LEMUR NEWS

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

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Cover: Possible hybrid between *Eulemur f. fulvus* and *E. macaco* at Manongarivo (see Goodman and Schütz 2000. Lemur News 5: 30-33).
Photo taken by Harald Schütz.

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PSG Chairman: Russel A. Mittermeier
PSG Deputy Chairman: William R. Konstant

Editors
Jörg U. Ganzhorn
Ken Glander
Berthe Rakotosamimanana
Michael Schwibbe

Assistant Editors
Anja Ganzhorn
Brigitte M. Raharivololona
Klaus Rupp
Birgit Thede

Layout
Heike Klensang

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Addresses for contributions
Jörg U. Ganzhorn
Institut für Zoologie
Universität Hamburg
Martin-Luther-King-Platz 3
D-20146 Hamburg
Germany
Fax: +49 40 42838 5980
E-mail: ganzhorn@zoologie.uni-hamburg.de

Berthe Rakotosamimanana
Dépt. de Paléontologie et d'Anthropologie Biologique
Faculté des Sciences
Université d'Antananarivo
B.P. 916
Antananarivo
Madagascar
E-mail: gerp@dts.mg

EDITORIAL

The year since publication of *Lemur News* Vol. 5 has brought a number of important news and events. Most excitingly, a large number of lemur species new to science have been described recently. In parallel, there have been various efforts to revise the taxonomy of lemurs and primates in general. As these revisions are still a matter of debate they are not presented in *Lemur News* for the time being. Nevertheless, the bottom line is that we have many more lemur species than we were aware of a few years ago. The new descriptions and taxonomic revisions go along with a steady increase of inventories in protected but also in non-protected areas. The emerging picture allows us to reconsider the biogeographic evolution of lemurs in Madagascar with much more sophisticated methods and with a much better database that it has been possible so far.

However, the steady increase in lemur species and the new information about species being described from areas where they have not been known before masks the ongoing degradation of lemur habitat. Many of the taxonomic units recognized (may they be species or subspecies or something else) are unlikely to live in viable populations any longer. The animals are still there and due to their long lifespan they may be there for a few more years down the road. But from all we know from population dynamics of other taxa and from what we see in Madagascar in terms of environmental destruction, the prospects for lemurs do not look promising. Surprisingly enough, and despite a long history of lemur research, there are too few longterm studies on population dynamics of lemurs in different habitats that would allow extrapolation of future population dynamics. This is something we have to work on. Students (and funding agencies) should be encouraged to tackle this problem that requires longterm commitments without much short-term benefits in terms of publications. This problem has been recognized by a number of organizations and resulted in a workshop on the "Evaluation et Plans de Gestion pour la Conservation" of the vertebrate fauna, hosted by the Ministère de l'Environnement and organized by a steering committee headed by ANGAP in Madagascar in May 2001. The results of this very promising and well organized workshop will be summarized in a forthcoming issue of *Lemur News*.

Along a different line: we are pleased to announce that *Lemur News* in now being indexed by BIOSIS. This should give the articles published in *Lemur News* a much wider recognition. Since nobody seems to read the "Instructions for Contributors" we would like to take the opportunity here to ask contributors to provide up to five Key words for their articles in the future; - and please don't be fancy: send us the text, tables and especially the figures in separate files without links (that are rarely transmitted anyhow and simply create nightmares) and you will see your articles much sooner in published form.

Jörg U. Ganzhorn
Institut für Zoologie, Universität Hamburg, Martin-Luther-King-Platz 3, 20146 Hamburg, Germany

Kenneth Glander
Duke University Primate Center, 3705 Erwin Road, Durham, NC 27707, USA

Berthe Rakotosamimanana
Dépt. de Paléontologie et d'Anthropologie Biologique, Faculté des Sciences, Université d'Antananarivo, Madagascar

Michael Schwibbe
Deutsches Primatenzentrum, Kellnerweg 4, 37077 Göttingen, Germany

NEWS and ANNOUNCEMENTS

Création d'un nouvel Institut: Institut des Sciences et Techniques de l'Environnement (I.S.T.E) à la Faculté des Sciences de l'Université de Fianarantsoa, Madagascar.

Une nouvelle institution dénommée "Département des Sciences et Techniques de l'Environnement" fut créée en 1996 au sein de la Faculté des Sciences de l'Université de Fianarantsoa (Andrainjato). Parmi les premiers promoteurs de cette création, citons: Dr. Germain Jules Spiral (Département de Paléontologie et d'Anthropologie Biologique, Faculté des Sciences, Université d'Antananarivo), Dr. Patricia C. Wright (Coordinatrice internationale de Madagascar Institut pour la Conservation des Environnements Tropicaux ou MICET), Dr. Benjamin Andriamihaja (Directeur Général de la MICET), Dr. Ratsimbazafy (Recteur de l'Université de Fianarantsoa à l'époque).

Les raisons de cette création étaient:
1) de compléter les filières de la Faculté des Sciences qui n' avait auparavant que les filières mathématique et physique - chimie.
2) de faire de l'Université de Fianarantsoa une université pilote en matière de biodiversité à Madagascar étant donné que la Province de Fianarantsoa est la plus riche en aires protégées y compris le Parc National de Ranomafana à 60 km de Fianarantsoa.

Les principaux investigateurs de cet institut sont l'Université de Fianarantsoa et la MICET qui a pris une part considérable dans le financement. Les matières à enseigner sont divisées en cinq modules, tous obligatoires et comprenant 17 matières réparties en première et en deuxième année (huit en première année et neuf en deuxième année).

module 1: Technologie
- techniques agricoles
- techniques forestières
- biotechnologie
- gestion durable des ressources naturelles
- secourismes
- économie, gestion, comptabilité.

module 2: Sciences naturelles
- écologie (ecologie générale et paléontologie)
- biologie générale (animale, végétale, physiologie)
- sciences du sol
- microbiologie

module 3: Sciences humaines
- éducation environnementale
- droit de l'environnement
- anthropologie socio - culturelle

module 4: Sciences exactes
- mathématique
- physique
- chimie
- informatique

module 5: Communication
- langues vivantes (anglais et français obligatoires)
- techniques de communication.

Depuis l'année 1999, le Département est transformé en Institut des Sciences et Techniques de l'Environnement siégeant à Tsianolondroa-Fianarantsoa et dirigé par le Docteur Pascal Ratalata.
Pendant les deux premières années, l'Institut a pour but de former des Techniciens supérieurs en environnement ayant un profil immédiatement opérationnel dans les aires protégées. Un Diplôme de Technicien Supérieur en Environnement ou D.T.S.E sera délivré après deux ans. Les étudiants titulaires de ce diplôme peuvent être des guides scientifiques, animateurs ruraux, agents de conservation, techniciens supérieurs de laboratoire dans les universités.
Actuellement, la première promotion comprenant 44 étudiants etait déjà sortie en décembre 1999. Plus tard, selon les différents responsables, l'Institut visera à une formation d'Ingénieurs en Environnement.
Dans une certaine mesure, tout ceci a été conçu dans le but d'atteindre quelques objectifs tels que: la création d'emplois pour les jeunes, protection de l'environnement et de la biodiversité, et la sauvegarde du patrimoine national.

Germain Jules Spiral et Brigitte Marie Raharivololona
Département de Paléontologie et d'Anthropologie Biologique, Faculté des Sciences, Université d'Antananarivo, B.P. 906, Antananarivo 101, Madagascar

Benjamin Andriamihaja
MICET, B.P. 3715, Tsimbazaza, Antananarivo 101, Madagascar

The 21st International Primatological Society Congress in Adelaide, Australia

Entitled as "Primates in the New Millennium", the 21st Congress of the International Primatological Society (IPS) was held in Adelaide (Australia) at the Ridley Convention Centre, in January 7 - 12, 2001. The meeting was organised by the Australasian Primatological Society with financial support from the Adelaide Zoo. More than 400 researchers from about 30 different countries contributed and made the Congress a real success.
The Congress in Adelaide was divided into more than 50 symposia. The papers were grouped by contributions, covering the areas of behavior ecology, physiology, evolution, molecular biology, phylogeny, and conservation of primates. As already pointed out at the 20th IPS meeting held in Antananarivo, Madagascar, in 1998, there has been a tremendous progress in the technologies and methodologies applied in studies on primates in the last decade. At the IPS Congress in Adelaide there was a diverse set of papers that discussed phylogenetic relationships or examined energetic strategies, using new technologies in the field of genetics and metabolism, respectively. One noteworthy trend was the increasing number of long-term field studies on numerous primate species. The success of such long-term field work again lies in the use of new and modern methodologies that provide important and urgently needed information on the interaction between primates and their natural habitat.
Another highlight of this conference was the good quality of the papers. Most of the authors used power-point presentations or power-point slides with clear structures and clearly presented results. Thus, the audience could follow easily and the talks were enriched with interesting and stimulating discussions. There was a diverse set of papers on Malagasy primates that covered a variety of ecological and physiological issues as well as topics on conservation management. In particular, the description of several new lemur species represented a great event *down under*. Thalman and Geismann (2000) named and described a new western woolly lemur, *Avahi unicolor*, of northwestern Madagascar. On the basis of collected specimens, Groves (2000) recognized seven species of dwarf lemurs (*Cheirogaleus*), a genus which conventially were considered to comprise only two different species. In particular, Groves described two new species, *Cheirogaleus ravus* and *C. minusculus*. Further detailed field work in areas of Madagascar that are unexplored or poorly known very likely will reveal more unrecognized or undescribed lemur species, particularly when considering the recent taxonomic revision of mouse lemurs (*Microcebus*) in western Madagascar (Rasoloarison *et al.* 2000). The evening of the third conference day was filled out with a symposium organized by Conservation International (CI, Washington D.C.). The symposium speakers summarized the ongoing conservation efforts and programs all over the world. They provided a detailed and up-to-date summary of what approaches are used and what needs to be improved. These contributions included so much information that the session had to be interrupted at 23.30 h after it had been going on for more than four hours, and needed to be continued the following day.
Many of the participants came from the northern hemisphaere, thus escaped the winter months and enjoyed the hot and sunny climate *down under*. The weather in fact contributed substantially to the success of the conference! People took the chance to sit outside in the warm evenings enjoying their drinks, exchanging ideas and new working hypotheses, but also chatting about non-scientifc topics. Accomodations were located close to a variety of restaurants and bars and thus people met and made contacts without any extra effort.
Unfortunately, a serious number of originally announced scientists were not able to attend the meeting, mainly because of the high airfare and registration fees. Particularly students and primatologists from habitat countries simply could not afford the trip to Australia. Several papers had to be canceled in the last minute and scheduling problems were on the order of the day. Apart from the conference fee of ca. US$ 315.- in Adelaide, delegates had to pay extra for any "further help" (e.g., they charged you A$ 20.- for burning your power-point presentation on a CD). Nonetheless, the attendees were patient and understanding and the organization committee in Adelaide remained friendly and cooperative. Nevertheless, as pointed out by Koenig *et al.* (2000), increasing fees should not be the policy of the IPS when organizing future meetings. It is very important and necessary to keep the costs low particularly for student members and delegates form habitat countries who want to attend the IPS meetings.

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Jutta Schmid
Institut für Zoologie, Universität Hamburg, Martin-Luther-King-Platz 3, 20146 Hamburg, Germany

Discussion e-mail list for research and conservation in the Zahamena Reserve, Madagascar

During 1999 and 2000 a number of successful research expeditions to the Zahamena Reserve, Madagascar were conducted by teams from the University of East Anglia (see website: **www.zahamenaprojects.homestead.com**) and Edinburgh University (see website: **www.ed.ac.uk/~andyw**). The aims of these projects were to provide information, particularly relating to lemurs, which would be beneficial to the long-term conservation of biodiversity in the area. However, we feel that it is extremely important that further research and interest in conservation in Zahamena is encouraged and facilitated. As an aid to this, to facilitate discussion, ideas exchange and other information flow regarding research and conservation in and around the reserve we have set up a discussion e-mail list with JISCmail. The aims of this discussion list will be to:
(1) encourage further research and conservation projects in the Zahamena Reserve, particularly as collaborations between UK and Malagasy organisations;
(2) facilitate information flow concerning current and future projects in the area;
(3) facilitate exchange of ideas;
(4) allow list members to ask advice on relevant problems or questions they have;
(5) allow those people interested in research and conservation projects in the area to keep in contact.

In order to join the list send an email to **jiscmail@jiscmail.ac.uk**, containing only the following text in the main body of the e-mail: "Join zahamena-uk FIRSTNAME LASTNAME". Leave the subject blank. You will then receive a confirmation from JISCmail with instructions on how to post messages to the list and other details. If you have any questions please contact the list owners at **zahamena-uk-request@jiscmail.ac.uk**.

Sophie Neale (list owner - Royal Botanical Gardens, Edinburgh),
Jonathan Rhodes (list owner - University of Queensland, Brisbane)
Andy Woods-Ballard, **Iona Beaumont**, **Claire Coulson** (University of East Anglia, Norwich)

La Société de Primatologie malgache ou Groupe d'Etude et de Recherche sur les Primates de Madagascar (GERP)

Le GERP ou Groupe d'Etude et de Recherche sur les Primates de Madagascar est une Organisation Non– Gouvernementale créée en Mars 1994 (cf. Agrément N 352/94/FAR/ANT/AT/ASS du 04 Mai 1994). Il est assiégé à Antananarivo – Madagascar et a comme logo l'*Indri indri* tenant l'Ile de Madagascar entre ses mains.

- Nom scientifique: *Indri indri* (Gmelin 1788)
- Nom vernaculaire: Babakoto, Amboanala, Endrina
- Caractéristiques:
  - Le plus grand des Lémuriens actuels. Vie en groupe.
  - Déclaré "en danger"
  - N'a jamais pu être retenu en captivité
  - Existe sous forme subfossile et actuel

Objectifs généraux

- Etude et recherche sur les lémuriens fossiles, subfossiles ou actuels, sur les écosystèmes où ils sont rattachés.
- Documentation sur les Prosimiens.
- Contribution à la connaissance des lémuriens dans leurs sites naturels , en laboratoires et / ou dans les parcs et jardins zoologiques ou les gisements fossilifères qui les abritent.
- Promotion de la vulgarisation des résultats de recherche obtenus.
- Organisation ou participation à des séminaires, réunions, colloques, congrès ou expositions sur les lémuriens.
- Promotion de l'éducation de la population dans le cadre du tourisme de découverte et la formation de guides dans le cadre de l'écotourisme sur les lémuriens.
- Protection et conservation des lémuriens en conformité avec la législation en vigueur.
- Amélioration du cadre de vie des populations humaines dans les zones périphériques des aires protégées où vivent les Lémuriens.

Les organes du GERP

1. Bureau

- Secrétaire Général: Professeur RAKOTOSAMIMANANA Berthe
- Secrétaire Exécutif: RAVELOSON Herimalala
- Trésorier: Docteur RALAIARISON RAHARIZELINA Raobivelonoro
- Conseillers: RASAMIMANANA Hantanirina et Docteur RAZAFINDRAIBE Hanta

2. Comité d'Orientation et de Surveillance (COS); quatre membres fondateurs et / ou membres avec ancienneté de 5 ans

- Docteur RALISON Farasolo
- Docteur ANDRIATSARAFARA Solofo
- Professeur RABARIVOLA Clément
- Docteur RAKOTOZAFY Lucien Marie Aimé

3. Assemblée Générale (AG)
- Membres fondateurs
- Membres sponsors
- Membres scientifiques
- Membres émérites

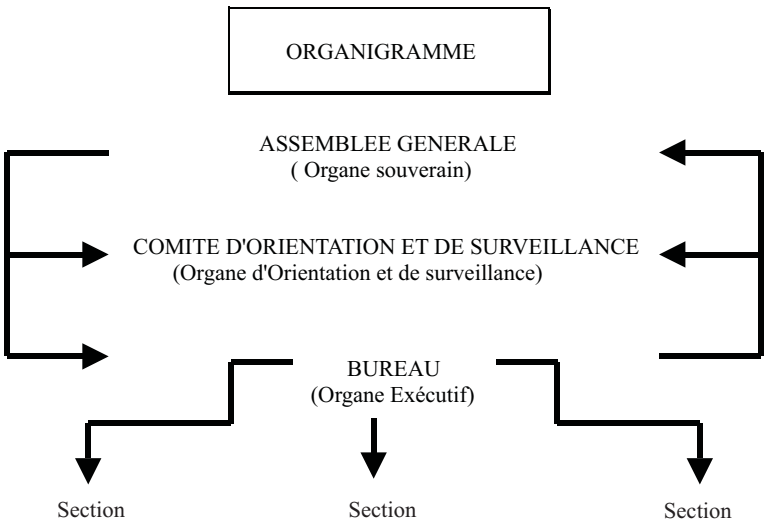
Réunion de l'assemblée générale
- Réunions techniques ordinaires: 2 fois par an.
- Réunions scientifiques ordinaires: 1 fois par semestre.
- Réunions extraordinaires: en tant que de besoin.

Le recrutement des membres se fait par soumission de la candidature à l'AG sur présentation de deux parrains.

Les ressources sont
- Contributions des membres
- Participations des membres
- Dons par les sponsors
- Recettes effectuées dans le cadre des activités

Rapport d'activités
Ce rapport concerne les activités du GERP depuis sa création en Mars 1994 jusqu'à l'année 2000, où s'est faite l'élection du Nouveau Bureau.
En résumé, de nombreuses activités ont été menées par le GERP durant ces six années d'existence (32 types d'activités différentes) dont les plus saillantes que l'on peut citer sont:
- l'assistance à trois Congrès de l'IPS
  - 15e Congrès ou Congrès de Bali (Indonésie)
  - 16e Congrès ou Congrès de Wisconsin (USA)
  - 17e Congrès ou Congrès d'Antananarivo (MADAGASCAR)

  Ce dernier a comme organisateur le GERP lui – même.
- Traduction en version française du livre **Lemur Guide** du Dr. Russell MITTERMEIER.
- Participation à des projets financés par des ONG internationaux.
  - Illustrations de contes pour les enfants dont le thème est les Lémuriens de Madagascar avec UNICEF
  - Production de posters sur les Lémuriens avec WWF.
- Participation à des ouvrages scientifiques, tel que:
  - Edition de Bulletin de Liaison (**Lemur News**) ou édition des « Proceedings » sur le XVIIe Congrès de l'IPS.
- L'acquisition d'équipements divers pour le GERP grâce à l'organisation du XVIIe Congrès de l'IPS.
- La réhabilitation du Campus Universitaire d'Ambohitsaina grâce à l'organisation du XVIIe Congrès de l'IPS (8 Amphithéâtres, Bibliothèque Universitaire et leurs toilettes, équipements électriques, jardins et panneaux indicateurs).
- L'initiation des membres du GERP à la préparation de Communications scientifiques.
- L'initiation des membres du GERP à la langue anglaise.
- L'augmentation du nombre des membres du GERP de 26 à 60 en six ans, ce qui lui a valu de devenir une Organisation Associée de l'IPS.
- Reboisement à Bongatsara-Anjomakely sur la route d'Antsirabe.



Actuellement, le GERP a crée une page web. Et pour plus d'informations concernant cet organisme et les nouvelles sur les primates malgaches, veuillez contacter notre website: **www.aston-mg.com/gerp**
Berthe Rakotosamimanana, Secrétaire générale du GERP, Département de Paléontologie et d'Anthropologie Biologique, Faculté des Sciences, B.P. 906, Université d'Antananarivo, Antananarivo 101, Madagascar, **gerp@dts.mg**

ARTICLES

Notes sur la Faune Lémurienne dans la Réserve Spéciale d'Ambohijanahary

Manganirina Randrianarisoa, Aimé Rasamison et Luris Rakotozafy
BIODEV Madagasacar, B.P. 6212, Antananarivo 101, Madagascar, biodevmad@simicro.mg

La Réserve Spéciale d'Ambohijanahary a été créée selon le décret n° 58.08 en date du 20/10/58. Elle fait partie des réserves de Catégorie B, considérées comme à forte pression anthropique, mais à potentiel de développement écotouristique réduit. La réserve se trouve à cheval sur la Sous-préfecture de Morafenobe (Province de Mahajanga) et la Sous-préfecture de Miandrivazo faisant partie de la Province de Toliary. Elle se situe à l'extrême ouest de la chaîne de Bongolava, à 80 km environ au nord-ouest de Tsiroanomandidy (18°15' - 18°25' S, 45°18' - 45°30' E). Cette réserve d'une superficie de 24.393 ha, est traversée au nord par la route nationale n°1 reliant Antananarivo à Maintirano. Dans l'ensemble, la réserve est recouverte par la forêt sclérophylle de moyenne altitude qui correspond à une zone écofloristique occidentale de moyenne altitude (Faramalala 1988) .

Lors d'une expédition effectuée par une équipe multidisciplinaire de BIODEV Madagascar dans cette Réserve Spéciale d'Ambohijanahary du 11 au 31 Mai 1999, une espèce de lémurien seulement a pu être observée, pendant les travaux diurnes et nocturnes. Il s'agit de l'espèce diurne *Propithecus verreauxi*. La plupart des individus que nous avons observés présentent un pelage blanc uniforme, caractéristique de la sous-espèce *Propithecus verreauxi deckeni*. Cette sous-espèce semble être très abondante dans cette Réserve. En effet, elle a été observée à plusieurs occasions dans les deux sites d'inventaire choisis lors de cette étude (Site 1 situé à 18°16'11.1"S et 45°24'18.4"E; Site 2 localisé à 18°18'29.1"S et 45°23'58.6"E). Le nombre moyen d'individus par groupe varie de 4 à 5. Certains auteurs ont également noté la présence de cette unique sous-espèce dans la Réserve d'Ambohijanahary (Nicoll *et al*. 1989).

Néanmoins, il importe aussi de noter la présence de quelques individus de propithèques présentant de grandes tâches noires surtout sur la partie dorsale du cou. Cette couleur noire se prolonge sur une grande partie du dos et/ou sur la partie dorsale de l'avant bras chez certains individus. Mais, ils étaient toujours avec des individus de formes typiques de *P. v. deckeni*. Ces individus appelés «Tsibahaka vondromay» par les villageois pourraient appartenir à la sous-espèce de *Propithecus verreauxi «majori»* (Mittermeier *et al*. 1994). En outre, l'équipe du Projet ZICOMA (1999) a aussi noté la présence de cette deuxième sous-espèce dans la réserve.

Peu de forêts naturelles de Madagascar abrite une seule espèce de lémurien, ce qui reflète la grande spécificité de cette Réserve d'Ambohijanahary. Ainsi, des questions se posent: Pourquoi une Réserve aussi vaste ne renferme-t-elle qu'une seule espèce de Lémurien? Quelle est la cause de cette faible diversité primatologique? S'agit-il d'un résultat de la répartition naturelle de ces organismes ou seulement de l'effet de l'isolement géographique? Cette série de questions a permis à BIODEV Madagascar d'élaborer un Plan de Recherche au niveau de cette Réserve Spéciale d'Ambohijanahary.

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Predation on *Lepilemur* by a Harrier Hawk and Implications for Sleeping Site Quality

Oliver Schülke and Julia Ostner
German Primate Center, Dept. of Ethology and Ecology, Kellnerweg 4, 37077 Göttingen, Germany

Small and medium-sized nocturnal lemurs are exposed to predation even while they are inactive and sleeping in their day shelters. One of the most important predators of these lemurs is the harrier hawk, *Polyboroides radiatus* (Goodman *et al*. 1993). Earlier observations indicate that this raptor makes prey by using its long legs as a probe and extracting the victim from the day shelter with its claws. Sleeping site quality in terms of predator avoidance has been measured using several physical parameters: height above ground, size of entrance, volume and thickness of walls (e.g. for *Microcebus*: Radespiel *et al*. 1998). These measurements may have to be supplemented by the measurements considering the following observation.

In October 1999 in the Kirindy Forest, West-Madagascar, a harrier hawk was observed preying on an adult *Lepilemur ruficaudatus*. The victim was still alive when the observer arrived at the scene and was identified by its typical distress calls. In this case the raptor did not use its legs to pull out the victim from the sleeping hole, but clinged to the tree trunk with its claws and grabbed the *Lepilemur* repeatedly with the bill through a crack in the tree trunk. The crack measured 1.2 x 38 cm only. Finally the raptor got hold of the lemur, tore off a piece of approximately 5 x 8 cm through the crack and flew off with its prey. After two minutes of ingestion the raptor returned and continued to tear off pieces of the carcass and feeding on them for eight minutes, after which the harrier hawk was disturbed and left.

Hence, small cracks in the tree trunk may reduce safety tremendously even if they are just the size of a raptor´s bill. Therefore, we would like to suggest that measurements of tree hole quality as far as safety from predators is concerned should include the existence and dimensions of cracks in the trunk of a sleeping tree.

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Predation of a Fat-tailed dwarf lemur *Cheirogaleus medius* by a Madagascar Harrier-hawk *Polyboroides radiatus*: an incidental Observation

Martin Gilbert
Greta Bank Farm, Brundholme Road, Keswick, Cumbria, CA12 4NS, UK. mart_gilbert@yahoo.com

Ruth E. Tingay
The Peregrine Fund (Madagascar Project), B.P. 4113, Antananarivo, Madagascar and Centre for Environmental Management, School of Geography, University of Nottingham, NG7 2RD, UK. tingay@geography.nottingham.ac.uk

Documented accounts of lemur predation have largely been inferred following observations of the behavioural responses of lemurs to potential predators (Bayart and Anthouard 1992; Sauther 1989), and prey remains in pellets, at the nests or in fecal samples (Goodman *et al.* 1993a,b, 1997, 1998; Rasoloarison *et al.* 1995; Goodman and Thorstrom 1998). The following account details an observed incident of a Madagascar harrier-hawk *Polyboroides radiatus* predating a Fat-tailed dwarf lemur *Cheirogaleus medius*.

The observations were made on 1st October 1999 during a study of the Madagascar fish eagles *Haliaeetus vociferoides* around the lakes within the Tsimembo Forest, south-west of Antsalova in western Madagascar. Daily observations of lemurs inhabiting the forest surrounding. The Peregrine Fund's Camp Ankivahivahy, began on a casual basis in June and continued until October. Aside from the instance noted in this account, no Fat-tailed dwarf lemurs were recorded until the 8th October 1999. As this period coincides with the cool/dry season it is likely that the lemur mentioned in this account was in the late stages of dormancy.

The incident occurred at 12.15hr while the authors were returning to the camp by pirogue. Our attention was drawn to the lake shore ~30 m away by a shrill incessant squeaking sound. An adult harrier-hawk could be seen on the ground, holding a small mammal, which was struggling and appeared to be the source of the sound. The harrier-hawk made no attempt to dispatch it's prey which at this stage was obscured by vegetation, and could not be identified. After ~5 minutes, the harrier-hawk flew to nearby trees with what could be seen to be a small lemur held in it's talons. The bird perched for a few seconds before moving deeper into cover and was lost from view.

Landing the pirogue, we were able to use the lemur's distress calls to locate the harrier-hawk. The bird was found perching on an unexposed branch, in a tree ~100 m from it's original position. The harrier-hawk began to feed on the lemur, tentatively tearing small amounts from the front leg whilst continually scanning the surrounding trees. The cries of the lemur became progressively weaker, and ~20 minutes after the incident was initially observed, the animal became silent and was presumed to have expired.

The cause of the harrier-hawk's vigilance became apparent with the arrival of a number of Yellow-billed kites *Milvus aegyptius*. The harrier-hawk defended the dead lemur from up to seven kites, as well as a second adult harrier hawk (the approaches of which elicited a red flushing to the bird's yellow facial mask). Due to the attention of the other birds, the harrier-hawk was unable to feed further, and after 55 minutes it dropped it's prey and flew from the tree. The body of the lemur was recovered by the authors and taken to the camp for examination.

The lemur was identified as a male Fat-tailed dwarf lemur, and appeared to be in very poor condition with little remaining body fat (as would be expected for an animal in the later stages of hibernation). This was reflected in a body weight of only 85 g. The left foreleg was missing to the level of the mid-humerus, but apart from a number of puncture wounds, the body was otherwise undamaged. Head-body length was 224 mm; tail length was 172 mm. Further examination revealed the animal to be a sub-adult with lack of cranial bone fusion and incomplete adult dentition (lower PM1: Emerging, upper PM2: Emerging).

Studies of the stomach contents collected from specimens of Madagascar harrier-hawk have suggested a diet consisting of arthropods, reptiles, amphibians, small rodents and carrion (Rand 1936). Langrand (1990) infers that the "...behaviour of certain lemur species ([*Eulemur*] *fulvus*, [*E.*] *coronatus*, *Propithicus diadema*, *Hapalemur griseus*) at approach of Madagascar harrier-hawk suggests that it may prey on these primates". To our knowledge, no evidence has been published documenting predation of members of the family Cheirogaleidae by Madagascar harrier-hawks. One of the foraging strategies favoured by the Madagascar harrier-hawk is to use it's long legs to investigate hollow trees and crevices in search of concealed prey (Rand 1936; Langrand 1990). Our observation confirms that the Madagascar harrier-hawk will prey on Cheirogaleids, and (with consideration to the harrier-hawk's methods of hunting) it is suggested that this species may pose a considerable threat to cavity-dwelling lemurs.

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Inventaire des Lémuriens dans la Réserve Spéciale de Kasijy

Pierre Manganirina Randrianarisoa, Aimé Rasamison, Luris Rakotozafy et Anselme Totovolahy
BIODEV Madagascar, B.P. 6212, Antananarivo 101, Madagascar, biodevmad@simicro.mg

La Réserve Spéciale (RS) de Kasijy se trouve dans la Province de Mahajanga, Sous-préfecture de Kandreho et Commune Rurale d'Antanimbaribe. Elle est située entre 16°59' - 17°07' S et 45°48' - 46°01' E. L'altitude est comprise entre 120 à 450 m (ZICOMA 1999). Cette réserve couvre une superficie de 18 800 ha et elle est formée de deux massifs forestiers: le massif de Kasijy et le petit massif d'Analamajera. Trois rivières en constituent la limite: l'Andranomaitso au nord, la Mahavavy à l'est et la Mahiarere au sud. A l'ouest, la limite est constituée par une ligne imaginaire qui relie la rivière Mahavavy à la source d'Andranomaitso.

La réserve est composée d'une forêt dense sèche semi-caducifoliée, avec des espèces dominantes comme: *Adansonia za, Cedrelopsis grevei, Hildegardia* sp., et d'une savane dominée surtout par *Heteropogon contortus* et *Hypparhenia* sp.

Peu d'informations sont disponibles concernant la faune mammalienne dans la RS de Kasijy. Avant notre visite dans cette Réserve, il semble qu'aucun mammalogiste n'y avait encore réalisé des inventaires systématiques de ce groupe d'animaux. Par contre, cette réserve a déjà fait l'objet d'inventaire des Oiseaux par le Projet ZICOMA (1999). Il faut cependant noter que comme cet inventaire a été effectué pendant la saison sèche, les résultats présentent seulement les espèces qui restent actives durant cette période.

Une équipe pluridisciplinaire du Cabinet d'étude BIODEV Madagascar s'est rendue dans cette Réserve de Kasijy du 06 Mai au 04 Juin 1999, afin d'y réaliser un diagnostic physico-bio-écologique dans le cadre de l'étude pour l'élaboration du Plan d'Aménagement et de Gestion de cette Aire Protégée pour le compte de l'Association Nationale pour la Gestion des Aires Protégées (ANGAP) sur financement du Fonds Environnemental Mondial.

Deux sites principaux ont été retenus à partir des données cartographiques et des premiers contacts avec la réalité du terrain: l'accessibilité et les contraintes calendaires (disponibilité de la population, durée et période de la mission) ont été aussi prises en compte. Le site 1 (17°04'01"S et 45°59'13"E) est situé dans la partie est de la réserve, tout proche de la grande courbure du fleuve de Mahavavy. Le site 2 (17°05'00"S et 45°55'57"E) est situé à 100 m au nord de la source de la rivière de Mahiarere, il se trouve dans la partie centrale de la réserve.

