# LEMUR NEWS

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

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DPZ Deutsches Primatenzentrum

SPECIES SURVIVAL COMMISSION

ZOOLOG. INSTITUT & ZOOLOG. MUSEUM HAMBURG

**Cover Foto:** *Lepilemur dorsalis* in Manongarivo;
photo taken by Harald Schütz


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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: **brakoto@simicro.mg**

# EDITORIAL

We are pleased to announce that the Margot Marsh Biodiversity Foundation awarded another grant to continue the production and circulation of *Lemur News* Vol. 5 and 6. The renewal of the grant came just in time. Primatology seems to have entered a new era in Madagascar. Today, there are many more researchers active in the country with a very strong component of Malagasy collegues working for Government institutions, NGOs, consultants, or research associates than just a few years ago. *Lemur News* Vol. 1 listed almost everybody among the editors who was working in Madagascar or with lemurs at that time. If we would do the same now, we would have to copy almost a phone book. Many of these new researchers on the scene sent us contributions. Nineteen of the 38 authors of research articles in the present *Lemur News* are Malagasy. Therefore we feel that *Lemur News* is on the right track and actually serves as an instrument to provide a forum to make new information available, facilitate communication and to exchange ideas.

In February 2000 a workshop, organized and sponsored by Conservation International, the Margot Marsh Biodiversity Foundation, and the Walt Disney Institute for Conservation was held in Orlando. The goal of the workshop was to review the evidence and to compile a list of primate taxa that should be considered as taxonomic entities for conservation action. A summary of the results of this workshop will be included in the next volume of *Lemur News*. The important message for research in Madagascar is that we are far from having enough information on species distributions, population sizes and at least vague ideas on what to consider a taxonomic unit. This is a challenge for all of us. Diurnal species can be described reasonably well, but evolution produced much less differentiation in nocturnal species that can be detected visually. Here we might have to resort to acustic, olfactory or genetic differences. All of these require new technical facilities, training and awareness what a method can do and especially what it can not do. Not everything that is "high tech" is better than a ruler and an open eye.

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

**Ken Glander**
Duke University Primate Center, 3705 Erwin Road, Durham, NC 27705, USA

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

**Michael Schwibbe**
Deutsches Primatenzentrum, Kellnerweg 4, D-37077 Göttingen, Germany

# NEWS and ANNOUNCEMENTS

## The Species Survival Commission (SSC) Species Information Service (SIS)

Since 1994, SSC has, through its volunteer network and guided by its Strategic Plan, been developing a Species Information Service (SIS). A Working Group of SSC volunteers, led by the Lagomorph Specialist Group Chair Andrew Smith and Steering Committee member Luigi Boitani, has examined the capacity and information needs of the volunteer network to participate in SIS and has analyzed in detail SSC's current services to the conservation community and how these products and analyses could be enhanced through SIS.

The proposed program envisions a world-wide Species Information Service (SIS) that is easily accessible to the conservation and development communities (scientists, natural resource managers, educators, decisionmakers, and donors). Thousands of species conservation experts throughout the world will have capacity to equitably, proactively, and effectively contribute to the conservation of biodiversity with quality information provided to the conservation and development decision-making processes. The network will be a decentralized means of sharing information that can be accessed by users interested in information at different geographical scales (global, regional, national, and subnational), and that is flexible so as to be adaptable to the user's needs.

A single (one-size-fits-all) system to suit the capabilities and expectations of all Specialist Groups is neither possible nor desirable, thus, planning has incorporated a flexible approach to the architecture of the SIS. The modular data management system ensures minimum requirements and is adaptable toward the needs of individual Specialist Groups. The modular system sets standards to facilitate data exchanges while allowing Specialist Groups to build in components that meet particular requirements relevant to the taxa under their purview. Particular attention in the development process is also being given to aspects of quality assurance and the protection of intellectual property rights of data owners.

At present, a full-prototype SIS modular software package has been developed and provided to Specialist Groups for review. A small planning group met in March to execute a logical framework analysis, a process that helped to clarify SIS development and implementation activities, SIS partners, and SIS audiences. Included among the agreed activities are software revisions based on the aforementioned review, a workshop to test and analyze this second version, and distribution of the working release version. SIS will be supported by a small Secretariat unit, which will be responsible for providing training and other capacity-building activities to Specialist Groups, links to BCIS, and assistance in the development of SIS information products. The principal outcomes of the planning meeting were a detailed program plan and funding proposal. Staff and Working Group members are now beginning active fundraising to enable SIS implementation.

### Links to the Biodiversity Conservation Information System (BCIS)

Concurrently, the relationship between SIS and BCIS is developing in two ways: 1) data management and custodianship polices and guidelines are being developed in tandem to ensure complementarity between SIS and other BCIS members; 2) BCIS is emerging as a forum for linking SSC's species conservation objectives to the ecosystem, protected areas, and legal conservation objectives of the BCIS members, thus increasing the member's collective influence on a wide range of policy fora. The complementary strengths and diversity of the BCIS members are proving to be a strong force in the conservation and development communities, as evidenced by the advisory services BCIS is increasingly providing to intergovernmental and other information management initiatives. For example, BCIS participates on the In-

formal Advisory Committee of the Convention on Biological Diversity's Clearinghouse Mechanism, and in the regional workshops designed to guide development of the Clearinghouse Mechanism. BCIS representatives are also involved in planning processes for two regional biodiversity information management initiatives: 1) the Inter-American Biodiversity Information net-work (IABIN); and 2) the Regional Biodiversity Information System of the SADC (Southern African Development Community) countries.

BCIS members are now in the process of building a metadatabase that will point to the multitude of data and information resources held by members. The SSC Secretariat has completed an initial survey of the many data sets held throughout the SSC network to be included in the metadatabase. Updates and revisions will be ongoing. Three pilot projects, funded in part by the initial grant from the Norwegian Agency for International Cooperation (NORAD), have been agreed upon. SSC and the World Commission on Protected Areas (WCPA) are taking the lead on a project to analyze the relationship between globally threatened bird and mammal species and protected areas. This project will test the principles of SIS and will contribute to SIS development. Wetlands International is leading a pilot project to develop a global resource of information about wetlands, and TRAFFIC is leading the development of a BCIS-wide information resource on threatened plants used for medicinal purposes. SSC will play an active role in all three of these projects.

In February 1998, BCIS welcomed its twelfth member: the International Species Information System (ISIS). ISIS is a network of 500 zoos and aquariums from 54 countries that record and share detailed specimen information on more than one million specimens (living and dead) of 7,000 vertebrate species. ISIS develops and supports several PC-based software packages (ARKS, SPARKS, MedARKS and REGASP) that assist in ex situ management and recordkeeping.

The BCIS Secretariat has developed a discussion paper, Data Policy and Procedures Manual, which is available on the BCIS Web site and has generated considerable interest. The Data Policy provides the coordination mechanism to more effectively integrate activities of data collectors, data managers, and information providers that participate in a distributed data and information network like BCIS and SIS. It describes an infrastructure and sets of standards, guidelines, and procedures that will be necessary to improve the effectiveness of data management and the creation and dissemination of data and information in support of conservation-related sustainable development and other environmental issues. The Data Custodianship and Access discussion paper has been posted to the custodianship policy that will help ensure equity and provide for network cohesion.

For more information about BCIS and its Members, visit the Web site at www.biodiversity.org or contact Susan Tressler for a copy of the BCIS Information Packet, **tressler@igc.apc.org**, c/o Chicago Zoological Society, Brookfield IL 60513, USA).

For more information about the Species Information Service, contact Mariano Gimenez Dixon at IUCN headquarters, **mgd@hq.iucn.org**.

From Species, Newsletter of the IUCN Species Survival Commission, (30): 7-8, June 1998.

**Luigi Boitani, Mariano Gimenez-Dixon, Andrew Smith and Susan Tressler,**
Species Survival Commission (SSC), The World Conservation Union (IUCN), Rue Mauverney 28, CH-1196 Gland, Switzerland.

## Species Information Service - An Update

### Introduction

This report provides a brief update of progress in development of the SSC Species Information Service (SIS). Development of a network-wide information management system was first prioritised with the adoption of SSC's 1994 strategic plan. The plan recognised that data, information, and expertise about species biology and status was SSC's most valuable asset. Opportunities offered by emerging electronic technologies coupled with increasing demands placed on SSC members to provide their information and expertise for the IUCN Red List, Action Plans, CITES analyses and other advisory services, called for more comprehensive information management support to network members.

SIS is comprised of three elements: software, a data custodian model, and a central service unit. The software will be used by SSC Specialist Groups and IUCN Red List Authorities (in those instances where they are not the same entity), allowing them to collect and organise their data in a standardised form. Data will be managed in the context of a distributed data custodian model, with an aim to manage data as close to the source as possible, and capture the most current information available. In most cases the data custodian will be the Specialist Group. Through the central service unit, the SIS geo-referencing component will allow GIS linkage, thus enhancing the utility of the IUCN Red List as an analytical tool for management and conservation planning.

SIS will build capacity at three levels: 1) Specialist Groups and their members will be provided with the tools and training needed to strengthen their information management capacity; 2) SSC as a whole will be able to draw from the network-wide common framework to efficiently produce relevant and timely biodiversity conservation information products; 3) SSC will be positioned to contribute to integrated information products through the Biodiversity Conservation Information System (BCIS), a consortium of twelve international conservation organisations working together to produce better data for better conservation decisions. For more information on BCIS, go to **www.biodiversity.org**, or contact the SSC secretariat.

### Progress to Date

Professors Luigi Boitani (member, SSC Executive and Steering Committees) and Andrew Smith (Chair, Lagomorph Specialist Group) are leading the SIS development process. The SIS Data Management Working Group (DMWG) guides development of the SIS software tool. It is comprised of members with expertise in informatics, information management and biodiversity analyses. Careful selection of the DMWG has ensured expertise representative of both terrestrial and aquatic species, plants, animals and invertebrates. As with the IUCN Red List Categories and Criteria, it is particularly challenging to develop a system relevant to the wide variety of life forms addressed by the SSC network, and the SIS planning team is committed to developing a software package and system that will support the needs and characteristics of all types of species.

### General Program Development

Over the past 18 months, the SIS planning team has focused on development of the full Service. This effort has included not only software development, but also planning for sufficient support into the network, composition of the Central Service Unit, and planning for analytical products (biodiversity analyses). A significant amount of time has been devoted to raising funds for system implementation, including an effort to secure funds for Specialist Group participation. Proposals with the European Union DG XII (5th Framework) and the US National Science Foundation are now pen-

ding. Both include funding for Specialist Groups with Chairs based in Europe and the United States, respectively (a requirement of each of these potential donors). Other small grants have been secured to support the SIS development process, and include funding for those Specialist Groups that are participating in the SIS testing phase (see below). Funding for SIS has been included in other programmatic budgets as well, for example proposals requesting support for developing SSC's freshwater capacity and Red List Programme. Copies of all funding proposals are available to Specialist Group Chairs. Please contact the SSC secretariat if you wish to see them.

Collaborative projects that will draw on SIS have been planned at the BCIS consortium level. For example, SSC, BirdLife International, the IUCN World Commission on Protected Areas and the World Conservation Monitoring Centre have designed a project to identify high concentrations of threatened species and analyse them against protected areas. Although the aim is to develop this capacity globally, BCIS is first proposing to test the concept in Mesoamerica, in collaboration with the IUCN Regional Office there (ORMA). SSC has chosen to pursue this project for several reasons, including relevance to information demands emerging from the CBD and the funding potential for SIS development (including support to Specialist Groups). The concept paper *Enhancing the Role of Protected Areas and Bio-Regional Planning in the Conservation of Threatened Species* is also available from the SSC secretariat upon request.

**SIS Software Development**

DMWG and representatives of several Specialist Groups met in November 1998 to evaluate the comments and critiques made to the first version of the SIS software (version 0.1), design the next version of SIS (content, structure, language, etc.) and plan for the second round of tests of the software, and prepare for the next stage of SIS implementation.

Based on the results and decisions made at that meeting, the next stages of SIS development (during the first half of 2000) were planned. One of the main tasks will be the completion of the software that is required. A three-step process was outlined to engage SSC members representing a wide variety of species. The process entails: 1) development of the 2nd trial software version (Version 0.2), to be completed by early November 1999; 2) review and test Version 0.2 throughout the remainder of 1999 and early 2000; 3) a workshop to agree to final revisions to Version 0.2, which will lead to the full working release version (Version 1.0). The workshop is scheduled to take place in Rome, Italy, in March 2000. Seven Specialist Groups have agreed to carry out in depth analysis of the software. These are the Mediterranean Island Plant, Orchid, Mollusc, Marine Turtle, Lagomorph, Primate, and Antelope Specialist Groups. BirdLife International and Wetlands International will test the system with their respective Specialist Groups as well. Representatives of the selected testing Specialist Groups, disciplinary Specialist Groups and SSC partners (e.g., BirdLife) will participate in the workshop.

Those Specialist Groups wishing to test the system that are not one of those selected for in-depth testing should contact Mariano Gimenez Dixon to discuss their intentions and to arrive at the most efficient and relevant testing approach for their SG.

**Looking ahead**

Once the trial software Version 0.2 is ready (early November) the testing Specialist Groups will be asked to: 1. Have a "hard-nosed" look at it and answer questions such as: Can it be used to manage the Specialist Group's data needs? Does it cover the modules and fields that are necessary? Is it user friendly? What are the problems? Can the data available be used in this system? (this includes importing existing data without too much difficulty). 2. Populate the system with data from the 50-100 species/populations identified to test SIS. 3. Compile the Specialist Group's comments and input to the SIS process and send these comments to SSC for their input at the workshop early next year.

**From April 2000 onwards**

Essential to the success of this process is timely follow-up to the decisions made at the workshop. Immediately following the workshop, the DMWG will meet to prepare the operational prescriptions to revise the software and programme the final (full release working) version (Version 1.0). The software is expected to be fully developed by September 2000 with the goal of presenting and officially launching it at the IUCN World Conservation Congress (Amman, Jordan, October 2000).

