.
- Eberle, M. (Univ. Freiburg graduate student): Sperm competition in *Microcebus*.
- Feistner, A.T.C. (Durrell Wildlife Conservation Trust, Jersey): Mating patterns and social structure in *Hapalemur griseus alaotrensis*: a genetic approach. Field work has just been carried out (Jan-Mar 1999) by Caroline Nievergelt of the University of San Diego and Durrell Wildlife Conservation Trust to collect the final set of hair samples for a study of mating and social system in Alaotran gentle lemurs using genetic analysis. Previous work using samples from both wild and captive animals has established the techniques. The data are currently being analysed.
- Fietz, J. (Univ. Tübingen graduate student): Social system and population genetics of *Cheirogaleus medius*.
- Ganzhorn, J.U. (Univ. Hamburg): Biogeography of Cheirogaleids in southern Madagascar and the utilization of forest fragments, secondary habitats and artificial corridors by lemurs.
- Grassi, C. (Univ. Texas at Austin graduate student): The behavioral ecology of *Hapalemur griseus*.
- Irwin, M. and Smith, T. (SUNY-Stony Brook graduate students): Survey of lemur communities in corridor forests between Ranomafana National Park and the Mangoro river to the north.
- Jolly, A. and collaborators (Princeton Univ.): Behavioral ecology and demography of lemurs at Berenty.
- Kappeler, P.M. (German Primate Center): Long-term studies on the social and breeding system of *Mirza coquereli*, *Propithecus v. verreauxi* and *Eulemur fulvus rufus*.
- Karpanty, S. (SUNY-Stony Brook graduate student): Raptors as major predators on lemurs, including the Madagascar Harrier Hawk.
- Müller, A. (Univ. Zurich graduate student): Socioecology of *Cheirogaleus medius* in Northwestern Madagascar. The strictly nocturnal dwarf lemurs, genus *Cheirogaleus*, undergo extended torpor phases of up to six months during the dry season which may influence their social life as the animals have only few months to reproduce and rear offspring. The fat-tailed dwarf lemur, *C. medius*, was studied between November 1995 and June 1997 at the Forestry Station Ampijoroa in order to discern its social organisation. Data on range overlap between individuals and sleeping associations indicate monogamy.
- Ostner, J. (Univ. Göttingen graduate student): Socio-endocrinological analyses of the reproductive strategies of redfronted lemurs.
- Overdorff, D.; Erhart, E. (Univ. Texas at Austin): Goal-oriented foraging, female dominance and feeding priority in *Propithecus diadema edwardsi*, *Eulemur fulvus rufus*, and *E. rubriventer*.
- Pastorini, J. (Univ. Zurich graduate student): Molecular phylogeny of lemurs based on mitochondrial DNA and tRNA.
- Pasteur (Univ. Antananarivo graduate student): Genetic differentiation between populations of *Hapalemur* spp.
- Ralison, J. (Univ. Antananarivo): Effects of forest fragmentation on *Eulemur fulvus collaris* in the Mandena region.
- Rasoloarison, R. (Univ. Antananarivo graduate student): Genetic differentiation between populations of *Microcebus*.

- Ratsimbazafy, J. (SUNY-Stony Brook graduate student): *Varecia v. variegata* in fragmented forests in the coastal forests of Manombo Special Reserve, Madagascar. Forests in this reserve, already fragmented by logging and slash and burn agriculture, were further damaged by a cyclone in 1997 that caused extensive tree fall. *Varecia* is the only large frugivore in the forest, and is considered a keystone species. The study comprises foraging and feeding behavior, grouping patterns, and reproductive behavior in an effort to understand how this normally pristine forest species manages to survive in such disturbed habitat. Conservation education programs are developed for local villagers, including lecturing to schoolchildren and producing a conservation education program on the local radio. The work is carried out in close collaboration with an international NGO that is regenerating deforested sections of the Manombo Special Reserve.
- Richard, A. and collaborators: (Yale Univ.): Social behavior and demography of *Propithecus v. verreauxi*.
- Schmid, J. (Univ. Aberdeen): Energetics of *Microcebus* and *Cheirogaleus*.
- Schülke, O.: (Univ. Göttingen graduate student): Socioecology of *Phaner furcifer*.
- Sussman, R. and collaborators (Washington Univ.): Socioecology and demography of *Lemur catta*.
- Tan, C. (SUNY-Stony Brook graduate student): Group composition, ranging behavior, and diet of the three sympatric *Hapalemur* species.
- Thalmann, U. (Univ. Zurich): Behavioural Ecology of *Avahi occidentalis* and *Lepilemur edwardsi*. A comparative study on ultimate and proximate aspects of behaviour, and ecology of woolly lemurs' and sportive lemurs' was conducted in the Ampijoroa Forestry Station (NW Madagascar) between 1995 and 1997. Preliminary data analyses strongly support "resource defense" as most important factor for monogamy in woolly lemurs. Sportive lemurs in Ampijoroa live in "range associations", possibly also monogamous.
- Wright, P.C. (SUNY-Stony Brook): Long-term (12 year) study of the behavioral ecology of *Propithecus diadema edwardsi*.
- Zimmermann, E. and collaborators (Tierärztliche Hochschule Hannover): Behavioral ecology of sympatric species of *Microcebus*.