Le but principal de notre étude était d'obtenir des informations sur toutes les espèces de lémuriens qui sont présentes dans la réserve. Tous les lémuriens rencontrés au cours des observations diurnes et nocturnes ont été répertoriés. A chaque site, dans différents types d'habitats, des pistes ont été lentement parcourues de 06h30 à 11h le matin et de 15h30 à 17h30 l'après-midi, pour détecter la présence des lémuriens soit par observation directe, soit par vocalisation ou mouvement des arbres. Les observations nocturnes ont été effectuées entre 19h et 22h30 en utilisant des lampes frontales de faible intensité pour repérer les espèces nocturnes par reflet lumineux de leurs yeux. D'autres lampes beaucoup plus puissantes ont été utilisées afin d'identifier l'espèce repérée. A chaque observation de lémuriens, les données suivantes ont été enregistrées: espèce, nom vernaculaire, heure d'observation. Autant que possible, le nombre d'individus, le sexe, la classe d'âge ainsi que le comportement ont été également enregistrés. Enfin, des informations ont été recueillies à partir des enquêtes et discussions effectuées auprès des guides et des villageois sur la présence éventuelle de certaines espèces de mammifères qui sont difficiles à observer (voire non observées lors de l'inventaire).

La présence de six espèces de lémuriens dont trois diurnes (*Propithecus verreauxi, Hapalemur griseus* et *Eulemur fulvus*) et trois nocturnes (*Phaner furcifer, Microcebus murinus* et *Lepilemur edwardsi*) ont été mis en évidence durant cette étude à Kasijy. Deux sous-espèces de *Propithecus verreauxi* pourraient être présente dans cette forêt:

Propithecus verreauxi deckeni: cette sous-espèce diurne est apparemment abondante dans cette réserve. Elle a été observée à plusieurs occasions dans les deux sites d'étude. Le nombre moyen d'individus dans un groupe est de 4 à 5. La destruction de l'habitat par les feux de brousse constitue la principale menace pour sa survie, tandis que la pression de chasse est encore de très faible importance.

Propithecus verreauxi coronatus pourrait aussi être présente dans cette forêt de Kasijy mais, elle y est apparemment très rare. En effet, quatre individus de Propithèques ressemblant à cette sous-espèce telle que décrite et illustrée par Mittermeier *et al.* (1994) ont été observés dans le site 2. Ces mêmes auteurs ont déjà signalé que cette réserve pourrait abriter une population de cette sous-espèce. Les quatre individus que nous avons trouvé, possèdent une tête entièrement noire; la partie dorsale de l'avant-bras ainsi que la moitié supérieure du dos sont teintées de brun. Néanmoins, ces individus ont été trouvés ensemble avec trois autres individus de forme typique de *Propithecus verreauxi deckeni*.

Eulemur fulvus rufus: cette espèce de lémuriens est particulièrement abondante dans cette réserve. Contrairement à celle trouvée dans les autres réserves telles qu'à Bemarivo (BIODEV 1999, Randrianarisoa et Rakotozafy, pas publié), Namoroka et Maningoza (BIODEV 1999), la population d'*Eulemur fulvus* de Kasijy ne subit pas encore une forte pression de chasse, grâce à l'éloignement des villages par rapport à la réserve. Aucun piège traditionnel servant à capturer cet animal n'a été repéré durant notre passage dans cette forêt.

Hapalemur griseus: cette espèce diurne est aussi présente dans la Réserve de Kasijy. Mais elle y est apparemment très rare. Un groupe de deux individus appartenant à cette espèce a été trouvé dans le site 2. L'aire de distribution de *Hapalemur griseus occidentalis* se trouve dans la région de Sambirano, dans le Tsingy de Bemaraha et dans la région de Soalala (Mittermeier *et al.* 1994). Théoriquement, cette espèce se trouve surtout dans des zones à bambous. Néanmoins, sa présence dans la Réserve de Namoroka où les bambous ne sont pas abondants a été déjà signalée par d'autres auteurs (Tattersall 1982; Thalmann *et al.* 1999; BIODEV 1999). Nous avons noté la présence de nombreux supports en bambous dressés dans cette forêt de Kasijy.

Phaner furcifer: la présence de cette espèce dans la Réserve de Namoroka a été déjà signalée par d'autres auteurs (Mittermeier *et al.* 1994). Par contre, sa présence dans cette forêt de Kasijy n'a pas encore été notée jusqu'à présent. Elle a été abondante aussi bien dans le premier que dans le deuxième site d'étude. Cette espèce était facile à reconnaître grâce à cris aiguës et à la présence de la ligne médiane noire le long de son dos; cette ligne se prolonge jusqu'à la tête où elle se bifurque en deux pour atteindre les yeux.

Microcebus murinus: cette espèce nocturne de petite taille a été aussi observée dans les deux sites d'étude. Elle se rencontre dans différents types d'habitat, et supporte une grande variété de dérangements humains.

Lepilemur edwardsi: cette espèce nocturne était apparemment moins abondante. Elle a été repérée une seule fois dans le site 2 et six fois dans le premier site. L'observation de quelques individus à une distance relativement faible nous a permis de voir qu'ils ressemblent beaucoup à *Lepilemur edwardsi* telle que décrite et illustrée dans le livre de Mitter-

meier *et al*. (1994). Théoriquement, l'aire de distribution de cette espèce s'étend d'Antsalova jusqu'à la baie de Mahajamba ceci inclue notre zone d'étude (Tattersall 1982; Mittermeier *et al*. 1994).
Enfin, la présence de *Cheirogaleus medius* dans cette forêt de Kasijy a été signalée par les villageois. Mais, cette espèce reste en état d'hibernation durant la saison sèche et demeure ainsi difficile à détecter.
Par comparaison avec d'autres forêts du nord-ouest malgache, cette Réserve de Kasijy est plus riche en faune lémurienne par rapport à la Réserve de Maningoza et d'Ambohijanahary (BIODEV 1999) et à la Réserve de Bemarivo (BIODEV 1999; Randrianarisoa, Rasamison et Raskotozafy, pas publié). Par contre, la communauté de Primates de Kasijy est plus pauvre par rapport à celle de Bemaraha qui possède au moins 12 espèces (Thalmann et Rakotoarison 1994) et par rapport à celle de Namoroka avec neuf espèces (Thalmann *et al*. 1999; BIODEV 1999).
Cet inventaire biologique mené dans la Réserve Spéciale de Kasijy nous a permis de reconnaître la diversité spécifique de cette réserve en matière de lémuriens, même si la durée d'inventaire demeurait très limité. En outre, cette étude démontre qu'il s'avère toujours nécessaire de continuer à mener des recherches sur la diversité biologique de Madagascar à travers des inventaires biologiques. Beaucoup d'informations restent encore inconnues dans la plupart des zones forestières malgaches alors que cette dernière ne cesse pas de se détériorer par la pression humaine qui constitue le grand fléau pour la conservation du patrimoine naturel. L'emplacement de cette réserve, située très loin des villages environnants et d'accès nettement difficile, permet de limiter la fréquence de passage des villageois. Ainsi, la localisation voire l'isolement de la réserve, constitue cette fois-ci un atout efficace pour la conservation de la diversité biologique de la réserve. Toutefois, bien que cette aire protégée ait son statut de Réserve Spéciale depuis longtemps (1956) et que son emplacement constitue un avantage pour sa préservation, la destruction de l'habitat qui se manifeste surtout par les feux de brousses constitue toujours une grande menace pour la survie de la faune dans cette Réserve de Kasijy. En effet, ces feux allumés chaque année pour reverdir les pâturages des saisons sèches et pour nettoyer les pistes, grignotent peu à peu les lisières et de nombreux zébus broutent dans la forêt ce qui peut compromettre la régénération naturelle.

Tableau 1: Liste des espèces de lémuriens rencontrées dans la Réserve Spéciale de Kasijy.

Taxa	Nom vernaculaire	Site 1	Site 2	Statut *
INDRIDAE				
Propithecus verreauxi deckeni	Tsibahaka	+	+	Vulnérable
Propithecus verreauxi coronatus	Tsibahaka		+	Gravement en danger
LEMURIDAE				
Eulemur fulvus rufus	Gidro	+	+	Abondant
Hapalemur griseus spp.	Kitronitrony		+	Vulnérable
CHEIROGALEIDAE				
Microcebus murinus	Tilitilivaha	+	+	Abondant
Phaner furcifer	Tanta	+	+	Abondant
Cheirogaleus medius	Kelibehohy	*	*	Abondant
MEGALADAPIDAE				
Lepilemur edwardsi	Fitsidiky	+	+	Abondant
***** d'après Mittermeier *et al*. (1994)				

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Biological Assessment of the Fandriana Marolambo Forest Corridor

Shawn M. Lehman and Jonah H. Ratsimbazafy
MICET, B.P. 3715, Tsimbazaza, Antananarivo 101, Madagascar, micet@dts.mg.

The goal of our component of the Rapid Assessment Program (RAP) was to survey lemur communities in the Fandriana-Marolambo Forest Corridor. There are few data on the conservation status and species composition of lemur communities in the corrridor.

Table 1: Locations, altitude, and survey periods for five biological survey sites in the Fandriana-Marolambo forest corridor.

Site	Name	Location	Altitude(m)	Survey Period
1	Mananjara	20°23'25"S 47°38'04"E	1353	15-26 February
2	Ranomena	20°23'37"S 47°39'11"E	1345	27 Feb-05 March
3	Korikory	20°22'58"S 47°39'57"E	1555	06-13 March
4	Garaonina	20°03'49"S 47°40'18"E	1670	18-25 March
5	Andrano korofisaka	20°04'35"S 47°41'27"E	1685	27 Mar-02 April

Methodology
Standard RAP survey techniques were used to document primate diversity from February 21 to April 4, 2000 in the Fandriana-Marolambo corridor (Table 1). Two to three transect lines were set up at each of five RAP sites. Each transect was walked slowly (0.5-1.0 km/h) twice per day during the times of the day best suited for locating lemurs (07.00-11.30 and 14.00-17.30 hours). Nocturnal surveys were conducted each night from 19.00 to 22.30 hours. The following data were collected whenever a lemur group was seen: data, time, transect number, participants, distance along trail, species/subspecies, group composition and size, sighting distance from trail at 90°, height (m) of first animal seen, group spread, and method of detection.
Interviews were conducted with local people. Interviews consisted of having people identify lemurs from color pic-

tures, asking about primates of the immediate area versus those that occur anywhere in Madagascar, asking for physical descriptions of each species, asking about the relative abundance of primates in the area (i.e., not found, rare, sometimes seen, abundant), and requesting information on hunting techniques.

Results

Table 2 shows the species composition of lemurs seen at the five sites in the Fandriana-Marolambo forest corridor. Three diurnal (*Eulemur rubriventer, Hapalemur g. griseus, Varecia v. variegata*) and four nocturnal (*Avahi laniger, Cheirogaleus major, Lepilemur mustelinus, Microcebus rufus*) primate species were censused during surveys. Bite marks in tne branches indicated the possible presence of *Daubentonia madagascariensis* at site 3 through 5. Despite reports from local people that *Eulemur f. fulvus, Eulemur fulvus rufus*, and *Propithecus diadema edwardsi* are present in the corridor, no sightings were made of these lemurs.

Table 2: Species composition of lemur communities at five sites in the Fandriana-Marolambo forest corridor.

Primate species	Site 1	Site 2	Site 3	Site 4	Site 5
Avahi laniger	+	+	+	+	?
Cheirogaleus major	+	+	+	-	+
Daubentonia madagascariensis[a]	-	-	+	+	+
Eulemur f. fulvus[b]	-	-	-	-	-
Eulemur fulvus rufus[b]	-	-	-	-	-
Eulemur rubriventer	+	+	+	+	+
Hapalemur g. griseus	+	+	+	+	+
Lepilemur mustelinus	-	-	-	+	?
Microcebus rufus	+	+	-	+	+
Propithecus diadema edwardsi[b]	-	-	-	-	-
Varecia v. variegata	+	-	-	-	-
Total number of species	**6**	**5**	**5**	**6**	**5 - 6**

[a] Presence due to track marks on trees

[b] Reported by local people to be present at each site

+: sightings -: no sightings ?: may be present

Thesre was considerable intersite variation in species composition. Of the seven lemur species sighted during surveys, only three (*Avahi laniger, Eulemur rubriventer,* and *Hapalemur g. griseus*) were seen at each site. *Varecia v. variegata* were seen at the first site. *Lepilemur mustelinus* were not seen at sites 1-3. *Cheirogaleus major* were absent from the high altitude site of camp four and *Microcebus rufus* were not sighted at site 3. Although local people informated us that all primates are hunted in the corridor, few interviewees would admit to personally hunting. *Varecia v. variegata, Propithecus diadema edwardsi,* and *Lepilemur mustelinus* we reported to be the main prey items. Lemurs are hunted with blowguns and darts as well as with slingshots. Local people reported that lemurs are also obtained using snare traps. However, no traps were seen during the RAP. None of the local people reported "fady" (taboos) against hunting lemurs. Lemurs are hunted for food rather than for sale.

Conclusions

Although there was little variation in total number of species between the five sites (5-6 species), there was considerable intersite variation in species composition. This variation may due to hunting pressures. Within the nocturnal primate community, *Avahi laniger, Cheirogaleus major,* and *Microcebus rufus* are hunted opportunistically because of their small body sizes.

The diurnal primate community in the corridor may be under extreme hunting pressures. One group of *Varecia v. variegata* was seen at the first site. This large (3.5-4.0 kg) conspicuous lemur is often hunted by local people because it can be located easily by its loud calls. *Propithecus diadema edwardsi, Eulemur fulvus* sspp. were not seen during surveys, although local people reported them to be present throughout the corridor. *Propithecus diadema edwardsi* is the largest primate in SE Madagascar (5.0-6.0 kg). As such, it is a favorite prey item among hunters. Lack of sightings of *Eulemur fulvus fulvus* and *Eulemur fulvus rufus* may also be due to trapping and hunting pressures. Local people informated us that *Eulemur fulvus* sspp. are easily hunted and captured in snare traps. Forest destruction and illegal hunting may have seriously compromised the composition of lemur communities in the Fandriana-Marolambo forest corridor. Therefore, primate populations in the corridor require immediate protection by conservation authorities.

Rapid Inventories and ecological Monitoring for Lemurs in Malagasy eastern Rainforests

Andrew F. A. Hawkins
BirdLife International, B.P. 1074, Antananarivo 101, Madagascar

Eleonore J. Sterling
Centre for Biodiversity and Conservation, American Museum of Natural History, Central Park West at 79th St., New York NY 10024, USA

Anna T.C. Feistner
Jersey Wildlife Preservation Trust, Les Augrès Manor, Jersey JE3 5BP, U.K.

Jutta Schmid
Deutsches Primatenzentrum, Kellnerweg 4, 37077 Göttingen, and Zoologisches Institut, Universität Hamburg, Martin-Luther-King-Platz 3, 20146 Hamburg, Germany

Rationale

Biodiversity loss in developing countries is usually caused by biodiversity-rich habitats having a greater immediate value to local people when converted to agriculture than in their pristine state. In order for biodiversity to be conserved, it must be capable of being managed, so that some of its value can be realised for the benefit of local people. This value can take the form of existence value, where people in countries far from those where the biodiversity exists are prepared to pay for the continuing existence of that biodiversity, or direct value, such as that realised from ecotourism. There are two essential information prerequisites for the management of biodiversity; what is there (measured by inventory) and how those elements vary with time and space (measured by ecological monitoring). These are very distinct parameters, and, especially in developing countries, thought must be given to simple, cheap and effective methods of measuring both, that, particularly for ecological monitoring, do not require continued investment in external specialist knowledge, high-tech equipment or complicated analyses.

Primates are essential ingredients in biodiversity management programmes in Madagascar; not only because they are the most prominent part of the fauna as far as ecotourism and existence value are concerned, but also because many show the key characters of indicator taxa, including ease of

detection and identification, generally even detectability with season, abundance in appropriate habitat, and easily-detectable and interpretable responses to environmental changes and pressures (for a different view see Ganzhorn 1999). In possessing these qualities they are distinct from all other terrestrial animal taxa in Madagascar. Other taxa may be more species-rich and thus exhibit a more fine-grained response to environmental variation, but in all other cases a combination of difficulty of identification, enormous seasonal variation in detectability, and incomplete knowledge of ecological relationships means that other terrestrial fauna are of limited use for ecological monitoring in Madagascar.

This paper evaluates the lessons learned from recent rapid inventories of rainforest protected areas in Madagascar (Andringitra; Sterling and Ramaroson, 1996, Anjanaharibe-sud; Schmid and Smolker 1998, Andohahela; Feistner and Schmid 1999, Marojejy; Sterling and McFadden 2000, and Masoala; Sterling and Rakotoarison 1998: Figure 1) about primate inventory techniques and their value for ecological monitoring.

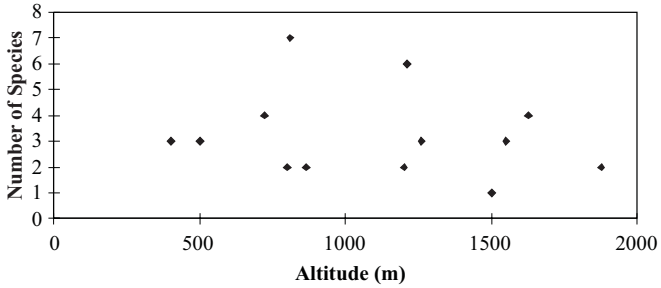

Fig. 1: Variation in number of diurnal lemur species with altitude.

Rapid inventories are intended to produce species lists and baseline data for ecological monitoring (e.g. Goodman 1996, 1998). For this analysis, the following questions were addressed: Which methods should be used to find primates? How much time should be spent sampling at a single site? Which species are most likely to be missed during inventories, and how can the chances of finding them be maximised? What abundance measures yield interpretable results and how much effort is necessary to collect sufficient data?

Methods

In the inventories considered here, dedicated searches for primates were made during the day between 15 min- 5 hr after first light, and 2 h-15 min before dark, and at all hours of the night, along marked and measured transects. Each contact with a primate resulted in the following data: species; position on transect, perpendicular distance from transect, number of individuals and age/sex class in the group. In addition, other members of multi-disciplinary teams involved in surveys noted contacts with primates ad lib. For selected inventory missions, the following data were compiled:

- sampling effort- distance of transect surveyed, person-hours spent surveying, number of repeat surveys of each transect;
- results- number of species per unit sampling effort; number of contacts per per species per unit sampling effort.

Species-richness and density calculation evaluation

An averaged species-accumulation curves (per hour sampled) showing the effort required to detect the species present were calculated from all five sites across all elevations. The distance of transect that would be required for density calculation using distance sampling methods, which require about 50-70 independent contacts per species per site-specific sample (Buckland *et al*. 1993), was calculated, based on the sampling frequency on transects.

Results

Species accumulation

For diurnal species, over all studies combined, 15 person-hours of survey was required to find 80 % of the species present, and 30 hours to find 95 % (Figure 2). For nocturnal species, detection rates were much higher, with 85 % of species detected after 5 hours and 98% after 10 hours.

In five of the total 22 samples (23 %) over the five sites, species encountered in the forest were not recorded on transects. The species missed were *Propithecus diadema* (three sites), *Eulemur rubriventer*, and *Cheirogaleus* sp. (one site each). *Daubentonia madagascariensis* were seen only twice, but were detected easily at almost all sites by the presence of feeding traces.

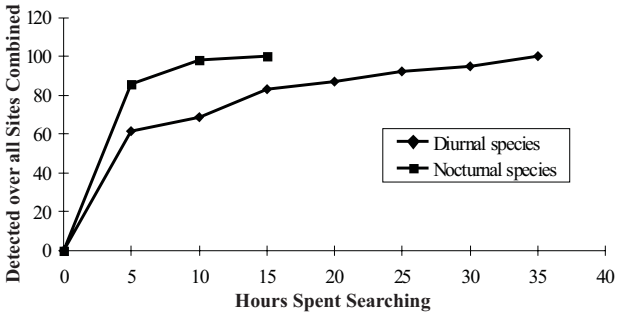

Fig. 2: Combined species accumulation curves.

Sampling effort required for calculation of density by distance sampling methods

Contact frequency for diurnal species at Andohahela, Anjanaharibe-Sud, Andringitra and Marojejy ranged from 2.6 groups per km of transect (*Propithecus diadema candidus*, Marojejy), to 0.08 groups per km (*Indri indri*, Anjanaharibe-Sud). Contact frequency for nocturnal species at the same sites ranged from 5.5 animals per km (*Cheirogaleus major*, Anjanaharibe-Sud) to 0.2 animals per kilometer (*Avahi laniger*, Marojejy). In order for distance sampling methods to provide density calculations useful for ecological monitoring purposes (50 samples with a coefficient of variation of < 30 %, Buckland *et al*. 1993), a minimum of 9 km of trail would have to be sampled for even the most abundant species. In these studies, between 3.2 and 11.9 km of transect were sampled over the five sites. For species of average contact frequency (around 1 individual or group per kilometer) 50 km of transect would have to be sampled, in homogenous habitat at the same elevation. These contact frequency estimates are calculated conservatively, as they relate to the total number of contacts on one transect over several (2-11) repeats, some of which undoubtedly related to the same groups. Thus many of these contacts are not independent samples. In addition, many other assumptions of distance sampling (100 % detection at mid-line, no movement of animals detected) are violated, particularly in nocturnal primate surveys (Duckworth in press). Thus even were it possible to cut transects of 50 km in homogenous forest, the density estimates resulting would probably be very inaccurate.

Conclusions

Species inventory

- Within the study areas sampled within each site (each < 5 km^2), almost all diurnal primates can be found within 30 hours and almost all nocturnal species after 10 hours.

- In 23 % of sample sites, a species was not recorded on transect samples; in particular *Propithecus diadema* ssp. is likely to be missed on transect samples, and effort should be made to search a larger area (for instance by scanning opposing hillsides) to find this species.
- If logistics permit, and only a single visit will be made to a site, then it is preferable to search as wide an area as possible, rather than making repeated samples of established transects.

Ecological monitoring

- These studies show that repeated sampling on transects for primates in eastern Malagasy rainforest does not produce data suitable for analysis using distance sampling methods.
- The data obtained using these methods cannot therefore be used as a baseline for ecological monitoring, except as presence/ absence data.

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Folklore and Beliefs about the Aye aye (*Daubentonia madagascariensis*)

Elwyn L. Simons and David M. Meyers
Duke University Primate Center, 3705 Erwin Road, Durham, N.C. 27707, USA

This contribution summarizes a series of interviews made by the authors in northern Madagascar and by the senior author after the discovery of a population of western aye aye by Simons in 1991. Local beliefs, told at various times to other representatives or staff of the Duke Primate Center and their Malagasy colleagues, are also recounted. Although these stories come primarily from the north and west of Madagascar four accounts from the eastern coastal region concerning this animal are also included.

The aye aye *(Daubentonia madagascariensis)* is the most taxonomically distinct of all lemurs, being the only living species of its family, Daubentoniidae. This family, in turn, is arguably the most endangered major taxonomic group among all Primates. Their basic adaptation consists of foraging for resources that combines features of both woodpeckers and squirrels neither of which occur in Madagascar (see Simons 1995 for a history of study and anatomical adaptations). Erikson (1991) has discussed their unique manner of foraging for insect larvae usually found under tree bark. The aye ayes tap rapidly on wood surfaces with the wire-like third digit and with large ears cocked foreward listen attentively to this drumming sound. If cavities and grubs are detected the covering wood is ripped away with the huge incisors and grubs hidden inside are skewered with the elongate finger and eaten. Observation in the wild (Sterling 1993) has shown that the single infant typically born at widely spaced intervals remains with the mother for a long period while it slowly learns this complex foraging procedure. This species builds and sleeps in nests and also like squirrels has a huge, hairy tail. It is the largest nocturnal primate and largest nocturnal prosimian. Tail hairs can exceed nine inches in length, 22.5 cm, and are the longest individual hairs of any extant prosimian primate.

Much of the anatomical uniqueness of the aye aye may derive from its feeding and foraging adaptations. The complex hand, eye and auditory coordination needed must select for neurological complexity and compared to its body size the aye aye has the largest and most convoluted brain of any prosimian. The huge, rodent-like ever-growing incisors have roots that extend far back into the skull and jaws and are unique among extant primates. The giant upper incisors are cause for the unusually wide interorbital spacing—the greatest of any living lemur. Interestingly the morphology of the milk incisors which are shed very soon after birth indicates a tooth-comb ancestor (Ankel-Simons 1996). In the hands the third digit is extremely flexible, while the neck and forelimbs are unusually short. All of the digits other than the flat-nailed hallux have claws. Simons (1994) has summarized the literature on the extinct, giant aye aye of southwestern Madagascar, *Daubentonia robusta*. Metrical comparisons indicate that the extinct species was two and a half to five times the volume of the living form. What sort of diet so large an animal could have subsisted on in the xeric southwestern forest is a mystery.

The very name of the aye aye is itself an enigma. The species does not utter a call or cry resembling aye aye, hai hai (high high) or hay hay—names it is usually called by the Malagasy—a great many Madagascan lemurs and birds are identified by the Malagasy with a name resembling the call or calls they emit. Sonnerat, the European discoverer of this animal, thought that he had coined the name from aiee!-aiee! an exclamation of surprise made by the Malagasy villagers when confronted with the aye aye, but the name occurs in the remotest places and cannot have come from a European source. Another theory is that the name comes from *heh heh* which means in Malagasy, "I don't know". For those who favor this meaning it is supposed that saying "I don't know" was originally a way of avoiding speaking the name of a feared animal.

As one of the world's rarest mammalian species the aye aye

is threatened, as are many other lemurs, not only by habitat loss and hunting, but it is also killed because of the distribution of a nearly island-wide taboo (*fady* in Malagasy) that often brings about its killing. *Fady* extend beyond basic taboos, in the traditional sense of something forbidden, to include events that bring bad luck. Hence, in general, animals that are *fady* can be considered bad luck if killed, if touched, or even if seen. In the specific case of the aye aye, *fady* associates the act of seeing the animal with ill fortune either as an omen or as a direct cause. As protection against the approach of this bad fortune, rural Malagasy kill aye ayes when an animal enters a village or even when it leaves the forest and is seen approaching houses or humans. During seasons of poor forage in primary forest it seems certain that aye aye will be attracted to village farm plots since it readily eats sugar cane, mangos, coconuts and sometimes even avocados and eggs.

Scientists from the Duke Primate Center have at various times been able to collect stories from villagers about this lemur both before and during the period when the founders of the aye aye colony at the Center were captured. In addition Meyers and Simons, while studying *Propithecus tattersalli* near Daraina in 1988 interviewed groups or individuals from nine villages in northern Madagascar with the goal of determining the distribution of aye aye in this region.

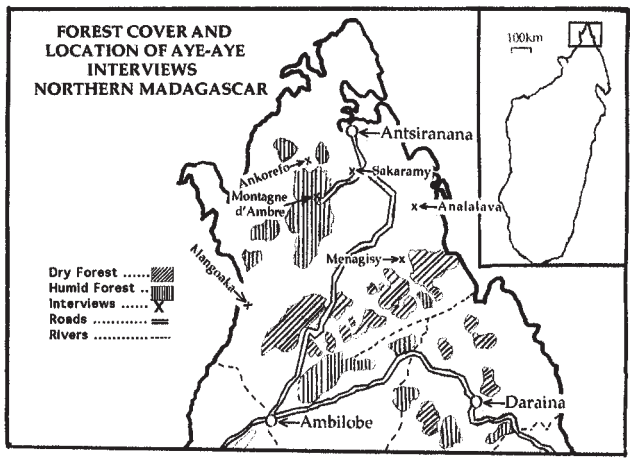

Fig. 1: Northern tip of Madagascar showing the location of five of the villages where interviews about the aye aye were conducted.

Due to the rarity of this primate in the north and the fascinating responses of local people to our questions, our secondary goal became to document the villagers' perceptions of the aye aye. Additionally, legends from eastern Madagascar provided by M. Jean-Prosper Abraham, a well traveled Malagasy botanist have been included here in order to provide a broad regional comparison.

In November 1991 Simons interviewed villagers in an area southwest of Antsoihy on the west coast of Madagascar. His center of field study was at Anjimangirana (meaning "at the shining sand") where he was accompanied by Gilbert Rakotoarisoa, Curator of Primates at Parc Tsimbazaza, Antananarivo. The population of western aye aye they discovered was located after a single aye aye had been captured in the region and donated to Parc Tsimbazaza. The authors' survey confirmed the aye aye exists in the area and the probability that several hundred aye aye live in the Manasamody hills to the west of Anjimangirana.

In December 1987, Dr. Patricia Wright together with Patrick Daniels collected two aye aye for the Duke Primate Center in the forest north of Mananara and at that time they learned about some of the various attitudes held towards the aye aye in that region. In October 1991, Charles Welch and Roger Mora from Parc Ivoloina captured aye aye for the Duke Primate Center and for Parc Ivoloina on the east coast of Madagascar near the village of Samanjaona, west of Mananara, and they also recorded local attitudes concerning the aye aye. Finally, at Parc Ranomafana in August 1988 Clement Rabarivola and Martine Vuillaume-Randriamanantena made a further relevant observation reported below.

Methods

During june 1988, interviews of local people were conducted in northem Madagascar at sites around the *Montagne d'Amber* (Amber Mountain), in the Ankarana Reserve, and at the Analamera Special Reserve by the authors (see Figure 1), with the initial goal of locating populations of aye aye. After the first interview, we began to write down local beliefs about the aye aye. Interviews were conducted with the help of a Malagasy interpreter and transcribed. Information gathered by Simons, at Anjimangirana was recorded in the same manner.

Interviews were usually conducted with either the elders of a village or the president of the *fokontany* (= Malagasy equivalent of a township). Additional information was gathered whenever possible from others. The interviews were recorded at five different villages (Figure 1) and include information from 11 groups of people or individuals. Together with these stories or legends, information on the relative abundance of the aye aye in each area was gathered.

At Anjimangirana, Simons and Rakotoarisoa stayed with, and interviewed the president of the *fokontany,* as well as his son, Urbaine, who assisted in capturing aye aye. A second source of information was Damu, a hunter, who also helped with the capture of aye aye. We later talked to villagers in a hamlet south of Amjimangirana and at another village further south called Ambodivohitra, that had been formerly called "Be-hai-hay", meaning "many *Phaner* (another type of lemur) or many aye aye". Interviews were also conducted at Anbodibonara, Ambodimanga, and Antanambao, towns located north of Anjimangirana.

In the North, due to the fady surrounding the aye and the concomitant sensitivity of the issue, discussions were initiated with questions concerning lemurs in general. Although villagers readily provided information on all lemurs in the area (including nocturnal lemurs), the aye aye was never brought up by them until we used its local name, "hey-hey", or spoke of a *fady* lemur. However, in the Anjimangirana area, where the name is pronounced "*high-high*", there seemed to be no avoidance of talking about the aye aye among the Tsimihety tribe, and the animal was freely discussed.

Jean-Prosper Abraham, a Malagasy botanist and herbal medicine specialist, was interviewed by one of us (DMM) concerning his knowledge about attitudes towards aye aye in eastern and northwestern Madagascar. Several other scientists connected with the Duke Primate Center's aye aye captures were interviewed by ELS.

Results

Throughout northern Madagascar the aye aye was considered *fady.* This general opinion was found among most informed people who were interviewed and even among local forest agents.