Following its presentation, the software will be distributed to all Specialist Groups and other relevant partners in the SSC network. Distribution will by diskette or CD-ROM. Full implementation of the Species Information Service will begin with this distribution. It is anticipated that SIS implementation will phase in over a period of several years. Specialist Group Chairs should discuss timing with their respective SSC Program Officers, and determine resource needs and feasible phase-in. At that time, an appropriate SIS focal point within the Specialist Group will be discussed (noting that in most cases this will be someone other than the Specialist Group Chair). Further background information can be obtained at the following website:
**http://indaba.iucn.org/extranet/documents/BrowseUnit.cfm?unit=SSC&cat=Meetings&folder=Rome_Meeting.**

**Mariano Gimenez Dixon**, Programme Officer/SSC, IUCN The World Conservation Union, rue Mauverney 28, CH-1196 Gland, Switzerland, Tel: 41 22 999 0155,
Fax: 41 22 999 0015, **mgd@hq.iucn.org**.

## Revision of IUCN Red List Criteria

The IUCN Red List categories and criteria are currently being reviewed. Below we reprint the base for current discussion (from Species 31-32, 1999).

The qualitative definitions for the threatened categories tend to overstate the predictive accuracy of the system. They also do not adequately convey to the general reader the fact that it is the criteria that determine listing in the threatened categories and that this evaluation requires a scientifically based assessment. The difficulty is how to phrase them without using quantitative terms but still convey a sense of urgency.

**Critically Endangered (CR)**

*Current Definition*

A taxon is Critically Endangered when it is facing an extremely high risk of extinction in the wild in the immediate future, as defined by any of the criteria (A to E), listed below.

*Recommended Definition*

A taxon is Critically Endangered when available scientific evidence that it meets any of the criteria A to E (below), and it is therefore considered to be facing an extremely high risk of extinction in the wild.

**Endangered (EN)**

*Current Definition*

A taxon is Endangered when it is not Critically Endangered, but is facing a very high risk of extinction in the wild in the near future, as defined by any of the criteria (A to E).

*Recommended Definition*
A taxon is Endangered when available scientific evidence indicates that it meets any of the criteria A to E (below), and it is therefore considered to be facing a very high risk of extinction in the wild.

**Vulnerable (VU)**

*Current Defination*
A taxon is Vulnerable when it is not Critically Endangered or Endangered but is facing high risk of extinction in the wild in the mediumterm future, as defined by any of the criteria (A to E)...

*Recommended Definition*
A taxon is Vulnerable when available scientific evidence indicates that it meets any of the criteria A to E (below), and it is therefore considered to be facing a high risk of extinction in the wild.

**Lower Risk (LR)**
The system is made unnecessarily complicated by having this as a category with three sub-categories, two of which should logically not be placed here.

*Recommendation*
It is proposed that this category be dropped, but that the wording under it should be incorporated into the definitions of the Near Threatened and Least Concern categories.

**Conservation Dependent (CD)**
The current use of Conservation Dependent as an independent Red List Category of Lower Risk is not logically consistent as a taxon can also be both threatened and conservation dependent. In addition assessors have used this category in a variety of sometimes subjective contexts making it less useful than was hoped. Two logical options were discussed. First, Conversation Dependent could be used as a flag under all the threatened categories but this did not appear a satisfactory solution as it would require many difficult judgements to be made about the effectiveness of conservation programs. Second, to remove this category.

*Recommendation*
Remove Conservation Dependent as a category, but encourage assessors to provide information in the documentation to indicate where continuing specific conservation actions are improving the status of a taxon.

**Near Threatened (NT)**
This category is increasingly being used more formally than was intended. At present it is very loosely defined so better guidance is required on when and how to use it. The development of criteria has been suggested, but this option would create many difficults. The "guidelines" will provide pratical and more consistent methods for determining when a species should be listed as Near Threatened. This might be where a taxon meets only some sub-criteria or where the range of plausible assessments includes a threatened category would include some taxa that previously would have been listed as Conservation Dependent.

*Current Definition*
Taxa which do not qualify for Conservation Dependent, but which are close to qualifying for Vulnerable.

*Recommended Definition*
Taxa which have been assessed against the criteria but do not qualify for Critically Endangered, Endangered or Vulnerable now, but are close to qualifying for or are likely to become Vulnerable in the near future. Also included here are taxa which are focus of a continuing taxon-specific or habitat-specific conservation program targeted towards the taxon in question, the cessation of which would result in the taxon qualifying for one of the threatened categories above within a period of five years. Such conservation programs must be described as part of the documentation requirements.

**Least Concern (LC)**
This category was provided to differentiate species that had been evaluated, and found not to be threatened. This gives the impression that one is required to conduct a formal assessment for blatantly commom (weedy) taxa. From basic observations it can be easily seen that most of these extremely common taxa would not qualify for listing even though they have not been put through a formal assessment.

*Current Definition*
Taxa which do not qualify for Conservation Dependent or Near Threatened.

*Recommended Definition*
Taxa which have been assessed against the criteria and do not qualify for Critically Endangered, Endangered or Vulnerable and which also do not qualify for Near Threatened. Based on casual observation, extremely common taxa can be included in this category without having undergone a formal assessment against the criteria, provided the justification for this is fully documented.

**The Criteria for Critically Endangered, Endangered and Vulnerable**

**Criterion A**
The current quantitative thresholds in the criterion do not scale well across all organisms and the rate under Vulnerable is thought to be too inclusive. In addition, the rates of decline do not take into account managed populations that are being harvested down to levels at which higher yield is attained, or dramatic declines that occurred in the distant past but are now halted or even reversed. Modeling also shows quantitative differences in extinction risk between types of decline that are irreversible e.g., through habitat loss, and reversible e.g., through density dependent responses to harvesting. The criterion also does not provide guidance on projecting into the future, especially for long-lived species, where such assessments may be both unreliable and irrelevant. Greater clarity is also required on whether the criterion allows the use of a shifting time window for species where only small amounts of data are available.

*Current Version*
A. Population reduction in the form of either of the following:
1. An obsesrved, estimated, inferred or suspected reduction of at least 20% over the last 10 years or three generations, whichever is longer, based on (and specifying) any of the following:
(a) direct observation
(b) (index of abundance appropriate for the taxon
(c) a decline in area of occupancy, extent of occurrence and/or qualify of habitat
(d) actual or potential levels of exploitation
(e) the effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites.
2. A reduction of at least 20%, projected or suspected to be met within the next 10 years or three generations, whichever is the longer, based on (and specifying) any of (b), (c), (d) or (e) above.
The reduction thresholds change to 50% and 80% under Endangered and Critically Endangered respectively.

*Recommendation*
To change the sub-criteria under Criterion A. The proposed wording given here is for Vulnerable but it is the same for Critically Endangered and Endangered using different quantitative thresholds.
Reduction in population size based on any of the following:
1. An observed, estimated,inferred or suspected population size reduction of ≥ 30% over the last 10 years or three generations, whichever is longer, where the causes of the reduction are not demonstrably reversible, OR not clearly understood, OR may not have ceased, OR could recur, based on (and specifying) any of the following:
(a) direct observation
(b) an index of abundance appropriate for the taxon
(c) a decline in area of occupancy, extent of occurrence and/ or quality of habitat
(d) actual or potential levels of exploitation
(e) the effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites.
2. An observed, estimated, inferred or suspected population size reduction of ≥ 50% over the last 10 years or three generations, whichever is longer, where the causes of the reduction are: demonstrably reversible AND understood AND ceased AND unlikely to recur, based on (and specifying) any of (a) to (e) under A1.
3. A population size reduction of at least 30%, projected or suspected to be met within the next 10 years or three generations, whichever is the longer (up to a maximum of 100 years), based on (and specifying) any of (b) to (e) under A1.
4. An observed, estimated, inferred, projected or suspected population size reduction of ≥ 30 % over any 10 years or three generations period, whichever is longer (up to a maximum of 100 years), where the time period includes both the past and the future, AND the causes of reduction are not demonstrably reversible OR not clearly understood OR may not have ceased OR could recur, based on (and specifying) any of the (a) to (e) under A1.

*Thresholds:*

| Sub-criteria | VU | EN | CR |
|---|---|---|---|
| A1, A3, A4 | ≥ 30% | ≥ 50% | ≥ 80% |
| A2 | ≥ 50% | ≥ 70% | ≥ 90% |

**Criterion B**
There is a logical conflict between having fixed range thresholds and the necessity of measuring range at different scales for different species. Estimates of Area of Occupancy (AOO) are especially dependent on the scale of estimation. The current definition directs that AOO should be measured at a scale that is appropriate to biological aspects of the taxon. However, the AOO thresholds are fixed at a level that is too inclusive for groups of taxa in which a fine scale of range estimation is biologically appropriate. This could lead to overlisting of taxa within these groups. No solution has yet been found, but work is continuing on this issue.

**Criterion C**
Few taxa have data on both population size and decline rates at the necessary resolution to apply sub-criterion C1. There is also some overlap between Criterion A and C1. Removal of C1 would simplify the criteria and enhance parity with Criterion B, however, no resolution on this was reached and work is continuing. A second issue is that under sub-criterion C2b, all individuals have to be in a single subpopulation. This is too exclusive and does not allow the listing of very skewed populations where a small number of mature individuals exist outside the main population. Criterion C also does not explicitly take into account extreme fluctuations in small populations.

*Current Version*
Population estimated to number ... and either:
1. An estimated continuing decline ...
2. A continuing decline, observed, projected or inferred, innumbers of mature individuals and population structure in the form of either:
(a) severely fragmented (i.e., no subpopulation estimated to contain more than 50 mature individuals
(b) all individuals are in single subpopulation.

*Recommendation*
To change the opening statement of the criterion and subcriterion C2 under Critically Endangered, Endangered and Vulnerable to read as follows:

Population size estimated to number and either:
1. An estimated continuing decline ...
2. A continuing decline, observed, projected or inferred, in numbers of mature individuals and population structure in the form of either:
(a) severely fragmented (i.e., no subpopulation estimated to contain more than 50 mature individuals) OR at least 95% of mature individuals are in one subpopulation
(b) show extreme fluctuations.

**Criterion D**
Sub-criterion D2 under Vulnerable was intended to be used for species with very small distributions. However, the thresholds for area of occupancy and number of locations, although given as indicators, are frequently interpreted too literally. Some people have argued that the sub-criterion is too inclusive and results in massive over-listing, whereas others argue that is too exclusive (for many marine species) and so is under-listing. The threats aspect needs to be emphasized more than the restricted distribution.

*Current Version*
D2. Population is characterized by any acute restriction in its area of occupancy (typically less than 100 km²) or in the number of locations (typically less than 5). Such a taxon would thus be prone to the effects of human activities (or stochastic events whose impact is incresaed by human activities) within a very short period of time in an unforeseeable future, and is thus capable of becoming Critically Endangered or even Extinct in a very short period.

D2. Population with a very restricted area of occupancy such that it is prone to the effects of human activities or stochastic events within a very short time period in an uncertain future, and is thus capable of becoming Critically Endangered or even Extinct in a very short time period. Typically such taxa would have areas of occupancy in the lower 10% of those for comparable taxa.

**Criterion E**
The thresholds for extinction probability and the time period for which such analyses should be done are not appropriate for all organisms. There is also an inconsistency in giving generation times for CR and EN but not for VU. There is no guidance given on how to deal with projected extinction risks, as extinction rates may change over time.

*Recommendation*
A cap of 100 years should be placed under Endangered and Critically Endangered i.e., the latter would read: Quantitative analysis showing the probability of extinction in the wild is at least 50% within 10 years or 3 generations, whichever is the longer up to a maximum of 100 years.

**Reprinted from:**
**IUCN/SSC Criteria Review Working Group** July 1999. *Species* 31-32: 52-57.
The full account and associated issues have been published in *Species* 31-32, 1999.

## Quick Guide to the Wisconsin Regional Primate Research Center Internet Programs

The following Internet programs are run by the Wisconsin Regional Primate Research Center (WRPRC) at the University of Wisconsin - Madison, supported by grant number RR00167, Regional Primate Centers Program, National Center for Research Resources, the National Institutes of Health.
*Primate Info Net (PIN)*: A WWW information resource for primatologists, includes taxonomy, endangered primates listings, the World Directory of Primatologists, newsletters, veterinary resources, etc. Documents can be viewed and downloaded locally. Connect to PIN at:
**www.primate.wisc.edu/pin.**
*Primate-Science*: An electronic discussion forum for NCRR primate centers, and other research-based primate centers, laboratories, institutions and zoological gardens worldwide. You must have an electronic mail address and access to the Internet to participate in Primate-Science. To apply, fill out the Primate-Science application form at:
**www.primate.wisc.edu/pin/ps/pscientry.html** or request an application form by sending a message containing "subscribe primate-science" (without the quotes) to:
**primate-science-request@primate.wisc.edu.**
*International Directory of Primatology* (*IDP*): Coverage includes: (1) detailed entries for major primate centers, laboratories, educational programs, foundations, conservation agencies and sanctuaries, (2) a listing of field projects, (3) primate societies, and (4) population management groups. Connect to the International Directory of Primatology at:
**www.primate.wisc.edu/pin/idp/.**
*World Directory of Primatologists* (*WDP*): A convenient Internet source of contact information for people in the field of primatology whose career interests involve or relate to primate research, conservation, education or veterinary medicine. Connect to the World Directory of Primatologists at:
**www.primate.wisc.edu/pin/idp/wdp.html.**
*Audiovisual Services*: An archival collection of primate-related videotapes, slides and audiotapes which may be borrowed for research or educational purposes. To see the catalog of available videotapes, and instructions on how to borrow from the collection, link to:
**www.primate.wisc.edu/pin/av.html.**
*Askprimate*: An Internet reference service available to the public. To ask a question or for referral, use the form at:
**www.primate.wisc.edu/pin/askprim.html.**
*Primate-Jobs*: An Internet job listing service. It includes positions wanted and available. Connect at:
**www.primate.wisc.edu/pin/jobs.**
*Careers in Primatology*: A source of information for those considering careers working with nonhuman primates. The URL is:
**www.primate.wisc.edu/pin/careers/careers.html.**
For more information about WRPRC Internet Services, contact Ray Hamel, Special Collections Librarian, at
**hamel@primate.wisc.edu**, or the Primate Center Library by phone: 1-608-263-3512, Fax: 1-608-263-4031, or
**library@primate.wisc.edu.**