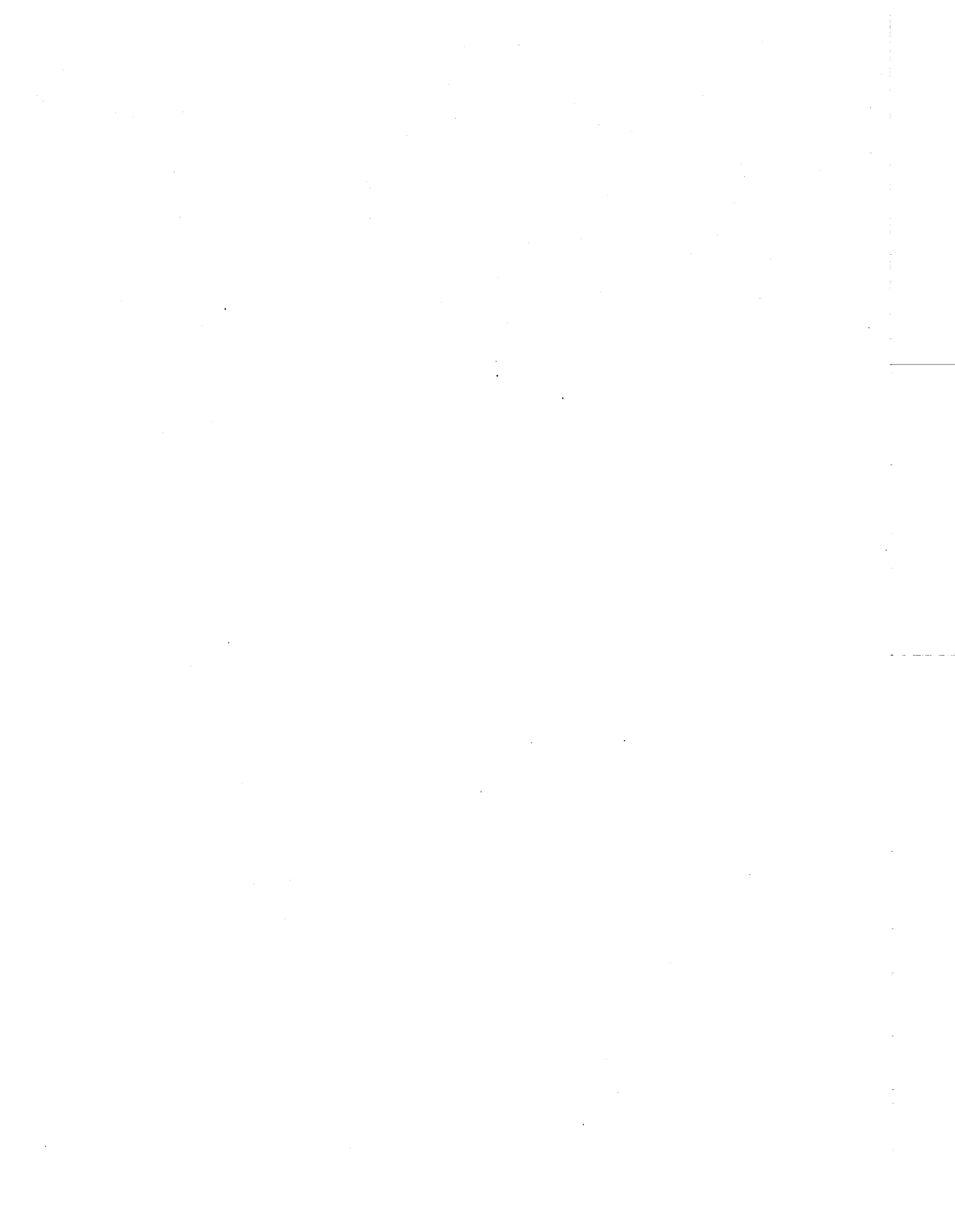
### Theses completed

- Bunte, S. 1998. Behavioral and bioacoustic studies on the vigilance and anti-predator behavior of mouse lemurs (*Microcebus* spp.) in captivity. Diploma thesis, München. (in German)
- Dausmann, K. 1997. Secondary seed dispersal and seed predation in the dry deciduous forest of western Madagascar. Diploma thesis. Würzburg University. (in German)
- Grassi, C. 1997 The feeding ecology of the Gentle Gray Bamboo Lemur, *Hapalemur griseus*, in Southeastern Madagascar. Master's thesis, University of Texas at Austin.
- Hafen, T. 1998. Dialects in lemurs. Bioacoustic, morphometrical and studies in molecular genetics of the intraspecific variability in the Grey Mouse Lemur (*Microcebus murinus*). PhD thesis, Konstanz University.
- Lee, D.C. 1997. Systematics and biogeography of Madagascan mycalesine butterflies (Lepidoptera: Satyrinae). Unpubl. PhD thesis, Univ. London. (relevant for the interpretation of lemur biogeography).
- Peters, C. 1999. Intrasexual competition in Grey Mouse Lemur (*Microcebus murinus*) males in northwestern Madagascar. Diploma thesis, Göttingen University. (in German)
- Pietsch, T. 1998. Sex-specific strategies in feeding behavior and habitat utilization of *Lepilemur ruficaudatus*. Diploma thesis, Hamburg University. (in German)
- Pohl, K. 1998. Comparative studies on the handedness of mouse lemurs (*Microcebus murinus* and *Microcebus ru-*



- fus). Diploma thesis, Tierärztliche Hochschule Hannover. (in German)
- Randria, G.F.N. 1998. Morphologie, analyses phénétique et cladistique des Lémuridae (Gray, 1821). Thèse de Doctorat d'Etat des Sciences - Naturelles en Primatologie, Faculté des Sciences, Université d'Antananarivo. Résumé: Dans le but de déterminer leurs différences ainsi que leurs ressemblances phénétiques et phylogénétiques, les caractéristiques anatomiques des Lémuridae ont été comparées avec celles de quelques genres et espèces de Lépilemuridae, de Cheirogaleidae, d'Indridae et de Cebidae. Deux méthodes d'analyse différentes par leurs principes ont été utilisées en parallèle: l'analyse numérique et l'analyse cladistique. Beaucoup des caractères distinctifs et des analogies relevés dans l'analyse phénétique ont été aussi retrouvés dans les résultats phylogénétiques. Les résultats des deux analyses diffèrent aussi, cependant, par l'exclusion de certains rapprochements phylogénétiques dans l'analyse phénétique. Tel est le cas des genres *Lemur* et *Varecia* proposés comme groupes - frères dans bon nombre de cladogrammes et exclu par le phénogramme proposé. Ainsi donc, pour ne pas se hasarder à statuer à une meilleur concision des résultats de la phénétique, on pourrait avancer prudemment que les ressemblances morphologiques, considérées isolément, pourraient masquer d'éventuelles ressemblances phylogénétiques mises en évidence par les caractères liés à l'évolution. En tenant compte des résultats des deux analyses à la fois, et en comparaison avec les analyses moléculaires réalisées par d'autres auteurs, nous retenons comme hypothèse finale: les genres *Haplemur* et *Lemur* sont groupes - frères et, ensemble, ils forment le groupe - frère du genre *Eulemur*. Enfin, ces deux derniers ensembles composent le groupe - frère de *Varecia*.