The regional attitude was centered around the Malagasy expression: "*Mangatambo hita, miseho tsy tsara.*" The translation of this statement is "If (the aye aye) is seen, there will be evil". The interpretation of this statement in northern areas is that if an aye aye is seen in the forest, someone in the village will subsequently become sick or die. If the aye aye comes into a village, then the people must abandon the entire

village or they all will be doomed to sickness and death. Even though the belief in this *fady* was not universal.
However, an abandoned village was actually photographed by Jean- Jacques Petter in the eastern region in the 1960s. One *fokontany* president suggested, that the association of ill-fortune through having seen the aye aye was only coincidental. Nevertheless, his opinion was the most divergent; several individuals told us that aye aye eat people. The basic belief that ill fortune follows the aye aye was know in all nine northern villages where interviews were conducted.
Details of the ingrained beliefs varied throughout the region. There was mainly variation in describing the results of seeing an aye aye in the forest. At Menagisy (see figure 1), if an elderly person were to see an aye aye in the forest then he or another old villager will die. Conversely, if the aye aye is seen by a younger villager, someone young will die. This contrasts with the view from Ankorefo (see Figure 1) where the age of the stricken individual depends on the age of the aye aye seen. At Ankorefo, there had been three sightings of aye aye in recent history. In 1966, an old aye aye was seen and a old man from the village died. When a young aye aye was spotted in 1984, a young boy died. The third sighting was a dead aye aye and no ill fortune was associated with this event.
The part of the tradition concerning what happens or what should be done when an aye aye *enters* a village, that is, abandonment was fairly consistent throughout the northern region. The only variant of this type of story was described by an elder from Menagisy. He said, that an aye aye entered the village of Analalava (meaning "where there is tall forest") and fearing the coming danger that the aye aye's presence foretold, half of the villagers left. All those who remained in the village fell ill and died. The elder concluded with the remark, that the village remains abandoned to this day.
How seriously the *fady* is taken varies and some individuals stated, that they would not leave their village if an aye aye visited it while others would not consider staying after such an event. The local forest agent in Antsiranana (Diego Suarez), when discussing the possibility of capturing aye aye suggested that we must be extremely careful and conceal the captured aye aye both from sight and sound when traveling through even large towns such as Anivorano-nord (over 3,000 inhabitants). An alternative version of the aye aye story was first mentioned to us by the President of Sakaramy, and was repeated again later by residents of Mangoaka. This story states, that the aye aye is only a problem when it enters a village and not when one is seen in the forest. This view is similar to that held by residents on the east coast of Madagascar. In the west at Anjimangirana, it is also the act of entry into the village of an aye aye coming from the forest which carries the bad luck. The villagers there seem to think that it is as if the ill-fortune is brought because a forest animal mysteriously displaces itself from where it ought to be into, or towards, the company of humans.
Another aspect of the aye aye *fady* is, that when an aye aye is seen, it must be killed and it, or it's tail, hung on a pole by a crossroad. Three explanations for this action were provided. First, killing an aye aye will help to avoid any deaths. Second, when other people, presumably strangers, come near the dead aye aye, the bad luck is carried away with them. The third manner in which the ill-fortune can be diminished is when people passing along the road carry the aye aye itself, thus transporting its ill-fortune further from the place where it was first seen and killed. Evidence of this practice was seen south of Ambanja. In one case, an aye aye tail was found seventy kilometers south and later an entire aye aye was found hung up closer to Ambanja. Both were tied to roadside poles (Figure 2).

Fig. 2: Photograph of a dead aye aye suspended upside down on a roadside pole in order to dispense bad luck away from the village where it was killed.
Photo courtesy of David Meyers.

In June 1990, we found an aye aye tail tied to a pole a the side of the main northwest highway six kilometers north of the northwest coastal town of Maromandia. Patryck Vaucoulon, who taught science in the high school at Antsiranana between 1986 and 1991 reported to us at his finding of two such aye aye tails attached to poles planted near roads in that region.
At Anjimangirana, and in the surrounding regions the aye aye was not as greatly feared as in the north, and no one spoke of abandoning villages. In fact, aye aye are sometimes eaten there, particularly at weddings or other festive occasions. If this is done, however, ill fortune associated with the animal first has to be expelled. This was formerly done by singing songs at the corners of the village. However, the older men said, that the words of these songs were now largely forgotten (1991), and the implication was, that the aye aye might be eaten nowadays without such precautions. It did seem that hunters in the Anjimangirana region did not normally go after aye aye, but reports from Damu and others were ambiguous. In the west, aye aye nests can easily be seen and these animals are often spotted in the forest without bad luck being conveyed. The view that aye aye brought bad luck when they came from the forest toward a village predominated. The president of Anjimangirana listed several instances when aye aye had been killed in recent years when they entered villages. Another story he told concerned the killing of an aye aye in 1989 in a pasture, ten or fifteen kilometers to the northwest of Anjimangirana. In this case, the aye aye left a small forest during daylight, about 4:00 pm and was making its way across a large grass covered valley towards another forest. In doing this, it came

directly toward several boys who were guarding cattle and they killed it.

The traditions concerning aye aye from the east, as presented by Jean-Prosper Abraham, record important variations from those of the north and west. The general belief in the region extending from Sambava and Antalaha, and southward from Maroantsetra and Mananara is that when an aye aye is seen in the forest there is no problem, because the forest is its home. Furthermore, the villagers of the east believe that when an aye aye enters a village, it will go to the top of a particular house where an illness will then occur within a week, suggesting that the aye aye is the harbinger and not the cause of sickness and death. Abraham reported that a very interesting activity, performed in the village of Marolambo, in the region of Tamatave, was conducted when an aye aye was seen and killed. The dead animal is brought to the village, and all the children gather around the aye aye and cry (but if they do not cry they are hit with a stick until they do). Once all of the childen cry, the animal can be eaten. However, if all children are not made to cry, those who eat the animal will die of some sort of "radiation" transferred from the skin of the animal. This belief, that with the proper ceremony the animal can be prepared to be eaten, is similar to the story told to ELS at Anjimangirana, namely that ill-effects can be removed through a specific procedure (magical songs).

In 1982 Michael Stuart and Jonah Andrianarivo visited the tiny coastal village of Andrainakodia (meaning "drops of water on the skin") southeast of Andasibe (Perinet), and there they were also told that the aye aye is a harbinger of death or ill-fortune and that a person would die if an aye aye looked at them or pointed its thin finger at them. The only way to avoid such bad luck was to immediately kill the animal. The reason that they went to visit the forest near Andrainakodiata was because an aye aye had been sighted there in 1979. Michael Stuart (1) wrote:

With local guides, we hiked back in the scrubby coastal woodlands to the site of that report, made by a woodcutter. He had chopped down a tree holding a nest that had sheltered a female aye aye and her nursing infant. The baby was killed but the mother managed to escape. As we examined the felled tree and the decomposing remnants of the nest, our guides recounted the incident and its aftermath. The woodcutter dies unexpectedly about a month after the encounter, and four weeks later his son died—both assuredly victims of the female's revenge. Our guides also told us about a man from a nearby village who had recently set fire to an area where an aye aye lived. Now the man's son lay deathly ill. None of the Madagascans had the least doubt as to the agent responsible.

The forest that Stuart and Andrianarivo explored, was said to be about three kilometers wide by ten kilometers long and, going there, they finally did find a tree with an aye aye nest and Jonah climbed up to examine the nest. When Stuart looked behind him he was surprised to find that all of the several guides that had brought them to this point had vanished into the forest presumably so as not to see an aye aye.

On the east coast Patricia Wright and Patrick Daniels conducted a capture mission in December 1987, in order to obtain the first Duke aye ayes. After arriving in the forest north of Mananara, and north of the Biosphere Reserve they learned that villagers had just killed seven aye aye because they were *fady*. However, this was done away from any village, but with the added complaint that the animals had been raiding crops. These killings had been so recent that Wright asked where the dead animals could be found and was told again that they were *fady* and had been discarded. Four years later, and not far away, near the village of Samanjaona, west of Mananara, Welch and Mora also detected this general aversion to aye aye. However, with those living in and near this small village the attitude seemed to be more one of mild fear and dislike caused in part by the fact that aye aye there had frequently raided the villagers' sugar cane, banana, and coconut plantings. One of the favorite foods of the aye aye are the seeds of the ramy tree, *Canarium madagascariensis*. These tall trees in the region around Samanjaona survive near tombs, where it is *fady* to cut them. Aye aye also nest in such tress and in forest patches near sacred burial regions. Thus the aye aye is physically associated with tombs and death in people's minds. Nevertheless, after Mora and Welch captured two aye aye and brought them into a village, a child died nearby and a funeral ceremony was held by his extended family at Samanjaona, apparently without anyone saying that the aye aye had brought bad luck.

Discussion

The legends described above provide a starting point from which a better understanding of the aye aye taboos or *fady* can be reached. The evolutionary distinctiveness, and the generally bizarre appearance of the aye aye (Figure 3) suggest to us that this animal typically offers a striking image to almost any person who sees it. In captivity, aye aye rapidly become quite fearless of humans and, similarly from time to time, they seem to boldly approach villagers in Madagascar. A surprising event occurred in August 1988, when aye aye were first found to occur in Parc Ranomafana, about 400 kilometers south of their previously documented sightings at Analamazaotra near Andasibe. Villagers in Ranomafana had no name for the aye aye, did not know it occured in Ranomafana, and consequently, had no *fady* concerning it. The discoverers of this southern population were Martine Vuillaume-Randriamanantena and Clement Ravarivola.

After they first saw this aye aye it climbed down the trunk of the tree in which it had been sighted, walked across the ground to Rabarivola and, showing no fear, briefly tapped one of his rubber boots with its elongated third finger. Then, it calmly walked back and climbed up into the trees. Any such event involving a biologically uneducated villager would make the animals' actions seem mysterious or inexplicable and therefore to be feared. The aye aye has, indeed, a frightening appearance.

For an animal as small as it is the eyes are remarkably far apart-producing the impression of a staring, elf-like face. Their wide spaced and forward directed eyes are surrounded by long guard-hairs and framed by the very large ears thus making the head look a great deal larger than it actually is. This would be a surprising face to encounter close up. Body

Fig. 3: Facial view of an aye aye showing the very widely spaced orbits and expressive stare of Baubentonia madagascariensis. Photo courtesy of David Haring.

proportions are odd, the neck is very short and the hands have long, spidery looking fingers, highlighted by the wire-like third finger. Also, this animal has mainly black hair and at night or in the twilight must typically seem quite sinister and ominous. Black is traditionally associated with the evil among the Malagasy, just as we speak of forces of darkness as opposed to those of light. Hence, even in overall color the aye aye is disadvantaged. One informant who must have been influenced by French colonists (since the animals named in his description are not from Madagascar) told one of us (ELS), that the aye aye was made by the devil because it has the teeth of a rabbit, the hair of a pig, the tail of a fox, and the ears of the bat. Nevertheless, odd looking animals often seem to attract the idea that they have been made by the "evil one." Certainly, this is also the case for the south-east Asian tarsier. In Borneo, Patricia Wright learned that the tarsier is believed to be an unlucky combination of other animals; —it has a call like a bird, rotates its head like an owl, possesses the tail of rat, the body of a mouse and the face of a human. These peculiarities perhaps in turn gave rise to its German name "Koboldmaki", meaning "goblin, or imp-lemur or monkey". In David Macdonald's book "Expedition to Borneo" (1982), it is reported that the name for tarsier among the Puana is *kat*, but in some areas no one would even talk about it. In Sembilang Macdonald learned that the name was *ingkat* and that it was not good to talk about it. An old man told him that "some people believed that a hunter who encountered an *ingkat* would find no food on that excursion." But others, he continued, believed its malevolent powers far surpassed merely thwarting a hunting trip. A man who saw an *ingkat* when his wife was pregnant ran the risk that the woman would lose her child. Others held that those, at whom the tarsier stared at over its shoulder, would die.

Conclusions

The fact that the aye aye is the only Malagasy lemur associated with a negative fady seems logical because, like the Asian tarsier, its appearance is so strange. Since Malagasy people came originally from southeast Asia they may well have brought with them tales of oddly- proportioned forest animals. No other lemurs of Madagascar appear to be considered bad luck although many are locally forbidden, or *fady as* food items. Perhaps the aye aye' s nocturnal activity pattern, its generally low population density (Tattersall 1982)—as well as its usually traveling alone—may all have contributed to the origin and maintenance of the *fady.*

The aye aye *fady* is so widespread throughout Madagascar that it likely receives reinforcement largely through story telling since sightings and contact with the animal are apparently so rare. Aye aye were relatively recently rediscovered in the forests of Andasibe, where scientists had been observing lemurs for many years without seeing them. Furthermore, even the forest agents of this Analamazoatra reserve, who have been living near the forest for decades, formerly did not know of the aye aye's presence. A superstitious explanation for bad events would not be believed if it occurred with much higher frequency than the bad events themselves. Presumably if aye aye were frequently seen to enter villages and no one died, the belief would be abandoned. In contrast, when an aye aye does come to a village, people begin to wait for a death. Considering the high death rate among children, during and after child birth, and from disease at all ages—especially in the eastern forest region—one would not have to wait long after an aye aye sighting for a human death. Most Malagasy are agriculturists and go to bed early—"with the chickens". Although people are sometimes active during the night, they are rarely in forests then. Thus, even where aye aye are relatively common, sightings of them by villagers may well be infrequent. Malagasy villagers go inside and close up their houses at night and hence would easily miss seeing noctumal forays of the aye aye.

Naturally during daylight aye aye are sighted in and around villages only rarely. As an indication of the general frequency of aye aye sighting in northernmost Madagascar only six actual sightings occurred at the village of Ankorefo during a twenty two year period and throughout the same period only two were seen at nearby Analalava. Even so Ankorefo was the closest to forest of all the villages we surveyed. The low frequency of aye aye sightings in this village was far less common than disease and death.

The activity that preceded eating of aye aye in the village of Marolambo in the east appears to be quite divergent from the procedures associated with the placement of aye ayes or their tails by roads or crossroads, as in the north and west. These activities in Marolambo could be a localized fady with some particular historical origin, or it could be a response to a high frequency of aye aye seen in the region combined with a consequent temptation to use them as food. By performing the crying ritual, the *fady* of the aye aye was removed and the animal could be eaten.

The observance of *fady* in Madagascar is a very important part of Malagasy life and it is well known that the rural people are tradition oriented. Conservation campaigns airned at the protection of the endangered aye aye must take into consideration the *fady* associated with this primate. Areas may exist, such as in the east around Mananara, where the abundance of aye aye is so high that the *fady* in the region does not involve the killing of this species when found in the forest. Conservation education geared toward preventing the killing of the aye aye may be difficult in areas such as northern Madagascar, where sightings are so rare that the *fady* may be associated with a subsequent death. Where sightings are much more frequent, such as at Anjimangirana and in the villages northest of Mananara, aye aye are thought of more as unimportant or objectionable vermin in much the way country people in the United States view snakes that should be killed and disposed of.

Conservation education in Madagascar should be directed to educating people about the rarity of the aye aye and that it is gravely threatened with extinction. Villagers should learn that this animal is an oddity to be proud of and an important part of Madagascars national heritage or patrimony. It must be stressed to the Malagasy people and to people everywhere that the aye aye is one of the most unusual animals in the world and that this creature should not be allowed to vanish. Its survivial is in great jeopardy because it is the only lemur to bear the burden of the strong and widespread tradition of killing it because it is bad luck. This process of extermination comes on top of threats to its survival from forest destruction for wood and *tavy* (slash and burn farming), from killing for food, from attacks of domestic animals, such as dogs, from introduced diseases, as well as from all classes of natural catastrophes such as drought, fire and cyclones.

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Results of a Reconnaissance Expedition in the western dry Forests between Morondava and Morombe

Dietmar Zinner, Julia Ostner, Alexandra Dill, Léonard Razafimanantsoa and Rodin Rasoloarison

Deutsches Primatenzentrum (DPZ), Abt. Verhaltensforschung and Ökologie, Kellnerweg 4, 37077 Göttingen., Germany. **dzinner@gwdg.de**

The western dry forests of Madagascar are vanishing rapidly and are being fragmented into small patches. Aridification seems to have been the most important factor in the fragmentation of western dry forest over the last few millennia (Goodman and Patterson 1997), however, this process has been rapidly accelerated within the last decades. The extent of Western Domain dry forest declined from 12.5 % in 1950 to 6.6 % in 1974 and to 2.8 % in 1990 (giving average deforestation rates of 61,000 ha per year between 1950 and 1990) (Mustoe *et al*. 2000). The most recent estimates of west Malagasy dry forest cover suggest that only 11 % (1.5 million ha) remains of the total original extent of forest (Nelson and Horning 1993). Only a few larger fragments still exist, while the vast majority of forest patches is smaller than 3,500 ha mainly distant from larger forest blocks (Hawkins 1994). In the 1995 workshop for biodiversity conservation in Madagascar several of the fragments reached very high or exceptional research priority, both for short term inventories as well as for long-term studies (Ganzhorn *et al*. 1997). But these formulated priorities have received little attention so far.

This paper summarizes results of a short term reconnaissance trip into the region between Morondava and Morombe undertaken in September 1999. We gathered information about the current status of the forests as well as on the primate communities in several of the larger forest patches.

Sites and methods

The western dry forests of the central region can be distinguished into four forest fragment assemblages separated by larger rivers (Fig. 1). Bordered from the Tsiribihina River in the north and the Morondava river in the south lays one of the largest still existing block of western dry forest, the

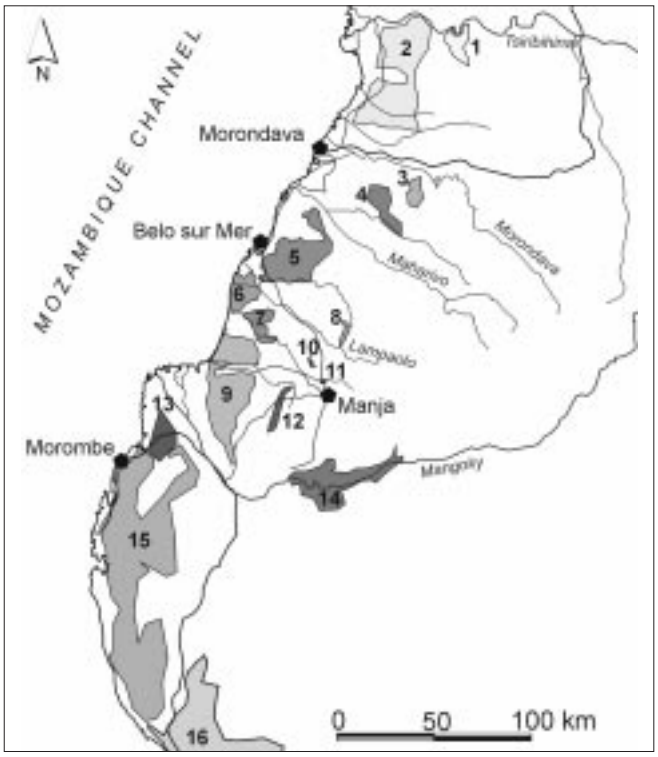

Fig. 1: Position and extent of dry forest patches holding primary vegetation in the Morondava and Morombe region at the west coast of Madagascar. (1) Ankalabobe, (2) Analabe, Kirindy/CFPF, Andranomena, (3) Ankiliany, (4) Bezeky, (5) Marofihitse (Mahaboboky, Betakitut), (6) Mité, (7) Andalandava/Ambatovanda, (8) Manjakarivo, (9) Antsavy (Amparehitsy, Tsaripioky, Besely, Lombiry), (10) Soalengo, (11) Manhabe, (12) Ambivy, (13) Ihotry, (14) Betabiky (lower Mangoky), (15) Northern Mikea, (16) Southern Mikea. Based on the western Madagascar vegetation map of Du Puy and Moat (1996, 1998).
http://www.rbgkew.org.uk/herbarium/madagascar/download.html

Menabe Forest, including Analabe, Kirindy/CFPF and Andranomena. Further south between Morondava and Maharivo River small fragments of the Ankilianjy and Bezeky Forests remain. Between Maharivo and Mangoky River one can find the southernmost extension of the dry deciduous forest, the Marofihitse, Mité and Andalandava Forests as well as some small patches farther inland, e.g., the Manjakarivo, Soalango and Manhabe Forests. Finally, in the south the Mangoky River runs through the Ihotry and Betabiky Forests, which are still classified as parts of the western dry forest. South of the Mangoky River, along the coast, one generally finds the Didierea wood- and shrubland of the Mikea and Tulear Forests and farther inland, above 500 m a.s.l. the Zombitse/Vohibasia and D'Isoky/Vohimena Forests (not in Fig 1). These upland forests are regarded as the last remnants of transition forest between the western and southern floristic domains. We did not include these forests into our survey, because we focussed on the lowland dry forests (< 300 m) and because the biological importance of the upland forests was recognized. In 1998 the Zombitse-Vohibasia National Park, 120 km east of Tulear, was declared as the first national park within the western dry forest domain.

The structure and composition of the lowland forests vary with a rainfall gradient, decreasing from north to south, and with local changes in substrate and water availability (Hawkins 1994). Close to the coast *Didierea* becomes more and more dominant from north to south. The Marofihitse and Antsavy Forests are at the driest end of the western forest continuum. The forests of the southern part of the western

domain are of special interest, because these lowland forests constitute a transition zone between the deciduous dry forests of the central western and the spiny forests of the southern domain. Accordingly, species diversity and degree of endemism is expected to be relatively high.

The larger forest fragments between Maharivo and Mangoky are expected to hold an array of at least eight species of lemurs. The community should closely resemble the one from Kirindy Forest/CFPF, with *Lemur catta* as an additional species (Appert 1966). In this region exists probably the northern most population of ring-tailed lemurs. Possible sympatric species are *Microcebus* sp., *Cheirogaleus medius*, *Mirza coquereli*, *Phaner furcifer*, *Lepilemur ruficaudatus*, *Eulemur fulvus rufus* and *Propithecus verreauxi verreauxi*. The recent status of all lemur species inhabiting this area is unknown.

In September 1999 we undertook a surveyof reconnoitering the forest fragments between Morondava and Morombe (Table 1). We visited several villages in the vincinity of the forests and interviewed local people concerning their knowledge of lemurs and other forest living animals and about the presence of any species in the vicinity of the respective villages. In total we traveled around 1000 km. At several sites we walked transects of 500–2000 m, both during the day and at night. All transects were walked with an average speed of 1 km h^{-1}. After an interval of one hour we returned along the same transect. Sightings, vocalizations and indirect evidence like foot-prints or droppings were used to verify the presence of certain species. The geographical position of sites with evidence of lemur presence was determined with a GPS.

Table 1. Conservation status and size of forest fragments between the rivers Maharivo and Mangoky.

Forest	Conservation status	Estimated area (ha)	Visited
Marofihitse Forest (5)	National Park, Kirindy Mité	67,100	yes
Mité Forest (6)	National Park, Kirindy Mité	22,100	yes
Andalandava / Ambatovanda Forest (7)	unprotected	16,300	no
Manjakarivo Forest (8)	unprotected	7,100	no
Antsavy Forest (9)	unprotected	96,600	yes
Soalengo Forest Patch (10)	unprotected	900	yes
Manhabe R Forest Patch (11)	unprotected	400	yes
Ambivy Forest Patch (12)	unprotected	7,100	yes
Ihotry Forest (13)	unprotected	22,400	no
Betabiky Forest, Lower Mangoky (14)	unprotected	66,400	yes
Northern Mikea Forest and Shrub (15)	unprotected	317,000	yes

Results

The condition of the forests vary from heavily degraded (Manhabe River and Ihotry Forests and parts of the northern Mikea Forest) to superficially undisturbed (parts of the Marofihitse, Antsavy and Betabiky Forests). However, in almost all forests slash and burn cultivation in order to grow maize is practiced, even in the Mité and Marofihitse Forests. Selective logging was also observed, in some areas particularly for the construction of pirogues. Near Belo sur Mer, Mangroves are also heavily used. A system of oxcart trails for transporting wood for house and boat construction is virtually present in all forest fragments. Former oil exploring tracks are the starting-points for the development of this trail system. Cattle and dogs run free in large parts of the forests.

In twelve forests we found evidence for at least one lemur species. The names of the sites and the species are given in Table 2. For comparison the lemur communities of the Kirindy Forest/CFPF and Zombitse-Vohibasia forests are included. As expected, the lemur communities in the various forests seem to be similar to the one in Kirindy, with the exception of *Lemur catta*, which we found just 60 km south of Morondava (Marofihitse Forest). Although we were not able to confirm the presence of *Cheirogaleus medius* and *Mirza*

Table 2: Evidence of lemur and fossa (*Cryptoprocta ferox*) presence in forest patches (numbers refer to Fig. 1). For comparison Kirindy Forest/CFPF and Zombitse – Vohibasia Forests are included. (*Microcebus* sp., *Cheirogaleus medius*, *Phaner furcifer*, *Mirza coquereli*, *Lepilemur ruficaudatus*, *Eulemur fulvus rufus*, *Lemur catta*, *Propithecus v. verreauxi* and *Cryptoprocta ferox*. Data sources: o = own observation; i = interview; n = not visited).

Site	Forest		*M.* sp.	*C.m.*	*P.f.*	*M.c.*	*L.r.*	*E.f.*	*L.c.*	*P.v.*	*C.f.*
Menabe (2)	Kirindy/CFPF	o	+	+	+	+	+	+		+	+
Kirindy Sud (5)	Mahaboboky Forest	o	+		+						
	Marofihitse Forest	o	+		+		+	+	+	+	+
	Betakitut Forest	o							+	+	
Antsavy (9)	Amparehitsy/ Tsaripioky Forest	oi	+	(+)	+		+	+	+	+	
	Besely/Tsaripioky Forest	i							+	+	
	Lombiry Forest	i	+		+		+	+	+	+	+
Lower Mangoky northern bank (14)	Savainomby Forest	oi						+		+	
	Soalengo Forest Patch (10)	oi	+		+		+	+	+	+	
	Manhabe River Forest Patch (11)	oi								+	
	Ambivy Forest Patch (12)	oi								+	
Northern Mikea (15)	Analalava Forest	oi	+								
	Ambalarao Forest	i							+		
Zombitse–Vohibasia (Ganzhorn 1994; Goodman *et al.* 1997)	Zombitse	n	+	+	+	+	+	+	+	+	
	Vohibasia, d'Isoky-Vohimena	n	+	+	+	+	+	+	+	+	

coquereli, it seems very likely that both species occur in some of the visited areas. Densities of *Microcebus* sp., *Lepilemur ruficaudatus* and *Phaner furcifer* in the Marofihitse forests seem to be at least not lower than in Kirindy Forest/CFPF. Compared to the forests of the Zombitse-Vohibasia National Park density of *Microcebus* seems to be much higher in the coastal forest, whereas densities of *Lepilemur* and *Phaner* seem to be similar (Table 3).

Table 3: Encountered (seen or heard) lemur individuals per km transect.

Site	*Microcebus*	*Lepilemur*	*Phaner*
Marofihitse 3 transects, each 2 times, 500 to 2000 m	1 – 13.3	0 – 1.7	1.5 – 10
Mikea north 1 transect, 2 times, 600 m	6.7	0	0
Kirindy/CFPF (Ganzhorn and Kappeler 1996; Schülke, Eberle pers. comm.)	0.3 – 5 (up to 10)	0.3 – 8.1	0.1 – 1.1
Zombitse (Ganzhorn 1994)	0 – 2.7	0 – 1.7	0 – 1.7
Vohibasia and d'Isoky–Vohimena (Goodman *et al.* 1977)	0 – 1	1 – 8	0 – 5

Hunting pressure on larger lemurs seems to be very high. In contrast to the Kirindy Forest/CFPF, all diurnal lemurs are very shy and approaching them is difficult. In several villages people reported that 5-10 years ago lemurs were frequently seen in the vicinity, but now they have not been detected for years. *Eulemur fulvus* and *Lemur catta* are also kept as pets and probably as a food resource in some villages. In conclusion, some of the forest between Maharivo and Mangoky are still holding the complete community of lemurs and probably also many other species, some of them in good numbers. However, further survey work is necessary to recognize diversity and abundance hotspots in the different forest fragments. Although all forests suffer more or less from human encroachment, there is still something left worth to be preserved. Hunting and slash-and-burn cultivation is reported from all forests. Some of the forests need actually more protection. Until 2000, all of the lowland forests had been virtually unprotected, although the Marofihitse/ Mité forest had the status of a Forêt Classée. However, in 2000 Kirindy Sud was gazetted as national park. The park includes parts of primary vegetation of the Marofihitse and Mité forests. The strict protection zone "Noyau dur" holds 40,000 ha and is divided in two blocks. The larger block is surrounded by a buffer zone of three blocks, comprising 13,000 ha, where traditional hunting, fishing, wood cutting and collection of medical plants is allowed. In a third class of zones additionally traditional cultivation and settlements are allowed. Included in the zoning are areas which are of special interest for tourist. Although the new national park was gazetted, people living within or at the border of the new park had no information of the legal change. If the park should actually function as a protected area, information and integration of local people is urgently needed.

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Effets de la Fragmentation de la Forêt humide sur les Populations d'Oiseaux et de Lémuriens dans le Corridor Mantadia-Zahamena

Rado H. Andriamasimanana, Marc N. Rabenandrasana, Voninavoko Raminoarisoa The Seing Sam, Marie Clémentine Virginie, Félix Jean Ratelolahy et Elysé Odon Rakotonirainy
Zicoma, B.P. 1074, Antananarivo 101, Madagascar,
zicoma@simicro.mg

Résumé
Cette étude de l'effet de la fragmentation forestière sur les lémuriens et les oiseaux a été effectuée dans les forêts humides sempervirentes de basse altitude de l'Est de Madagascar, entre le Parc National Zahamena et celui de Mantadia. Cette étude a pour but de fournir des informations biologiques sur la superficie d'un bloc de forêt isolé pouvant héberger une population viable en oiseaux forestiers et en lémuriens. Les sites d'étude ont été choisis en fonction de la distance du bloc isolé par rapport au corridor Zahamena-Mantadia et la superficie du bloc. Six fragments ont été inventoriés pendant cette étude.
La forêt de Vohitralanana, forêts de Tantavona Anjiro Nord et Sud de Brickaville, forêt de Mahala de Razanaka, celle de

Marokitay d'Ambodilazana et la forêt de Vavazahana sont ces six fragments. La forêt d'Andriantantely, qui est une forêt visitée récemment séparée du corridor, a été utilisée lors de cette étude. Les forêts de Namarafana de Zahamena, du Parc National Mantadia et celle de Sandranantitra sont utilisés comme référence pendant cette étude. Après l'analyse effectuée, l'étude a montré que plus la surface du fragment de forêt est grande plus ce fragment est intéressant pour la conservation des lémuriens et de la faune aviaire exclusivement forestiers. En fait, cette étude nous a montré que les animaux de grande taille comme les lémuriens et les oiseaux sont sensibles à la fragmentation de leur habitat naturel en blocs isolés.

Introduction

L'étude de fragmentation de forêt humide sempervirente de basse altitude de l'Est de Madagascar a été lancée pendant la saison d'été 1999 par Conservation International (CI) pour poursuivre sa première phase du programme d'Inventaire Biologique Rapide (R.A.P.). L'étude a été effectuée dans la zone d'étude qui se situe entre le Parc National Mantadia et celui de Zahamena par l'équipe du Projet Zone d'Importance pour la Conservation des Oiseaux à Madagascar (ZICOMA).

Etant donné que le corridor est un moyen d'échange de variabilité génétique entre les aires protégées, il est important de savoir pour les fragments isolés du corridor la taille minimale et la distance minimale par rapport au corridor pour lesquelles les fragments puissent supporter des populations viables en oiseaux et en lémuriens.

Puisque les lémuriens et les oiseaux sont des animaux de grande taille, ils seraient donc les plus sensibles à la fragmentation de la forêt. Ces deux taxons sont considérés comme étant de bons indicateurs biologiques de la qualité de l'habitat et permettent donc l'évaluation de l'état de l'environnement et le degré de pression s'exerçant sur l'habitat. Nos recherches ont pour but d'avoir une liste complète des espèces de lémuriens et d'oiseaux présentes dans chaque site d'étude.

Sites d'étude

Les sites visités ont été choisis en fonction de la distance par rapport au corridor de la forêt humide et la superficie du bloc forestier. Du 24 novembre au 23 décembre 1999, l'équipe du Projet ZICOMA a donc pu visiter six fragments: la forêt de Vohitralanana, les forêts de Tantavona Anjiro Nord et Sud de Brickaville, la forêt de Mahala de Razanaka, celle de Marokitay d'Ambodilazana et la forêt de Vavazahana. En plus de ces six fragments visités par l'équipe ZICOMA, la forêt classée d'Andriantantely qui a été visitée par l'équipe RAP pendant la première phase du programme est parmi les fragments à étudier (Schmid *et al*. 1999). La forêt de Namarafana dans le Parc National Zahamena (Hawkins 1995), celle du Parc National Mantadia ainsi que la forêt classée de Sandranantitra (Schmid *et al*. 1999; Schmid 2000) ont servi de référence pour l'étude car ces forêts sont encore rattachées au corridor. La distance séparant les fragments et la superficie des sites d'étude sont obtenues au moyen de l'ordinateur d´après les cartes disponibles.

Tableau 1: Caractéristiques des sites visités lors de l'étude des fragments de forêts du corridor Zahamena-Mantadia.