## Announcement from the American Society of Primatologists

In April 1999, the American Society of Primatologists (ASP) Board of Directors recommended to Wiley-Liss, the publisher of the American Journal of Primatology, that Dr. Michael W. Andrews be appointed as the new editor of our journal. Dr. Andrews replaces Dr. Mike Raleigh, who has served as AJP editor since 1992. Dr. Raleigh announced his intention to step down from his editorial post in 1998. Dr. Andrews has clearly demonstrated his commitment to ASP, AJP, and primate research. He has served as a member and Chair of the ASP Publications Committee and as the Media Reviews Editor of AJP. He is an accomplished scientist with a strong record of peer-reviewed research in primate social development and in computerized assessment of primate cognition and motor performance.
The new address for American Journal of Primatology manuscript submissions: Michael W. Andrews, Ph.D., Editor, American Journal of Primatology, Department of Psychology, Southern Oregon University, 1250 Siskiyou Blvd., Ashland, OR 97520.
Instructions to authors can be found at:
**http://www.interscience.wiley.com/jpages/0275-2565/authors.html.**

## ASP Conservation Award and Grants

The Conservation Committee of the American Society of Primatologists, chaired by Randall Kyes, approved the following awards on the 14th August 1999, during the Society's annual meeting, held in New Orleans, LA. *Conservation Award*: Rondang S. E. Siregar of Indonesia for her work with orang-utan rehabilitation and reintroduction and her commitment to primate conservation. *AJP Subscription Awards*: Michael Abedi-Lartey of the Ankasa Resource Reserve, Ghana; Junus Daniel of Sam Ratulangi University, Indonesia; Edem A. Eniang of the University of Uyo, Nigeria; and Gabriel Ramos-Fernandez of the Universidad Nacional Autonoma, Mexico. *Conservation Small Grants*: Alex Degan, University of Chicago, "The behavior of extinction: Predicting biogepographic patterns of lemur repsonses to habitat fragmentation in south-east Madagascar"; Kaberi Kar Gupta, Arizona State University, "Ecology and conservation of slender loris in Kalakad-Mundanthurai Tiger Reserve, India"; Joanna E. Lambert, University of Oregon, "The influence of habitat conversion and hunting on primate populations in the Dja Faunal Reserve, Cameroon", Sahdin B. Lias, Kinabatangan Orang-utan Conservation Project, Malaysia, "Solving orang-utan conflicts with local communities in the Kinabatangan floodplain, Sabah, Malysia"; Alecia B. Lilly, Center of Orang-utan and Chimpanzee Conservation and SUNY - Stony Brook, "The effects of increasing human population density on intestinal parasite loads in gorillas (*Gorilla gorilla gorilla*), chimpanzees (*Pan troglodytes*), and indigenous human populations in and around the Mondika Research Center, Dzanga-Ndoki National Park, Central African Republic"; Barita O. Manullang, Wildlife Foundation of Indonesia, Indonesia, "Preliminary survey on population status and distribution of primate species in disturbed habitats after forest-fires in Central Kalimantan, Indonesia"; Joseph A. Ntui, Federal University of Technology, Nigeria, "A preliminary investigation of the chimpanzee (*Pan troglodytes*) in Oban Hills Forest Reserve, Nigeria"; R. Ethan Pride, Princeton University, "Population density, social behavior, and physiological stress in *Lemur catta*"; Saúl Juan Solano, Universidad Nacional Autonoma, Mexico, "A comparative study of resource use by groups of howler monkeys (*Alouatta palliata*) in isolated rain forest

fragments in the region of Los Tuxtlas, Veracruz, Mexico"; Sandra S. Suarez, New York University, "Paternity, relatedness and male socio-reproductive behavior in red-bellied tamarins (*Saguinus labiatus labiatus*) in Bolivia: Training local investigators in field techniques"; Elizabeth B. Yaap, Harvard University, "An orang-utan conservation education programme for the Gunung Palung area, West Kalimantan, Indonesia". The 1999 *Senior Biology and Conservation Award* was not presented.

## The L. S. B. Leakey Foundation - Awards 1997-1998

In the budget year 1997-1998, The Leakey Foundation, celebrating its 30th anniversary, provided 61 grants for research in Cultural Anthropology, Primatology, chemical dating and Geology, fossil recovery, Genetics, Morphology, and Prehistory.
For more information: The L. S. B. Leakey Foundation, P. O. Box 29346, Presidio Building 1002A, O'Reilly Avenue, San Francisco, CA 94129, USA, Tel: 415 561 4646,
Fax: 415 561 4647, **info@leakeyfoundation.org**;
**www.leakeyfoundation.org**.

## New Addresses

**Primate Conservation Inc.** has a new address. Please post all correspondence to us at this address:
Noel Rowe, Primate Conservation Inc., 1411 Shannock Rd., Charlestown, Rhode Island 02813-3726
phone: 401 364 7140, **nrowe@primate.org**; **www.primate.org**

The headquarters of **Conservation International** (Washington) will move by the end of the year. The new address will be: Conservation International, 4401 Connecticut Avenue, Washington D.C. 20016, USA.

## Canopy Citations Database

The Canopy Citations Database is now available on the World Wide Web. It contains over 1,300 citations regarding canopy ecology. Search for authors, titles, dates, journals, keywords or words within an abstract.
**www.evergreen.edu/canopycitations**.

## Alwyn Gentry's Projects Continue at Missouri Botanical Garden

Botanist Alwyn Gentry died tragically in a plane crash on 3 August 1993 in western Ecuador. The Missouri Botanical Garden is, however, continuing his project on the study of the floristic diversity of the world's tropical forests. Gentry and his collaborators had surveyed nearly 250 sites on six continents, establishing and collecting data from 0.1 ha transects. A review of these studies has been compiled by James Miller, Oliver Phillips, and Nancy Hediger, and the raw data is available on the Garden's web site:
**www.mobot.org/MOBOT/research/applied_research/gentry.html**.
The data for each site are being analyzed, and a volume summarizing the results will be published by the MBG. In addition to summarizing the transect data, the book will review the historical development of Gentry's ecological studies, the methods by which the date were collected, and their significnce in contributing to our understanding of global patterns of plant diversity. Missouri Botanical Garden, Tel: 314 577 5169, Fax: 314 577 0830. From: *Tropinet*, 10(3), September 1999.

## Topics in Primate Conservation

Nancy Ruggeri and Dean Anderson will soon begin a new monthly series on primate conservation on the electronic discussion forum "Primate Science." The series will be entitled "Topics in Primate Conservation" and it will focus on current issues and developments affecting the conservation of threatened and endangered primates. Coverage will include: conservation strategies and activities; systematics and geographic distribution; habitat evaluation; and field research on ecology, evolution and behavior. This will be a collaborative effort with those engaged in conservation work or research with nonhuman primates, and we invite submissions of brief reports or suggestions for topics. The purpose of the Primate Science forum is the factual, science-based exchange of ideas and information about nonhuman primates and is intended to serve the international primatological research community. You can read more about it and/or subscribe at the following web site:
**www.primate.wisc.edu/pin/ps/ps.html**.
For questions, comments, or material to submit please contact Dean Anderson, **danders3@students.wisc.edu**
or Nancy Ruggeri, **nruggeri@facstaff.wisc.edu**.

## Thank you!

Given some incertainty whether or not publication of *Lemur News* could be financed beyond volume 4, we asked subscribers for volontary contributions. We thank the following people for their contributions: S. Atsalis, N. Garbutt, A. Müller, J. Pastorini, and U. Thalmann.

# ARTICLES

## Storm Damage at Berenty Reserve

On October 2nd, 1999, a violent wind storm hit Amboasary Sud, Ambovombé, and the rest of the Mandrare Valley. It was not a cyclone, lasting only 2-4 hours in a given place, and accompanied by very little rain. Trees and houses blew down but since the storm came in early evening, most people were awake but near shelter, and there was little or no loss of life. In December, 1999, the authors recensused and extended a labeled sample of trees in Berenty Reserve. The tree sample, established by Blumenfeld-Jones, Rasamimanana, Mertl-Millhollen and Jolly, records trees which overhang the major trails of the reserve, wide paths established sometime before 1950, and also the small "interior" trails, made in the 1980's and 90's, which are footpaths where trees meet overhead. Thus, trees are sampled according to their contribution to the shade of the forest.
Overall of 548 trees in 24 species with dbh > 20 cm, we found 3% uprooted, 6% with trunks totally snapped, 23% with more than half the canopy gone, 30% with some branches broken in less than half the tree's canopy, and 38% undamaged. The major determinant of damage was tree species. Of 161 *Tamarindus indica* (kily) only 2% were broken or uprooted, and a further 46% with canopy damage. In contrast, of 90 *Acacia rovumae,* (benono), the tallest emergents of the forest, 18% were uprooted or snapped, and 61% damaged. As expected, kilys on the wider paths were more broken than those on small interior paths. This effect was slight, however, compared to the importance of tree species, andis not significant in the total sample.
Wright (1999) suggests that many aspects of lemurs' biology, from hibernation to female dominance, reflect an "energy frugality strategy", in the face of predictable seasonal resource shortage and also recurrent catastrophes brought by

drought and storm. Gould *et al*. 1999 go so far as to say that *Lemur catta* is a relatively r-selected primate, whose populations drop in such catastrophes and then rapidly recover. The storm had little immediate effect on the lemur populations—except for one stunned sifaka, kown troops were intact afterward. However, food limitation from the loss of canopy may well affect lemur survival in 1999-2000.

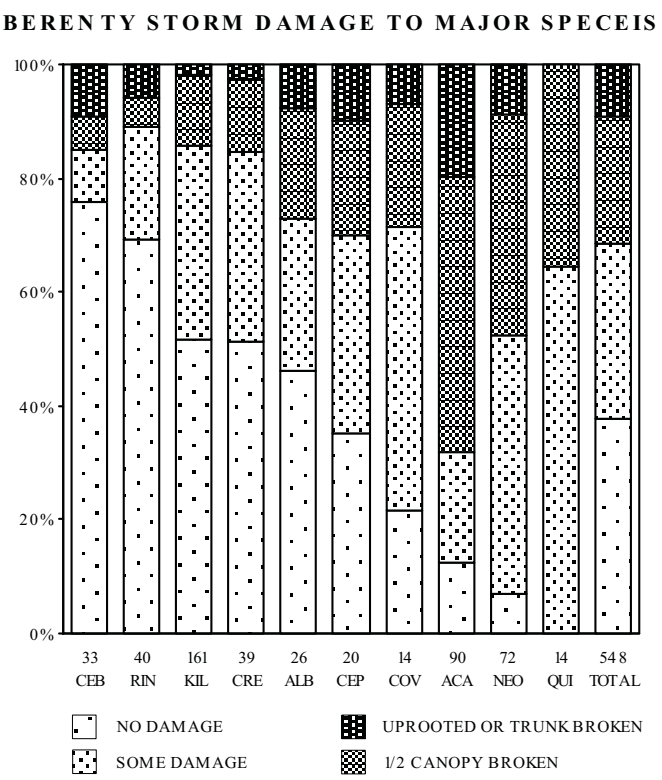


Fig. 1: Damage on trees > 20 cm dbh after the storm in October 1999. CEB: *Celtis bifida*; RIN: *Rinorea greveana*; KIL *Tamarindus indica*; CRE *Crataeva greveana*; ALB *Albizzia polyphylla*; CEP *Celtis philippensis*; COV *Cordia varo*; ACA *Acacia rovumae*; NEO *Neotina isoneura*; QUI *Quisivianthe papinae. Numbers are numbers of individuals.*

**References**

Gould, L., Sussman, R.W., Sauther, M.L. (1999). Natural disasters and primate populations: the effects of a two-year-drought on a naturally occurring population of ring-tailed lemurs (*Lemur catta*) in southwestern Madagascar. *Int. J. Primatol.* 20: 69-85.

Wright, P.C. (1999). Lemur traits and Madagascar Ecology: Coping with an island environment. *Yrb. Phys. Anthropol.* 42: 31-72.

**Hanta Rasamimanana, and Ratovonirina**
Ecole Normale Supérieur, Université d'Antananarivo, BP 881, Antananarivo, Madagascar, **hrasamim@syfed.refer.mg**

**Alison Jolly, and Ethan Pride**
Department of Ecology and Evolutionary Biology, Princeton University, Princeton NG 08544, USA, **ajolly@princeton.edu**

## Suivi écologique des Lémuriens diurnes dans le Parc National d'Andohahela à Fort-Dauphin

Le Parc National d'Andohahela se trouve à 40 km au Nord-Ouest de Fort-Dauphin, dans l'extrême Sud de Madagascar. (24°30'58"S, 46°32'52"E). Il est localisé entre le Fivondronampokontany de Fort-Dauphin et celui d'Amboasary (Fig. 1). Le Parc National d'Andohahela s'étend sur une superficie de 76020 ha, divisé en trois parcelles non contiguës (Nicoll et Langrand 1989; Goodman 1999): la parcelle 1, la plus large, a une surface de 63100 ha; la parcelle 2 présente une surface de 12420 ha et la parcelle 3 couvre une surface de 500 ha.

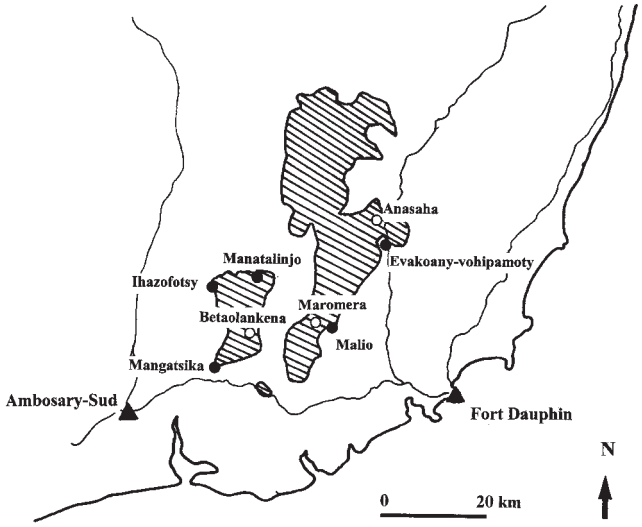


Fig. 1: Carte des zones d'études. Les Parcelles du PN d'Andohahela sont marquíes. Circles noirs - sites perturbées; circles blancs - sites non perturbées.