- Razafimanantsoa, L. 1998. Contribution à l'étude de l'utilisation des supports au cours du déplacement et de l'alimentation chez *Propithecus verreauxi verreauxi* (Grandidier, 1867) et *Eulemur fulvus rufus* (Audebert, 1800). Dépt. de Paléontologie et d'Anthropologie Biologique. Faculté des Sciences, Université d'Antananarivo. Résumé: Des études comparatives des supports utilisés par *Propithecus verreauxi verreauxi* et *Eulemur fulvus rufus* au cours de leur déplacement et de leur alimentation ont été effectuées dans la forêt de Kirindy. La comparaison entre les supports disponibles et ceux utilisés par ces Lémuriens montre que *P. verreauxi* préfère se déplacer sur des supports de dimension intermédiaire et large orientés verticalement, tandis que *E. f. rufus* ne montre de préférence que pour les supports à orientation horizontale et oblique. Au cours de leur prise de nourriture, les supports de dimension petite et d'orientation horizontale et oblique sont communément employés par les deux espèces. D'après les études comparatives des supports exploités par les deux espèces, une différence a été notée aussi bien au niveau de la dimension qu'au niveau de l'orientation des supports, durant leur alimentation et leur déplacement. Cependant, les supports fréquentés au cours du déplacement sont aussi employés durant l'alimentation; *P. verreauxi* utilise les dimensions intermédiaire et large orientées verticalement et anguleusement, alors que *E. f. rufus* emploie la dimension petite avec des orientations horizontale et oblique. Du fait de la différence entre les orientations des supports exploités durant leurs déplacement, une différence a été aussi notée entre les types de locomotions pratiqués par chaque espèce.
- Rendigs, A. 1999. Field studies on the habitat structure and food composition of sympatric and allopatric species of mouse lemurs in the dry deciduous forest of northwestern Madagascar. Diploma thesis, Göttingen University. (in German)
- Sarikaya, Z. 1999. Female reproductive strategies in the Grey Mouse Lemur (*Microcebus murinus*) in northwestern Madagascar. Diploma thesis, Göttingen University. (in German)
- Spehn, S. 1998. Dispersal and predation on seeds of three species of *Grewia* in the dry deciduous forest of western Madagascar. Diploma thesis. Tübingen University. (in German)
- Tombomiadana, S. 1999. Contribution à l'étude du domaine vital et de l'alimentation de *Eulemur fulvus rufus* (Audebert, 1800) dans la forêt dense sèche de Kirindy, Morondava - Madagascar. Dépt. de Paléontologie et d'Anthropologie Biologique. Faculté des Sciences, Université d'Antananarivo. Résumé: Du septembre à novembre 1997, deux groupes de *Eulemur fulvus rufus* ont été observés dans la forêt dense sèche de Kirindy, Morondava. Des données sur la superficie du domaine vital, sur le régime alimentaire, l'activité, le comportement de la femelle par rapport au mâle avant et après la naissance des bébés ont été enregistrés pour 11 animaux. Les deux groupes, composés respectivement de 3 et 8 animaux, utilisaient des domaines vitaux de 24,8 ha et 14,8 ha. Les valeurs moyennes de la distance journalière parcourue trouvées oscillent entre 500 à 1775m pour les deux groupes étudiés. Pendant la période d'étude, *Eulemur fulvus rufus* consacre plus que la moitié de la journée à se reposer et l'alimentation occupe le quart de son temps après le repos. Des observations faites sur le comportement de la femelle par rapport au mâle montrent la domination intra groupe de la femelle surtout après la naissance des bébés. *Eulemur fulvus rufus* étaient principalement frugivores. Ils se nourrissent de 23 espèces végétales durant l'observation dont 11 espèces sont consommées pour leur fruits. Le domaine vital et son utilisation dépendaient de la disponibilité des ressources alimentaires en fruits et en eau.
- Vasey, N. 1997. Community ecology and behavior of *Varecia variegata rubra* and *Lemur fulvus albifrons*, on the Masoala Peninsula, Madagascar. Ph.D Thesis, Washington University.