Nom des sites	Abréviation	Statut	Position	Altitude (m)	Surface (ha)	Distance/ corridor (km)
Zahamena Vavatenina	Zah	Parc National	17°44' S 48°58' E	465-675	73160	0
Sandranantitra Tamatave	San	Parc National	18°02' S 49°05' E	450	25700	0
Mantadia Moramanga	Man	Parc National	18°47' S 48°58' E	895	10000	0
Tantavona Anjiro Sud Ambalarondra	TvnS	Forêt Classée	18°32' S 48°58' E	500-630	6680	0.45
Andriantantely Brickaville	And	Forêt Clasée	18°41' E 48°48' E	530	4170	0.10
Tantavona Anjiro Nord Ambalarondra	TvnN	Forêt Classée	18°25' S 49°16' E	275-607	2086	0.38
Vohitralanana Brickaville	Voh	Forêt domaniale	18°48' S 48°56' E	80-300	2313	20.10
Vavazahana Vavatenina	Vav	Forêt domaniale	18°41' S 49°09' E	300-586	669	13.70
Marokitay Ambodilazana	Mar	Forêt domaniale	18°06' S 49°03' E	550-729	558	2.48
Mahala Razanaka Brickaville	Mah	Forêt domaniale	18°43' S 48°53' E	60-115	510	6.36

Méthodologie

Inventaire

Pour le recensement des oiseaux l'observateur a suivi une piste déjà existante et choisie préalablement avec une vitesse moyenne d'environ 1 à 1,5 km par heure. Toutes les espèces détectées ont été notées tout en complétant la liste de McKinnon. En fait, il s'agit ici d'établir une liste de dix espèces à chaque contact avec des groupes d'oiseaux ou individus isolés. L'inventaire a pu être aussi complété par les traces laissées par les oiseaux comme les plumes, les nids ou les pelotes de régurgitation des rapaces nocturnes.

Pour les lémuriens, des recherches actives ont été effectuées dans les différents types d'habitat (vallées, crêtes, sommets) des sites d'études. L'inventaire s'est déroulée en observant les lémuriens avec des jumelles pour identifier les espèces. Des écoutes et des études de traces ont été pratiquées pour vérifier et localiser les différents groupes. Des observations nocturnes ont été effectuées en utilisant une lampe frontale de faible intensité pour repérer les individus par le reflet des lumières incidentes provenant de leurs yeux. La lampe de forte intensité a été aussi utilisée pour décrire les espèces.

Analyse

L'analyse de présence des espèces au niveau des sites d'étude a été effectuée pour voir la sensibilité de chaque espèce à la fragmentation du corridor par rapport aux autres. Les pourcentages de présence de chaque espèce ont été calculés en divisant le nombre de présence d'une espèce sur les sites d'étude par le nombre total des sites. Pour vérifier si la distance séparant les fragments de forêt et le corridor ainsi que la grandeur des fragments de forêt sont liées á la presence des espèces forestières, l'analyse de régression a été choisie. La relation entre les variables est alors traduite par une équation dont la formule est y = a+bx. La signification de la ligne de régression est déterminée par la valeur t de Student (Fowler et Cohen 1986).

Résultats

Oiseaux

Pour cette étude de la fragmentation du corridor Zahamena-Mantadia dans la forêt humide, en tenant compte des résultats des autres missions ultérieures, le total du nombre d'espèces pour tous les sites d'étude est de 88 (Tableau 2).

Lémuriens

Quartorze espèces de lémuriens étaient recensées pour tous les sites à étudier entre le Parc National Zahamena et le Parc National Mantadia. Parmi ces espèces, sept soit 50%, sont des espèces menacées (Mittermeier *et al*. 1994; Tableau 3).

Tableau 2: Liste des espèces d'oiseaux forestières présentes dans les sites choisis pour l'étude de l'effet de fragmentation de la forêt humide dans le corridor Zahamena – Mantadia; pour les abbreviations des sites voir Tableau 1.

	Corridor			**Block forestiers**						
	Zah	San	Man	TvnS	And	Voh	TvnN	Vav	Mar	Mah
Tailla (ha)	73160	25700	10000	6680	4170	2313	2086	669	558	510
Lophotibis cristata	+	+	+	+	+	+				+
Aviceda madagascariensis										+
Eutriorchis astur	+									
Polyboroides radiatus	+	+	+		+					
Accipiter henstii	+		+		+					
Accipiter madagascariensis	+									
Accipiter francesi			+							
Mesitornis unicolor	+									
Canirallus kioloides	+		+	+	+	+	+	+		
Coua serriana	+	+	+	+		+	+			+
Coua reynaudii	+	+	+	+	+		+	+		
Coua caerulea	+	+	+	+	+	+	+	+	+	+
Ispidina madagascariensis	+	+	+	+			+			
Brachypteracias leptosomus	+		+	+	+		+			
Brachypteracias squamiger	+	+	+		+					
Atelornis pittoides	+	+	+		+					
Philepitta castanea	+	+	+	+	+					
Neodrepanis coruscans	+	+	+							
Bernieria madagascariensis	+	+	+	+	+		+		+	
Bernieria zosterops	+	+	+		+		+			
Bernieria tenebrosus	+									
Randia pseudozosterops	+		+		+					
Newtonia brunneicauda	+	+	+	+	+	+	+	+	+	+
Newtonia amphichroa	+		+	+						
Newtonia fanovanae	+									
Neomixis viridis	+		+		+					
Pseudobias wardi	+	+	+							
Oxylabes madagascariensis	+	+	+	+	+		+			
Mystacornis crossleyi	+		+		+					
Calicalicus madagascariensis	+	+	+	+	+	+	+	+	+	+
Schetba rufa	+	+	+	+	+		+			
Cyanolanius madagascarinus	+	+	+		+		+			
Oriolia bernieri	+	+								
Euryceros prevostii	+		+							
Hypositta corallirostris	+		+							
Tylas eduardi	+		+		+					
Ploceus nelicourvi	+	+	+	+	+	+	+	+		+
Foudia omissa	+	+	+	+	+		+			

Tableau 3: Liste des espèces de lémuriens inventoriées dans la forêt du corridor et les blocs de forêt isolés entre le corridor des Parcs Nationaux de Zahamena et de Mantadia.

	Corridor			**Blocs forestiers**						
	Zah	San	Man	TvnS	And	Voh	TvnN	Vav	Mar	Mah
Microcebus rufus	+	+	+	+	+		+	+		+
Indri indri[2]	+	+	+	+	+	+	+			+
Hapalemur g. griseus	+		+		+	+	+		+	
Eulemurfulvus	+	+	+		+	+	+	+		+
Varecia v. variegata[2]	+		+	+	+		+		+	
Avahi laniger	+		+	+	+		+			+
Eulemur rubriventer[1]	+		+		+	+				
Propithecus d. diadema[2]	+	+	+		+				+	
Cheirogaleus major	+	+	+		+					
Daubentonia madagascariensis[2]	+	+	+				+			
Lepilemur mustelinus		+	#							
Lepilemur microdon	+°									
Allocebus trichotis[3]	+°									
Phaner furcifer[1]	+									

+ :Présence; +° **:** Rapport Zahamena 1995; # **:**Espèce recensée pendant RAP Octobre 98- Janvier 99; [1]vulnerable; [2]en danger; [3]en danger critique

Rélations avec la surface et les distances des sites au corridor

La relation entre la surface (x = $\log_{10}$ surface) et le nombre d'espèces d'oiseaux forestiéres (y) observé se traduit par l'équation: y= -31,91 + 13,60x (t = 5,49, n = 10, p < 0,001, Fig. 1). Pour les lémuriens, la droite de régression a pour formule y = -8,00 + 4,04x (t = 3,76, n = 10, p < 0,01, Fig.1).

Pour la distance, le nombres d'espèces d'oiseaux et de lémuriens sont liés significativement aux distances (correlations de Spearman: oiseaux: r_s = -0,86; p = 0,002; lémuriens: r_s = -0,85; p = 0,002; n = 10).

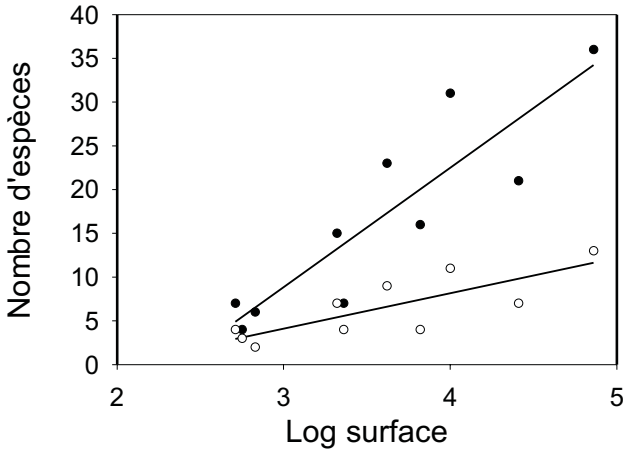

Fig. 1: Relation entre la surface ($\log_{10}$ surface en ha) et le nombre d'espèces d'oiseaux forestières (●) et des lémuriens (○).

Discussion

Oiseaux

Selon l'analyse de présence des espèces dans les sites choisis pour l'étude de fragmentation du corridor Zahamena-Mantadia, 13 espèces sont omniprésentes. Parmi ces espèces, seules, *Coua caerulea, Newtonia brunneicauda* et *Calicalicus madagascariensis* sont exclusivement forestières mais aucune n'est menacée. Ces espèces forestières (Tableau 2) sont classées parmi celles qui sont indifférentes aux fragmentations de la forêt.

Parmi les espèces forestières qui sont moins sensibles aux fragmentations de la forêt, il y a *Ploceus nelicourvi* et *Canirallus kioloides* qui sont présentes entre 100 et 65 % des sites visités.
Huit espèces forestières plus sensibles mais plus fréquentes dans les fragments de forêt humide de basse altitude se trouvent entre 65 et 35 % des sites. Parmi ces espèces, *Lophotibis cristata* (Presque menacée) et *Brachypteracias leptosomus*, (Vulnérable), sont menacées.
Les espèces dépendant de la forêt présentes dans les fragments entre 35 et 1% sont considerées très sensibles à l'effet de la fragmentation de la forêt humide. Parmi les 14 espèces classées dans cette classe quatre dont *Accipiter henstii* (Presque menacée), *Brachypteracias squamiger* (Vulnérable), *Atelornis pittoides* (Presque menacée) et *Randia pseudozosterops* (Presque menacée), représentant 10 % des espèces, sont menacées.
En dernier lieu, 10 espèces ne sont présentes que dans les forêts de référence (Namarafana, Sandranantitra et Mantadia). Ces espèces sont absentes dans les fragments de forêt du corridor. En effet, elles disparaissent dès qu'il y a une séparation entre la forêt et le corridor. Ces espèces sont *Eutriorchis astur* (Critique), *Accipiter madagascariensis* (Presque menacée), *Mesitornis unicolor* (Vulnérable), *Neodrepanis coruscans, Bernieria tenebrosus* (Vulnérable), *Newtonia fanovanae* (Vulnérable), *Pseudobias wardi* (Presque menacée), *Oriolia bernieri* (Vulnérable)**,** *Euryceros prevostii* (Presque menacée) et *Hypositta corallirostris*. Huit de ces espèces possèdent un statut, ce qui représentent 26 % des espèces forestières. L'augmentation des pourcentages des espèces statutaires par site est inversement proportionnelle à celle des pourcentages de présence. Cette analyse a justifié les statuts des espèces forestières, car plus les espèces sont sensibles plus elles occupent un rang élevé dans le statut de menace. Les espèces à rang élevé dans le statut de menace sont donc les plus sensibles à la fragmentation du corridor.
Selon l'analyse de régression sur le nombre d'espèces suivant la grandeur et la distance de séparation pour chaque site d'étude par rapport au corridor, une nette signification a été observée sur l'analyse de la surface. La distance n'influe pas le nombre d'espèces d'oiseaux recensées d'après des regressions multivariées. Proche ou loin du corridor, le nombre d'espèces hébergées dans les fragments de forêt reste le même pour une forêt de même surface. Plus la surface de la couverture forestière est grande, plus le nombre d'espèces forestières qu'elle héberge est élevé. A partir de l'analyse de présence des espèces, on peut donc dire que plus la surface de forêt est grande plus elle est importante, car elle a plus de chance de contenir des espèces d'oiseaux à rang élevé dans le statut de menace.

Lémuriens

Selon l'analyse de régression, la relation entre les surfaces et les nombres d'espèces est très significative, ce qui implique l'importance de la superficie sur la diversité de l'espèce. Par contre, d'après des regressions multivariées, la distance entre le fragment de forêt et le corridor n'a pas d'effet sur le nombre d'espèces. Bien que les surfaces influencent les nombres d'espèces, quelques reflets de tolérance ont été notés. Six espèces existent toujours dans les fragments de petite taille: *Hapalemur g. griseus, Eulemur f. fulvus, Varecia v. variegata, Indri indri, Microcebus rufus, Avahi laniger*. Ce sont les espèces les moins sensibles aux fragmentations. Pour *Propithecus d. diadema*, sa présence dans le site Marokitay a été signalée par les gens locaux; si cette information était vérifiée, cette espèce sera considérée comme moins sensible mais dans le cas contraire elle sera classée comme vulnérable aux fragmentations. Les trois espèces *Eulemur rubriventer, Daubentonia madagascariensis* et *Cheirogaleus major* sont considérées comme des espèces sensibles aux phénomènes de fragmentation. Le nombre d'espèces dans la forêt d'Andriantantely est nettement élevé, 50 % des espèces des sites de référence, par rapport à ce qui est compté dans la forêt classée de Tantavona Anjiro Sud, 29 %, alors que la surface de cette dernière est plus grande (6680 ha contre 4170 ha). Cette contradiction pourrait être due à l'âge de la fragmentation.

Conclusion

Comme les études antérieures déjà effectuées (Langrand 1995; Langrand et Wilmé 1997; Andrianarimisa *et al*. 2000) sur la fragmentation, nous avons trouvé que la superficie des fragments de forêt a un effet significatif sur le nombre d'espèces d'oiseaux et de lémuriens recensées dans une forêt. Les espèces d'oiseaux qui pourraient être les plus sensibles sont *Eutriorchis astur, Accipiter madagascariensis, Mesitornis unicolor, Neodrepanis coruscans, Bernieria tenebrosus, Newtonia fanovanae, Pseudobias wardi, Oriolia bernieri, Euryceros prevostii, Hypositta corallirostris* et pour les lémuriens *Propithecus diadema diadema, Lepilemur mustelinus, Lepilemur microdon* et *Phaner furcifer*. La fragmentation a une influence sur les êtres vivants par la réduction de la surface dans laquelle ils vivent. Plus la forest est fragmentée en petites portions plus l'effet de la fragmentation est fort. C'est l'espace vital des êtres vivants qui est la plus importante pour la pérennité des espèces d'un groupe, non pas la proximité des fragments par rapport au corridor qui est le lieu de brassage génétique des espèces. L'âge de la fragmentation a aussi une influence sur la richesse spécifique des fragments de forêt. Pour une surface de forêt inférieure à 4000 ha, beaucoup d'espèces forestières commencent à disparaître.

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Preliminary Study on the Lemur Communities at three Sites of dry deciduous Forest in the Réserve Naturelle d'Ankarafantsika

Ute Radespiel
Institute of Zoology, School of Veterinary Medicine Hannover, Buenteweg 17, 30559 Hannover, Germany

Herimalala Raveloson
Départment de Paléontologie et d'Anthropologie biologique, Faculté des Sciences, Université d'Antananarivo, B.P. 906, Antananarivo 101, Madagascar

The Reserve Naturelle d'Ankarafantsika was founded in 1927 with a size of 65,000 ha. Together with the adjacent Reserve Forestière d'Ampijoroa of about 70 000 ha this forest area is one of the largest protected zones in Madagascar. It contains diverse habitat types and vegetation zones that are generally categorized as dry deciduous forest.
ANGAP has taken over the responsibility for the park from Conservation International in the year 2000 and keeps 12 stations with permanent staff for the protection and surveillance of the forest. The major threats to the forest are connected to the large number of people living in the periphery or even within the protected area. Main causes for habitat loss are the exploitation of wood for construction or charcoal production, agriculture, bush fires and exploitation of raffia. These threats are not evenly distributed and depend on the respective human population density. It can be assumed that the pressures on lemurs vary in different parts of the reserve as well. Lemurs are mainly threatened by habitat destruction and hunting.
A new species of mouse lemurs, the golden brown mouse lemur (*Microcebus ravelobensis*) was described a few years ago from the forests surrounding Ampijoroa (Zimmermann *et al.* 1998) and its species status could recently been confirmed with mtDNA sequence data (Yoder *et al.* 2000; Pastorini *et al.* 2001). It lives in sympatry with the gray mouse lemur (*M. murinus*) in one forest patch in Ampijoroa (**J**ardin **B**otanique **A**), whereas it occurs exclusively in another patch (JBB). The distribution of mouse lemur species throughout the remaining parts of the reserve is not known, since capture/release studies have so far only been conducted in Ampijoroa and capturing is necessary for reliable species identification.
Besides mouse lemurs, three other nocturnal (*Avahi occidentalis*, *Lepilemur edwardsii*, *Cheirogaleus medius*), two cathemeral (*Eulemur f. fulvus*, *Eulemur mongoz*) and one diurnal (*Propithecus verreauxi coquereli*) lemur species are known from Ampijoroa and other parts of the reserve (Schmid and Rasoloarison 1997; CI 1999).
A preliminary field study was carried out in September 2000 in order to investigate the actual presence of lemur species and in particular the distribution of the different mouse lemur species in three additional sites (Figure 1).

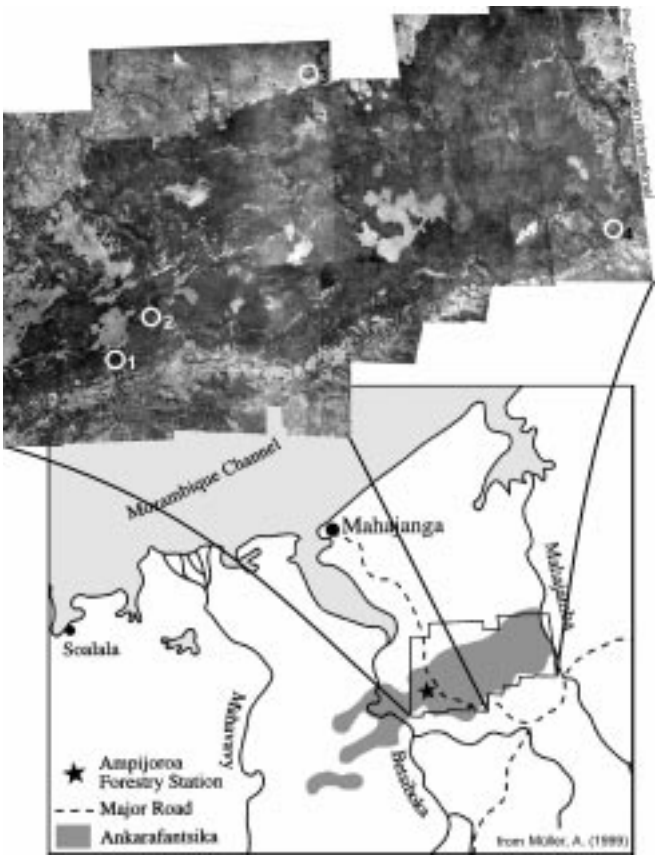

Fig. 1: Geographical map and aerial photograph (taken 1997 by Conservation International) of the reserve. White circles indicate study sites (1: Ankarokaroka, 2: Ampijoroa, 3: Ste. Marie, 4: Bevazaha).

Study sites
1. Ste. Marie (16°07'S; 46°57'E), 04.-08.09.2000
The study site is situated in an isolated forest fragment of about 150 ha in size. It is heavily disturbed and consists of secondary forest only. The main pressures within this forest patch are bush fires, exploitation of wood and forest products and the usage as cattle pasture.
2. Ankarokaroka (16°20'S; 46°48'E), 10.-14.09.2000
The study site is part of a continuous forest stretching from Ampijoroa towards the river Betsiboka. It consists of moderately degraded forest with a mixture of dense scrub, low xerophytic forest patches, riverine forests and humid forest patches with higher canopy (up to 20m). The study site is situated below a large lavaka and sedimentation is therefore a serious problem. The forest is furthermore constantly diminished by systematic tree cutting, large clear-cuts are already established and wide paths allow access with vehicles and are used to extract the wood. Lemurs are severely hunted.
3. Ampijoroa
The site has been described elsewhere (e.g. Richard 1978; Albignac 1981; Pagès-Feuillade 1988; Zimmermann *et al.* 1998; Müller 1999; Radespiel 2000; Rasoloharijaona *et al.* 2000; Schmelting *et al.* 2000).
4. Bevazaha (16°14'S; 47°09'E), 15.-19.09.2000
The study site is situated in a primary forest which is disturbed only to a minor extent. Exploitation of wood was not observed. The study site includes dry and dense forests with a low canopy (3-5 m) on the slopes of the valleys and humid forests with high canopy (14-16 m, single trees up to 25 m) with only moderate undergrowth along the river. The major threat to the lemurs is hunting which is apparent despite the presence of ANGAP staff.

Methods

We used preexisting trails for establishing at least two census lines per study site, one for nocturnal census walks and one for trapping (in Ste. Marie we used two shorter ones for each method).

1. Census walks

The line transect method was used to census nocturnal lemur populations during three nocturnal surveys that were conducted within the first 3.5 hours of the night. The trails were walked once per night at a slow pace (average: 552 m/hr) and one or both sides of the trail (depending on the existence of forests at the sides) were scanned with two observers using headlamps to detect lemurs by their eye shine. The trails were walked in different directions in successive nights. When lemurs were discovered, the species and number of individuals were recorded. Mouse lemurs were recorded as one species category, since the two sibling species cannot reliably be distinguished under census conditions.
The "encounter rate", i.e. the number of animals seen per km of census was calculated for each walk. In addition to sightings, lemur vocalizations were noted whenever they occurred. The composition of the lemur communities at the study sites was derived from the nocturnal census data, the vocalizations and daily or nocturnal *ad libitum* observations. The results are preliminary, since diurnal species were not systematically investigated. For comparative reasons, a species list is also provided for Ampijoroa, a site where intensive field work on lemurs was conducted over the last decades (see references listed above).

2. Capture/release

Two capture nights were conducted per site in order to a) determine the presence/absence of the different mouse lemur species and b) to gain a relative measure for their species-specific abundance. A total of 88 to 100 Sherman Live Traps were installed per study site and night. They were set up in the late afternoon at heights of 1-2 m every 20 m along the trail and baited with pieces of banana. They were checked for mouse lemurs between six and seven o'clock the next morning. The species and sex of the individuals was identified and the reproductive condition was determined following Buesching *et al.* (1998). The animals were released at the same evening at their exact place of capture.

Results and Discussion

Mouse lemurs were present in all three study sites despite the difference in forest composition and levels of disturbance. They could be observed during the nocturnal census walks in high numbers ranging from 8.9 to 51.1 individuals per kilometer (Table 1).
These values are high if compared to the results of other studies in other parts of Madagascar (e.g. Ganzhorn 1995; Irwin *et al.* 2000; Lehmann and Wright 2000; Nash 2000). This may be due to edge effects, since mouse lemurs have been shown to prefer forest edges that may offer preferred food sources (Ganzhorn 1995). Another explanation could be that mouse lemurs showed increased activities due to the beginning of the mating season and therefore were more visible and easily detectable. It cannot be decided, however, if the populations of mouse lemurs are stable and viable or not. In all three study sites we could capture estrous females but no informations are available on pregnancies, births or reproductive success.
The other nocturnal lemur species could be observed only in much lower numbers (Table 1). Only *Lepilemur edwardsii* and *Eulemur fulvus fulvus* could be confirmed to live in all three study sites. The other species were not observed in all forest patches. The absence of *Cheirogaleus medius* could possibly be explained by their habit to hibernate during the dry season (Müller 1999). They might not have yet emerged from their shelters. The absence of the larger lemur species in several sites, however, are more likely connected to the high hunting pressure in these areas. This could also be an explanation for the absence of *Avahi occidentalis* in Bevazaha.

Table 1: Median of "Encounter rates" during nocturnal census walks (animals per km, median (minimum, maximum)) and presence/absence of species on the basis of all available data (Type of census: Trail was scanned at one or two sides; +/-: species present/absent).

	Ste. Marie (a)	**Ste. Marie (b)**	**Ankarokaroka**	**Bevazaha**	**Ampijoroa**
Length of trail Type of census	**450m Two**	**450m One**	**950m Two**	**850m Two**	
Microcebus spp. (*murinus*/ *ravelobensis*)	22.2 (8.9-51.1) (+/+)	26.7 (15.6-33.3) (+/+)	21.1 (20-26.3) (+/+)	14.7 (10.6-20) (-/+)	(+/+)
Cheirogaleus medius	0 ?	0 ?	0 ?	0 (0-1.2) +	+
Lepilemur edwardsii	0 +	0 +	4.2 (3.2-5.3) +	0 (0-1.2) +	+
Avahi occidentalis	0 ?	0 ?	0 (0-2.1) +	0 ?	+
Eulemur f. fulvus	0 +	0 +	0 +	5.9 (0-5.9) +	+
Eulemur mongoz	0 +	0 ?	0 ?	0 ?	+
Propithecus verreauxi coquereli	0 +	0 ?	0 ?	0 ?	+
No. of confirmed lemur species	6	4	5	4	8

In Ste. Marie we captured 11 mouse lemurs corresponding to 8 (3 males, 5 females) different individuals in a total of 166 trap-nights. We captured 24 mouse lemurs and 16 (7,9) individuals in Ankarokaroka and 6 mouse lemurs and 6 (2,4) individuals in Bevazaha, each time with 200 trap-nights. The majority of animals belonged to *Microcebus ravelobensis* and this species was found in all three study sites. Only four individuals were grey mouse lemurs (*Microcebus murinus*). They were all found in Ste. Marie or in Ankarokaroka. None was captured in Bevazaha.
It can be concluded that the golden brown mouse lemur has a wider distribution than previously thought, at least within the reserve (Schmid and Rasoloarison 1997). On the other hand, the grey mouse lemur is less common than its sibling species. The reasons for these unexpected distribution pattern are not understood and will be investigated in an ongoing study.
Human impact in the protected area influences the distribution and abundance of the different lemur species. Only the smallest species, the mouse lemurs, seem to cope with the environmental changes. However, the stability and long-term viability of these populations and the species-specific responses still have to be investigated.

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A Biological Inventory of the Lemur Community of Réserve Spéciale de Kalambatritra, South-Central Madagascar

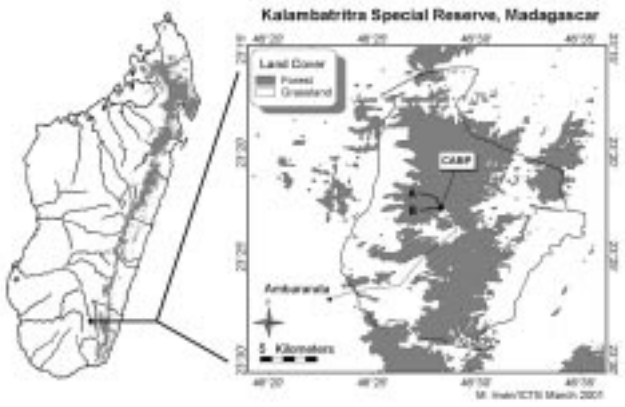
Mitchell T. Irwin
Department of Anthropology, State University of New York at Stony Brook, Stony Brook, NY, USA 11794-4364, **mirwin@ic.sunysb.edu**

Karen E. Samonds
Department of Anatomical Sciences, State University of New York at Stony Brook, Stony Brook, NY, USA 11794-8081, **ksamonds@ic.sunysb.edu**

Jean-Luc Raharison
Ecologie-Environnement, Département Biologie Animale, Université d'Antananarivo, Antananarivo 101, Madagascar, **MICET@dts.mg**

Many of Madagascar's protected areas have been the focus of long-term intensive study, and are therefore well-known in terms of their lemur community, and biology in general (e.g. Ranomafana National Park, Berenty Private Reserve, Beza-Mahafaly Special Reserve). However, even today, some protected areas remain largely unstudied. While long-term and intensive study is of great value, it is also important that efforts be made to directly survey poorly-known protected and unprotected forests, in order to gather accurate baseline knowledge of species' ranges and conservation status.

Kalambatritra Special Reserve (23º15'-23º29' S, 46º23'-46º36' E; 28,250 ha; elevation 740-1680 m) is located in southern central Madagascar, in both Fianarantsoa and Toliara provinces (Fig. 1). It is unique in that it lies significantly further west than any comparable rainforest in southeastern Madagascar, and straddles the continental divide between eastern (Mananara) and western (Mangoky/Onilahy) drainages. Approximately 45 % of the reserve is covered by largely continuous primary rainforest (elevation 1200-1680 m), including one large massif in the northern central part of the reserve (Ambalabe), a smaller massif in the south, and several smaller patches. This forest is not directly continuous with the main eastern rainforest corridor (a non-forested break of approx. 16 km exists between forests extending southeast from Kalambatritra and Midongy-du-Sud National Park). The remainder of Kalambatritra's land area is covered with grassland containing an ex-



Fig, 1: Location of RS Kalambatritra. Forest cover for Madagascar from Green and Sussman (1990); forest cover for Kalambatritra from a 1999 Landsat 7 satellite image. A, B denote census trails, dashed line indicates trail from Ambararata to survey camp.

tremely low human population density and very little cultivated land. It is difficult to determine whether this grassland is natural or anthropogenic (e.g. MacPhee *et al.* 1985); however, a comparison of topographic maps reporting land cover from aerial photographs taken in the 1950s (FTM 1972,1974) with a Landsat 7 satellite image from October 1999 reveal that little or no deforestation has taken place within this time (M. Irwin, unpublished data).

Very little research has been conducted within RS Kalambatritra and little is known about its flora and fauna. To our knowledge, only five biological expeditions have been conducted within the reserve: Nicoll and Langrand (brief biological survey, 1989), Nussbaum (1995, results not available), a Belgian University (results not available), ZICOMA (ornithological survey, 1998), and Intercoopération Suisse/ Marie E.R.T.A. (biological inventory, 1999).

The survey of Nicoll and Langrand (1989) was brief (M. Nicoll, pers. comm. to P. Wright), and reported the presence of four lemur species: *Eulemur fulvus rufus*, *Lemur catta* (in the gallery forests west of the reserve) and two unnamed nocturnals. The ZICOMA survey (ZICOMA 1999) reported the presence of four lemur species: *Hapalemur griseus griseus*, *Eulemur fulvus collaris*, *Eulemur rubriventer*, and *Lepilemur* sp. The Intercoopération Suisse/Marie E.R.T.A. survey (Intercoopération Suisse/Marie E.R.T.A. 1999b) reported the presence of five lemur species: *Microcebus rufus*, *Lepilemur* cf. *mustelinus*, *Hapalemur g. griseus*, *Lemur catta, and Eulemur fulvus rufus.*

Despite these previous efforts, characterization of Kalambatritra's lemur community remains uncertain. In particular, the following questions remain unanswered:

1. Which subspecies of *Eulemur fulvus* is present? The existence of conflicting reports requires clarification.
2. Is the family Indridae truly absent? The absence of this family (particularly *Avahi*, which is widespread) would be unusual among eastern rainforest localities and requires verification.

The surveys to date are inadequate to answer these questions. As mentioned above, Nicoll and Langrand (1989) apparently did not penetrate the large forest blocks of Kalambatritra, nor did the Intercoopération survey (see Intercoopération Suisse/Marie E.R.T.A. 1999b: 32). Both of the Intercoopération study sites were located in patchy forest (SW and SE of Ambalabe), and none of the ¨Points de passage des équipes¨ were more than 1.5 km from the forest edge. In addition, their report gives no details of their primate census methodology or sampling effort. It is therefore impossible to know whether this survey detected all possible lemur species. Finally, none of the five previous expeditions are known to have included primate specialists.