La parcelle 1 varie en altitude de 100 à 1956 m (pic d'Andohahela). Son climat est humide avec une pluviométrie annuelle de 1500 à 2000 mm sans saison sèche et avec une température moyenne annuelle d'environ 23°C. C'est un bassin hydrographique important où plus de 10 fleuves prennent leur source. Le Parc National d'Andohahela constitue un château d'eau pour le Sud de l'île. La parcelle 1 présente des formations végétales variées: la forêt pluviale de basse altitude (domaine de l'Est), la forêt du Centre Est (domaine du Centre) et les formations sclérophylles d'altitude (domaine de Haute Montagne).

La parcelle 2 se trouve entre 110 et 1005 m d'altitude (pic de Vohidagoro). Le climat est plus sec, avec une pluviométrie entre 500 à 700 mm/an et une saison sèche de 5 à 6 mois. La parcelle 2 est caractérisée par des formations de bush épineux subaride du domaine du Sud et des savanes.

La parcelle 3 est d'environ 120 à 300 m d'altitude. Elle possède une ceinture végétale qui fait la transition entre la forêt humide du domaine oriental et le bush épineux. Cette dernière a été créée spécialement pour la protection de *Dypsis decaryi* (Arecaceae) ou palmier trièdre. C'est le site principal de cette espèce endémique (Nicoll et Langrand 1989).

Cette mission s'est déroulée dans le Parc National d'Andohahela du 08 Mars au 22 Mai 1999. Elle a pour but de développer des méthodes appropriées de collecte et d'analyse des données pour la Cellule Suivi Ecologique du Parc National d'Andohahela et de collecter des données de base dans le suivi des lémuriens au sein de cette aire protégée.

**Méthodes**

Selon les termes de référence exigés, deux indicateurs ont été choisis pour mesurer les changements au niveau de la biologie et de l'écologie des lémuriens face à des pressions anthropiques: leurs comportements et la structure et dynamique de la population lémurienne. Mais l'étude des comportements n'a pas pu être faite à cause de la durée trop courte du temps de travail. Pour voir l'évolution démogra-

phique de ces animaux face à des pressions anthropiques, le suivi dans deux types de forêts différents s'avèrent nécessaire: forêt perturbée par l'homme et forêt non perturbée servant de zone de contrôle. Ces deux types de forêt devraient présenter le même gradient d'altitude et le même type de végétation.

Les lémuriens diurnes ont été choisis comme espèces indicatrices de pression car ils sont tous vulnérables selon la Liste Rouge de l'IUCN 1990, à l'exception d'*Hapalemur griseus*, mais actuellement, ils sont tous menacés de disparition à cause de la chasse très accentuée dans la région. Les espèces qui font l'objet du suivi écologique des lémuriens sont: *Propithecus verreauxi verreauxi, Lemur catta, Eulemur fulvus collaris* et *Hapalemur griseus griseus*.

Sept sites oni été choisis par l'ANGAP de Fort-Dauphin pour effectuer le suivi des lémuriens:

*trois sites dans la parcelle 2, à savoir: Ihazofotsy et Manatalinjo, Mangatsiaka (forêts perturbées), Betaolankena (forêt non perturbée);

*quatre sites dans la parcelle 1, à savoir: Evakoany-Vohipamoty, Malio (forêts perturbées), Anasaha (forêt non perturbée) d´après les informations disponible avant l´inventaire, Maromera-Ilemoka était choisi comme forêt non perturbée, mais effectivement cette forêt était fortement perturbée.

Pour le suivi de la dynamique des populations de lémuriens, cinq paramètres ont été choisis: le nombre de groupes, la densité relative, la taille moyenne des groupes, le sexe ratio et la reproduction. La méthode utilisée pour ce type de suivi est l'échantillonnage par transect. A cet effet, différentes étapes ont été suivies:

- établissement des transects de suivi, de nombre et de longueur égaux, dans chaque site (trois transects par site de longueur de 2 km de chacun). Les transects ont été tracés dans des directions différentes ou suivant des directions parallèles espacées l'une de l'autre de 1 km au minimum.
- mise en place des repères à l'aide des rubans plastiques dans les sites de recherche ou les sites non touristiques ou à l'aide de pierres dans les sites touristiques, marqués tous les 25 m le long du transect et prise de la position de chaque repère par rapport à un autre pour pouvoir localiser le transect sur la carte.
- recensement journalier des animaux vus et entendus dans les transects: le matin de 06h30 à 11h30 et l'après-midi de 14h à 18h avec une vitesse moyenne de parcours entre 700 et 800 m/h. Tous les trois transects d'un site doivent être visités chaque jour.
- enregistrement de tous animaux vus ou entendus en collectant les données suivantes: temps, espèce, distance du premier animal vu ou entendu par rapport à l'observateur, distance du premier animal vu ou entendu perpendiculaire au transect, numéro de la piste (numéro du ruban ou de la pierre le plus proche de l'endroit où l'animal a été vu ou entendu), direction de l'animal, vu ou entendu, nombre total d'individus (enfant, jeune mâle, jeune femelle, adulte mâle, adulte femelle) et activités de l'animal pendant sa première observation.

Le meilleur moyen d'identifier tous les groupes résidents dans les transects est d'échantillonner complètement chaque site pendant une semaine. A la fin, une liste des groupes de lémuriens par espèce rencontrés dans chaque transect à chaque site sera établie. Ces listes seront mises à jour annuellement avec leur composition respective. Le suivi se fait une seule fois par an: pendant les mois de Mars et Avril.

La densité était calculé comme suit: Densité = nombre total d'individus dénombrés dans un site divisé par la surface couverte par le transect. La surface couverte par le transecte était calculée comme la moyenne des distances entre les transects et les endroits où on a vu les animaux fois le longueur total des transects dans un site.

Les données recueillies seront analysées statistiquement pour voir si les pressions anthropiques affectent la population lémurienne. Pour ce faire, il faut comparer l'évolution démographique de la population lémurienne dans la forêt perturbée à celle de la forêt non perturbée et comparer en parallèle l'évolution démographique de la population lémurienne d'une année à l'autre dans la forêt perturbée et dans la forêt non perturbée.

## Résultats

Parcelle 2: Forêt sèche

Tableau 1: Résultats obtenus dans la forêt sèche.

| Espèces-biologiues | Forêt sèche | | | |
|---|---|---|---|---|
| | Forêt perturbée | | | Forêt non perturbée |
| | Ihazofotsy | Manata-linjo | Mangat-siaka | Betaolan-kena |
| *Propithecus verreauxi verreauxi* | 6 groupes de 28 individus au total<br>d=420 ind/km$^2$ | 3 groupes de 11 individus au total<br>d=1 ind/km$^2$ | 4 groupes de 19 individus au total<br>d=76 ind/km$^2$ | 3 groupes de 23 individus en moyenne*<br>d=230 ind/km$^2$ |
| *Lemur catta* | 1 groupe de 10 individus au total<br>d=8 ind/km$^2$ | aucun groupe<br>d=0 ind/km$^2$ | 1 groupe de 12 individus en moyenne*<br>d=10 ind/km$^2$ | 2 groupes de 35 individus en moyenne*<br>d=64 ind/km$^2$ |

d: densité relative de l'espèce dans le site.

*: quelques fois, nous ne sommes pas arrivés à dénombrer le nombre total d'individus de certains groupes car ils s'enfuient dès la vue des observateurs. C'est pourquoi, pour avoir une idée générale sur la densité relative de l'espèce dans le site, il serait mieux de prendre la valeur moyenne de la taille des groupes (en additionnant le nombre minimum et le nombre maximum classiques d'individus composants un groupe, le tout divisé par deux).

La parcelle 2 est presque perturbée, le choix du site de Betaolankena semble arbitraire.

Ihazofotsy

Les pressions qui s'exercent sur cette forêt sont l'écotourisme et la divagation des troupeaux de bovins et d'ovins à l'intérieur du parc.

Six groupes de *Propithecus verreauxi* composés au total de 28 individus y ont été recensés. La densité de cette espèce dans la forêt d'Ihazofotsy est de 420 ind/km$^2$ qui est très élevée par rapport à celle d'autre forêt, exemple: 150 à 200 ind/km$^2$ dans la forêt proche de Berenty (Jolly *et al.* 1982). La taille des groupes varie entre 3 à 7 individus. Il semble que l'écotourisme pourrait affecter plutôt les comportements des lémuriens, mais pas la structure de leur population car les animaux sont beaucoup plus protégés là où à y a de l'écotourisme.

Pour *Lemur catta*, on n'a trouvé qu'un seul groupe de 10 individus et qui a donné une densité égale à 8 ind/km$^2$. La rareté de cette espèce pourrait être due à la disponibilité de la nourriture ou au type d'habitat de la région. La densité est beaucoup plus élevée dans la forêt galerie non perturbée que dans la forêt sèche (Mittermeier *et al.* 1994) comme celle d'Ihazofotsy.

Manatalinjo

Les perturbations qui affectent la population de lémuriens dans ce site sont la chasse, la pénétration des bovins dans la forêt et la coupe de bois pour la collecte du miel.

On a dénombré 3 groupes de *Propithecus verreauxi* composés de 11 individus au total. Le nombre d'individus dans un groupe est de 2 à 5. La densité de cette espece qui est de 1 ind/km$^2$ est très basse par rapport à celle d'Ihazofotsy. La chasse aux lémuriens est très accentuée dans cette région. Nous tenons à signaler que nous n'avons vu ces 3 groupes de Sifakas qu'une seule fois pendant les sept jours de recensement. Ce fait pourrait indiquer la prudence de l'animal vis-à-vis de son prédateur qui est l'homme. Un groupe était formé de 2 individus seulement: un adulte mâle et une adul-

te femelle. Ceci pourrait être la conséquence d'une chasse très poussée de cette espèce, de même pour *Lemur catta* dont aucun individu n'a été vu ni même entendu.

Mangatsiaka

Les principaux types de pressions qui affectent la population de lémuriens sont l'entrée des zébus, des chèvres et des moutons dans cette forêt, la coupe de bois pour la production de charbon et la construction de maison, la recherche du miel et la chasse.

D'après les résultats obtenus, les densités sont de 76 ind/km$^2$ pour *Propithecus verreauxi* et de 10 ind/km$^2$ pour *Lemur catta*. Actuellement, les Propithèques, se sentent particulièrement protégés et sont progressivement habitués aux observateurs humains à cause de la fréquente patrouille des agents de conservation dans la forêt. Mais, les Maki restent encore très sauvages. Ce comportement pourrait être expliqué par leur vigilance. Les villages à l'intérieur de la forêt étendent petit à petit leurs zones d'exploitation et leurs terres de culture (Nicoll et Langrand 1989), constituant un type de perturbation de l'habitat. De plus, la proximité Sud-Est de Mangatsiaka subit également une exploitation sélective des plantes médicinales par les villageois en cas de maladie, conduisant à des ouvertures au sein de la forêt. Les défrichements pratiqués par les éleveurs de boeufs et de chèvres à l'intérieur et à la périphérie de la forêt contribuent également à la réduction de l'étendue du site (Nicoll et Langrand 1989). De plus, la chasse récemment pratiquée par les gens du camp pénal au Sud-Ouest du village entraîne une diminution de la densité des lémuriens. Actuellement, les Tenrecs et les Oiseaux sont chassés régulièrement et les troupeaux de boeufs pénètrent continuellement à l'Ouest de la forêt.

Betaolankena

Nous avons vu deux groupes de *Propithecus verreauxi* composés de 16 individus et nous avons seulement entendu un autre groupe. La densité des Sifakas est estimée à 230 ind/km$^2$. Elle est petite par rapport à celle d'Ihazofotsy (420 ind/km$^2$), alors que Betaolankena est une forêt non perturbée. Ce fait pourrait être dû à la superficie réduite de la forêt et démontre que l'écotourisme n'exerce pas une pression dans la structure de la population des lémuriens mais pourrait agir sur le comportement de ces animaux. La taille des groupes des Propithèques est un peu élevée dans ce site: 7 à 9 individus. Nous avons aussi constaté que les Sifakas dans cette région sont beaucoup plus grands du point de vue la taille. En outre, la variété *Propithecus v. 'majori'*, appelée communément « Sifakavahy » existe dans ce site et elle vit ensemble avec *Propithecus v. verreauxi*.

Pour *Lemur catta*, nous avons vu un groupe formé de 24 individus et entendu un autre groupe. La densité estimée de Maki dans cette région est environ 64 ind/km$^2$. Elle est élevée par rapport à celle d'Ihazofotsy et de Mangatsiaka. Ceci pourrait être dû au fait que les *Lemur catta* préfèrent des forêts galeries comme celle de Betaolankena ou encore à l'inexistence de pression qui s'exerce sur la forêt.

Parcelle 1: Forêt humide

Tableau 2: Résultats obtenus dans la forêt humide.

| Espèces Biologiques | Forêt humide | | | |
|---|---|---|---|---|
| | Forêt perturbée | | | Forêt non perturbée |
| | Evakoany-Vohipamoty | Mialio | Maromera-Ilemoka | Anasaha |
| *Eulemur fulvus collaris* | 8 groupes de 37 individus au total<br>d=38 ind/km$^2$ | 1 groupe de 7 individus au total<br>d=33 ind/km$^2$ | aucun groupe<br>d=0 ind/km$^2$ | 4 groupes de 44 individus au minimum*<br>d=400 ind/km$^2$ |
| *Hapalemur griseus griseus* | 3 groupes de 11 individus au total<br>d=59 ind/km$^2$ | 1 groupe de 5 individus au total<br>d=44 ind/km$^2$ | aucun groupe<br>d=0 ind/km$^2$ | 1 groupe de 3 individus au total<br>d=30 ind/km$^2$ |

*: *Eulemur fulvus collaris*. Pour avoir une idée générale sur la densité relative dans le site, nous avons pris le nombre d'individus que nous avons pu dénombrer au sein du groupe.

A Maromera-Ilemoka, des défrichements très récents ont été effectués destinés à l'installations de pièges de lémuriens. Donc, ce site ne peut plus être considéré comme non perturbé.

Evakoany-Vohipamoty

Les pressions qui pourraient affecter la population de lémuriens dans cette forêt sont la chasse, la coupe d'arbres servant à la construction des maisons et à la collecte du miel, les feux sur les savanes et quelquefois sur la forêt. Les gens chassent les lémuriens en se servant de pièges traditionnels (Tandraho), de catapultes et même de fusils.