# Instructions for Contributors

*Lemur News* publishes manuscripts that deal largely or exclusively with lemurs and their habitat. The aims of *Lemur News* are: 1) to provide a forum for exchange of information about all aspects of lemur biology and conservation, and 2) to alert interested people to particular threats to lemurs as they arise. *Lemur News* is distributed free-of-charge to all interested persons. To the extent that donations are sufficient to meet the need, the policy of free distribution will continue. Manuscripts should be sent to the editors at the address on the letterhead by mail, fax or e-mail. Manuscripts should be composed either in English or French, be legibly typewritten and double spaced (generally 1-8 pages including references and figures). The author's name, affiliation and address must be provided; please provide fax, e-mail and pertinent telephone numbers also. Tables and figures should include brief captions. Graphics should be clear and "camera ready" (large lettering is appreciated since most figures are reduced before printing). The editors retain the privilege of soliciting peer comment on any manuscript submitted and may request that the author(s) revise the article according to comments received. *Lemur News* welcomes the results of original research, field surveys, advances in field and laboratory techniques, book reviews, and informal status reports from research, conservation, and management programs with lemurs in Madagascar and from around the world. In addition, notes on changes in the legal status of lemurs, public awareness programs, the availability of new educational materials (include the name and address of distributor and cost, if applicable), job announcements (paid or volunteer), and notification of newly published scientific papers, technical reports and academic theses are all appropriate contributions. Readers are also encouraged to alert *Lemur News* to pertinent letter-writing campaigns and other activities which may need the support of the lemur research and conservation community. Finally, *Lemur News* serves as a conduit for debate and discussion and welcomes contributions on any aspect of the legal or scientific status of lemurs, or on conservation philosophy.

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