An adequate characterization of Kalambatritra's lemur community is desired for two reasons. First, researchers examining the effects of community composition on lemur ecology can test theories by studying in forests of differing lemur composition. If Kalambatritra truly lacks the family Indridae, it could offer a valuable opportunity for researchers interested in the presence of this family on other folivorous lemurs (e.g. *Lepilemur*). Secondly, in order to develop an effective management plan for the reserve, it is important to know the composition of the lemur community. Among Madagascar's native flora and fauna, lemurs remain one of the most popular tourist attractions. In order to predict a reserve's viability as a tourist attraction, it is important to first know which lemurs are present, and how easy they are to see (e.g. distribution and abundance).

The primary goal of the present study is to characterize the lemur community of RS Kalambatritra (species richness, distribution, and abundance), and specifically address the two questions listed above. To accomplish this, we penetrated the larger forest block in the northern half of the reserve (23º21' S, 46º28' E), which has never before been visited by a primatological survey team. The survey took place between 18 and 26 June, 2000.

Methods

Line-transect censusing

Two 2-km trails were established in the study area (Fig. 1). Because no trails existed in the study area, it was necessary to cut trails. Standard line-transect census methodology (Struhsaker 1981; Whitesides *et al.* 1988; Johnson and Overdorff 1999) was employed. A total of 21 diurnal censuses were conducted, both in the morning (approximately 8:00 to 10:00) and in the afternoon (approx. 15:00 to 17:00). In addition, nine nocturnal censuses (approx. 18:00 to 20:00) were conducted. The distance sampled was 31.56 km for diurnal census (14.56 km trail A + 17 km trail B) and 6.965 km for nocturnal census (1.965 km trail A + 5 km trail B).

Diurnal lemur densities were calculated using the perpendicular-distance method (Whitesides *et al.* 1988), using a fall-off distance of 20 m and a strip width of 48 m (24 m each side of the trail). Although the sample size of the present survey was inadequate to accurately determine a specific fall-off distance for Kalambatritra, the fall-off distance of approx. 20 m has been determined from previous surveys in the southeastern rainforests (Irwin *et al.* 2000b; P.C. Wright, unpub. data). Average perpendicular sighting distances at Kalambatritra were similar to those of the other surveys (Irwin *et al.* 2000a, unpublished data). For the nocturnal *Lepilemur*, the average perpendicular sighting distance was almost exactly half that of diurnal species; therefore a strip width of 24 m (12 m each side of the trail) was used.

Botanical Assessment

Three botanical transects were established along each 2-km census trail, evenly spaced at 400 m intervals (total = 6 transects). At each location, a 10 m by 100 m transect was established perpendicular to the trail. For all trees over 10 cm diameter at breast height (dbh), the following data were recorded: local name, dbh, height and crown diameter. In order to census smaller trees and lianas, additional 5 m by 5 m plots were established within each botanical transect, in which all trees or lianas regardless of size were inventoried.

Assessment of Forest Disturbance and Hunting

Evidence of human disturbance (e.g. trees felled, tavy, traps, human habitation) was noted whenever encountered. In addition, interviews with local people, whenever possible, were conducted in order to determine the nature and extent of forest use and hunting practices.

Results

Study Site

Our camp (23º22.4' S, 46º28.2' E) was established within Ambalabe, the largest continuous forest block found in RS Kalambatritra. Note that the FTM topographic map (FTM, 1972) contains an error: the area labelled «Befarafara» (23º23' S, 46º27' E) is known locally as «Ambalabe», while the forest approximately 5 km to the east (23º23' S, 46º30' E) is known as «Befarafara». Our camp was approximately 12.4 km NE of Ambararata (23º27.0' S, 46º22.8' E), and 5.7 km ESE of Ambaro (23º21.1' S, 46º25.1' E). We established two 2 km census trails, Trail A (starting approximately 0.5 km north of camp and continuing west) and Trail B (starting near camp and continuing roughly west. Elevation of the study area is approx. 1400-1680 m. The site was accessed by driving through Ihosy and Betroka to Ivahona (23º27.3' S, 46º10.3' E) and hiking from there (approximately 32 km).

Lemur Census

Results are summarized in Table 1. Two diurnal species were seen: *Eulemur fulvus collaris* and *Hapalemur griseus* ssp. A third, *Lemur catta*, was not directly observed but locals testified that it exists in gallery forests to the west of the study area. Two nocturnal species were seen: *Lepilemur* sp. and *Microcebus rufus*. Traces of a third species (*Daubentonia madagascariensis*) were also seen.

Table 1: Census results.

Species	Census Sightings		Sightings per km walked	Group density (groups/km^2)	Minimum Number of Groups
	Trail A	Trail B			
Eulemur fulvus collaris	5	2	0.22	4.62[a]	4
Hapalemur griseus ssp.	4	2	0.19	3.96[a]	4
Daubentonia madagascariensis	0	0	0	-	1++
Lepilemur sp.	7	5	1.72	71.79[b,c]	4
Microcebus rufus	0	2	0.29	-	1

a. using strip width of 48 m (see Methods); b. using strip width of 24 m (see Methods); c. equals individual density (all encounters were with lone animals)

Eulemur fulvus collaris (local name = *Varika*/*Varikabe*): Most individuals seen matched published descriptions of this subspecies and were easily distinguished from other subspecies of *Eulemur fulvus*, including *E. f. rufus* (e.g. Mittermeier *et al.* 1994). However, there was some variation in beard color: some individuals had orange beards while others had lighter (almost white) beards. Although Kalambatritra is not far from the known range of *E. f. albocollaris*, it seems most likely that the animals observed here represent one slightly variable population of *E. f. collaris*. The mean number of individuals per sighting was 3.3, with a range of one (a lone adult male) to five (three males, two females).

Hapalemur griseus ssp. (local name = *Varika* / *Varikakely*): Much phenotypic variation was observed among the individuals of this species. Some individuals appeared to be much larger than is known for wild *H. g. griseus* (visual estimates of >1.5 kg), had darker brown pelage and larger, more projecting, rounded ears with a white fringe. However, other individuals were much smaller (visual estimate <1 kg) with greyer pelage, and smaller, inconspicuous ears (closely matching published descriptions of *H. g. griseus*; e.g. Mittermeier *et al*. 1994). We strongly believe that these animals represent *H. griseus* rather than *H. simus* or *H. aureus*, based on overall pelage as well as distinctive vocalizations. However, it remains possible that this population represents *H. g. meridionalis* or a novel subspecies. The mean number of individuals per sighting was 2.2 (range 1 to >5).

Daubentonia madagascariensis: Several feeding traces of this species were found (tooth gouges), usually in dead and rotting palm trees (*Dypsis* sp.). Some of these traces were quite recent (less than one week old). No individuals were directly observed.

Lepilemur sp. (local name = *Trangalavaka*): This species was commonly observed on both transects and appears to be quite abundant at the study site. All individuals observed were brown in color, with a tail which became dark towards the tip, and white below the chin. Little or no dorsal stripe was observed. All encounters were with lone individuals, and an extremely high population is extrapolated (71.79 individuals / km^2). This would be equivalent to a spatially continuous population of pairs each having home range 2.8 ha.

Intercoopération and Marie E.R.T.A. (1999b) report that the *Lepilemur* individuals they encountered appeared to belong to *L. mustelinus*, previously known only from significantly further north (north of approximately 18°S). However, no individuals were captured during the course of their study or the present study; any species designation is therefore highly speculative. Capture and DNA analyses would be necessary to definitively diagnose this population, and the most parsimonious alternatives are *L. microdon* (found in the southeastern rainforests, to the east of Kalambatritra), *L. leucopus* (found in the dry forests of southern Madagascar, south of Kalambatritra) or *L. ruficaudatus* (found in the dry forests of southwestern Madagascar, west of Kalambatritra).

A *Lepilemur* latrine was encountered on trail A. A large pile of feces (diameter 0.5 m, depth approx. 5 cm) was found at the base of a Hafitra tree (*Dombeya* sp.), and that tree, along with several other Hafitra trees in the vicinity, displayed several single scratches (1-2 cm long and 1-2 m above ground). A vigil revealed that the feces were those of *Lepilemur* sp., and the scratches are likely due to concurrent scentmarking. Other trees with similar traces (and one older pile of feces) were found elsewhere on the census trails, at great distance from the location mentioned above, suggesting that this behavior is common in the area. At present we do not believe this behavior has been previously reported in *Lepilemur* (or any other lemur species), and speculate that it may be a territorial response to their extremely high population density.

Microcebus rufus: This species was observed on two occasions on trail B. Phenotypically, the animal(s) observed seemed to fit the published descriptions of *M. rufus*.

The present survey found no evidence of *Propithecus* or *Avahi*, which is consistent with previous surveys, and adds further evidence indicating the absence of the family Indridae. This survey also found no evidence of *Eulemur rubriventer*, which was reportedly found by the ZICOMA survey (ZICOMA 1999). Further confirmation of this sighting is necessary, but the absence of *E. rubriventer* is consistent with its apparent absence at nearby PN Midongy-du-Sud. The failure to detect *Cheirogaleus* sp. is likely an artifact of the timing of the survey, during which most individuals would be expected to be in torpor.

Botanical Inventory

A total of 0.6 ha (305 trees) was sampled. Ambalabe contains primary forest with no evidence of disturbance. The canopy height averages approximately 25 meters, with several trees attaining heights of greater than 30 meters. Trees with dbh exceeding 2 m were routinely encountered in the transects. In both height and dbh, Kalambatritra contains consistently larger trees than comparable southeastern rainforest localities (Figure 2). In the largest parts of the forest, there exists a sharp distinction between the canopy and the herbaceous understory, which averages approximately 3 meters in height. Palm trees (*Dypsis* sp.) are conspicuous and frequently attain heights exceeding 25 m. 63 tree species were identified in the botanical transects; Table 2 presents the ten most abundant species (following Turk 1995).

Table 2: Common tree species at Kalambatritra.

Malagasy Name	Family	Scientific Name
Faho	Cyatheaceae	*Cyathea* sp.
Karambitona	Euphorbiaceae	*Macaranga myriolepidea*
Merana	Compositae	*Brachylaena merana*
Ramilevina	Compositae	*Apodocephala pauciflora*
Sandramy	Anacardiaceae	*Protorhus* sp.
Tavolo	Lauraceae	*Cryptocarya* sp.
Vakoana	Pandanaceae	*Pandanus* sp.
Vanana	Elaeocarpaceae	*Sloanea rodantha*
Varongy	Lauraceae	*Ocotea* sp.
Vatsilana	Araliaceae	*Schefflera* sp.

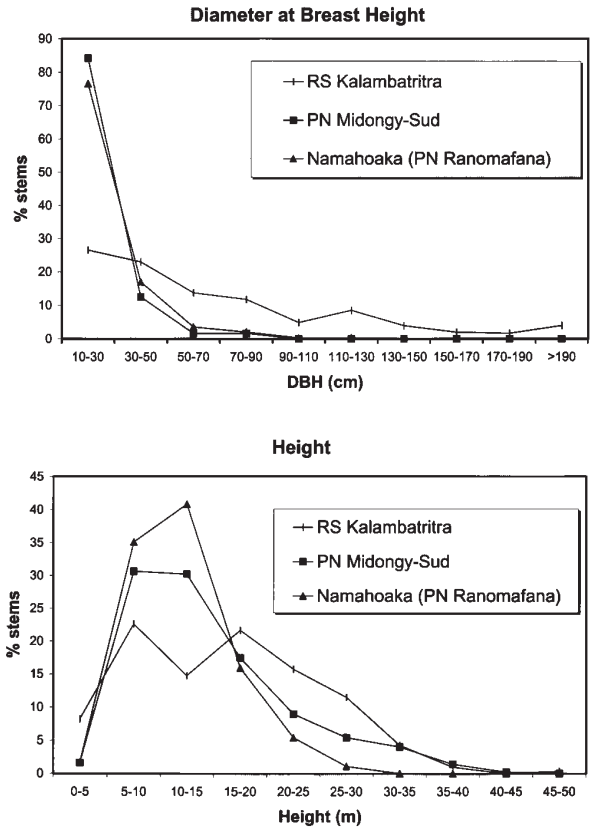


Fig. 2. Comparisons of Kalambatritra forest structure with two other southeastern rainforest localities (trees > 10 cm dbh). Midongy data from P. Wright (unpublished), Namahoaka from Irwin *et al.* (2000b). Area/No. of trees sampled: Kalambatritra, 0.6 ha/305; Midongy, 0.6 ha /424; Namahoaka, 1.0 ha /647.

Forest Disturbance

We saw traces of human presence (e.g. well-used trails, cut trees) in two smaller forest blocks that we passed through (Befarara and Befarafara) on the way to Ambalabe. However, within Ambalabe, no signs of human presence were observed near camp or on any of our trails (total length approx. 4.5 km). No existing trails for human or zebu use were encountered, nor were any human signs of any kind. Locals testified that some hunting of frugivorous lemurs is conducted within the rainy season, by clearing small areas within the forest and setting snares. However, such activities tend to leave traces which last for more than one year, and no such traces were encountered at Ambalabe. The absence of both traps and trails suggests that such activities probably occur closer to the forest edge. This study area is therefore extremely unique in showing absolutely no evidence of human use; few forests in Madagascar have been completely free of exploitation by humans. The primary reason for Kalambatritra's pristine nature is probably the extremely low human population density in the region, and the fact that Ambalabe is more than 5 km from the nearest village.

Discussion

The results of the present survey allow us to provide some answers to the questions posed here (see Introduction). First, contrary to the reports of Nicoll and Langrand (1989) and Intercoopération Suisse/Marie E.R.T.A. (1999b), the subspecies (or species; see Djelati *et al.* 1997, Wyner *et al.* 1999) of *Eulemur fulvus* represented is *E. f. collaris*. This is not surprising given that *E. f. collaris* is also found in PN Midongy-du-Sud, the closest well-known forest (approximately 40 km to the east). It appears that this lemur was misidentified both by the brief survey of Nicoll and Langrand (1989) and the supposedly more extensive Intercoopération survey (although they report encountering only two groups of *Eulemur fulvus*; Intercoopération Suisse/Marie E.R.T.A. 1999b: 73).

Second, it appears that the family Indridae is indeed absent from this forest. During eight days of data collection, we accumulated a large sampling effort for lemur censuses: almost 32 km for diurnal censuses and 7 km for nocturnal censuses (and a total of approx. 150 and 20 hours spent on the census trails during day and night, respectively). In addition, examination of the species accumulation curve reveals that all five species found by our survey were detected by the second of eight days of data collection, implying that the sampling effort was sufficient. Finally the large number of sightings of other species (e.g. 12 for *Lepilemur*) also suggests that the sampling effort was adequate.

Equally striking is the seemingly high population density of *Lepilemur*. It seems possible that the reason for this abundance is the absence of other folivores with which it might compete for food (*Propithecus* and *Avahi*; e.g. Ganzhorn 1993). This is an interesting biological phenomenon and worthy of further research in order to: (i) more definitively establish the absence of Indridae, (ii) determine which species of *Lepilemur* is present at Kalambatritra, and (iii) gain further understanding of the interspecific relationships among *Lepilemur, Propithecus*, and *Avahi* by studying *Lepilemur* in the absence of its two competitors.

There exists a slight possibility that *Propithecus* and/or *Avahi* do exist within RS Kalambatritra but remained undetected by our censuses. For example, they may exist in other regions of the reserve (although our study site was situated in the largest continuous forest block). However, our data suggest that even if *Propithecus* is present at Kalambatritra, they seem to exist in exceedingly low population densities. This in itself would be an interesting biological phenomenon, as *Lepilemur* is not often known to exist at high densities relative to its competitors in the southeast (e.g. PN Ranomafana).

Kalambatritra's species richness is fairly low for an eastern rainforest locality (5 species detected, 7 likely present, including *Lemur catta* and *Cheirogaleus* sp.). However, this reserve holds a unique assemblage of species, and therefore presents a unique research opportunity for those interested in lemur community dynamics. Unfortunately, the absence of many large-bodied diurnal lemur species (especially *Propithecus* and *Varecia*) means that Kalambatritra may be less attractive to tourists than other protected areas in the region (e.g. PN Andringitra, RS Manombo). Nevertheless, the pristine primary forest of Ambalabe is extremely impressive to behold, and it is our opinion that this alone could be one of the primary attractions of the reserve. In other parts of the world, forests of extreme size and age are protected and visited by tourists (e.g. temperate rainforests of western North America). Kalambatritra may prove to be truly exceptional within Madagascar in the size and age of its trees, and should be protected as an example of the potential of Malagasy forest in the absence of human disturbance.

The Intercoopération report concludes, because human pressures are currently very low at Kalambatritra, that "cette region ne constitue pas une priorité pour l'Etat" ("This region does not constitute a priority for Madagascar"; Intercoopération Suisse/Marie E.R.T.A. 1999a: 16). We strongly disagree with this assessment. Kalambatritra is unique in its biogeography, flora, and lemur and bird communities (including three rare and vulnerable bird species; Irwin *et al.* 2000a) and represents a rare example of pristine, undamaged eastern rainforest. Further inventories should be undertaken to examine the species composition and endemism of other groups of plants and animals. The unique biogeo-

graphic position of the reserve, coupled with its isolation from the continuous rainforest corridor to the east, means that such studies may well find new species and unique communities. Effective management plans should be implemented, and demographic and socio-economic changes in and around the reserve should be monitored carefully, in order to maintain the sanctity of this protected area.

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Indications for Hybridisation between Red-fronted Lemurs (*Eulemur fulvus rufus*) and Mongoose Lemurs (*E. mongoz*) in Northwest Madagascar

Alphonse Zaramody
Département des Sciences de la Terre, Université de Mahajanga, B.P. 652, Mahajanga 401, Madagascar

Jennifer Pastorini
Department of Biology SCI 348, Southwest Texas State University, 601 University Drive, San Marcos, TX 78666, USA,
jp37@swt.edu

Eulemur is the most diverse and widespread genus of the family Lemuridae, with five currently recognised species. The mongoose lemur, *Eulemur mongoz*, occurs in three geographically isolated populations; on two Comorian islands (Anjouan and Mohéli) and in northwest Madagascar. The brown lemur, *E. fulvus*, has the largest distribution of the five *Eulemur* species and contains at least six subspecies. Brown lemurs are found on the Comorian island Mayotte, in all forested areas of Madagascar except the South and. *E. fulvus* is found in sympatry with all four other *Eulemur* species, including *E. mongoz* in northwestern Madagascar (for review see Tattersall 1982; Harcourt and Thornback 1990; Mittermeier *et al.* 1994).
One of the authors (AZ) collaborated on a 10-month study on mongoose lemurs at Anjamena in northwestern Madagascar (Fig. 1) carried out by D.J. Curtis (Curtis and Zaramody 1998, 1999; Curtis *et al.* 1999). During the field work from September 1994 to September 1995, animals were observed which presented pelage coloration intermediate between *E. mongoz* and *E. f. rufus*. This phenotypic variation led to the suspicion that interspecific hybridisation might be occurring at this site (see Table 1 in Curtis and Zaramody 1998). However, apart from this anecdotal observation, no one has reported hybrids among *Eulemur* species in the wild and no genetic evidence has been published supporting that claim. Mongoose lemurs and brown lemurs represent well accepted discrete species which are phenotypically distinct.

Within the scope of a comprehensive study on the systematics of lemurs (Pastorini 2000; Pastorini *et al.* 2000, 2001, 2001) a mitochondrial DNA (mtDNA) fragment for several representatives of *E. mongoz* and *E. fulvus* from Anjamena was sequenced. The small subset of samples thus far analysed hardens the suspicion of a hybrid zone between mongoose lemurs and red-fronted lemurs in northwestern Madagascar. The goal of this report is to present the available preliminary data which indicate that *E. mongoz* and *E. f. rufus* may hybridise in the wild.

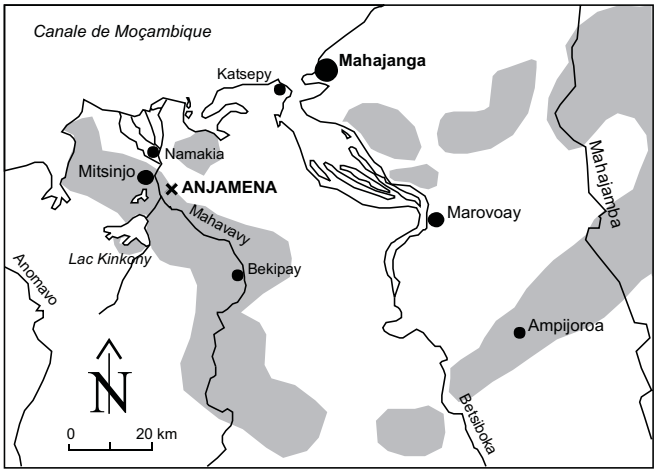

Fig. 1: Map of Madagascar showing the study site (adapted from Curtis and Zaramody 1999). Primary and secondary forests are shaded.

Methods

Field work

We conducted the field study from July to September 1997 on several neighbouring groups of *E. mongoz* and *E. fulvus* in northwestern Madagascar. The study site was close to the village Anjamena (45º55'E, 16º03'S) in the riverine forests to the East of the Mahavavy river (Fig. 1). The village Anadabomandry is located on the other side of the river (west) and is near our additional capture location. Samples were analysed from five *Eulemur mongoz* and six *E. fulvus rufus* (Table1). For comparison, one *E. coronatus*, two *E. macaco* (2ssp.), one *E. rubriventer* and four *E. fulvus* (4 ssp.) were included in the dataset (GenBank Accession Numbers AF2244524, AF224530, AF224531, AF224525, AF224536, AF224558, AF224560, AF224568). One *Lemur catta* (AF053684) was used as the outgroup.

Table 1: Sample information for the mongoose lemurs and brown lemurs sequenced from the hybrid zone.

Taxon	Origin	ID	GB
E. mongoz 1	Anjamena	JP169	AF224514
E. mongoz 2	Anjamena	JP178	AF224516
E. mongoz 3	Anjamena	JP196	AF224517
E. mongoz 4	Anadabomandry	JP177	AF224515
E. mongoz 5	Anadabomandry	JP211	AF224518
E. fulvus rufus 1	Anjamena	JP161	AF224545
*E. fulvus rufus 2**	Anjamena	JP162	AF224546
E. fulvus rufus 3	Anjamena	JP171	AF224547
E. fulvus rufus 4	Anjamena	JP206	AF224550
E. fulvus rufus 5	Anadabomandry	JP176	AF224548
E. fulvus rufus 6	Anadabomandry	JP181	AF224549
ID = identificaton number, GB = GenBank accession number; * = potential hybrid			

Genetic analysis

MtDNA analysis has become established as a powerful tool for the study of molecular evolution. DNA sequence data can also be used to determine the taxonomic affiliation of individuals of unknown origin. In this study we present the phylogenetic relationships among mongoose lemurs and red-fronted lemurs from Anjamena, based on the sequences of a large fragment of mtDNA. Close attention is given to the relative positions within the genus *Eulemur* of each individual taken from this site. This approach allows detection of individuals whose genotype (mtDNA) is not the same as their phenotype (fur coloration).

DNA was extracted from hair, blood or tissue samples. The segment of the mtDNA amplified and sequenced includes a fragment of the COIII gene, complete sequences for three NADH-dehydrogenase subunits (ND3, ND4L, ND4), as well as five tRNA genes (Gly, Arg, His, Ser, partial Leu). Amplification and internal sequencing primers are provided in Pastorini *et al.* (2000). The sequencing reactions were electrophoresed and analysed on an automated sequencer (ABI 377). All templates were sequenced in their entirety for both strands. The procedures are detailed in Pastorini *et al.* (2000).

Aligned sequences were analysed using maximum parsimony, neighbor-joining, and maximum likelihood methods in PAUP* 4.0b4 (Swofford 1999). Branch-and-bound searches were utilised in parsimony analyses and Kimura 2-parameter distance corrections were used for neighbor-joining analyses. Maximum likelihood trees were calculated via heuristic search using the equivalent of the HKY model. Bootstrap analyses of 2500 replicates were performed to estimate statistical support for each clade.

Results

The mtDNA sequences for the taxa examined have been deposited in GenBank (Table 1). The nucleotide sequences span a total of 2393 base positions (bp) and yielded 337 parsimony-informative characters. The maximum parsimony search with all characters weighted equally results in four trees of 919 steps in length with a consistency index of 0.69 and a retention index of 0.79. The final maximum likelihood tree (–ln likelihood = 5646.85) was obtained with a previously estimated transition/transversion ratio of 13.61 and gamma shape parameter of 0.05.

The relationships among the clades remain consistent in all analyses. Generally, there is very high bootstrap and jackknife support in maximum parsimony or neighbor-joining analyses for the branching order of the different taxa (Fig. 2). All analyses group five *E. f. rufus* into one clade and five *E. mongoz* into another clade. However, the latter clade additionally includes one *E. f. rufus* (No. 2). In maximum parsimony or neighbor-joining analyses, the mongoose lemur clade, which includes this single *E. f. rufus* individual, is supported with bootstrap values of 100 %, as is the clade containing the remaining five *E. f. rufus* individuals. The maximum likelihood phylogram presented in Figure 2c maintains branch lengths proportional to the number of changes. Long branches separate the clade including five red-fronted lemurs from the clade formed by five mongoose lemurs and one red-fronted lemur.

Absolute pairwise distances range from a maximum of 318 to 341 bp between *L. catta* and the ingroup to between 0 and 90 bp within the genus *Eulemur*. Examination of absolute pairwise distances within the genus *Eulemur* reveals three levels of differentiation: The divergences between *Eulemur* species are higher (142-198 bp) than between *Eulemur* subspecies (31-89 bp). Pairwise comparisons of the individuals within the *E. mongoz* clade (including *E. f. rufus* No. 2) and the *E. f. rufus* clade give values in the range of 0 to 10 bp.

Discussion

Animals which exhibited an intermediate pelage pattern of *E. f. rufus* and *E. mongoz* were observed in the area of sympatry at Anjamena in northwestern Madagascar. The suspi-

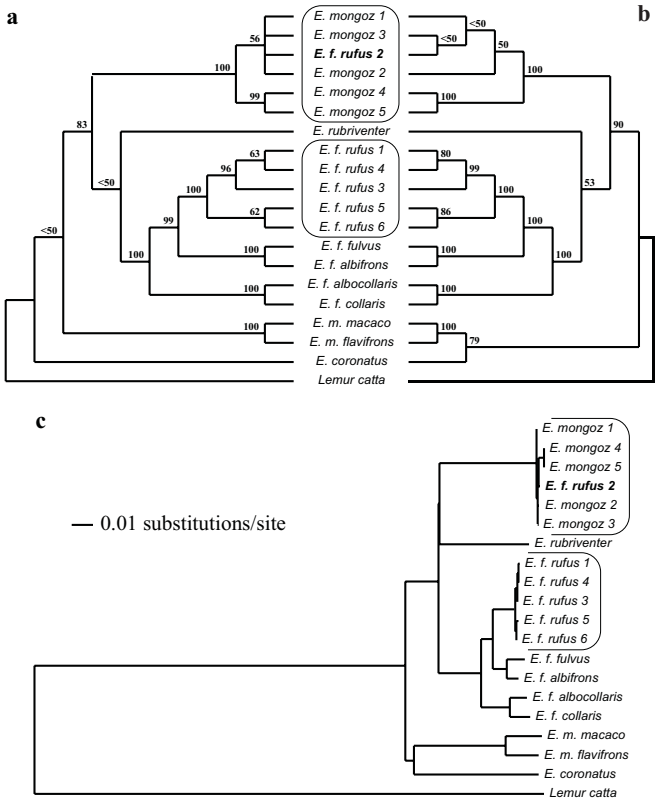

Fig. 2: (a): Maximum parsimony tree with bootstrap values (as percentages, above nodes). (b): Neighbor-joining tree with bootstrap values. (c): Maximum likelihood phylogram with proportional branch lengths. The potential hybrid is highlighted with bold letters.

cion of this potential hybrid zone has been substantiated by a red-fronted lemur which showed the mtDNA genotype of a mongoose lemur. All genetic analyses unambiguously group five *E. f. rufus* individuals into one clade and link one *E. f. rufus* individual with *E. mongoz* into another clade. Both clades are strongly supported by bootstrap analyses and in the maximum likelihood phylogram they are separated from each other by long branches. Such paraphyly strongly indicates that this *E. f. rufus* individual No. 2 has the mtDNA genotype of a mongoose lemur. Pairwise distance comparisons confirm this conclusion: Genetic distances between that single *E. f. rufus* individual and *E. mongoz* (3-9 bp) are of the same order as among *E. mongoz* individuals (0-10 bp). In contrast, the genetic distances between *E. f. rufus* individual No. 2 and the other five *E. f. rufus* individuals (151-159 bp) are fairly high and clearly lie in the range of comparisons among *Eulemur* species (142-198 bp).

The 11 lemurs sequenced for this study all had the correct and unmistakable fur coloration of either *E. mongoz* or *E. fulvus* and lived in social groups including only animals of their own taxon. However, one individual which phenotypically looks like a *E. f. rufus* groups genetically within the *E. mongoz* clade. A mistake in identifying the correct taxon is not very likely, because it is quite easy to distinguish among male as well as among female *E. f. rufus* and *E. mongoz* (for illustrations see Mittermeier *et al.* 1994). The fact, that the *E. f. rufus* individual No. 2 which had the mtDNA genotype of *E. mongoz* was phenotypically a normal red-fronted lemur female could indicate that the hybrid cross occurred generations ago. This would imply that crosses between *E. f. rufus* and *E. mongoz* give rise to fertile hybrids. However, as no artificial hybrids are known in captivity we cannot be certain of the F1 phenotypic results from such a mating. It is possible that a simple F1 mating between these species could result in a phenotype indistinguishable from either parental species. Furthermore, because mtDNA is inherited through matrilines it follows that the hybrid cross included a female mongoose lemur and a male red-fronted lemur. Interestingly, during our field work in 1997 we observed two mongoose lemur groups with females which had a pelage coloration intermediate between *E. mongoz* and *E. f. rufus*. Both groups consisted of one adult female (phenotypic hybrid), one adult male (*E. mongoz*) and a juvenile. If we assume the females to be the mothers of those juveniles, this would support the hypothesis, that the hybrids are fertile.

The small sample presented here provides support that hybridisation might occur between *E. mongoz* and *E. f. rufus*. So far there are no reports of hybridisation among *E. fulvus* and another sympatric *Eulemur* species in the wild. As *E. fulvus* and *E. mongoz* appear to fail to meet the widely specified criterion, namely reproductive isolation from each other, recognition of two species might be considered as questionable. However, there is no doubt that *E. mongoz* and *E. fulvus* should continue to be considered separate species. There is strong morphological evidence supporting the distinction between species of *E. mongoz* and *E. fulvus*. The genetic sequence data presented here unambiguously depict high levels of differentiation between *E. mongoz* and *E. fulvus* scaled relative to other members of the genus *Eulemur*, which further supports their species status. However, *E. mongoz* and some of the *E. fulvus* subspecies have the same karyotype (2N=60), which might explain the successful interbreeding resulting in fertile hybrids. In contrast, *E.coronatus* (2N=46), *E. macaco* (2N=44), *E. rubriventer* (2N=50), as well as the two subspecies *E. f. albocollaris* (2N=48) and *E. f. collaris* (2N=52) have different karyotpyes (Rumpler 1975). Despite the identical karyotype and case for sympatric hybridisation presented here, the two taxa are distinguishable both phenotypically and genetically for their range.

The genetic results presented here are only preliminary and were not specifically designed to test the hybrid zone. The sample size is very small and no individuals with the observed intermediate pelage pattern of *E. f. rufus* and *E. mongoz* were available for analyses. The use of mtDNA sequence data exclusively tends to underestimate the number of potential hybrids because only the genetic contribution through the matriline is considered. Additional samples from the site are currently being analysed using mtDNA sequence data as well as microsatellites. The addition of nuclear data will provide a more accurate picture of the potential genetic exchange among brown lemurs and mongoose lemurs at Anjamena. The processing of phenotypically intermediate individuals for genetical characterisation should assist with determining the value of fur coloration to predict a hybrid.