Nous avons recensé 8 groupes *d'Eulemur fulvus collaris* composés de 37 individus au total. La densité de cette espèce est environ 38 ind/km$^2$. La taille moyenne des groupes varie entre 4 *à* 5 individus. Par rapport aux résultats qu'on a obtenu à Anasaha (cf. paragraphe ultérieure), la taille moyenne des groupes est plus petite dans cette région: 4 à 5 individus contre 11 individus à Anasaha. Cette réduction de la taille du groupe pourrait être due à la chasse ou à la fluidité de la composition du groupe comme le cas *d'Eulemur fulvus* à Mayotte: les larges groupes se divisent en petits groupes pendant le jour (Mittermeier *et al.* 1994), car soit certains groupes sont très proches l'un de l'autre, soit le territoire d'un groupe devient petit à cause de la réduction de la taille de ce dernier.

Pour *Hapalemur griseus griseus*, on a dénombré 3 groupes de 11 individus au total donnant une densité de 59 ind/km$^2$. La densité de la population de cette espèce à Périnet (= Andasibe) est estimée à 47 - 62 ind/km$^2$ (Pollock 1979, dans Mittermeier *et al.* 1994). La taille des groupes varie entre 3 à 4 individus.

Malio

Avant la prise du Parc par l'ANGAP sous sa responsabilité pour une meilleur gestion et pour une meilleure conservation de la biodiversité, les lémuriens étaient activement chassés par les Antanosy qui ne considèrent pas leur consommation comme tabou. Un seul groupe *d'Eulemur fulvus collaris* composé de 7 individus a été rencontré dans cette forêt, donnant une densité de 33 ind/km$^2$. Pour *Hapalemur griseus*, un seul groupe de 5 individus a été vu malgré la grande superficie du site, soit environ 44 ind/km$^2$.

Les lémuriens à Andranomitily étaient fortement chassés par les braconniers avant l'aménagement de ce site actuel. Les multiples pressions venant des villages périphériques d'Andranomitily telles que la divagation des zébus dans la forêt, la coupe de bois, le défrichement, les feux de brousse, la recherche du miel et l'exploitation de "Vahipiky" pourraient aussi contribuer à la déclinaison de la population de lémuriens (le Vahipiky est une liane très exploitée par les villageois, servant à fabriquer des paniers, des chapeaux et autres choses). Maintenant la chasse est arrêtée au fur et à mesure de l'aménagement.

Anasaha

On a recensé 4 groupes de *E. fulvus* de 44 individus au minimum. La taille moyenne des groupes est large par rapport à celle de la forêt perturbée: 11 individus contre 4 à 5 individus à Evakoany-Vohipamoty et 7 à Malio. La densité de cette espèce est très élevée dans cette forêt: 400 ind/km$^2$. La densité élevée et la grande taille des groupes pourraient être

donc des paramètres indicateurs de la non perturbation d'une forêt.

Pour *Hapalemur griseus*, un seul groupe de 3 individus a été vu, donnant une densité de 30 ind/km$^2$. Il semble qu'il n'y a pas de différence significative entre la densité de cette espèce dans ce site et celles des sites perturbés (Evakoany-Vohipamoty et Malio).

Maromera-Ilemoka

Lors des dernières patrouilles des agents de conservation dans la région, la forêt de Maromera-Ilemoka est dite une forêt privée de toute activité humaine. Or, pendant notre reconaissance du site, nous avons eu la grande surprise de constater le contraire. Des pièges de lémuriens récemment installés ont été vus. Les coupes d'arbres sont très récentes, l'installation de pièges de lémuriens consistent à défricher une étroite surface de forêt (3 à 4 m de large et 5 à 8 m de long). Afin de piéger l'animal, les braconniers suspendent un pont fait de tronc d'arbre mort au milieu de la partie défrichée. Les lémuriens en tant qu'animaux arboricoles, devraient obligatoirement traverser ce pont au cas où ils passent dans cette partie. Un pont comporte 5 à 6 boucles de corde placées le long du trajet de l'animal. Toutes les surfaces défrichées seront substituées par la suite par des forêts secondaires constituées d'arbres de petit diamètre, comme *l'Harungana madagascariensis*. Aucun animal n'a été observé durant notre séjour. Pendant les 8 jours d'observations, 18 pièges ont été dénombrés et nous les avons tous enlevé. La forêt de Maromera-Ilemoka n'est plus non perturbée mais totalement perturbée.

**Discussion**

Les autres paramètres comme le nombre de groupes, la taille moyenne des groupes, le sexe ratio et la reproduction n'ont pas pu être calculés pendant cette mission en raison de l'hétérogénéité de la longueur des transects. Donc, pour la suivi écologique il faut ajuster et rectifier certains transects et aussi choisir une autre forêt humide non perturbée à la place de Maromera-Ilemoka, par exemple: au sein d'Andohahela proprement dit.

La chasse est la principale cause de la déclinaison de la faune lémurienne dans le Parc National d'Andohahela. La densité et la taille des groupes des lémuriens semblent se réduire à cause des pressions anthropiques qui s'exercent sur le parc. Par contre, l'écotourisme, qui est aussi une sorte de perturbation du milieu naturel, est un facteur favorisant la protection de ces animaux, mais pourrait avoir un impact sur le comportement de ces derniers.

**Remerciements**

Ce travail entre dans le cadre de la collaboration du WWF et de l'ANGAP. Sa réalisation a pu se faire grâce à la collaboration de nombreuses personnes auxquelles nous tenons à adresser nos vifs et sincères remerciements, notamment: au Biodiversity Programme Officer du WWF Antananarivo pour nous avoir donné la permission de publier ce travail, à tous les personnels administratifs et financiers du WWF Antananarivo et Fort-Dauphin, à l'équipe SIG du WWF Antananarivo et de l'ANGAP Fort-Dauphin, à Marius P.H. Rakotondratsima du WCS Antananarivo, à tous les personnels des différents volets de l'ANGAP Fort-Dauphin, plus particulièrement, le volet Conservation et Recherches finalisées, le volet Ecotourisme et Education et le volet Administratif et Financier, à tous les Chefs secteurs du Parc National d'Andohahela qui nous ont beaucoup aidé, ainsi qu'à tous les assistants de recherche et agents de conservation qui ont largement contribué à l'exécution des travaux sur le terrain.

**Bibliographie**

Goodman, S.M. (ed.) 1999. A Floral and Faunal Inventory of the Réserve Naturelle Intégrale d'Andohahela, Madagascar: with reference to elevational variation, *Fieldiana*: Zoology, new series. Vol. 94. Field Museum Natural History, Chicago.

Jolly, A.; Gustafson, H.; Oliver, W.L.R, S.M. O' Connor 1982. *Propithecus verreauxi* population and ranging at Berenty, Madagascar 1975 and 1980. Folia Primatol. 39: 124- 144.

Mittermeier, R.A.; Tattersall, I.; Konstant, W.R.; Meyers, D.M., R.B. Mast 1994. Lemurs of Madagascar. Conservation International, Washington, DC.

Nicoll, M.E.; Langrand, O. 1989. Madagascar: revue de la conservation et des Aires protégées. WWF, Gland.

**Brigitte Marie Raharivololona et Voajanahary Ranaivosoa**

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

## Rapport des Enquêtes sur les Chasses dans les Fokontany d´Ivondro, d´Erara et d´Etsilesy

Du temps de leur abondance, les lémuriens ont été chassés inconsciemment dans presque toutes les régions de Madagascar. Actuellement, ils sont classés parmi les espèces les plus menacés du monde. Jusqu'à présent, les différents programmes de conservation de l'île ont plutôt focalisé leurs efforts dans la protection des habitats et des couvertures forestières; peu de recherches et d'analyses sont disponibles sur le problématique de la chasse, et les contraintes liées aux applications des lois en vigueur. Pour répondre à cela, une étude de cas a été menée en Juillet-Août 1998 dans trois villages aux alentours de la région de Manangotry, afin d'avoir des informations sur les phénomènes de la chasse des lémuriens en particulier, et celle des autres espèces en général. Ce rapport sera partagé aux différents entités et responsables de la ville de Fort-Dauphin et les autorités traditionnelles dans les régions concernées, afin de voir ensemble les solutions aux problèmes des villageois, ensuite de décider sur les mesures qu'on devrait prendre.

**Présentation des villages**

Isaka-Ivondro est une des communes de la région de Fort-Dauphin, située à 35 km de la route inter-provinciale de Ranomafana; Ivondro est le chef lieu de la commune. La majorité de ses 647 habitants sont des Antanosy mais il y a aussi quelques Antavaratra. Etsilesy est à 2 km à l'ouest d'Ivondro, avec ses 332 habitants Antanosy. Erara se trouve à 3 km au Nord-Est d'Ivondro avec ses 978 habitants et composés d'Antanosy en majorité, quelques immigrants Antandroy et Antavatra.

Les villages d'Ivondro, d'Etsilesy et d'Erara ont été choisis pour effectuer les enquêtes du fait que:

1. Ils font parties des zones priorisées par l'ANGAP et le WWF
2. Beaucoup des villageois pratiquent encore la chasse des lémuriens et des autres animaux comme les oiseaux, les sangliers et les tanrecs, etc. On ne connait pas encore les impacts de la chasse sur l'écosystème, mais de toute manière, les perturbations qui en déroulent ont des repercussions sur le développement aussi bien du Parc National d´Andohahela que des forêts classées environnantes qui présentent des potentialités écotouristiques.

Les zones d'activités des ces communes incluent les bassins versants suivants:

*Ivondro*: Masoparaky, Andranotelo, Tongindambo (Ampandriambosotry), Ampanoroanary, Andakatokepaky, Vohipamonty, Ebiby, Ambahatsy, Vakoa, Ambatovy, Agnasa, Andratsiba, Ampitaninandroasovoky;

*Etsilesy*: Ampanasakovao, Mangatsiaky, Andohanandenobe (Vohitsivala), -Lemakambohitsy, Evorokosy, Emikotra, Enakosoitsy, Ampangalapanamo;
*Erara*: Evandriky, Ampandriambosotry, Engavo, Ampasy.

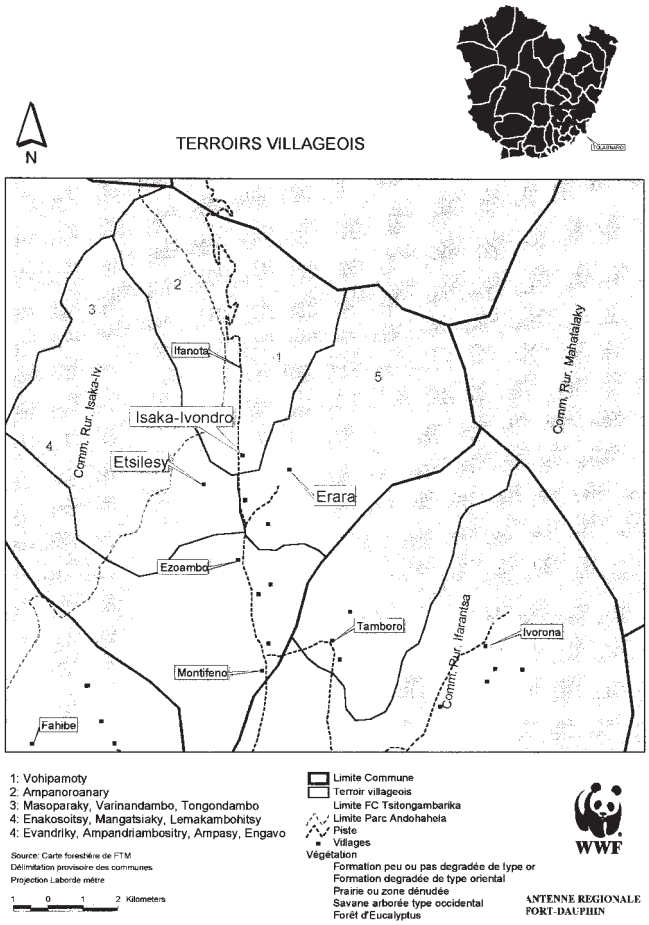


Fig. 1: Carte des sites étudiées dans la région de Fort Dauphin.

**Mode de vie des villageois**

La plupart des villageois sont des cultivateurs. Ils cultivent du riz et d'autres cultures vivrières comme le manioc, le maïs, la patate douce, l'arachide, le sorgho. Dans l'année, les gens mangent beaucoup plus de manioc et du maïs que du riz soit parce qu'ils n'ont pas assez de rizières et la récolte est loin d'être suffisante, soit parce qu'ils vendent une grande partie de leur production de riz pour combler d'autres nécessités.

Tableau 1: Périodes culturales annuelles.

| Culture | Préparation | Semis | Repiquage | Récolte | Pratiquants |
|---|---|---|---|---|---|
| Vary aloha ou riz de contre saison | Juin | Juin | Juillet | Décembre | Quelques paysans |
| Vary anivo | Septembre | Octobre | Novembre | Avril | Des gens riches |
| Tsipala ou riz de saison | Décembre | Déc-Janv | Janvier | Mai-Juin | Tous les paysans |
| Manioc | Août-Sept-Oct | | | Avril-Mai-Juin | Tous les paysans |
| Maïs, arachide, sorgho ou autres | Octobre | | | Mai-Juin-Juillet | Tous les paysans |

Dans la majorité de ces trois villages, chaque toit abrite une grande famille qui n'a qu'un petit lot de rizière; les habitants vivent au dépens de ce qu'ils produisent dans l'année. Néanmoins, il y a une minorité des gens riches qui possèdent de grandes surfaces cultivables et plusieurs têtes de zébus.

**Techniques d'approche pour les enquêtes**

Comme la chasse touche la vie profonde des certains villageois, tirer des informations sur cette activité est un sujet difficile. Les méthodologies d'approche devraient être bien étudiées pour que les résultats obtenus soient fiables. En premier lieu, on a formulé des questionnaires (voir l'Annexe), cependant, on a mené les enquêtes pour qu'elles aient une image de discours ordinaire mais non un type de question-réponse.
L'intégration dans la société des villageois est primordiale pour faciliter les collectes d'informations et surtout pour obtenir la réciprocité de confiance. Durant les enquêtes, on a pris en considération toutes les catégories de classes d'âges et de sexes pour que les renseignements soient à la fois quantitativement et qualitativement présentables.
Par les différentes approches utilisées, on a pu collecter des informations variées sur les phénomènes de chasse; avec les Ray aman-dreny, on a su les historiques des villages, des montagnes environnantes et aussi de la chasse d'autrefois. Les femmes et les enfants indiquent souvent l'endroit de chasse. Avec les hommes, qu'ils soient chasseurs ou non, on obtient les réponses attendues de l'enquête. Quelquefois les noms des chasseurs sortent lors des discussions.
Parmi les chasseurs, il y a ceux qui sont fiers de l'être (cas d'Ivondro), par contre certains ont peur de dire la vérité. Les pauvres disent que c'est grâce à la chasse qu'ils peuvent assurer les besoins familiaux comme les vêtements, médicaments et autres. Les riches déclarent que quatre mois de chasse de lémuriens leur permettent d'acheter soit du fusil, soit deux têtes de zébus.

**La chasse des lémuriens**

Le territoire par village
Chaque village a son territoire respectif (Fig. 1), le plus souvent formé par l'ensemble de quelques bassins versants. Auparavant les gens ont l'habitude de chasser dans les forêts proches de leur village, par exemple les chasseurs d'Ivondro vont dans les forêts de Tongondambo, d'Ampamarignadambo et de Masoparaky. Ceux d'Etsilesy chassent à Enakosoitsy, Mangatsiaky et à Lemakambohitsy. Enfin les gens d'Erara chassent dans les forêts d'Evandriky, d'Ampandriambosotsy, d'Ampasy et d'Engavo. Actuellement, les chasseurs étendent leur zone de chasse dans les autres forêts de Vohitsivala et d'Ampanasamby pour le cas d'Etsilesy.

Les raisons de la chasse
Il y a quelques raisons qui poussent les gens à chasser et suivant l'analyse des réponses, on a pu estimer leur pourcentage. Il y a tout d'abord la pauvreté qui touche environ les 60% des chasseurs. Les produits de chasse sont vendus en totalité afin de pouvoir acheter les besoins familiaux comme le pétrole, l'habillement et autres.
Il y a aussi le besoin en consommation, environ 20% des chasseurs mènent cette activité parce qu'ils n'ont pas le moyen d'acheter de la viande au marché. Néanmoins, lorsque la chasse est bonne, ils en vendent une partie (4 lémuriens sur 10). Il y a environ 15% des chasseurs qui font la chasse à titre d'activité héritée des ascendants et ils le resteront toujours. Enfin, environ 5% font la chasse par distraction c'est-à-dire quand on ne fait pas des travaux de champs à mi-temps.

Les techniques de chasse
Il y a d'une part, la technique traditionnelle appelée tandroho qui est utilisée par la plupart des Antanosy. Le tandroho est un système de pièges à étalages dont la mise en place est bien analysée. En effet, 2 ou 3 jours avant l'installation, les chasseurs localisent les endroits où on peut trouver le plus des groupes de lémuriens. Puis ils installent les pièges en

choisissant la proximité des arbres fruitiers tels que Rehiaky, Raotsy, Voatsila et Amborabe, qui constituent l'alimentation des lémuriens. Pour la mise en place du tandroho, les chasseurs défrichent une superficie d'au moins 50 $m^2$.
D'autre part, il y a la chasse par fusils qui est pratiquée par une minorité d'Antanosy et des immigrants Antandroy qui achètent des balles à 10.000 Fmg /pièce. A Etsilesy, il y a des gens qui louent des fusils de chasse à 15000 Fmg par jour.

Tableau 2: Informations générales sur la chasse.

| Techniques Utilisées | Tandroho | | Fusil |
|---|---|---|---|
| | Chasseurs diurnes | Chasseurs permanents | |
| Durée de chaque séance de chasse | Environ 13h par jour | 3 à 5 jours | Variable dans la journée |
| Nombre d'animaux chassés par séance | 0 à 5 lémuriens | 8 à 20 lémuriens | 4 à 8 lémuriens |
| Périodicité dechasse | 4 fois par mois | 2 fois par mois | 1 fois par mois |
| Durée totale dechasse dans l'année | 2 mois | 4 mois | 4 mois |

Un groupe de chasseurs diurnes est composé de 2 à 3 personnes tandis que celui des chasseurs permanents en contient 3 à 6. La formation d'un groupe se fait par séance de chasse mais ceci n'est pas gardé durant l'année. Le choix entre les deux types de groupes dépend de la disponibilité et de l'entente entre chasseurs. Les différents groupes ne font pas la chasse en même temps.

Tableau 3: Estimation des effectifs des chasseurs par village.

| | Erara | Ivondro | Etsilesy |
|---|---|---|---|
| Nombre de groupes de chasseurs | 3 groupes | 2 groupes et 2 fusils | 4 groupes et 1 fusil |
| Nombre de chasseurs | 18 | 12 | 24 |

De par l'instabilité des groupes, ces effectifs sont estimés au minimum. Suivant les informations obtenues, environ 200 lémuriens par an sont tués par les chasseurs de chaque village.

Les périodes de chasse
Pratiquement, la chasse existe durant toute l'année, cependant elle est intensifiée 6 mois sur 12 suivant les différentes périodes: d'abord, aux mois de février et mars ou «mois de repos» pendant lesquels il n'y a pas des travaux de champs, ensuite pendant la «récolte de Tsipala» au mois de juin; en cette saison, les villageois ont de l'argent pour louer des fusils ou pour acheter les proies chassées. C'est la période la plus favorable pour la chasse car elle correspond à l'abondance de la nourriture des lémuriens et ils sont faciles à répérer. Enfin, pendant la saison du «vary anivo» aux mois de septembre, octobre et novembre.

Les produits de chasse
Vue la diminution en variété et en nombre des lémuriens, les gens chassent tous ceux qu'ils rencontrent sans distinction d'espèce ni de sexe ni d'âge. Néanmoins, du point de vue consommation, les varika sont les plus appréciées par les villageois. Le prix justifie ce fait car suivant les tailles, elles se vendent de 8000 Fmg jusqu'à 15000 Fmg.
En 1989, le prix unitaire de ces animaux est de 1500 Fmg à 2500 Fmg. A ce temps là, ils se vendent difficilement car on peut les trouver tout près des villages. En cette année 1998, ils deviennent 10 fois plus chers et se vendent facilement aux richards du village et à tous les villageois en mois de juin.

**La chasse aux autres espèces animales**
En plus des lémuriens, les gens chassent aussi des oiseaux comme *Alectroenas* (foliala), *Coua caerulea* (tetso), *Numida sp.* (pintade), *Lophotibis cristata* (akohoala) et des mammifères comme *Potamochoerus larvatus* (sanglier) et *Tenrec ecaudatus* (hérisson).
Il y a plusieurs types de pièges utilisés pour chaque catégorie: pour les tetso et foliala sur les arbres, les gens utilisent des lances pierres. Par contre pour les pintades et les akohoala qui sont terrestres, ils utilisent des pièges à hameçon dont les viky et les gozo. Le flair des chiens fait l'affaire avec les hérissons. Les cables sont destinés pour les sangliers. Les sangliers sont aussi chassés occasionnellement lorsqu'ils ravagent les champs de manioc.
Le prix de vente de chaque espèce est à débattre mais en moyenne les pintades et les akohala qui sont rares se vendent de 4000 à 5000 Fmg. Le sanglier se vend à 2500 Fmg le kilo. Les hérissons et les petits oiseaux ne sont pas vendus mais servent de nourriture pour la famille.

**Impacts de la chasse**
D'après les villageois, si l'activité de chasse a augmenté ces derniers temps c'est parce que leurs surfaces de rizières cultivables diminuaient progressivement. Les hommes ont alors recours à la chasse (traditionnelle) pour avoir de l'argent assez vite car selon eux, celle-ci ne demande que d'effort et du courage. Cependant, ce qu'ils ignorent sont les impacts de leurs activités sur l'écosystème forestier et aussi sur leur propre vie quotidienne.
Nous avons commencé l'étude sur les lémuriens vers la fin de l'année 1997 dans les forêts de Vohipamonty et d'Ampanoroanary dans la zone de Manangotry. Jusqu'en juin 1998, nous avons constaté les points suivants:

- la diminution des nombres de groupes rencontrés: en décembre 97, pour 5 jours d'observation par site, nous avons recensé 15 groupes de varika et 3 groupes de halo. En avril 98 avec le même effort d'observation, le nombre de groupes rencontrés est tombé à 4 seulement;
- la réduction des tailles de groupes: auparavant, les groupes de varika contiennent en moyenne six à sept individus mais cet effectif peut varier à neuf et même à 12 individus. Trois autres individus solitaires et furtifs ont été repertoriés, probablement issus de la dissociation des groupes;
- le changement de leur domaine vital à cause de la perturbation: si en décembre 97, beaucoup de groupes ont été rencontrés vers 250 m d'altitude, en juin 98 à Vohipamonty, le premier groupe de varika que nous avons vu après trois jours de recherche se trouvait presque au niveau des crêtes à 450 m d'altitude;
- le défrichement de la forêt en plus des autres pressions existantes et la perturbation des autres espèces faunistiques.

Le temps que nous avons dépensé pour aboutir à ces résultats est très court. Pour le moment, on ne peut pas encore dire que ces changements sont vraiment dûs à la chasse car il y a d'autres facteurs externes qui peuvent être à l'origine de ces différents changements, entre autres la saison, la nourriture. Néammoins, ces variations doivent être suivis de près pour bien analyser la situation.

**Propositions des villageois**
D'après l'entretien avec certains villageois, ils sont conscients qu'ils violent la loi en exploitant la forêt à leur façon. Ils connaissent l'existence du service des Eaux et Forêts, du WWF, de l'ANGAP et du KASTI. De plus, les lois concernant l'exploitation des animaux menacés ne leur sont pas inconnue, cependant ils continuent toujours leurs exploits car comme ils le disent , ils n'ont pas le choix ou «on ne leur avait pas appliqué ces lois jusqu'à maintenant».
De leur prise de conscience, certains villageois ne sont pas contre l'application des lois, cependant, ils ont proposé quelques solutions, d'une part pour freiner ou tout au moins pour

réduire la chasse dans la forêt, d'autre part, pour qu'ils puissent améliorer leur condition de vie, à savoir:

- les formations sur la culture maraichère, l'apiculture et la pisciculture pour la nourriture et pour la vente;
- la confection des barrages d'irrigation;
- l'étude des prix des matériels agricoles (charrue, sarcleuse, etc.) afin que tous les paysans peuvent les acheter pour pouvoir augmenter leur rendement;
- l'étude de la redélimitation de l'Aire protégée pour qu'ils puissent accroitre l'espace cultivable;
- le redressement de la loi et réglémentations sur le défrichement;
- le renforcement de la gardiennage forestière pour attraper les chasseurs et les emprisonner.

Enfin, ces villageois sollicitent que l'Etat les aide en donnant du travail à leurs enfants, et du crédit rural aux parents qui leur permettra de démarrer aux activités rénumératrices.

**Plan d'action**

Compte tenue de toutes ces informations sur le phénomène de chasse et les propositions des villageois, un plan d'action-recherche visant la diminution de la chasse sera initié afin que les différents entités locaux réunissent leurs efforts dans la recherche des mesures à prendre pour la résolution des problèmes, entre autres:

- préparation des séances de travail avec les autorités ou le personnel de la justice;
- appui des entités compétents à l'application des lois (Eaux et Forêts et Tribunal);
- élaboration des programmes éducatifs et information des villages concernés;
- recherche des solutions aux problèmes des familles pauvres concernées.

**Conclusion**

Les informations que nous avons obtenues de ces enquêtes nous ont permis d'avoir un trait général sur le phénomène de la chasse. A travers les discours et récits des villageois, on a pu imaginé la destruction progressive de l'habitat forestier, ainsi que la déclinaison des différentes espèces faunistiques qui en dépendent.

Pour les lémuriens, si 10 ans auparavant, il y avait quatre espèces diurnes, actuellement, les unes commencent disparaitre dans quelques forêts; d'ici 10 ans, il est probable que les restes disparaitront progressivement dans la région même. Les cas rencontrés dans ces villages ne sont que quelques exemples parmi tant d'autres.

En matière de conservation et surtout dans le but de maintenir la biodiversité, il est temps ou jamais de profiter cette prise de conscience des villageois pour mettre la chasse des espèces menacées au rang des autres délits comme les défrichements sans permis. Avant leur application, les lois devraient être expliquées aux villageois comme quoi les sanctions seront directement appliquées aux délinquants.

ANNEXE

LES QUESTIONNAIRES

1. Provenance des chasseurs: groupe clanique
2. Causes et raisons qui poussent les gens à pratiquer la chasse
3. Type de chasseurs: pauvre, riche, hérédité, spécialiste
4. Calendrier cultural
5. Saison de chasse: été, hiver, saisonnière
6. Moyens utilisés: fusil, piège
7. Quantités de lémuriens obtenus par chasse: espèces, âge, sexe
8. Objectifs de la chasse pratiquée: à vendre (prix, filière de la vente), consommer (espèces préférées)
9. Distance parcourue et temps dépensé pour chasser (avant et maintenant)
10. Perception de l'état de peuplement des lémuriens:
    -types de lémuriens qui ont éxisté avant et maintenant
    -espèces chassées avant et maintenant
11. Autres espèces chassées: oiseaux, hérissons, sangliers ou autres
12. Solutions envisagées par les paysans pour anéantir la chasse
13. Technique d'approche adoptée

**Malatatiana H. Randriamanalina, Lucien Rafararano, Landrie Babary, Rolland, Laha**
WWF, BP 42, Tolagnaro (614), Madagascar

In the article by Randriamanalina *et al.* the local populations expressed their need to supplement their income by new activities and their desire to get training in activities such as bee keeping. In the following article A. Fohavelo and J. Gulley summarize the first steps of an initially very successful initiative to improve bee keeping and marketing honey in a local community of western Madagascar. Their initiative included construction of hives with local means to avoid the destructive way of collecting honey from wild bees by burning the tree (and sometimes substantial areas around it) when collecting the honey and to put in place a structure to supply the market of the nearest town (Morondava) for extended periods of the year. The costs of the initiative amounted to about 5 US$ for book keeping and a barrel or a few jerrycans to keep the honey into the season when honey from wild bees was no longer available. This allowed to maintain the supply of the market for longer and to achieve higher prices. The initiative proved very successful within less than two years. The whole enterprise collapsed within a few weeks after the departure of J. Gulley because some members of the cooperative were unwilling to cooporate for long-term benefits instead of short-term profit. This exercise demonstrated how little it takes to create sustainable income for local communities that is compatible with nature conservation and how difficult it is to integrate new approaches into the tradition of local economics. (J. Ganzhorn)

## Les Espèces de Plantes Mellifères dans les Alentours de Marofandilia

Depuis 1995, les hommes de Marofandilia, un village au nord de Morondava dans la domain de la forêt sèche, se sont mis à améliorer la commercialisation du miel sauvage. Depuis le début on a parlé d'élevage des abeilles et des essais ont été entrepris. A partir de 1996, des données de bases sur la flore mellifère de la forêt ont éte collectées. Depuis la seconde moitié de 1997, les membres de l'Association Zemahavatsy ont commencé à mettre en place un système d'élevage d'abeilles. Une connaissance de la flore mellifère forme la base pour l'élevage d'abeilles. Jusqu'à présent, il n'existe aucune information pour la forêt dense sèche de la région du Menabe. En vue d'une valorisation de l'apiculture dans la région, il faut approfondir les connaissances des espèces intéressantes pour les abeilles pour que les gens puissent construire un calendrier de travail effectif pour l'apiculture.