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Suivi écologique de deux espèces de lémuriens diurnes *Varecia variegata rubra* et *Eulemur fulvus albifrons* dans la presqu'île de Masoala (1993-1998)

Marius Rakotondratsima
Wildlife Conservation Society, B.P. 8500, Antananarivo 101, Madagascar. **wcsmad@bow.dts.mg**

Claire Kremen
Center for Conservation Biology and Wildlife Conservation Society, Biological Sciences Department, Stanford University, Stanford, CA 94305. **ckremen@leland.stanford.edu**

Depuis l'établissement du Programme de Conservation et de Développement Intégré de Masoala, *Varecia variegata rubra* et *Eulemur fulvus albifrons* ont été choisi comme indicateurs biologiques compte tenu de l'importance de leur rôle écologique au sein de ce massif forestier en l'occurrence dans la dispersion des graines. Comme ces animaux occupent un large domaine vital, ils sont considérés comme espèces "parapluie". Si bien que les lémuriens seraient non seulement des espèces porte-fanion, mais aussi des espèces-clés appropriées pour aider à suivre et évaluer la réussite des efforts de préservation de l'écosystème tout entier et de la gestion des ressources forestières à travers de l'établissement d'un PCDI et du Parc National Masoala (Kremen *et al*. 1994; Merenlender *et al*. 1998).

Peu d'études ont été effectuées sur la dynamique de populations des lémuriens Malagasy et sur leur réponse à la destruction et la perturbation de l'habitat (e.g., Ganzhorn and Schmid 1998). En outre, les lémuriens subissent aussi la pression de la chasse (Mittermeier *et al*. 1994). A Masoala, la destruction forestière se manifeste par la transformation progressive des forêts en zones d'agriculture et la perturbation est provoquée par les exploitations forestières telles que l'extraction d'espèces d'arbre. *V. variegata rubra* apparaît l'espèce la plus touchée par ces deux formes de menace. Elle est connu comme une espèce strictement arboricole et forestière, montrant une exigence plus élevée vis-à-vis de la typologie de la forêt (Rigamonti 1993). Par ailleurs, les lémuriens jouent des rôles écologiques importantes. Une altération de la structure et de la composition de l'habitat pourrait modifier la distribution et réduire l'abondance des lémuriens, et vice versa (Merenlender *et al*. 1998). Comme la chair de ces deux espèces est très appréciée et qu'elles figurent parmi les plus grands mammifères de la forêt, elles sont fortement chassées. Les pièges sont plus fréquents surtout dans les forêts près des zones d'agriculture. La chasse au fusil est également rapportée par les villageois.

Cet article montrera les résultats de suivi de populations des deux espèces de lémuriens depuis 1993. L'étude a été conduite chaque année afin de suivre l'évolution et la tendance de la dynamique de population de ces deux espèces de lémuriens à l'intérieur du noyau dur du Parc et à l'extérieur dans les zones tampons et zones périphériques.

Méthodologie

Choix des sites

Les six sites d'étude sont localisés principalement dans le versant ouest de la presqu'île entre le village d'Ambanizana et la pointe de Tampolo. Trois de ces sites, Andranobe, Antrafonaomby et Bedinta, sont choisis dans des zones de forêt non ou peu perturbées. Alors que les trois autres, Ambanizana, Antambakoanorona et Ambodiforaha, sont dans des zones perturbées (Merenlender 1995; Rakoton-

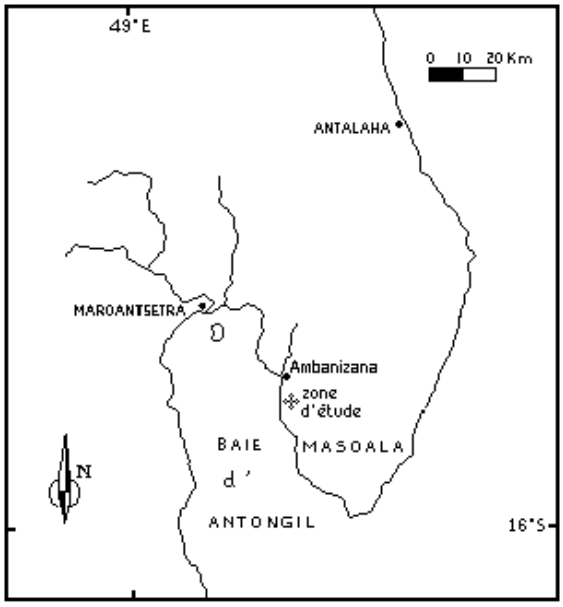

Fig. 1: Carte de localisation de la presqu'île de Masoala et la zone d'étude.

dratsima 1995; Merenlender *et al*. 1998). Nous précisons que ces sites non perturbés sont localisés dans le noyau dur du Parc, et les sites dits perturbés se trouvent en chevauchement entre zones tampons et zones périphériques du Parc (Projet Masoala 1995).
Les pistes d'étude sont choisis parmi les pistes préexistantes utilisées par les villageois dans leur recherche des ressources forestières ou bien des pistes utilisées par les autres chercheurs dans la région. Ces pistes suivent souvent des lignes de crêtes. Cette situation facilite la détection des lémuriens par la vue ou par l'écoute de cri ou d'autres bruits provoqués par ces animaux. Comme la presqu'île présente une topographie très accidentée, il est impossible de concevoir des transects rectilignes. Toutefois, les pistes choisies sont plus ou moins orientées dans une même direction.
Toutes les pistes d'observation sont marquées tous les 50 mètres à l'aide d'un ruban (flag tape) coloré noué sur des branches bordant les pistes facilement visibles lors des observations des animaux. En plus, des points GPS sont collectés sur les pistes tous les 500 m chaque fois que possible. Toutes ces données serviront à la numérisation des pistes et à l'estimation des surfaces échantillonnées (Merenlender *et al*. 1998; Tableau 1).

Tableau 1: Surface échantillonnée en hectare au sein des six sites de suivi (d'après Merenlender *et al*. 1998).

Perturbation	Site	Surface échantillonnée (ha)
Site non perturbé	Andranobe	814,6
	Antrafonaomby	275,7
	Bedinta	371,5
Site perturbé	Ambanizana	498,5
	Antambakoanorona	329,4
	Ambodiforaha	484,4

Recolte des données
Dans une forêt dense humide comme celle de Masoala, la méthode la plus adéquate et efficace pour étudier les populations de lémuriens serait d'adopter un recensement direct utilisant des transects et des pistes. Les observations étaient effectuées particulièrement durant la saison chaude et sans pluie au cours de laquelle les lémuriens sont plus actifs et le nombre de jours de pluie tourne autour de son minimum. Cette saison correspond principalement du mois de septembre au janvier (Rakotondratsima 1995; Vasey 2000). Cette méthode de recensement adoptée consiste en un recensement par observation répétitive par des agents de terrain. Les observations commencent tôt le matin. Elles se font en marchant lentement suivant les pistes avec des petits arrêts. Ces conditions faciliteraient la détection des animaux soit par la vue soit par leurs cris. A chaque observation d'un lémurien ou de groupe de lémuriens, nous avons collecté la composition et la localisation.
On assigne un nom à un groupe de lémuriens donné sur terrain quand ce groupe est observé trois fois et plus. L'identification de groupe permettra de le caractériser en taille, composition exacte et territoire habituel. Un individu ou un groupe donné ne devrait en aucun cas être noté deux fois dans la même journée. De plus, des études antérieures (Merenlender *et al*. 1998) ont montrées qu'il faut au moins 8 visites pour un site donné à chaque saison de suivi pour que presque tous les groupes de lémuriens soient observés

Traitement et analyse des données
Comme ces deux espèces de lémuriens se subdivisent en sous-groupes dans la plus part du temps pendant leur activités journalières (Morland 1991), la détermination de la composition exacte des groupes se fait en compilant les relevés des observations. Pour une saison de suivi donnée, la composition d'un groupe se définit par le nombre maximum d'individus de chaque classe d'âge et de chaque sexe. Ce dernier est applicable seulement pour *Eulemur fulvus albifrons*; chez *Varecia variegata rubra* le sexe ne peut pas être déterminé. La méthode d'identification des groupes que nous avons adoptée est celle qui est décrite dans Merenlender *et al*. (1998).
L'analyse porte sur les données collectées depuis la saison 1993 jusqu'à la saison 1998. Le principe d'analyse repose sur la comparaison des données dans le temps, entre les sites et en fonction de la perturbation en utilisant des tests statistiques. Ces comparaisons portent sur les cinq paramètres démographiques issus des observations: l'abondance et la densité, la taille de groupe, le sex ratio, et le taux de reproduction.
Des tests statistiques paramétriques sont utilisés quand les données suivent une distribution normale. Sinon, elles sont transformées en logarithme décimal dans le cas de la densité, ou en arcsinus de la racine-carré dans le cas des données en proportions telles que le taux de reproduction. Quand la distribution des valeurs transformées n'est pas encore normale, on utilise des tests non paramétriques tels que le test de Kruskal-Wallis et de Mann-Whitney ou Wilcoxon (SAS Institute Inc. 1995; SPSS Inc. 1997) au lieu de test de Student *t* et ANOVA, le test non paramétrique apparié de Wilcoxon (SPSS Inc. 1997) au lieu de test *t* apparié, et le test d'association G-test (Sokal et Rohlf 1981).
Pour les analyses au niveau des sites, on a exclu les années 1993 et 1996 à cause de certaines lacunes dans les données. De ce fait les données de 1994 deviennent les données de base t_0 (Tableau 2). En effet, l'année 1993 a connu la conception et la mise au point de la méthodologie. Les agents venaient d'être formés à la méthodologie et ne connaissaient pas assez les sites. En plus, quatre sites seulement sur six ont été échantillonnés cette année-là. En 1996, les efforts développés dans la récolte de données n'ont pas été suffisants pour identifier tous les groupes. Cette période correspond au temps de transition du PCDI (Raymond pers. comm.) et au recrutement de nouveaux agents pour la suite du travail. Beaucoup de groupes rencontrés en 1995 ne sont pas observés pendant cette année, alors que ces mêmes groupes ont réapparu dans les observations de l'année 1997. On note que le nombre d'individus identifiés en 1993 et 1996 est presque la moitié des autres années (Tableau 2).

Tableau 2: Nombre de groupes et d'individus identifiés par année.

Année	Nombre de groupes	Nombre d'individus
1993	34	215
1994	44	415
1995	45	479
1996	34	206
1997	43	408
1998	50	390

Pour les analyses au niveau des groupes, on a pu utiliser les données de chaque année à conditions que les groupes inclus soient observés au moins trois fois pendant une année d'étude. En effet, l'observation répétitive des groupes améliore la qualité des données et de l'échantillonnage.
Dans l'analyse des intervalles de naissances, on a considéré principalement les groupes observés au moins trois fois dans l'année et sur des années consécutives. Comme ce paramètre caractérise chaque groupe par la présence ou absence d'enfants, un groupe est cependant pris en compte quand au moins un enfant est présent même s'il n'a été observé qu'une fois. Par contre, en cas d'absence d'enfant, il est nécessaire encore une fois que le groupe soit observé au moins trois fois pour être certain qu'il n'y a pas d'enfants.

Resultats

Eulemur fulvus albifrons

Taille des groupes
Un total de 131 enregistrements de groupe serviront pour l'analyse. On a constaté que la taille des groupes varie en moyenne entre 4,33 et 13,67 individus durant les années de suivi avec une moyenne de 9,08 individus (ES = 1,8; N=131).

Tableau 3: Moyenne des tailles de groupes (T) de *Eulemur fulvus albifrons* avec le nombre de groupes de lémuriens considerés (N) pendant les années de suivi successives de 1993 à 1998, dans les sites perturbés (Sp) et les sites non perturbés (Snp).

	1993		1994		1995		1997		1998	
	T	N	T	N	T	N	T	N	T	N
Sp	6,92	12	9,68	22	10,40	20	9,75	8	9,75	4
Snp	6,30	10	9,18	22	11,82	11	10,88	16	10,25	4
Sp+Snp	6,64	22	9,43	44	10,90	31	10,50	24	10,00	8

Il n'y avait pas de différence significative entre les sites non perturbés et les sites perturbés pour chaque année au niveau de la taille moyenne des groupes de lémurs fulvus (Tests de Mann-Whitney: $z < 1,33$ pour toutes les années). Toutefois, on peut constater une certaine fluctuation de la taille des groupes individuels suivant les années (Test apparié de Wilcoxon; Tableau 3) que ce soit dans les sites non perturbés ou dans les sites perturbés. Une légère croissance significative est constatée en 1993-1994 et en 1994-1995, mais la taille des groupes présente une certaine stabilité par la suite. Ce qui fait qu'on n'a pas constaté, en global, une tendance ni positive ni négative dans la taille de groupes entre années.

Densité
La densité, ici definie, se calcule en divisant le nombre d'individus dans tous les groupes sociaux de chaque site par la surface echantillonnée. Ainsi, la densité est estimée en moyenne à 14,5 ± 1,1 ind/km^2 dans les sites non perturbés et 15,9 ± 2,2 ind/km^2 dans les sites perturbés. On a constaté aussi que la variation interannuelle de cette densité apparaît légèrement plus importante dans les milieux plus perturbés comparée avec celle dans les sites non perturbés. Toutefois, aucune variation statistiquement significative n'est observée pour la densité ni entre sites non perturbés et sites perturbés ni entre les années (ANOVA à deux voies de la transformation logarithmique de la densité: ddl = 23; R^2 = 0,04; F = 0,29; p = 0,84).

Structure d'âge et sex ratio
Tous les individus pris par année, les femelles sont significativement plus nombreuses que les mâles au cours des années de suivi. Le sex ratio (SR) = 0,86 ± 0,06 est statistiquement différent à la normale 1:1 (Test de Wilcoxon z = 2,201; p = 0,028). Toutefois, le résultat ne montre pas de variation du sex ratio entre les sites perturbés et non perturbés pour chaque année de la période de suivi. (p > 0,05). De même, il n'y a pas de différence interannuelle entre les sites non perturbés ou les sites perturbés.
On constate aussi d'après le résultat qu'il n'y a pas variation du sex ratio suivant les classes d'âge, que ce soit dans les sites non perturbés ou dans les sites perturbés (d'après le test de chi-deux c^2 (goodness of fit) pour comparer les ratios de chacun des deux sexes entre les classes d'age de chaque année de suivi).

Taux de reproduction
Le taux de reproduction ne présente aucune différence significative entre site non perturbé et site perturbé sauf en 1997. En effet, ce taux est légèrement statistiquement plus élevé dans les sites non perturbés (Test de Mann Whitney: z = -1,99; p = 0,046). Dans l'ensemble, une variation s'observe entre les différentes années à propos du taux de reproduction (Test de Kruskal-Wallis: c^2 = 21,56; ddl = 5; p < 0,001). Cette fluctuation est plus remarquable dans les sites perturbés (c^2 = 15,20; ddl = 5; p< 0,01) comparée avec celle des sites non perturbés (Test de Wilcoxon: c^2 = 11,18; ddl = 5; p = 0,048). Ce qui veut dire que les fluctuations interannuelles paraissent plus sévères dans les sites perturbés pour le taux de reproduction. Surtout aux années à faible reproduction, le taux de reproduction est encore plus bas pour les sites perturbés. Dans l'ensemble, ce taux paraît également plus haut dans ces même sites pendant les années de haut reproduction (Fig. 2).

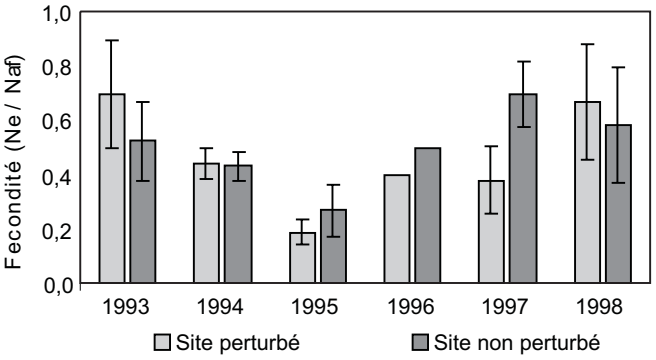

Fig. 2: Moyennes du taux de reproduction de *Eulemur fulvus albifrons* dans les sites non perturbés et les sites perturbés, avec les erreurs standards (Ne = nombre d'enfants; Naf = nombre de femelles adultes).

Intervalle de naissance
L'intervalle des naissances a été calculé à partir des données d'années consécutives de chaque groupe. En tout, on a pu tenir en compte 102 naissances. L'intervalle de naissance de un an est représenté à 78,4 % soit 80 naissances, alors que les 21,6 % avec 22 naissances restantes sont partagés par les intervalles de naissance supérieurs ou égaux à deux ans.
On a essayé également de voir si la perturbation a un effet sur l'intervalle de naissance (1 an et > 1 an). Jusqu'à maintenant, les données montrent qu'il n'y a pas d'interaction entre la perturbation et l'intervalle de naissance (Test d'association G-test: ddl = 1; G = 0,63; p > 0,05).

Varecia variegata rubra

Taille de groupe
Tout comme on a procédé pour *E. f. albifrons*, seuls les groupes observés plus de trois fois sont considérés et qu'un groupe d'individus observé régulièrement a été considéré comme un groupe (Merenlender *et al.* 1998). On a pu alors identifier 52 groupes dont 27 dans les sites non perturbés et 25 dans les sites perturbés. Soit 31 groupes en moyenne par an (calcul basé sur les années 1993, 1994, 1995 et 1998). Dans l'ensemble, la taille des groupes varie entre 3,47 et 5,22 individus entre les années de suivi, avec une moyenne 4,23 individus (ES = 0,27; N = 135).
Le résultat ne montre aucune différence significative entre les sites non perturbés et les sites perturbés (Test de Kruskal-Wallis: p > 0,05). Cependant, on constate une variation de la taille de groupe suivant les années bien que cette fluctuation ne soit significative à l'exception des sites non perturbés entre 1993 et 1994 (Test de Mann-Whitney: z = 2,271; p = 0,023).

Tableau 4: Moyenne des tailles de groupes (T) de *Varecia variegata rubra* avec le nombre de groupes considerés (N) pendant les années de suivi successives de 1993 à 1998, dans les sites perturbés (Sp) et les sites non perturbés (Snp).

	1993		1994		1995		1996		1997		1998	
	T	N	T	N	T	N	T	N	T	N	T	N
Sp	3,45	11	4,13	23	4,28	18	4,67	3	5,00	2	3,50	10
Snp	3,50	8	4,32	25	4,17	18	-	-	5,29	7	3,60	10
Sp+Snp	3,47	19	4,23	48	4,23	36	4,67	3	5,23	9	3,55	20

Densité

La présente étude évalue la densité de *Varecia variegata rubra* à 6,22 ± 0,49 ind/km^2 en moyenne. Aucune variation significative n'est constatée ni suivant le niveau de perturbation ni suivant les années (Analyse de variance à deux voies utilisant la transformation logarithmique de la densité: ddl = 23; R^2 = 0,22; F = 0,65; p = 0,71).

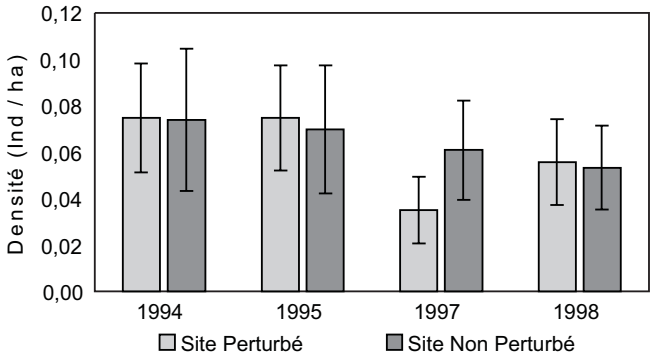

Fig. 3: Moyennes de la densité de *Varecia variegata rubra* dans les sites non perturbés et sites perturbés, avec les erreurs standards.

Taux de reproduction

On constate que la perturbation n'affecte pas le taux de reproduction dans les sites de suivi. Les tests statistiques n'ont montré aucune différence significative en comparant le taux de reproduction entre sites non perturbés et sites perturbés pour chacune des années de suivi (p > 0,05). On a pourtant constaté dans l'ensemble que le taux de reproduction chez *Varecia variegata rubra* dans la région d'étude varie beaucoup entre les années (Test de Kruskal Wallis: c^2 = 33,77; ddl = 5; p < 0,0001). En effet, des valeurs significatives sont données par le test de Kruskal Wallis pour chacun des deux niveaux de perturbation autant que cette variation interannuelle soit légèrement plus grand dans les sites non perturbés (c^2 = 19,83; ddl = 5; p < 0,001; taux de reproduction = 0,19) comparée à celle des sites perturbés (c^2 = 15,84; dll = 5; p=0,007; taux de reproduction = 0,24).

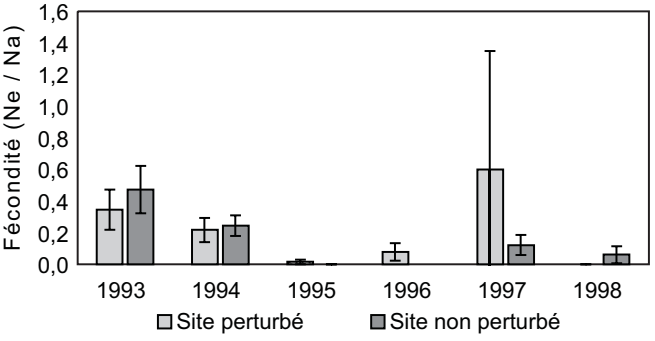

Fig. 4: Moyennes du taux de reproduction de *Varecia variegata rubra* dans les sites non perturbés et les sites perturbés, avec les erreurs standards (Ne = nombre d'enfants; Na = nombre d'adultes mâles et femelles confondus).

Intervalle de naissance

Pour *Varecia variegata rubra*, on a pu considérer 78 enregistrements de groupes. Parmi ces naissances considérées, l'intervalle de naissance de 1 an représente 6,4 % (soit 5 naissances). Et l'intervalle de naissance supérieur ou égal à 2 ans figure 93,6 % des observations (soit 73 naissances). On constate qu'il n'y a pas d'interaction entre la perturbation et l'intervalle de naissance (Test d'association G-test : ddl = 1; G = 0,164; p > 0,05).

Discussion

Eulemur est un des genres de lémuriens les plus répandues dans les écosystèmes malagasy. Il est même rapporté qu'ils sont résistants à certain niveau de perturbation de forêt (Merenlender *et al*. 1998). Ce qui semble être confirmé par notre résultat. On n'a effectivement pas trouvé de différence significative entre sites non perturbés et sites perturbés quant à la densité, la taille de groupes, la structure d'âge et taux de reproduction. Le seul effet de la perturbation paraît être sur la variation dans le taux de reproduction entre les années, qui est plus important dans les sites perturbés. Il est possible qu'un faible niveau de perturbation tel qu'on trouve dans la zone d'étude ne pose pas encore de danger pour ces populations de lémuriens. En plus, tous les sites d'étude se trouvent dans les zones de forêt primaire. La principale différence entre les deux catégories de site réside sur le fait que le taux d'extraction des ressources est beaucoup plus élevé dans les sites dits perturbés (Rakotondratsima 1997). Ce qui fait que les sites non perturbés pourraient être appelés également sites légèrement perturbés. Les mêmes effets ont été rencontrés pour *Varecia variegata rubra*. Les populations de *V. v. rubra* n'a pas montré de différence significative entre sites non perturbés et sites perturbés au point de vue paramètres démographiques.

Il faut noter cependant que la survie des lémuriens dépendrait de la maintenance de la surface forestière. Mais dans tous les cas, *E. fulvus* est probablement plus tolérante que l'autre espèce *V. variegata*. *E. f. albifrons* peut descendre parfois jusqu'aux zones d'agriculture à la recherche de fruits alors que *V. v. rubra* reste exclusivement dans la forêt. Elle exige une certaine condition relative à la structure et distribution des arbres de la forêt (Rigamonti 1993).

Quant à la densité des deux espèces, notre résultat a montré une certaine stabilité suivant les années. On connaît seulement le taux de reproduction des espèces étudiées, mais on ne connaît pas encore ni le taux de naissance réel ni le taux de mortalité par classe d'âge ni le taux annuel chassé ou piégé, démontrant cette stabilité démographique. On ne connaît également pas les informations sur les immigrations et émigrations. Bien qu'il soit encourageant que la densité des lémuriens reste stable entre les années malgré la chasse, il est possible que ceci soit dû à des migrations de l'intérieur de la forêt vers l'extérieur, là où la chasse est plus élevée. Sans une étude poussée sur la chasse, on ne peut pas songer à ce qui pourrait être l'effet de la chasse sur ces deux espèces.

Le résultat a montré également une variation interannuelle significative du taux de reproduction pour les deux espèces étudiées. Bien qu'elle soit plus prononcée dans les sites perturbés, il s'agit d'un effet général de l'environnement. Le modèle de variation des taux de reproduction – en terme simple d'augmentation et de diminution – le confirme effectivement. On peut noter dans le résultat que le sens de variation paraît identique pour les deux espèces et pour les deux types d'habitat (site perturbé et site non perturbé). Il est possible que l'un des paramètres environnementaux déterminatifs consiste à la disponibilité de leur nourriture, en particulier des fruits. D'une manière générale, ces deux espèces de lémuriens se nourrissent principalement de fruits et de feuilles (Rakotondratsima 1997). Toutefois, l'effet de ce paramètre paraît beaucoup plus important chez *V. v. rubra*

comme elle est fortement frugivore (Rigamonti 1993; Rakotondratsima 1997), alors que son sympatriote *E. f. albifrons* peut compenser en mangeant d'autres choses. Ce qui fait que l'amplitude de cette variation interannuelle de la reproduction est plus importante chez *V. v. rubra* que chez *E. f. albifrons*. En plus, l'intervalle de naissance pourrait y jouer son rôle significativement car l'intervalle de naissance de *V. v. rubra* est plus élevé, soit supérieur ou égal à deux ans à 93,6 %, par opposition de *E. f. albifrons* avec 21,6% de naissance pour un groupe donné.

Il est possible aussi que ces variations interannuelles soient liées aux facteurs intrinsèques de la population elle-même comme la variation de la structure d'âge. En effet, on peut noter dans le résultat chez *E. f. albifrons* que le taux de reproduction diminue quand le nombre des enfants et jeunes augmente.

A partir de cette remarque mentionnée sur l'intervalle de naissance, on peut dire aussi que *E. f. albifrons* reproduit beaucoup plus fréquemment que les lémurs varis rouges. Ce qui fait que la population de *V. v. rubra* serait biologiquement plus sensible à une éventuelle prise de quelques individus (e.g. par la chasse), d'autant plus que sa densité est faible une fois comparée avec les autres espèces de lémuriens.

Recommendations pour le suivi écologique à Masoala

- Nous recommandons par conséquent de continuer d'une façon effective ce suivi écologique des lémuriens. Notre expérience affirme que des données manquantes ou insuffisantes d'une année présentent une lacune considérable à l'analyse pour le report de suivi.
- On devrait également compléter le programme de suivi avec les études sur l'écologie de l'alimentation de ces espèces de lémuriens et sur la phénologie de fructification. Ceci pourra, en effet, confirmer l'hypothèse concernant la variation interannuelle du taux de reproduction.
- La récolte de données serait meilleure quand les agents restent les mêmes d'une année à une autre pour un site donné.
- Tout en faisant partie du suivi écologique et pour aider à la compréhension des résultats démographiques, de l'étude d'évaluation de la chasse et de piégeage des lémuriens est recommandée.

Remerciements

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The Impact of *Cryptoprocta ferox* on the *Varecia v.variegata* Reinforcement Project at Betampona

Adam Britt, Charlie Welch and Andrea Katz

Madagascar Fauna Group, BP 442, Tamatave 501, Madagascar, **mfgmad@bow.dts.mg**

As previously reported the Madagascar Fauna Group have been attempting an experimental reinforcement of captive-bred black and white ruffed lemurs (*Varecia v. variegata*) in the Betampona Reserve since 1997 (Britt *et al.* 1998, 2000). Whilst some individuals have shown encouraging signs of adaptation to a wild existence, others have adapted poorly. However, regardless of the degree of adaptation it is clear that captive-bred individuals of this species are extremely vulnerable to predation by the Fossa (*Cryptoprocta ferox*). This paper will discuss the impact of this predator on the success of the project and its implications for future reinforcement or reintroduction efforts.

The release programme

Of the 13 captive-bred *V. v. variegata* released to date, five (2 males, 3 females) have been killed by *C. ferox*. Of these five, one pair produced triplets in October 1999, and at least one of these offspring is also presumed to have fallen victim to *C. ferox* predation. It is particularly disappointing that this pair who had been able to reproduce and raise triplets were killed. Of the remaining animals one male died as a result of

injuries sustained during a fall or possibly malnutrition and another female simply disappeared. One male from the November 1997 release is integrated into a wild group and thriving. A female released in November 1998 has been withdrawn from the programme following the killing of her two fellow releasees by *C. ferox*, but also due to her poor adaptation over a period of two years in the forest. Three males and one female released in January 2001 are still surviving and showing good signs of adaptation in terms of food location, travel and navigation within the forest.

Preliminary analyses of behavioural data indicate that individuals with early or long-term experience in enclosures that simulate the natural forest environment of this species adapt better to life in the wild. This has been the case for both the first and third release groups. For both groups it has been possible to stop supplemental feeding within a few months of release. Also both groups have shown similar ranging patterns to wild *V. v. variegata* and have established territories of comparable size. However, the second release group had very limited experience (a few months) in "natural habitat enclosures" and remained reliant on provisioning throughout their two years in the forest. This group showed no inclination to range far from their release site in search of food.

Cryptoprocta ferox at Betampona

The size of the *C. ferox* population at Betampona is unknown, but it seems likely that the species exists at a low density as suggested by MacDonald (1984) and Dollar *et al.* (1997). Despite the daily presence of project personnel in the reserve there have been only two sightings at Betampona since 1997: one adult in May 2000 and a presumed adult female and offspring also in May 2000. However, tracks are often found on the trail system. Two individuals have been trapped and released: one juvenile female by the Carnivore Research Team lead by Luke Dollar and an adult male by Ed Louis and team from the Henry Doorly Zoo, Omaha, both in December 2000.

The only observed predation threat to large diurnal lemurs, such as *V. v. variegata*, is *C. ferox* (Rasoloarison *et al.* 1995; Overdorff and Strait 1995; Wright 1995; Wright *et al.* 1997). Thus it seems safe to conclude that the remains of the released *V. v. variegata* found are a result of *C. ferox* predation. On two occasions in 1998 the remains (fur, tail and stomach contents) of *Eulemur fulvus albifrons* were found in the reserve - these were presumed to have been taken by *C. ferox*. Additionally in 1991 two adult *C. ferox* were disturbed whilst feeding on an adult *E. f. albifrons*. In all five cases of *C. ferox* predation on the released *V. v. variegata*, the skulls have been retrieved. In three cases there was considerable damage to the rear of the cranium and clear canine puncture marks suggestive of a killing bite to the back of the head/neck. In the remaining two cases there was no damage to the skull, and in one of these it was apparent that the killing bite was delivered to the throat. In the most recent killing it seems likely that the *C. ferox* was disturbed as only the internal organs had been consumed. The killings occurred in February 1998, and in June, July, October and November 2000.

There are no reported cases in the literature of *C. ferox* preying upon *V. v. variegata*, but the species is known to prey on other diurnal species such as *Propithecus diadema edwardsi*, *P. v. verreauxi*, *Eulemur rubriventer* and *E. fulvus rufus* (Wright *et al.* 1997; Rasoloarison *et al.* 1995; Overdorff and Strait 1995). Since 1996 no wild adult *V. v. variegata* from the study population at Betampona have disappeared. This is suggestive that *C. ferox* at Betampona rarely prey on this species. It is hypothesised that as *V. v. variegata* generally remain high in the canopy and are extremely agile in moving among fine terminal branches, the benefits to *C. ferox* from hunting this species will be poor and hence it will concentrate on easier prey.

It seems likely that one or more *C. ferox* have discovered that the released captive-bred *V. v. variegata* can be readily captured. A tentative conclusion is that these animals are naïve to the threat posed by *C. ferox* and are either not alert to its presence, or are aware of it but allow the predator to get too close giving it the advantage necessary to make the kill. None of the attacks has been witnessed, but it is suspected that *C. ferox* make surprise attacks whilst lemurs are in sleeping trees during the darkest time of night (Wright *et al.* 1997). Subjectively there does not appear to be any difference in sleeping sites selected by the released and wild *V. v. variegata* at Betampona in terms of height in the canopy or substrate properties. However these data require more thorough analysis.

Implications for the release of captive-bred lemurs

Although the project has demonstrated that captive *V. v. variegata* that are raised or kept long-term in naturalistic environments can adapt to a wild existence, they appear to lack predator avoidance skills. It is debatable whether captive animals could be trained in predator avoidance pre-release, and equally it is difficult to envisage what could be used to simulate the impressive arboreal hunting skills of *C. ferox*. The only individual remaining from the first two releases is the male who has become integrated into a wild group. It is possible that he has learnt predator avoidance behaviour from his wild conspecifics.

The third release took place in an area inhabited by a wild male and a female offspring of the first release group, who may well have witnessed the predation of her parents by *C. ferox*. It is hoped that the two groups will integrate, but to date this has not occurred. The current situation is thus that the third release group remain vulnerable to *C. ferox* predation as was the case for the two previous groups.

A more effective method for releasing captive-bred *V. v. variegata* back to the wild may be to attempt to rapidly integrate individuals into wild groups. Problems with such an approach arise due to the social system of the species. These are further complicated by the fact that social dynamics may vary considerably between populations of a species in different parts of its range (e.g. for *V. v. variegata*: Morland 1991; White 1991; Britt 1996; Balko 1998). Limited evidence suggests that female *V. v. variegata* remain in their natal territory, whilst males depart to join other groups (White *et al.*1993; Britt pers. obs.). Rather than releasing pairs or family groups perhaps a more appropriate strategy would be to release young sexually mature males (4 to 6 years old) peripherally to wild groups. In the context of a population reinforcement project (versus a reintroduction), it is strongly advised that the social dynamics of a species be given thorough consideration when selecting appropriate candidates for release and devising a release strategy.

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Brief Observations of Hairy-Eared Dwarf Lemur (*Allocebus trichotis*) in Analamazaotra Special Reserve, Eastern Madagascar

Nick Garbutt
15a Druids Hill, Stoke Bishop, Bristol. BS9 1EW, England.
ng.indri@netgates.co.uk

Described in 1875, the Hairy-eared Dwarf Lemur (*Allocebus trichotis*) was known from only five museum specimens collected in the nineteenth century until its rediscovery in 1989 (Harcourt and Thornback 1990). It was then thought to be restricted to the remaining lowland rainforests in the region of Mananara-Nord in north east Madagascar (Meier and Albignac 1989, 1991). Subsequently, this species has been recorded at a number of other sites covering much of the north east rainforest region: Réserve Special d'Anjanaharibe-Sud (Schmid and Smolker 1997), Parc National de Masoala (Sterling and Rakotoarison 1998), Réserve Naturelle Intégrale de Zahamena (Rakotoarison 1995) and Forêt de Vohidrazana (Rakotoarison *et al*. 1996). Forêt de Vohidrazana lies just 15km to the east of Andasibe and Réserve Special d'Analamazaotra, yet *Allocebus trichotis* has, to date, not been recorded in this protected area.

On Wednesday 14th October 1998, myself and five British naturalists along with Malagasy guides Maurice Besoa Ratsisakanana and Vivi Razaka, were conducting a nocturnal walk around Lac Vert in Analamazaotra Special Reserve. At approximately 7.45 pm "eye-shine" was seen around 2.5 m above the ground on a vine next to the trail, some 70m east of the bridge at Lac Vert (see map). The animal was small and remained motionless and was initially assumed to be a Brown Mouse Lemur (*Microcebus rufus*). However, on examination through 10x binoculars with excellent illumination from a distance of 4-5 m, I was immediately able to identify the animal as Hairy-eared Dwarf Lemur (*Allocebus trichotis*), the pointed snout and conspicuous ear tufts being obvious. The lemur remained motionless on the vine for between 10 and 15 seconds, before climbing up the vine into a tangle of other vines and thin branches. There its remained for the next 10 minutes, only moving slightly amongst the network of twigs and occasionally licking at the bark as it moved around. Twice the lemur began to descend the original vine, climbing down perhaps 30 to 40 cm, which allowed for further excellent views, before on each occasion returning to the tangle of vines above. After a total of 12 minutes or so, the lemur ascended into the tangled vegetation further and disappeared from view.

To my knowledge the Hairy-eared Dwarf Lemur has not previously been recorded in Analamazaotra Special Reserve. Given that more nocturnal walks and observations take place in Analamazaotra than perhaps any other rainforest reserve in Madagascar this seems remarkable. Two possible conclusions may be drawn. Either, *Allocebus trichotis* is very rare and secretive and so has thus far evaded detection or that it has been "observed" before, perhaps on numerous occasions, but has never been recognised by the observer for what it is - presumably being mis-identified and dismissed as Brown Mouse Lemur. The fact that *Allocebus* has been recorded in forests only 15km from Analamazaotra, suggests the second conclusion is far more likely.

In light of this record it will pay all those who subsequently conduct nocturnal observations in Analamazaotra Special Reserve to look very closely at any small nocturnal lemur they see.

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Analyse de l'Interface humain-forêts et Directives d'Aménagement du Bassin versant de Vohidrazana: Falaise Est de Madagascar

Lala Razafy Fara
Université d'Antananarivo, Ecole Supérieure des Sciences Agronomiques, Département des Eaux et Forêts, B.P. 175, Antananarivo 101, Madagascar, fl.razafy@simicro.mg

Cadre de l'étude
L'analyse de l'interface humain-forêt dans le bassin versant de Vohidrazana d'une superficie de 900 ha a été menée à la lumière d'une approche systémique par test de quatre hypothèses. La cartographie a été effectuée pour connaître le dynamisme spatio-temporel de l'occupation des sols dans le bassin versant. Les enquêtes informelles et formelles ont été abordées pour l'obtention des informations de bases sur l'identification des groupes d'acteurs exploitants les ressources forestières. Les quatre groupes d'acteurs identifiés comme ayant des influences et/ou impacts directs, indirects ou induits sur les ressources forestières sont: l'Etat, les différents Projets de recherches, de développement ou de protection, les exploitants légaux et illégaux et les paysans. Les inventaires sont conduits pour connaître la potentialité de la forêt en ressources ligneuses et non ligneuses, suivi des études des accroissements de certaines espèces ligneuses. Ces différentes approches combinées sont utilisées pour tester les hypothèses de travail avant les propositions de directives d'aménagement.

Evolution des ressources forestières
De ces études, il a été trouvé que la superficie de la forêt dans le bassin versant de Vohidrazana régresse annuellement à raison de 3,24 ha. Les inventaires ont aussi relevé que la forêt de Vohidrazana renferme un volume exploitable non négligeable par rapport aux autres forêts environnantes, de 20,86 m^3/ha à 96,08 m^3/ha selon les types de forêts. Les produits non ligneux commercialisés sont aussi assez divergents: pots fangeons, orchidées, pandanus, produits aquatiques. Tous ces produits sont utilisés directement par les paysans pour assurer leur existence. La connaissance des accroissements en surface terrière de certaines espèces ligneuses montrent en général, la lenteur de ces accroissements 0.2 m^2/ha/an.

Comportement des acteurs face à la ressource
La conduite des tests des hypothèses proprement dite pour l'analyse de l'interface humain-forêt a été menée selon une méthodologie dialectique pour les quatre hypothèses. Dix critères de bases sont donnés et testés à l'aide des indicateurs de corroboration et de réfutation. En fonction de la fréquence d'acceptation ou non de ces indicateurs, l'hypothèse en question est retenue ou rejetée.
L'hypothèse sur la rationalité de la conversion des forêts par les paysans est ainsi acceptée. Il a été souligné ainsi que la rationalité des actions paysannes réside sur les faits que l'Etat lui-même reconnaît la pratique du tavy et la protège en quelque sorte par des lois et ordonnances. Il a été noté aussi que jusqu'à preuve de concurrence, le tavy constitue la meilleure alternative pour produire du riz et pour coloniser l'espace (lutte contre les mauvaises herbes, pentes raides, etc.) tout en s'inscrivant dans le mode de vie des Betsimisaraka.
L'hypothèse sur la perte tacite de la forêt par l'inefficacité de l'application de la législation est de même corroborée par les résultats des analyses. Il en ressortait que malgré leurs biens fondés, les textes législatifs ont péchés par défaillance de leur application et d'encadrement des paysans. Plusieurs facteurs aidant (augmentation du nombre de la population, stagnation du nombre de personnel de l'Etat, aggravation de la situation politique au niveau national,...) les lois sont restées inappliquées dans l'ensemble.
L'hypothèse sur la faible potentialité biologique de la forêt pour un aménagement soutenu pour des bénéfices socio-économiques est à la limite de la corroboration. En effet, il a été conclu par six critères sur dix que la forêt a quand même une potentialité biologique en volume élevé mais en croissance faible. L'exploitation durable ne pourrait être ainsi rentable que si des mesures d'accompagnement sont prises. En effet, les capacités de résistance et de résilience de la forêt sont faibles.
Les critères établis pour tester l' hypothèse sur faisabilité de l'aménagement intégral par les différents acteurs l'ont dans la majorité des cas corroborés. Les acteurs travaillant dans la zone sont intéressés à atteindre leurs objectifs. Les paysans conscients de la précarité de leur situation sont très ouverts à d'autres innovations et adoptent même des techniques qui ne leur sont pas familier en cas de nécessité. Les exploitants légaux cherchent à profiter au maximum de l'exploitation des forêts à cause de l'absence de contrôle étatique efficace les laissant libres de conduire l'exploitation sans respect des clauses. Les projets de recherches sont aussi conscient de la nécessité de l'application et la diffusion des résultats de recherches. Dans cette optique, ils s'orientent beaucoup plus maintenant vers des recherches appliquées. Des concertations sont aussi notées entre les différents acteurs et des processus de conjugaison des efforts en matière de la gestion durable des ressources naturelles sont observées. Les acteurs (projet, ONG, programme, exploitant, paysans) sont tous conscients de l'intérêt de freiner la dégradation des ressources naturelles tout en améliorant la qualité de la vie des paysans.

Alternative d'aménagement du bassin versant de Vohidrazana
Des scénarios d'aménagement écocentrique et anthropocentrique sont présentés après les analyses et tenant compte des conditions favorables et cadres. L'aménagement écocentrique est basé sur la conservation mais, en introduisant des accords entre les acteurs. Par contre, l'aménagement anthropocentrique est basé sur la satisfaction des besoins humains mais, des efforts de réconciliations entre la conservation et le développement durable sont installés. bassin Une option pour un aménagement intégral est choisis pour le bassin versant. Cet aménagement prend en compte la mise en valeur de l'espace avec des considérations écologiques, économiques et sociales en écartant la vision trop forestière et conservationiste des opérations à mener.
En bref, les différents acteurs agissant au niveau du bassin versant de Vohidrazana sont tous conscients de l'importance de cette zone: importance écologique, importance sociale et importance économique. Cette importance diffère pourtant d'un acteur à un autre. Néanmoins, quelle que soit l'importance attribuée à cette zone, les intérêts de chaque acteur se trouvent dans l'exploitation durable des ressources forestières. Chacun se voie ainsi dans l'obligation de conjuguer leurs efforts afin de prolonger aussi longtemps que possible l'utilisation des ressources qui les intéresserait.

Le *tavy* réalisée à Beforona (Centre Est de Madagascar); une Etude réalisée dans le Cadre du Projet BEMA

Jean-Laurent Pfund
Ecole Polytéchnique Fédérale, Zürich, Suisse et WWF, PBP 42, Tolagnaro, Madagascar, **pfund@dts.mg**

Entourée d'une équipe toujours plus multidisciplinaire, cette recherche s'est inscrite dans le projet BEMA qui avait comme finalité la mise à disposition des divers acteurs du développement de la Côte est de Madagascar d'informations fiables et utiles pour concevoir et mettre en œuvre des interventions visant une amélioration durable des conditions de vie rurales (Pfund J.-L. 2001: Thése 13966 de l' Ecole Polytéchnique Fédérale, Zürich, Suisse).
Sur le plan de la gestion des ressources naturelles, le système traditionnel du versant Est de Madagascar est mani-

festement dominé par la culture sur brûlis appelée *tavy* dans la région et destinée à produire du riz pluvial. Plusieurs facteurs renforcent la perception locale du *tavy* comme élément quasiment vital de la vie des Betsimisaraka, l'ethnie dominante de la région: le riz représente l'aliment de base de la population malgache, la pratique du *tavy* a été héritée des ancêtres qui représentent les «maîtres à penser» des vivants et enfin, le relief accidenté et la fréquence de très fortes précipitations rendent difficile l'aménagement de rizières irriguées. Souvent perçu de l'extérieur comme un scandale écologique incompréhensible, le système du *tavy* et plus globalement la gestion des ressources naturelles par les villageois méritait une analyse scientifique précise de ses impacts ainsi que des perspectives d'amélioration de la durabilité du système. Cette mise au point fut en résumé l'objectif de la recherche qui a été menée avec une forte volonté de s'en tenir aux réalités locales et d'impliquer les villageois dans les réflexions.

Outre la considération des résultats de plusieurs proches collaborateurs, l'approche de la recherche s'est focalisée sur trois axes d'approfondissement méthodologique afin d'aboutir à une analyse relativement large des conditions locales et, partant, à des propositions de solutions concrètes. Le travail entend en premier lieu mettre en évidence les mécanismes de la succession végétale secondaire des jachères après brûlis, en utilisant d'abord une approche phytosociologique et phytoécologique. Pour ce faire, il utilise les outils modernes d'ordination et d'autres analyses statistiques multivariées pour valoriser l'indication écologique apportée par la végétation. Il s'agit ensuite de comprendre les phénomènes de perturbation dus au défrichement, au brûlis et à la mise en jachère, et notamment les pertes de fertilité qui s'ensuivent, en prenant en compte les composantes de la végétation, de la biomasse hypogée et épigée et des nutriments. Par des enquêtes sociologiques semi-structurées auprès des populations, on veut mettre en évidence les intérêts des groupes d'usagers, leur rôle et surtout leur comportement dans la gestion des ressources. Cela permet de mieux comprendre les mécanismes socioculturels nécessaires à l'implémentation de changements de comportement à la fois propices au développement durable et socialement acceptables.

Les résultats des analyses écologiques démontrent le caractère décisif des premières défriches-brûlis forestières, d'une part bien sûr parce que la vocation des terres bascule normalement définitivement dans le domaine agricole, d'autre part parce que les pertes en espèces végétales et surtout en nutriments sont les plus importantes à ce stade par rapport à l'ensemble du processus de dégradation à long terme du *tavy*. La répétition des mises en culture, une saison pluviale pour le riz et quelquefois une seconde pour d'autres produits moins exigeants comme le manioc ou la patate douce, entraîne une dégradation de la fertilité fortement dépendante de la durée de la jachère qui suit, de cinq ans en moyenne, et des conditions topographiques. Les analyses floristiques font ressortir cinq types généraux de végétation secondaire qui illustrent une succession régressive: les *jachères périforestières* qui contiennent encore des rejets de souche et d'autres essences forestières typiques; les *jachères arbustives* dans lesquelles certaines espèces secondaires ligneuses typiques résistent; les *jachères rudérales productives* parmi lesquelles des plantes envahissantes et souvent introduites, comme *Lantana camara* ou *Rubus mollucanus*, fournissent une biomasse suffisante à la mise en culture; les *jachères rudérales dégradées* qui sont localisées sur les sites les plus fragiles, les crêtes et les fortes pentes et qui ne permettent plus de mise en valeur agricole; et enfin les savanes ou pseudosteppes selon Koechlin qui illustrent l'ultime stade de dégradation dû au feu.

Sur le plan de la fertilité, le travail a confirmé l'importance de considérer l'ensemble du système sol-végétation dans les pays tropicaux, en particulier si, comme dans le cas du *tavy*, la biomasse joue un rôle déterminant pour la productivité du site. Une tendance générale de corrélation entre les éléments du sol et de la végétation apparaît: plus ils sont déficitaires dans le sol, plus ils se trouvent en quantité élevée dans la végétation (à l'exemple du potassium pour la zone d'étude). La quantité de biomasse produite par les jachères qui seront brûlées est corrélée avec les éléments bien connus des agriculteurs: N, P et K, qui semblent (en particulier pour le phosphore) également déterminants pour les rendements culturaux. Par contre, les sols des ultimes stades de dégradation, comme les fourrés de fougères ou pire les savanes anthropiques à *Aristida sp*. se distinguent nettement des autres par leurs déficits en bases échangeables et les problèmes de toxicité aluminique qui leur sont liés. Dans le cas de Beforona, il convient de revoir dans une optique topographique le débat qui oppose les spécialistes quant au problème principal de la culture sur brûlis, les uns désignant l'apparition des mauvaises herbes et les autres la baisse de fertilité. En effet, si les stations (par exemple de haut de pente) sont fragiles au début de la mise en culture, la fertilité du sol représentera en fin de course le facteur limitant (et sera couplée avec des difficultés de sarclage avant son abandon), alors que sur les sites naturellement plus fertiles, les mauvaises herbes représenteront à elles seules le facteur perturbateur et la raison de mise en jachère.

Les enquêtes menées ont servi à préciser les diverses utilisations paysannes des ressources naturelles, notamment des jachères essentiellement utilisées comme source de bois d'énergie et de construction pour les plus anciennes, et dans une moindre mesure de réserves de cordes et de plantes médicinales. En outre, ces investigations socio-économiques ont surtout permis de discuter de la gestion du *tavy* parmi l'ensemble des ressources naturelles et des composantes du système agraire. C'est ainsi que "l'arbre hors forêt", dans sa forme agroforestière typique de la côte Est, celle du *tanimboly* ou verger de case essentiellement voué à la production de café et de bananes, est ressorti comme une des pistes de valorisation durable des terres aussi bien qu'une des principales sources de revenu.

Comme on est arrivé à un stade où les besoins monétaires entraînent des ventes de riz de *tavy* lors de chaque récolte, et que le riz restant ne suffira pas jusqu'à la prochaine récolte, la combinaison idéale de la production vivrière autoconsommée et de la production de rente est devenue le centre des préoccupations. Les productions de rente offrant les meilleurs retours (rendement financier par jour de travail investi) deviennent prioritaires dans les choix d'avenir à réaliser.

De ce point de vue, les arbres ou arbustes présentent justement un avantage important: même s'ils demandent un effort d'investissement important lors de leur installation, une fois adultes, ils produisent à moindre frais puisque leur entretien est relativement simple. Actuellement, les plantations de caféiers, bananiers et fruitiers offrent le meilleur rendement monétaire des cultures paysannes. En définitive, c'est l'arbre à fonction commerciale qui est devenu l'objet d'une gestion paysanne et le noyau d'autres activités non agroforestières qui se rattachent actuellement au concept du tanimboly.

Deux outils participatifs ont été utilisés pour tenter de cerner la problématique globale du développement local: l'analyse systémique, réalisée en équipe de chercheurs, et la restitution paysanne, commentée et débattue, des premiers résultats du travail. Les résultats de ces analyses coïncident sur les points suivants comme facteurs clés du développement: sur le plan socio-organisationnel, il s'agit de mettre en valeur le rôle des autorités traditionnelles, notamment dans le cadre de réorganisation par vallons et familles (ou clans)

de l'accès aux terres, qui renforcerait indirectement le caractère de "noyau de l'exploitation" du *tanimboly*, et pour l'introduction de conventions collectives de gestion des ressources et d'aménagement de l'espace; sur le plan technique, il faudrait faciliter un renforcement général du savoir-faire local, une intensification de l'élevage (volaille ou zébus) et de la production de riz irrigué.

En discussion et conclusion, les pistes d'appui présentées insistent sur l'importance d'un aménagement localement conçu et maîtrisé. Comme l'aménagement proposé reste un processus, c'est un accompagnement de processus qui est indiqué comme appui à donner. Les acteurs qui pourraient intervenir dans la démarche d'aménagement proposée rempliraient divers rôles. Après avoir acquis la confiance des villageois, un *facilitateur* serait chargé du suivi régulier des activités, de la circulation et de la recherche d'informations. Un spécialiste du développement rural se chargerait des appuis à donner dans les moments forts (diagnostic, négociation, planification, etc.) et de la récolte d'informations techniques au sens large qui pourraient alimenter une sorte de référentiel de développement, de paquet technologique. Les autres acteurs occupent des fonctions administratives (services techniques), politiques (Maire et conseil communal) et bien sûr économiques dans le cadre des activités de commercialisation. C'est parmi tous ces acteurs qu'une entité de suivi indispensable pourrait être définie, par exemple au sein d'une plate-forme locale de développement.

MEETINGS

XIXth Congress of the International Primatological Society, 4-9 August 2002, Beijing, China. Organized by the Mammalogical Society of China and the Institute of Zoology, Chinese Academy of Sciences. The main themes of the Congress will focus on the progress and prospects of primatology and the conservation of non-human-primates. The first deadline is for symposium and workshop titles, to be submitted by 31 August, 2001. *Contact address*: Prof. Fuwen Wei, Secretary General, 19th Congress of the International Primatological Society, c/o Institute of Zoology. Chinese Academy of Sciences, 19 Zhongguancan Lu, Haidian, Beijing 100080, China, Fax: (86-10) 82627388,
e-mail: **IPS_Beijing@panda.ioz.ac.cn.**
Web site: **http://www.ips.ioz.ac.cn.**

Annual Meetings of the IUCN/SSC Conservation Breeding Specialists Group (CBSG) 10-13 August, 2002, **The World Zoo Organization** (WZO), 13-17 August 2002, and **The International Association of Zoo Educators (IZE)**, 17-22 August, 2002, Hofburg Palace, Redoutensäle, Vienna. Hosted by the Schoenbrunn Zoo. For more information: Austropa Interconvention, Conference Office, Friedrichstrasse 7, A-1010 Vienna, Austria,
Fax: +43 1 315 56 50, e-mail: **austropa.congress@verkehrsbuero.at.**

3rd Göttinger Freilandtage: Sexual Selection in Primates, 11-14 December 2001, hosted by the German Primate Center (DPZ), Göttingen, Germany. Invited speakers will summarize and evaluate recent empirical and theoretical work dealing with causes, mechanisms and consequences of sexual selection in primates, including humans. In addition, it is hoped to identify general principles through comparison with other mammals. Oral (15 min) and poster contributions. Deadline for submission of abstracts is 1 August, 2001. Guests must also register in advance by October 1, 2001. Additional details are available from Peter Kappeler, e-mail: **pkappel@gwdg.de**, and the web site:
http://www.dpz.gwdg.de/voe_page/GFT2001/freiland01C.htm.

RECENT PUBLICATIONS

Books

Conservation Research in the African Rain Forests: A Technical Handbook, edited by Lee White and Ann Edwards, 454pp, 2000. Wildlife Conservation Society, Bronx, New York. ISBN 0-963-20644-3 (English). ISBN 0-963-20645-1 (French). A remarkable and most useful book for the practicalities of field research. As stated in the Introduction "The purpose of this manual is to assist people working in African forests to collect information from many different sources and use it effectively for management and conservation…We hope to: 1) Help protected area managers to establish goals and determine priorities for management and to design research programmes appropriate to these objectives. 20 Outline simple, current, commonly used methods for collecting information, specifically on population densities and behavioural ecology of ofv larger animals, vegetation, physical features of the land, weather patterns, and the numbers impacts, needs and expectations of people that use and/or live near protected areas. 3) Present guidelines for analyzing field data realistically and with confidence. 4) Present guidelines for interpreting and storing information with the aim of making it useful and accessible to a variety of audiences." *Contents*: Protected area management and the role of research – A. Lanjouw, A. Edwards & L. White, pp. 1-14; Research priorities and design of research programmes – L. White & A. Edwards, pp. 15-22; An introduction to sampling – L. White & A. Edwards, pp. 23-30; An introduction to data analysis and interpretation – L. White & A. Edwards, pp. 31-51; Making observations and recording data – A. Edwards, A. Rabinowitz & L. White, pp. 53-61; Maps, compasses, GPS units and the principals of navigation – A. Edwards & L. White, pp. 63-83; Methods for recording the weather – A. Edwards and L. White, pp. 85-92; Collecting botanical specimens – A. Dold, P. Phillipson, R. Liesner, P. Lowry & L. White, pp. 93-118; Vegetation inventory and description, L. White & A. Edwards, pp. 119-155; Information from animal tracks and trail – R. J. Parnell, pp. 157-189; Information from dead animals and their curation – A. Rabinowitz, J. Hart & L. White, pp. 191-201; Necropsy procedures for wild animals – L. Munson, pp. 203-224; Methods for assessing the status of animal populations – L. White & A. Edwards, pp. 225-275; Behavioural ecology data and its relevance for management – K. Abernethy, pp. 277-329; Socio-economic dsata and their relevance to protected area management – B. Curran. D. Wilkie & R. Tshombe, pp. 331-353; Statistical techniques – N. Chalmers, P. Parker and K. McConway, pp. 355-422; Presenting and conserving your findings – A. Edwards & L. White, pp. 423-440. *Available from*: The Wildlife Conservation Society, 185th Street & Southern Boulevard, Bronx. New York, NY 10460-1099, USA.

Priorities for the Conservation of Mammalian Diversity: Has the Panda Had Its Day? edited by Abigail Entwhistle and Nigel Dunstone, 455pp., 2000. Cambridge University Press, Cambridge. ISBN 0-521-77279-6 (Hardback), 0-521-77536-1 (Paperback). This book is No. 3 in the Conservation Biology series of CUP, edited by Morris Gos-

ling in Association with the Zoological Society of London. No. 1 was *Conservation in a Changing World*, edited by Georgina M. Mace, Andrew Balmford and Joshua R. Ginsberg, and No. 2 was *Behaviour and Conservation*, edited by L. M. Gosling and J. Sutherland. This excellent review has three parts, besides and introductory chapter by Abigail Entwistle, Simon Mickleburgh and Nigel Dunstone – Mammal conservation: current contexts and opportunities. Part 1. Justifying the conservation of mammals. Part 2. Setting priorities for mammalian conservation. Part 3. Conservation approaches for mammalian species and diversity. Orders in the USA: Cambridge University Press, 40 West 20th Street, New York, NY 10011-4211, USA. Orders elsewhere: Cambridge University Press, The Edinburgh Building, Cambridge CB2 1BR, UK. E-mail to Hannah Proctor hproctor@cup.cam.uuc.uk. Web site: http://www.cambridge.org.

Primate Taxonomy, by Colin P. Groves, April, 2001, 368 pp. Smithsonian Institution Press, Washington, D. C. ISBN 1-560-9887-2 X (Hardback). Price US$65.00 (+ p&p). Smithsonian Series in Comparative Evolutionary Biology. An absolute must for any primatologist. In this book, Colin Groves proposes a complete taxonomy of living primates, reviewing the history and practice of their classification and providing an up-to-date synthesis of recent molecular and phylogenetic research. He contends that the taxonomic designation of individual species is the starting point for conservation , and that the taxonomy living species is critical to understanding evolutionary relationships. According to Russell A. Mittermeier, "Groves' monumental book is the most comprehensive view of primate taxonomy published in decades…recognizing that primates are a much more diverse group than previously recognized…given that understanding taxonomic relationships among primates is essential to assessing their conservation status, he provides us with a very useful tool for primate conservation as well". *Part 1*. The theory of primate taxonomy: Chapter 1 - What is taxonomy meant to do and how should it be do it?; Chapter 2 - Taxonomic ranking and nomenclature; Chapter 3 - The species group; Chapter 4 - A brief history of primate taxonomy: Rogues' gallery: Who they were and how they rate today; Chapter 5 - Taxonomy of primates abover the family level. *Part 2*. Malagasy lemurs, Loriformes, Tarsiiformes, Platyrrhini, Old World monkeys, Superfamily Cercopithecoidea, Hominoids, Superfamily Hominoidea Gray, 1825. Appendix: A word about fossil primates. Available from: Smithsonian Institution Press, P.O. Box 960, Herndon, VA 20172-0960, USA,
Tel: 1 800 782 4612 or (703) 661-1599, Fax: (703) 661-1501.

Common Names of Mammals of the World, by Don E. Wilson and F. Russell Cole, 2000, 204 pp. Smithsonian Institution Press, Washington, DC. ISBN 1-560-98383-3. Price US$19.95. This book provides a complete, authoritative list of standardized and unique vernacular English names for all 4,629 of the currently recognized mammals species of the world. The authors draw extensively on existing literature and on their own expertise to formulate English names that describe a distinctive aspect of each animals appearance, ecological habits, or geographical distribution. Presented in phylogenetic order, the book's list includes order and family names, as well as those of genera and species. An extensive bibliography of sources and two indexes round out the volume. Available from: Smithsonian Institution Press, P.O. Box 960, Herndon, VA 20172-0960, USA, Tel: 1 800 782 4612 or (703) 661-1599, Fax: (703) 661-1501.

2000 IUCN Red List of Threatened Species

The *2000 IUCN Red List of Threatened Species*, 2000, 61pp., + CD-ROM, was launched on the 28th September 2000, in London, Washington, Geneva, and Ottawa. It was compiled by Craig Hilton-Taylor, with the assistance of Caroline Pollock, Matthew Linkie, Alan Mauric, Janice Long, Mariano Gimenez-Dixon, Simon Stuart, Alison Stattersfield, Martin Sneary, and Georgina M. Mace, in association with experts in the IUCN/SSC Species Survival Commission specialist groups and BirdlLife International. Includes a foreword by David Brackett, Chair of the IUCN Species Survival Commission, and an introductory essay "A challenge to the global community" by Russell A. Mittermeier, President of Conservation International and Chairman of the Primate Specialist Group. Seven annexes: 1. Recent developments in the IUCN/SSC Red List Programme; 2. Organization of information; 3. Information sources and quality; 4. Habitat types authority file; 5. Threat types authority file; 6. The 1994 IUCN Red List categories and criteria; 7. Summary of the results of the review of IUCN Red List categories and criteria 1996-2000 (Georgina M. Mace). There are a number of innovations introduced to enhance the effectiveness of the List as a conservation tool. *Improved species coverage*: All bird species have been completely reassessed by BirdlLife International and its partners; all primates have been reassessed following a consultative review workshop on primate systematics (see *Neotropical Primates* 8(1), pp. 49-50); many other mammals, including antelope, bats, cetaceans, otters, wild pigs, wild cattle and wild goats, and some rodents were reassessed; improved coverage of sharks, rays and saw-fish; all South-east Asian freshwater turtles were comprehensively assessed; a number of new reptile and amphibian assessments from Brazil, the Philippines, Russian Federation and the Russian Republics were carried out; the correction of some insect information and the addition of a number of new European butterfly assessments; correction of errors in the mollusc listings in the *1996 Red List*, a thorough re-evaluation of all potentially extinct species of mollusk and the inclusion of a number of new assessments; all the tree assessments from *The World List of Threatened Trees* (Oldfield *et al*. 1998) were incorporated and updated where necessary; all conifers were comprehensively reassessed; and new assessments for plants from Cameroon, Galápagos, Mauritius and South Africa were included, as were comprehensive assessments for the carnivorous plant genera *Nepenthes* and *Sarracenia*, and the for the first almost 100 assessments of mosses were included. *Peer review process* carried out by the appointment of Red List Authorities responsible for the evaluation of all assessments on the Red List to help ensure the maintenance of standards and the correct application of the criteria. *Improved documentation*: with the inclusion of a rationale for many listings explaining how they were reached to improve accountability; provision of information on range, current population trends, main habitats, major threats and conservation measures taken; and improved documentation of extinct species. *Introduction of a petitions process* whereby listings can challenged. *Increased accessibility* via a new web site and a CD-ROM. The web site provides a mechanism whereby users can feed corrections and additional information back to the Red List Programme. Web site:
http://www.iucn.org/redlist/2000/index.html.
The *2000 IUCN Red List of Threatened Species* (Book with analysis and CD-ROM) is available only in English. Price: £30 or US$45 at: IUCN Publication Services Unit, 219c Huntingdon Road, Cambridge, CB3 0DL, UK, Tel: +44 1223 277894, Fax: +44 1223 277175, e-mail: info@books.iucn.org, or order at: http://www.iucn.org/bookstore/index.html.