Dans ce rapport, on résume les observations faites d'octobre 1996 jusqu'à octobre 1997 sur les activités des abeilles autour de Marofandilia. Ce rapport donne des information sur les périodes de miellée et de disette ainsi que sur les espèces mellifères.

**Méthode**

L'étude est effectuée environ 40 km au nord de Morondava autour du village de Marofandilia. Dans cette partie centrale du Menabe s'étendent encore des forêts dense sèches, de formations secondaires et de brousse (Cabalzar 1996; Favre 1996; Genini 1996; Raonintsoa 1996; Sorg 1996a, 1998). Nous avons choisi quatre sites près du village de Marofandilia pour représenter les différents types de végétation qu'une abeille butineuse peut rencontrer, à savoir:

I. La végétation dans le village même.
II. La Forêt Classée d'Ampataka, c'est une forêt utilisée pour les besoins paysans à l'ouest de Marofandilia.
III. La forêt Milemboky au sud-est de Marofandilia, vers les monka, entre la mare de Milemboky et la Réserve Spéciale d'Andranomena.
IV. Les terres défrichées des anciennes rizières au nord du village, maintenant peuplées de jujubieres (*Zizyphus mauritania*).

Chaque site était visitée au moins une fois tous les quinze jours du premier octobre 1996 au octobre 1997. Lors de chaque visite les espèces butinées par les abeilles étaient notés au long des trajets déterminés qui traversait chaque zone.

**Résultats**

La liste des espèces observées pendant l'année se trouve dans le Tableau 1 et l'Annexe. Le calendrier de floration se base sur les dates d'observation et peut varier légèrement. Cette remarque est valable également pour les espèces indiquées uniquement pour un site bien qu'elles puissent exister ailleurs sans avoir été butinées. Enfin, nous avons indiqué le nombre de pieds butinés (cela peut être seulement un pied ou plusieurs); nous avons simplement différencié les espèces fortement butinées par les abeilles et les espèces qui n'ont attiré que peu d'abeilles. Les resultats sont résumés dans la Figure 1 et dans l'Annexe.

En étudiant les résultats nous pouvons faire quelques observations générales:

1. La période de disette pour les abeilles semble être les mois de juillet-août-septembre. Le faible taux d'activités observé dans la ruche pendant cette période semble confirmer cette observation. Les abeilles trouvent moins de pollen et de nectar et leurs heures de travail sont diminuées par le froid de l'écourtement des jours.
2. Les résultats s'accordent avec les connaissances des chasseurs de miel. Il y a deux grandes floraisons (octobre-décembre et mars-mai), toutefois le miel sauvage ne devient abondant qu'à partir de février. Il rest à savoir si la première floraison peut donner un rendement intéressant dans les colonies gerées ou si elle ne contribue qu'à une grande miellée de mai à mars.
3. On ne peut pas dire si un des sites est plus favorable aux abeilles. Bien qu'il soit intéressant de voir les différences dans les types de végétation butinée, il est possible qu'une colonie d'abeilles élevée à Maronfandilia butine dans toutes ces zones et profite de la combinaison de différentes fleurs. Pour faire des comparaisons précises, il faudra affiner les méthodes d'observation et regarder les résultats collectés pendant plusieurs années ainsi que comparer les rendements die miel produits dans les différents sites. Même s'il semble logique que la diversité de la forêt primaire soit préférable, aucun résultat ne peut encore confirmer cette affirmation.
4. Il semblerait que le milieu du village offre le meilleur environnement pour les colonies des abeilles (il y a des ressources tout au long l'année), néanmoins il faut bien considérer la quantité de ces ressources. De plus, on peut se demander si les résultats ne sont pas biaisés par le fait que les chercheurs habitent dans le village et observent d'une manière plus minutieuse. Par contre il serait utile de considérer les deux espèces, le kapok et l'eucalyptus, qui sont les seules

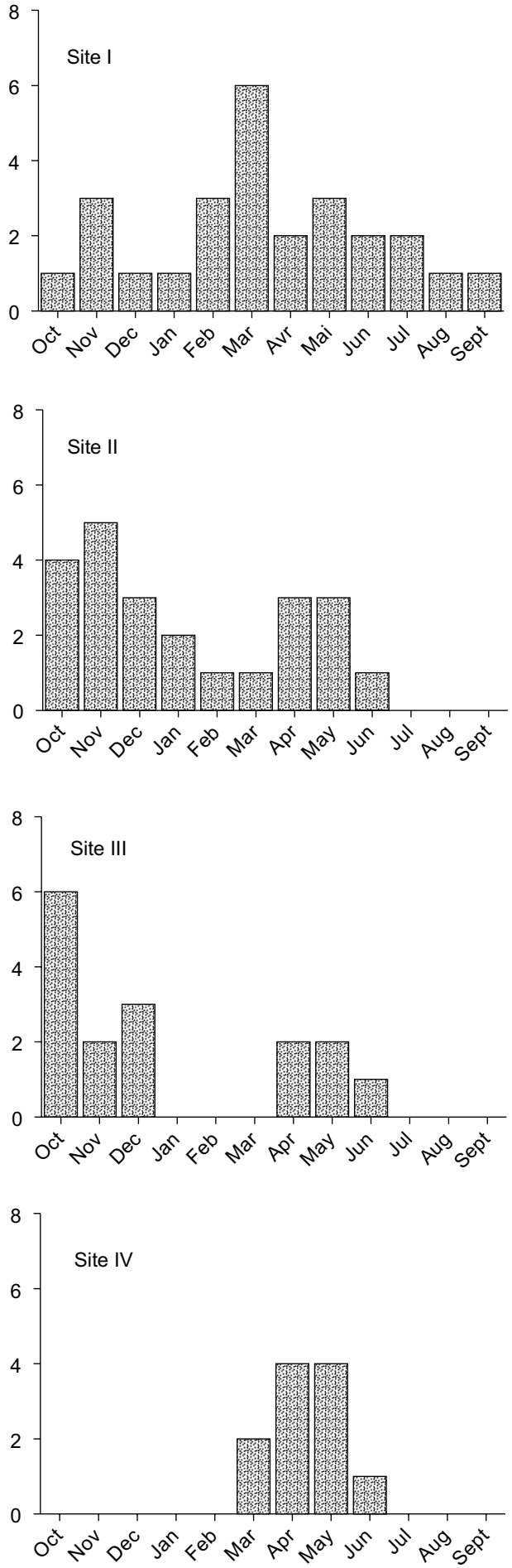


Fig. 1: Nombre des espèces butinées par les abeilles dans quatre types de veégeétation autour du village de Marofandilia.

espèces qui fleurissent pendant la période de disette et qui pourraient aider les colonies à survivre et à sortir renforcées des périodes de disette.

**Conclusion**

Il faut tenir compte que cette année d'étude représente la première étape d'une étude que devrait se poursuivre pendant plusieurs années. Ceci pour bien connaître la flore et le calendrier de floraison des espèces mellifères dans la forêt du Menabe. On a appris et modifié les méthodes en cours d'année. Les études qui suivront profiteront de cette prémière année d'expérience. Les recommandations suivantes peuvent être proposées pour la méthodologie de l'année 1997-1998:

1. Ajouter à l'étude un site forestier de la partie nord de la Réserve Spéciale d'Andranomena.
2. Mieux étudier le rôle des herbes et des lianes dans la flore mellifère.
3. Affiner la méthodologie en:

- précisant bien les jours d'étude pour chaque mois;
- notant l'heure de visite et en variant (si possible) ces heures;
- notant le degré de visite par les abeilles de chaque arbre (p.e. employer une échelle 1 à 5);
- comptant et rapportant combien de pieds d'une seule espèce sont butinés par les abeilles;
- élargissant l'étude pour faire des comparaisons entre la forêt primaire et les terres dégradées.

Cette étude fournira une base de données très importantes aux futurs apiculteurs du Menable en établissant par exemple un calendrier de travail pour les apiculteurs. En plus, elle peut être aussi employée pour choisir des espèces de reboisement qui aideraient les abeilles pendant la période de disette, qui augmenteraient le fourrage pendant la miellée et ainsi maximiseraient la récolte. Finalement, elle peut éclaircir les différences entre les différents types d'environnement (forêt intacte, forêt dégradée, zones de jujubier, etc.) par rapport aux besoins des abeilles.

**Remerciements**

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**Bibliographie**

Cabalzar, G. 1996. Le milieu humain. In: Ecology and Economy of a Tropical Dry Forest in Madagascar. J.U. Ganzhorn; J.-P. Sorg (eds.) Primate Report, 46-1: 13-19.

Favre, J.-C. 1996. Traditional utilization of the forest. In: Ecology and Economy of a Tropical Dry Forest in Madagascar. J.U. Ganzhorn; J.-P. Sorg (eds.) Primate Report, 46-1: 33-40.

Genini, M. 1996. Deforestation. In: Ecology and Economy of a Tropical Dry Forest in Madagascar. J.U. Ganzhorn; J.-P. Sorg (eds.) Primate Report, 46-1: 49-55.

Raonintsoa, P.N. 1996. The role of the forest in the local economy. In: Ecology and Economy of a Tropical Dry Forest in Madagascar. J.U. Ganzhorn; J.-P. Sorg (eds.) Primate Report, 46-1: 41-47.

Sorg, J.-P. 1996a. L'étude de la végétation, un outil au service de l'amenagement et de la gestion des ressources forestières à Madagascar. Akon'ny Ala 18: 26-36.

Sorg, J.-P. 1996b. Vernacular and scientific names of plants of the Morondava region. In: Ecology and Economy of a Tropical Dry Forest in Madagascar J.U. Ganzhorn; J.-P. Sorg (eds.) Primate Report, 46-1: 339-346.

Sorg, J.-P. 1998. Organisation de la recherche forestière dans les zones sèches: un cas concret dans l'ouest de Madagascar. Lemur News 3, 17-20.

Annexe: Liste de noms d'espèces vernaculaires et scientifiques (d'après Sorg 1996b); [f] spèces avec une faible visite des abeilles sont marquées avec (f).

| Nom vernaculaire | Nom scientifique | Mois de floraison | Présent aux sites |
|---|---|---|---|
| Ahidambo [f] | | avril | IV |
| Akata matimaly | | mars | I |
| Alimboro | *Albizia androyensis* | nov. | III |
| Anakaraka | *Cordyla madagascariensis* | oct.–nov. | I |
| Arofy grandes feuilles | *Cmmiphora guillaumini* | nov. | III |
| Beholitsy | *Hymenodictyon* sp. | oct.-nov. | II, III |
| Hamotsy [f] | | mars-avril | II |
| Hazomby | *Strychnos madagascariensis* | jan. | II, III |
| Hazomena | *Securinega perrieri* | nov.–dec. | II |
| Holaboy (Holabe) | *Adenia firingalavensis* | nov. | II |
| Kapoaka | *Ceiba pentandra* | juil. | I |
| Kililo | | avril–mai | I, II, III, IV |
| Kily [f] | *Tamarindus indica* | nov. | I |
| Kindresy | | mars | I |
| Kinina | | juil–sept. | I |
| Kironono [f] | *Capurodendron rubrocostatum* | nov. | II |
| Liane Inconnue | | fév. | I |
| Mahabolotsaky | | nov. | III |
| Malamasafoy | *Delonix adansonioides* | oct.–nov. | II, III |
| Maragnitsy atoraka [f] | | avril | I |
| Matora (Mantaora) | *Cedrelopsis* sp. | jan. | III |
| Mendoravy | *Albizia greveana* | nov.–dec. | I, II |
| Mokonazy | *Zizyphus mauritania* | mars–mai | I; II, III, IV |
| Monongo | *Zanthoxylum tsihanimposa* | nov.–jan. | III |
| Reniala | *Adansonia grandidieri* | mai–juin | I, II, III, IV |
| Sarivonjo | | mars | I |
| Sarongaza [f] | *Colvillea racemosa* | mars | I |
| Sary Kimalao | | mars | I |
| Taigaiky (Tagoaiky) | | jan.–fév. | I, II, III |
| Tandrindritsy | | dec. | II |
| Tsiandala [f] | *Berchemia discolor* | oct. | II |
| Vary njanahary | | mars–avril | IV |
| Volily [f] | | oct. | II |

**Alpha Fohavelo**
Marofandilia, Morondava 619, Madagascar

**Jeremy Gulley**
PO Box 1660, Fisco CO 80443-1660, Etats Unis

## Inventaire Biologique dans la Réserve Spéciale de Bemarivo: volet Primatologie

Dans le cadre de la mise en œuvre du Plan d'Action Environnementale, qui est actuellement à sa deuxième phase ou PE2, le cabinet d'études BIODEV Madagascar a entrepris au courant du mois de Juin 1999, des travaux de diagnostic physico-bio-écologique qui constituent une étape importante pour l'élaboration du Plan d'Aménagement et de Gestion de la Réserve Spéciale de Bemarivo. A cet effet, le présent article définit les principaux résultats relatifs à la biodiversité qui relève de la primatologie au niveau de cette Réserve Spéciale.