Conservation Biology – Special Section on Habitat Disturbance

The December 2000 issue, Vol. 14(6), of *Conservation Biology*, the Journal of the Society for Conservation Biology, has a special section with 12 articles devoted to the theme "Habi-

tat Disturbance and Tropical Rainforest Mammals", put together by the Guest Editor Alfredo D. Cuarón of the Departamento de Ecología de los Recursos Naturales, Instituto de Ecología, Universidad Nacional Autónoma de México, Michoacán, México. It includes the following papers: A global perspective on habitat disturbance and tropical rainforest mammals - A.D. Cuarón, pp. 1574-1579; Monitoring mammal populations in Costa Rican protected areas under differing huntin g restrictions, E. Carrillo, G. Wong & A.D. Cuarón, pp. 1580-1591; Habitat mosaic, wildlife availability, and hunting in the tropical forest of Calakmul, Mexico - A. Escamilla, M. Sanvicente, M. Sosa & C. Galindo-Leal, pp. 1592-1601; Bushmeat markets on Bioko Island as a measure of hunting pressure - J.E. Fa, J.E. Garcia Yuste & Ramon Castelo, pp. 1602-1613; Roads, development, and conservation in the Congo basin - D. Wilkie, E. Shae, F. Rotberg, G. Morelli & P. Auzel, pp. 1614-1622; Influence of timber extraction routes on Central African small-mammal communities, forest structure, and tree diversity – J.R. Malcom & J.C. Ray, pp. 1623-1638; Effects of habitat disturbance and protected areas on mammals of Peninsular Malaysia – R.K. Laidlaw, pp. 1639-1648; Density and population size of mammals in remnants of Brazilian Atlantic forest – A.G. Chiarello, pp. 1649-1657; Effects of human colonization on the abundance and diversity of mammals in eastern Brazilian Amazonia – M.A. Lopes & S.F. Ferrari, pp. 1658-1665; Bat diversity and abundance as indicators of disturbance in Neotropical rainforests – R.A. Medellín, M. Equiha & M.A. Amin, pp. 1666-1675; Effects of land-cover changes on mammals in a Neotropical region: A modeling approach - A. D. Cuarón, pp. 1676-1692; Bat- and bird-generated seed rains at isolated trees in pastures in tropical rainforest – J. Galindo-González, S. Guevara & V.J. Sosa, pp. 1693-1703.

Hunting and Biodiversity Conservation and Tropical Forest Management – Two Publications

In September 2000, The World Bank in collaboration with the Wildlife Conservation Society (WCS), New York, published two important documents on hunting and biodiversity conservation. They are monographs in the *Biodiversity Series – Impact Studies, Environment Department Papers*. The first, "Biodiversity Conservation in the Context of Tropical Forest Management" by Francis E. Putz, Kent H. Redford, John G. Robinson, Robert Fimbel and Geoffrey M. Blate, 80pp., has six chapters, as follows: 1. Introduction; 2. Disaggregating "Biodiversity"; 3. Disaggregating "Logging"; 4. Impacts of Forest Management on Biodiversity; 5. Overview of Biodiversity Conservation in Relation to Logging and Other Silvicultural Treatments; 6. Recommendations. There are seven appendices. The second, "Hunting of Wildlife in Tropical Forests: Implications for Biodiversity and Forest Peoples", by Elizabeth L. Bennett and John G. Robinson, 42 pp., is a based on the book recently published by the same authors, *Hunting for Sustainability in Tropical Forests*, Columbia University Press, New York, 2000. Besides an executive summary, it has five chapters: 1. Introduction; 2. The Sustainability of Hunting in Tropical Forests; 3. Factors Affecting the Sustainability of Hunting; 4. Enhancing the Sustainability of Hunting; 5. Conclusions and Recommendations. Copies are available from: Environment Department, The World Bank, 1818 H Street, NW, Washington, DC 20433, USA, Tel: +1 202 473-3641,
Fax: +1 202 4770565.

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Putz, F.E.; Redford, K.H.; Robinson, J.G.; Fimbel, R.; Blate, G.M. 2000. Biodiversity conservation in the context of tropical forest management. Biodiversity Series – Impact Studies, Environment Department Papers (75): 80 pp. The World Bank, Washington, DC.

Bennett, E.L.; Robinson, J.G. 2000. Hunting of wildlife in tropical forests: Implications for biodiversity and forest peoples Biodiversity Series – Impact Studies, Environment Department Papers (76): 42 pp. The World Bank, Washington, DC.

Bushmeat Hunting

As part of their new publication series, *Advances in Applied Biodiversity Science*, Editor Philippa Benson, The Center for Applied Biodiversity Science (CABS) at Conservation International, Washington, D. C., has recently published "Hunting and Bushmeat Utilization in the African Rain Forest: Perspectives Toward a Blueprint for Conservation Action", edited by Mohamed I. Bakarr, Gustavo A. B. da Fonseca, Russell A. Mittermeier, Anthony B. Rylands, and Kristen W. Painemilla, (*Advances in Applied Biodiversity Science*, 2001, No. 2, 170 pp., ISBN 1-881-17337-2). The publication resulted from a series of documents drawn up for a regional workshop on hunting and bushmeat utilization in West Africa, held in Ghana in December 1999.

The purpose of this volume was to draw attention to the complex nature of the bushmeat crisis in West and Central Africa, and to serve as a starting point for dialogue across sectors about how best to develop and implement solutions. The ideas are neither a manual of conservation actions nor a prescription for addressing the bushmeat crisis. Instead, it is a collection of diverse perspectives to offer a framework for action, one that is based on the social, cultural and ecological context within which the bushmeat crisis has arisen. The wildlife and human dimensions are analyzed by experts, all of whom submit their own methods, perspectives, and beliefs to help strengthen conservation initiatives. The audience targeted includes conservation practitioners, development agencies and private sector industries interested in mitigating the bushmeat crisis. It includes the following chapters: Part 1. The Complex Nature of Bushmeat Hunting and Threats to Wildlife. 1. Regional dynamics of hunting and bushmeat utilization in West Africa – an overview – Hans-Ulrich Caspary; 2. Bushmeat hunting in the Congo basin – a brief overview – David S. Wilkie; 3. Colonial history, concessionary politics, and collaborative management of Equatorial African rain forests- Philippe Auzel & Rebecca Hardin; 4. Impacts of bushmeat hunting on wildlife populations in West Africa's Upper Guinea forest ecosystem – Heather E. Eves & Mohamed I. Bakarr; Part 2. The Human Dimensions and Conservation Challenges of the Bushmeat Crisis. 5. Social change and social values in mitigating bushmeat commerce – Anthony L. Rose; 6. Culture, ethics and conservation in addressing the bushmeat crisis in West Africa – Kerry Bowman; 7. Wildlife utilization and the emergence of viral diseases – Rebecca Hardin & Philippe Auzel; 8. Legal and institutional mechanisms for wildlife and habiotat protection in West Africa – The need for an integrated policy assessment – Cyril Kormos & Mohamed I. Bakarr. Part 3. Using Bioeconomic Modeling to Assess Sustainability of Bushmeat Hunting. 9. Potential applications of bioeconomic modeling in West Africa – Jim Cannon; 10. Assessing sustainability of hunting: Insights from bioeconomic modeling – E.J. Milner-Gulland. There is an Appendix: Data on Protected Areas in Cote d'Ivoire, Ghana, Guinea, Liberia and Sierra Leone.

Available from: Nedra Johnstone, Center for Applied Biodiversity Science, Conservation International, 1919 M Street NW, Suite 600, Washington, DC 20036;
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CD- ROMS

Lemurs of Madagascar and the Comoros, Authors: J.-J. Petter , J.-H. van der Sloot. Lemurs are threatened species that occur only on Madagascar and the Comoros. In cooperation with Conservatoire Vivant des Mascareignes and IUCN (with Red Book data), ETI produced this CD-ROM, which presents a completely revised monograph on all Lemurs. Detailed information about 61 (sub)species and 34 higher taxa is presented, with color drawings, photos, film-shots and sounds. Included are three types of fully illustrated computer assisted identification keys. The distribution information is stored in an interactive geographical information system. All text is hyperlinked: an illustrated glossary defines more than 1000 scientific terms. Thousands of literature references for this group are stored in a reference database. This CD-ROM is not only an excellent introduction to the Lemurs of Madagascar and the Comoros, but also a unique encyclopedical work. ISBN: Mac: 3-540-14552-4. Win: 3-540-14551-6, Prize: 99.95 Euro. J.H. van der Sloot., ETI Biodiversity Center, University of Amsterdam, Mauritskade 61, 1092 AD Amsterdam, The Netherlands, tel. 31.20.5257177, fax. 31.20.5257238,
e-mail: **jhvdsloot@eti.uva.nl**, **http://www.eti.uva.nl/**

Ongoing lemur studies

Braune, P. Acoustic variability and its biological significance in mouse lemurs (*Microcebus* spp.). PhD thesis, University of Hannover.

Lutermann, H. Reproductive strategies of female grey mouse lemurs (*Microcebus murinus*) in Northwest Madagascar. PhD thesis, University of Hannover.

Radespiel, U. The influence of habitat fragmentation and characteristics on the distribution, population ecology and genetics of mouse lemur species in Northwestern Madagascar.

Randrianambinina, B. Contribution à l'étude comparative de l'ecoéthologie de deux Microcèbes rouges de Madagascar, *Microcebus ravelobensis* (Zimmermann *et al.*, 1998) et *Microcebus rufus* (Lesson, 1840). Thèse de Doctorat de 3è cycle. Université d'Antananarivo.

Rasoloharijaona, S. Contribution à l'étude comparative de la communication vocale et de la vie sociale de deux formes de *Lepilemur* (Geoffroy, 1858) (Lepilemuridae, Rumpler *et al.* 1972) provenant de la forêt seche de l'ouest et de la forêt humide de l'est de Madagascar. Thèse du Doctorat de 3è Cycle. Université d'Antananarivo.

Reimann, W.E. Comparative feeding ecology of two sympatric mouse lemurs species (*Microcebus murinus* and *M. ravelobensis*) in Northwestern Madagascar. Dissertation. School of Veterinary Medicine Hannover .

Schmelting, B. Reproductive strategies of male grey mouse lemurs (*Microcebus murinus*) in Northwestern Madagascar. PhD thesis. School of Veterinary Medicine Hannover.

Weidt, A. Socio-ecology of female golden brown mouse lemur (*Microcebus ravelobensis*) during the dry season in Northwestern Madagascar. Diploma thesis. University of Göttingen.

Zimmermann, E. Geographical variation in vocal communication, morphology and genetics of sportive lemurs (*Lepilemur* ssp.) in Madagascar.

Theses completed

Altrichter, H. Playback study for the discrimination of information categories in the social calls of the Milne Edwards' Sportive Lemur (*Lepilemur edwardsi*) in Northwestern Madagascar. 2001. Diploma thesis. University of Osnabrück.

Ehresmann, P. Ecological differentiation of two sympatric mouse lemur species (*Microcebus murinus* and *M. ravelobensis*) in a dry deciduous forest of Northwestern Madagascar. 2000. PhD thesis, University of Hannover. The coexistence of closely related species can generally by explained by an ecological differentiation that leads to decreased interspecific competition. Two sympatric mouse lemur species (*Microcebus murinus* and *M. ravelobensis*) occurring in a dry deciduous forest in northwestern Madagascar (near Ampijoroa) were studied and compared with regard to their population ecology, their home range size and overlaps and their sleeping sites usage pattern in order to illuminate the mechanisms of their coexistence. The study was conducted over a period of three months (August to October 1996) and another of eight months (April to November 1997) within a study site of about 30ha. The first year covered the reproductive season, whereas in the second year data were collected from inside and outside the reproductive season. In order to investigate the population ecology, capture-recapture techniques were employed. Home ranges and sleeping sites were investigated with radiotelemetry. Both species showed stable population size and the main areas of capture differed for *M. murinus* and *M. ravelobensis*. The latter could be the result of different habitat preferences and therefore of species-specific usage patterns of resources. No periods of prolonged inactivity could be detected in either species during the lean dry season. In both species testes sizes increased significantly during the reproductive season and home ranges of both sexes overlapped considerably which indicates a promiscuous mating system in both species. Male home ranges increases significantly in *M. murinus* and *M. ravelobensis* when estrous females were present, suggesting that competitive mate searching is prominent in both species. Estrous females of *M. murinus* could be captured at the end of September only whereas estrous females of *M. ravelobensis* were found from the beginning of September to the end of October. These findings suggest an earlier start of reproduction and a lesser degree of estrous synchrony in *M. ravelobensis* than in *M. murinus*. Both mouse lemur species differ significantly with respect to their sleeping sites. *M. murinus* preferentially occupied closed, deep tree holes whereas *M. ravelobensis* were mainly found on branches and lianas and only rarely in tree holes. This species-specific usage pattern of protected sleeping sites seems to be connected to the species-specific response to disturbances. Whereas *M. murinus* were usually hiding within their shelters, *M. ravelobensis* regularly showed a flight response when an observer approached. The use of different sleeping sites in combination with a species-specific behavioural response to disturbances reduces the interspecific competition for this important resource and can therefore be regarded as one possible explanation for the stable coexistence of these two sibling species in this study site.

Flügge, P. Characterization of MHC-class-I Genes of the grey mouse lemur (*Microcebus murinus*). 2000. Diploma thesis, University of Hannover.

Hagenah, N. Ecology and intrasexual competition of male golden brown mouse lemurs (*Microcebus ravelobensis*) in Northwestern Madagascar during the dry season. 2001. Diploma thesis. University of Hannover.

Norosoarinaivo, J.A. 2000. Etude du comportement chez *Hapalemur aureus* (B. Meier, R. Albignac, A. Peyriéras, Y. Rumpler et P.C. Wright 1987) du stade enfant jusqu'au stade juvénile dans le Parc National de Ranomafana. Mémoire de D.E.A, Département de Biologie animale. Faculté des Sciences, Université d'Antananarivo. Résumé: *Hapalemur aureus* (Meier et Coll 1987) est la dernière nouvelle espèce du genre *Hapalemur* découverte dans la forêt du Parc National de Ranomafana. C'est un animal crépusculaire arboricole. Il mange des pousses de bambous et vit par groupe de 2 à 4 individus. A Talatakely, un groupe de *Hapalemur aureus* occupe un territoire de 26 ha (Tan 1990) et parcourt une distance de 200 à 650 m par jour selon le climat. Le couple pousse un cri territorial avant de quitter son dortoir. L'accouplement se ferait entre juillet et août avec 5 mois environ de gestation. La mise-bas a lieu entre novembre et décembre, pendant la saison pluvieuse de Ranomafana. La femelle donne un enfant par an. Avant la naissance du jeune, elle ne construit pas de nid comme *Hapalemur griseus* (Petter 1977). Dès la naissance jusqu'à la huitième semaine, durant 57 jours environ, elle a l'habitude de laisser son petit entre les branches d'arbre sur une hauteur moyenne environ de 9 m, à l'abri des prédateurs et des intempéries alors qu'elle part à la recherche de nourriture. C'est «l'enfant parking» (P. Wright 1990; Tan communications personnelles). Le développement du nouveau-né est plus rapide que celui de *Propithecus diadema edwardsi* et comprend trois phases: phase de dépendance (dès la naissance jusqu'à l'âge de 2 mois et une semaine soit 9 semaines), phase de semi-indépendance (2 mois et une semaine jusqu'à l'âge de 3 mois et une semaine soit 13 semaines) et phase d'indépendance (à partir de 3 mois et une semaine). Durant 4 mois et demi, la mère est la première responsable de son enfant. Cette responsabilité de la femelle vis-à-vis de son enfant est souvent perturbée par les touristes. En vue de conserver les espèces menacées et endémiques de Madagascar, il est nécessaire d'améliorer les règlements touristiques en tenant compte des résultats de ce travail.

Polenz, S. Acoustic and social behaviour of the golden brown mouse lemur (*Microcebus murinus*) during the mating season. 2000. Diploma thesis, University of Hannover.

Rabelaza, A.O. 2000. Suivi-démographique des populations de *Eulemur fulvus albifrons* et de *Indri indri* en Octobre-Novembre 1996, Octobre-Novembre 1997 et Janvier-Février 1999, face aux pressions humaines dans le PN n° 13 de Marojejy et dans la RS n° 4 d'Anjanaharibe-Sud. Mémoire de D.E.A, Département de Biologie animale. Faculté des Sciences, Université d'Antananarivo. Résumé: *Eulemur fulvus albifrons* et *Indri indri* sont des espèces de lémuriens menacées par la chasse et les défrichements (les "tavy"), pratiqués par les populations riveraines dans le complexe de Marojejy/Anjanaharibe-Sud, au Nord Est de Madagascar. Le suivi-démographique de ces animaux, à des périodes de trois années et dans des zones à différents niveaux de perturbation, a pu montrer des fluctuations irrégulières de l'accroissement numérique des populations de *Eulemur fulvus albifrons*. Des variations quantitatives des populations s'observent au niveau de la densité, la taille de groupes, du sex ratio et du taux de reproduction. Nombreuses en sont les causes responsables mais elles sont vraisemblablement liées soit aux facteurs climatiques, aux facteurs alimentaires, aux facteurs de perturbation d'origine humaine ou aux facteurs internes d'autorégulation des populations (changements quantitatifs induits par des variations de densité). *Eulemur fulvus albifrons* semble moins sensible à la dégradation forestière mais pourrait être exposé au risque d'une rapide disparition à la suite d'une chasse intensive. A cause des difficultés de leur observation, beaucoup de points pouvant concerner l'étude de la dynamique des populations des *Indri* d'Anjanaharibe-Sud restent encore assez mal connus. Leur faible densité notée à Ranomafana (Anjanaharibe-Sud), zone forestière perturbée, pourrait, toutefois, indiquer une inquiétante déforestation à ce niveau mais pressent surtout une grande menace de la survie de cette espèce.

Rahajanirina, V.V. 2000. Contribution à l'étude systématique et écologique des bambous consommés par *Hapalemur* dans le région du Parc National de Ranomafana. Mémoire de D.E.A, Département de Biologie et Ecologie végétales. Faculté des Sciences, Université d'Antananarivo. Résumé: En plus des importances économiques, les bambous constituent l'aliment de base de *Hapalemur* dans la région du Parc National de Ranomafana. Quatre espèces de bambous à savoir: *Cathariostachys madagascariensis*, *Schizostachyum* sp., *Cephalostachyum viguieri* et *Nastus elongatus* sont consommées par *Hapalemur*. Les planches et les descriptions faites nous donnent des informations sur la morphologie et la détermination de ces espèces. Le test biochimique de l'extrait de chaque espèce pour la souris montre que *Schizostachyum* sp. et *Cephalostachyum viguieri* sont létales pour la souris. *Cathariostachys madagascariensis* est héliophile. *Schizostachyum* sp. et *Céphalostachyum viguieri* ont plus d'affinité dans les forêts fermées. *Nastus elongatus* a une amplitude écologique restreinte sur les stations humides, elle est aussi sciaphile. La régénération de bambous se fait généralement par multiplication végétative de rhizome sauf pour *Cephalostachyum viguieri*. Elle est généralement faible à cause de la consommation faite par *Hapalemur*. Les bambous sont encore disponibles pour les *Hapalemur* si l'utilisation humaine est rationelle. Alors pour bien conserver les *Hapalemur*, il est nécessaire de prendre des mesures sur les utilisations de bambous par l'homme.

Ramarosandratana, H.V. 2000. Contribution à l'étude des espèces végétales consommées par *Varecia variegata variegata* dans la Forêt de Manombo (Farafangana). Mémoire de D.E.A, Département de Biologie et Ecologie végétale. Faculté des Sciences, Université d'Antananarivo. Résumé: Notre étude concernant les espèces végétales consommées par *Varecia variegata variegata*, un lémurien dans la Forêt de Manombo, dans le Sud-Est de Madagascar nous a permis de caractériser les différents types de formations végétales, habitat de ces lémuriens, de déterminer leurs disponibilité alimentaire au sein de leurs territoire. Ceci par le biais d'une inventaire des espèces consommées par ce lémurien dans cette forêt laquelle se présente actuellement sous une forme perturbée, d'une évaluation de l'abondance, de la densité de ces ressources au niveau des différentes formations fréquentées par l'animal, des enquêtes sur les utilisations de ces espèces végétales, en vue de determiner les pressions anthropiques qui peuvent les menacer. Nous avons pu également définir le mode de distribution des populations de quelques espèces consommées, ainsi que leurs régénérations naturelles. Et dire que *Varecia variegata varuegata* est un endozoochore, disséminateur de graines et qui favorise la régénération de la forêt. Une relation d'interdépendance existe donc entre la population lémurienne et l'écosystème forestier. Ainsi la conservation de la forêt s'avère être une action primordiale pour assurer la survie de l'espèce animale .

Ramasiarisoa, P.L. 2000. Contribution à l'étude de l'exploitation de l'espace à travers l'activité alimentaire de trois

lémuriens *Propithecus verreauxi verreauxi, Lemur catta*, et *Eulemur fulvus rufus* dans la Réserve de Berenty. Mémoire de D.E.A, Département de Biologie animale. Faculté des Sciences, Université d'Antananarivo. Résumé : Les comportements et régimes alimentaires des trois espèces sympatriques *Propithecus verreauxi verreauxi, Lemur catta, Eulemur fulvus rufus*, ont été étudiés dans la Réserve de Berenty au mois de Mai-Juin 1998 et Février-Mars 1999. Le degré et la distribution globale de l'activité alimentaire diurne diffèrent entre les espèces et varient à l'intérieur même des espèces suivant la disponibilité alimentaire saisonnière. La composition de leur régime est aussi en corrélation avec cette disponibilité alimentaire saisonnière. En général, les trois espèces de lémuriens augmentent leur temps d'alimentation pendant la période où il manque des ressources (saison sèche) et chaque lémurien utilise différentes stratégies pour ne pas avoir une compétition directe durant cette période. En plus, ils consomment des parties des plantes de plusieurs espèces qui réagissent différemment au test de screening. Ils exploitent l'espace suivant la répartition de la nourriture préférentielle. Cette différence interspécifique dans le comportement et le choix alimentaire permet à ces espèces animales de coexister dans le même environnement.

Rambinintsoa, A. 1999. Contribution à l'étude comparative anatomique et ostéométrique de *Hapalemur simus* (Gray 1870) subfossile de l'Ankarana et forme actuelle de Ranomafana (Ifanadiana). Idées actuelles sur le paléoenvironnement de l'Ankarana. Mémoire de D.E.A, Département de Paléontologie et d'Anthropologie Biologique. Faculté des Sciences, Université d'Antananarivo. Résumé: Après des expéditions faites par l'équipe du Duke University Primate Center et le Département de Paléontologie et d'Anthropologie Biologique dans l'Ankarana, des ossements de *Hapalemur simus* subfossiles ont été stockés dans le Laboratoire de Primatologie et Biologie évolutive. Des ossements de *Hapalemur simus* actuel offerts par l'Académie Malgache sont aussi étudiés. Après des études comparatives de l'anatomie et de l'ostéométrie ainsi sue des études statistiques entre les deux formes, nous avons trouvé des différences sur la largeur du crâne, la robustesse de la mandibule, la largeur de la branche montante, le diamètre mesio-distal des dents inférieures, le diamètre vestibulo-lingual des dents supérieures, la robustesse de l'humérus, du radius et du cubitus, du diamètre antéro-postérieur de la tête fémorale et de la robustesse du tibia. Au cours de l'Holocène, il y a eu extinction des lémuriens à Madagascar due à l'action de l'Homme et à d'autres facteurs. A partir des études de la faune de l'Ankarana et d'autres sites, nous avons conclu l'existence de deux cas possibles du paléoenvironnement de l'Ankarana: le climat pouvait être identique à celui qu'actuellement avec une forêt sempervirente, le climat pouvait être identique à celui qu'actuellement avec une forêt sèche semi-caducifoliée. Après la datation isotopique par ^{14}C, *Hapalemur simus* de l'Ankarana date de 4560 ± 70 ans B.P.

Rasoloarison, M.R. 2000. Taxonomie et Biogéographie des *Microcebus* spp. dans la portion Ouest de Madagascar. Thèse de Doctorat de 3è cycle, Département de Paléontologie et d'Anthropologie Biologique. Faculté des Sciences, Université d'Antananarivo. Résumé: Les Microcèbes, genre *Microcebus*, sont les plus petits des primates vivants. Tout récemment, ils ont encore été considérés comme étant constitués de deux espèces différentes: *Microcebus murinus*, une forme grise largement limitée aux forêts sèches de la portion Ouest de Madagascar et *Microcebus rufus*, une forme rousse qui se rencontre à travers les formations forestières humides de l'Est. Des spécimens et des observations récentes effectuées dans cette portion Ouest de l'île ont démontré que des animaux roux y sont présents. Cependant, la taxonomie actuelle est confuse, largement due au manque de matériel comparatif nécessaire pour quantifier la variation morphologique intrapopulation et intraspécifique. Sur la base des matériels de ce genre, collectés récemment dans douze localités à travers la portion occidentale de Madagascar, depuis Ankarana au Nord jusqu'à Beza Mahafaly au Sud, une étude taxonomique et biogéographique, utilisant d'une part une analyse morphologique basée essentiellement sur des caractères morphologiques externes, crâniens et dentaires, et d'autres part une analyse phylogénétique de la séquence d'ADN mitochondrial. Sur la base de ces deux méthodes d'approche, on reconnaît sept espèces du genre *Microcebus* dans cette portion occidentale de Madagascar.

Raveloarisoa, A. 2000. Contribution à l'étude de la préférence alimentaire des *Propithecus verreauxi verreauxi* (Grandidier A., 1867) de la Réserve Spéciale de Beza-Mahafaly (Parcelle 1). Mémoire de D.E.A, Département de Biologie animale. Faculté des Sciences, Université d'Antananarivo. Résumé: Les *Propithecus verreauxi verreauxi* sont les lémuriens diurnes qui dépendent strictement du milieu forestier pour leur mœurs et pour leur alimentation. L'étude de leur préférence alimentaire fait l'objet du présent mémoire. Bien que les *Propithecus verreauxi verreauxi* sont des lémuriens à régime alimentaire typiquement végétarien, ils ne consomment indifféremment n'importe quels fruits ou feuilles. En effet, 58 espèces de la Réserve font partie de la ressource alimentaire de ces animaux dont seule l'espèce *Breidellia pervilleana* (Euphorbiaceae) est supposée efficace dans l'élimination des parasites intestinaux. Selon les disponibilités saisonnières et annuelles des différentes catégories alimentaires et les différentes essences exploitables dans leur domaine vital pendant une saison de l'année; leur régime est aussi large que varié, ce qui détermine la 'préférendum alimentaire' chez les *Propithecus verreauxi verreauxi*.

Razanantsoa, Z.U.A. 2000. Contribution à l'étude de la population de Propithèque de Decken *Propithecus verreauxi deckeni* (Peters, 1870) dans la forêt de Tsimembo aux alentours du complexe des trois lacs et impact des activités humaine sur cette population. Mémoire de D.E.A, Département de Biologie animale. Faculté des Sciences, Université d'Antananarivo. Résumé: Trois groupes sociaux de *Propithecus verreauxi deckeni*, choisis à partir de certains critères ont été suivis dans la forêt dense sèche caducifoliée de Tsimembo au bord du complexe des trois lacs: Soamalipo, Befotaka et Ankerika, région d'Antsalova. Des données sur l'exploitation de l'espace, les différentes activités, les comportements et le régime alimentaire ont été notés journalièrement et pendant deux saisons successives (sèche et humide). Par ailleurs, des enquêtes ont été effectuées au niveau des paysans et pêcheurs pour connaître si les pressions humaines ont eu des impacts sur la population de *Propithecus verreauxi deckeni* dans le site d'étude. Les valeurs moyennes de la distance parcourue oscillent entre 416,16 ± 49,31 m à 799 ± 111,87 m en saison sèche et de 486,67 ± 24,82 m à 899 ± 122,09 m en saison humide. L'étendue du domaine vital varie de 3,39 ha à 6,90 ha en saison sèche et de 2,34 ha à 4,78 ha en saison des pluies. *Propithecus verreauxi deckeni* consacrent plus de la moitié de la journée à se reposer durant les deux saisons mais ils sont plus actifs et mangent beaucoup plus en saison humide. En effet, l'exploitation de l'espace ainsi que les temps consacrés aux activités principales dépendent essentiellement de la répartition des espèces végétales feuillées en période sèche et les espèces à fruits en période humide. Le régime folivore représente plus de 75 % de leur nourriture en saison sèche mais ils sont relativement frugivores en saison des pluies (plus de 43 %). 37 espèces végétales parmi les 64 consommées en saison sèche constituent la nourriture principale de ces animaux tandis qu'en saison de pluies,

30 espèces seulement parmi les 82 exploitées leur suffisent. La plupart de ces espèces végétales utilisées et consommées par *Propithecus verreauxi deckeni* sont affectées par les activités humaines. Les perturbations, surtout pendant la période de la pêche, ont des conséquences sur leurs comportements. L'impact humain sur la population des Propithèques risque de s'aggraver si des mesures ne sont prises à leur égard.

Schmelting, B. Seasonal activity and reproduction in male grey mouse lemurs (*Microcebus murinus*, J.F. Miller 1777) in Northwestern Madagascar. 2000. Dissertation. School of Veterinary Medicine Hannover. The aim of this study is to examine the seasonal activity of the lemur species *Microcebus murinus* in a complete annual cycle in the dry deciduous forest of Ampijoroa, Northwestern Madagaskar, specifically concerning male reproductive strategies. From May 1998 to April 1999 a total of 105 (68 males, 37 females) different individuals were captured, in a study site of approx. 30 ha, using the mark-recapture method. The calculated population density ranged between 75 animals/km^2 in the rainy season and 148 animals/km^2 in the dry season. Both males and females were caught throughout all months of the year. No significant deviation from an even sex ratio (1:1) was observed during any month of the year. No prolonged periods of seasonal torpor occurred neither in males nor in females. Prior to the beginning of the mating season in September, the testes volume and the body mass of all captured males increased significantly and then decreased during the mating season. A second increase of the testes volume was observed in November. Twelve radiocollared males were studied with respect to sleeping sites, feeding behaviour, social interactions, nocturnal path lengths and home ranges. The males were found to follow seasonally specific strategies with regards to sleeping site choices, which could be due to seasonal changes in vegetation, predation pressure and/or parasitic load. 1244 (427 different) sleeping sites were determined. In the dry season, males slept twice as often in holes than in exposed and unsheltered sites. The animals had some preferred sleeping sites, to which they returned up to 27 times. At the end of the dry season male sleeping groups (without any female participation) were observed 33 times. Only resident males slept together more than once. In the rainy season approx. 90 % of the chosen sleeping sites were exposed in the open foliage. In over half of the cases animals slept in the same sleeping site no more than twice. More than 331 h of nocturnal focal observations were analysed. The preferred diet and forest layer use by the animals changed monthly and seemed to be dependent on seasonal changes of the vegetation. During the dry season, the diet consisted mainly of tree exudates and insect secretions.At the beginning of the rainy season, the diet changed towards insects and fruits, followed by nectar and the end of the rainy season towards fruits and tree exudates. It is proposed that mouse lemurs could play an important role in the pollination of *Canthium* sp. during the rainy season. In January, the observed males fed almost exclusively on this tree species, licking nectar without destroying the flowers. Within this study, it has been proven that in the wild *M. murinus* had two distinct mating seasons with correlating birth seasons within one breeding season. The first mating season took place in September, followed by an interception starting in mid October. The second started at the end of November and lasted until the beginning of January. Most social interactions were recorded in September and November, copulations were observed in September, November and the beginning of January. The longest nocturnal path lengths were measured in September (mean: 1028 m) and the end of November (mean: 869 m) and the shortest in March (mean: 538 m). The males had the largest home ranges in September (mean 2.97 ha) and November (mean 2.54 ha) and the smallest in March (mean 0.7 ha). The largest and relative number of home range overlaps were detected in September and November. In general, larger home ranges included more female capture sites. In the first mating season (but not in the second mating season) the home range size of the males correlated with their body weight. Furthermore, the home range size within each mating season seemed to be related to the spatial experience of a male. In each mating season the majority of resident males had larger home ranges than most young or non resident males (males captured the first time in this field study). The results of this study indicate that male *M. murinus* might develop experience-dependent reproductive strategies .

Zietemann, V. Species diversity in mouse lemurs: The significance of acoustic communication. 2000. PhD thesis. University of Hannover.

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