Cette Réserve Spéciale (R.S) n°12 de Bemarivo créée par le décret du 10 septembre 1956 et promulguée par l'arrêté n° 2425 AP/4, fait partie de la zone littorale du Nord Ouest de Madagascar. Elle se trouve dans la commune rurale de Besalampy, dans la province de Mahajanga. La Réserve est localisée entre 16°50' et 17°00'S, 44°20' et 44°26'E avec une superficie de 11575 ha. L'altitude est comprise entre 25 à 80 m (BIODEV 1999).

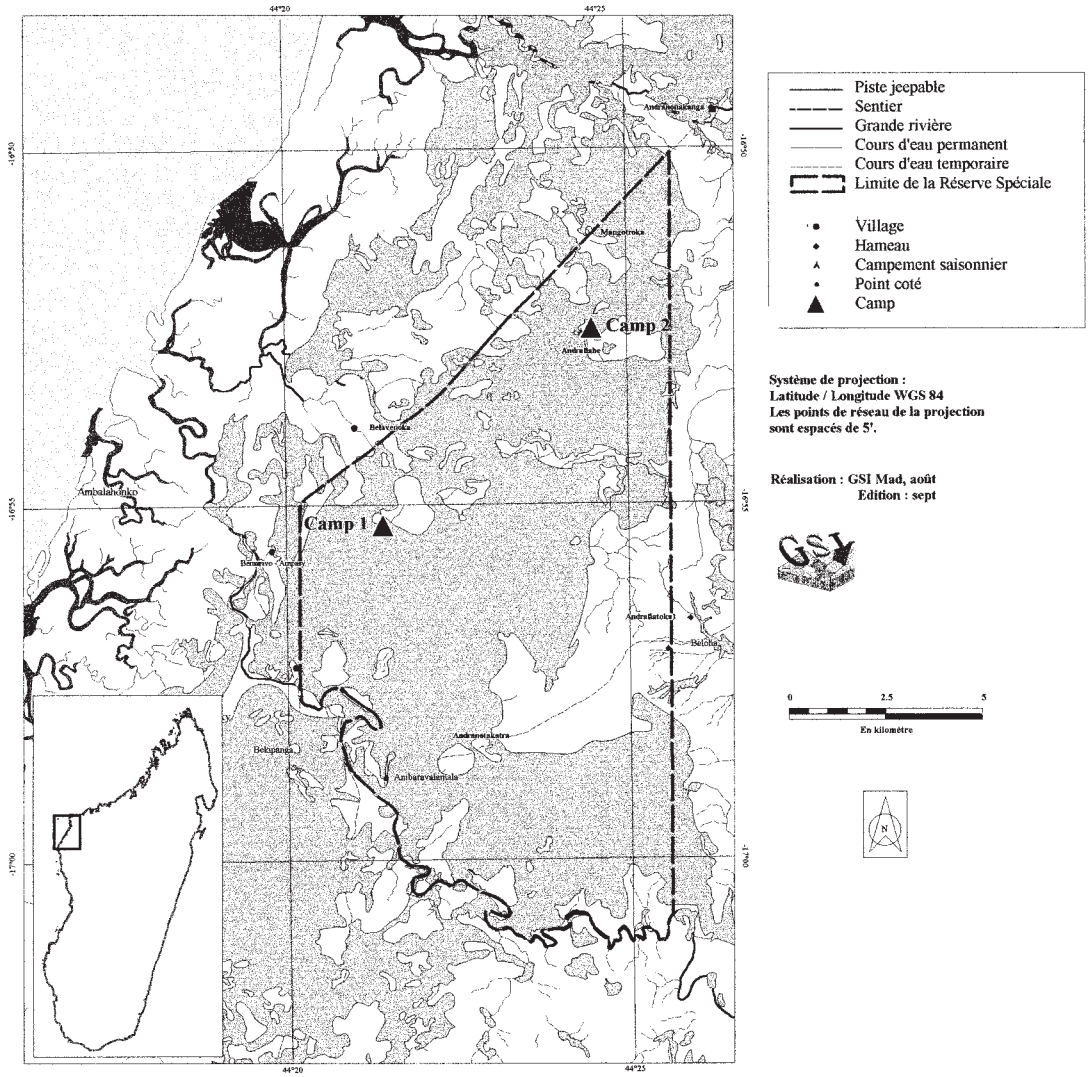


Fig. 1: Reserve speciale de Bemarivo: Sites inventoriés par BIODEV Madagascar en juin 1999.

La zone d'étude fait partie de la flore sous le vent (Perrier de la Bathie 1921) et appartient au domaine occidental de 0 à 800m d'altitude de la série à *Dalbergia - Commiphora* et *Hildegardia* selon la subdivision phytogéographique de Humbert *et al.* (1965). Elle correspond également à une zone écofloristique occidentale de basse altitude (Faramalala 1988). La RS de Bemarivo est formée surtout par le massif forestier de Bebonaky au Nord, et celui de Bemarivo - Analabe au Sud. Quatres types de formations végétales existent dans cette Réserve: la forêt dense sèche caducifoliée, la forêt dense subhumide, les fourrées xérophytiques et les formations graminéennes avec ou sans éléments ligneux (savane ou pseudo-steppe). Au total, 80,9% des espèces floristiques recensées dans cette réserve sont endémiques et il y a aussi une famille (Rhopalocarpaceae) et huit genres endémiques de Madagascar (BIODEV 1999).

Avant la visite de cette Réserve par l'équipe de BIODEV, il semble qu'aucun mammalogiste n'y avait encore réalisé un inventaire systématique des Mammifères. Par contre, elle a déjà fait l'objet d'inventaire ornithologique par le projet ZICOMA (1999). Le but principal de l'étude consiste à avoir les informations valables pour justifier la présence et/ou l'absence d'espèces de lémuriens dans les différents types de formations végétales de la Réserve Spéciale de Bemarivo. Tous les lémuriens rencontrés au cours des observations diurnes et nocturnes ont été alors répertoriés. A chaque site, dans différents types d'habitats, des pistes ont été lentement parcourues de 6h 30 à 11h le matin et de 15h 30 à 17h 30 l'après-midi, pour détecter la présence des lémuriens soit par observation directe, soit par vocalisation ou mouvement dans les arbres. Les observations nocturnes ont été effectuées entre 19h 00 et 22h 30 en utilisant des lampes frontales de faible intensité pour repérer les espèces nocturnes par reflet lumineaux de leur yeux. D'autres lampes beaucoup plus puissantes ont été utilisées afin d'identifier l'espèce repérée. A chaque observation de lémuriens, les données suivante ont été enregistrées: espèce, nom vernaculaire, heure d'observation. Si 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 effectuées auprès des guides et des villageois sur la présence éventuelle d'autres espèces de lémuriens dont l'observation directe s'avère difficile.

Deux sites d'étude ont été choisis pour mener à bien cet inventaire:

Site A a été implanté dans la partie centrale de la Réserve avec un campement principal installé à côté d'un ruisseau (16°55'14"S; 44°24'25"E).

Site B se trouve dans la partie nord de la réserve et le campement a été installé en forêt près d'une plantation de canne à sucre et de manioc et près d'un ruisseau (16°52'29"S; 44°24'28"E).

Cette étude a mis en évidence la présence de six espèces de lémuriens dont trois diurnes (*Propithecus verreauxi deckeni, Eulemur fulvus rufus* et *Hapalemur griseus)* et trois nocturnes *(Microcebus murinus, Lepilemur edwardsi* et *Cheirogaleus medius).*

*Propithecus verreauxi deckeni*
La présence de cette sous-espèce dans la RS de Bemarivo a été déjà signalée par le projet ZICOMA (1999). En outre, Mittermeier *et al*. (1994) ont noté que cette Réserve pourrait abriter une population de *P.v. deckeni*. Deux groupes de quatre individus seulement ont été observés durant cette étude. Ces individus présentaient un pelage blanc uniforme. Aucun individu présentant une variation de pelage n'a été trouvé, contrairement à la population de *P.v. deckeni* dans la Réserve Spéciale d'Ambohijanahary où des individus ayant des tâches noires sur le dos ou/et sur l'avant-bras ont été observés (BIODEV 1999). Les populations vivant au voisinage de la réserve ont mentionné que cette sous-espèce est sujette à la chasse.

*Eulemur fulvus rufus*
Cette sous-espèce diurne a été observée à quelques occasions dans les deux sites d'étude. Un groupe est composé d'environ 8 à 10 individus. La chair de cet animal est très appréciée par les villageois, et il subit ainsi une très forte pression de chasse. De nombreux pièges traditionnels servant à capturer cet animal ont été repérés dans la réserve. En outre, les individus observés étaient très méfiants de l'homme. Ils s'enfuient rapidement dans la forêt presque immédiatement après être repérés.

*Hapalemur griseus* ssp.
Cette espèce exclusivement diurne est apparemment très rare dans la RS de Bemarivo. Deux groupes composés respectivement de deux et trois individus ont été trouvés dans le site 2. Elle est aussi sujette à la chasse selon les guides. Théoriquement, cette espèce se rencontre dans les forêts à bambou (Petter et Peyrieras 1970; Tattersall 1982; Mittermeier *et al*. 1994). Néanmoins, elle a déjà été observée dans des milieux forestiers où les bambous sont peu importants comme à Namoroka (Garbutt 1999; Thalmann *et al*. 1999; BIODEV 1999). Plusieurs supports en bambous dréssés ont été trouvés dans la forêt de Bemarivo.

*Lepilemur edwardsi*
Cette espèce nocturne semble être peu abondante à Bemarivo. Deux individus seulement ont été observés durant cette étude. Un de ces animaux a pu être délogé par nos guides et ses caractères phénétiques externes ressemblaient à ceux de *Lepilemur edwardsi* tels que décrits et illustrés par Mittermeier et al (1994). Théoriquement, l'aire de distribution de cette espèce s'étend du nord de la rivière Tsiribihina jusqu'à la baie de Mahajamba (ceci inclue notre zone d'étude). Les Lepilemurs sont aussi chassés par les riverains.

*Microcebus murinus*
Quelques individus de cette espèce ont été trouvés durant notre passage dans cette RS de Bemarivo. Les individus observés à une distance relativement faible présentaient un pelage gris uniforme caractéristique de *M. murinus*.

*Cheirogaleus medius*
La présence de cette espèce dans la forêt de Bemarivo a été signalée par les populations riveraines. Mais cette espèce nocturne reste en état d'hibernation durant la saison sèche, raison pour laquelle, elle n'a pas pu être observée durant cet inventaire.Théoriquement, *Cheirogaleus medius* se rencontre dans presque toutes les forêts sèches de Madagascar.
La RS de Bemarivo abrite au moins six espèces de lémuriens. Elle est donc plus riche en primates par rapport à la Réserve d'Ambohijanahary où il n'y a qu'une seule espèce (Nicoll et Langrand 1989; BIODEV 1999). Par contre, cette Réserve est plus pauvre en communauté de primates par rapport à la Réserve Naturelle Intégrale de Namoroka avec au moins neuf espèces (Thalmann *et al*. 1999) et à la R.S de Kasijy avec au moins sept espèces (BIODEV 1999).
La destruction de leur habitat et la pression de chasse constituent les principales menaces pour la survie de la faune lémurienne dans cette Réserve de Bemarivo. Les défrichements sont d'une grande importance notamment dans la partie nord de la Réserve. Les villageois coupent et brûlent la forêt au profit des cultures sur brûlis. En effet, de nombreuses plantations de riz, de manioc et de canne à sucre ont été trouvées aussi bien à la périphérie qu'au coeur de la Réserve. Les feux de brousse, allumés chaque année pour reverdir les pâturages de saison sèche, atteignent souvent les lisières forestières. La chasse de lémuriens pour l'alimentation est amplement pratiquée dans toute la Réserve. Les espèces les plus recherchées sont: *Eulemur fulvus rufus* et *Propithecus verreauxi deckeni*. Les techniques de chasse sont surtout les sarbacanes et les pièges traditionnels. Des mesures urgent s'avèrent prioritaires pour conserver cette forêt de Bemarivo ainsi que la faune qui y vit.

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

| Famille | Espèces | Nom vernaculaire | Statut* |
|---|---|---|---|
| Cheirogaleidae | *Microcebus murinus* | Tilitilivaha | Abondant |
| | *Cheirogaleus medius* | Kelibehohy | Abondant |
| Megaladapidae | *Lepilemur edwardsi* | Fitsidika | Abondant |
| Lemuridae | *Hapalemur griseus* spp. | Kofi | Vulnérable |
| | *Eulemur fulvus rufus* | Gidro | Abondant |
| Indriidae | *Propithecus verreauxi deckeni* | Tsibahaka | Vulnérable |
| * d'après Mittermeier *et al*. (1994). | | | |

**Remerciements**
Nous tenons à remercier la Direction des Eaux et Forêts et l'Association Nationale pour la Gestion des Aires Protégées, sans leur collaboration, cet inventaire n'a pu être réalisé. Notre profonde gratitude va aux autres membres de l'expédition: Mamy Andrianasolo, Jean de Dieu Randriamanantena, Lalaina Robenarimangason, Vola Raherisoa, Bertrand R.; leur contribution dans la collecte des informations sur terrain nous a été d'une grande importance. Nous prions Mr. Jean Marc Duplantier d'accepter nos sincères remerciements pour les aides qu'il nous a fourni sur terrain.

**Bibliographie**
BIODEV 1999. Diagnostic Physico-Bio-Ecologique dans les Réserves Spéciales de Bemarivo, d'Ambohijanahary, de Kasijy et de Maningoza et dans la Réserve Naturelle Intégrale de Namoroka. Rapport de synthèse.
Faramalala, M.H. 1988. Etude de la végétation de Madagascar à l'aide des données spatiales. Thèse de doctorat d'état (Université Paul Sabatier), Toulouse, 167p.
Garbutt, N. 1999. Mammals of Madagascar. Pica Press. Sussex.
Humbert, H.; Darnes, C.G. 1965. Notice de la carte de Madagascar. Mission pondechery. pp: 31-78.
Mittermeier, R.A.; Tattersall, I.; Konstant, W.R.; Meyers, D.M.; Mast, R.B. 1994. Lemurs of Madagascar. Conservation International, Washington, D.C.
Nicoll, M.E.; Langrand, O. 1989. Madagascar: Revue de la conservation et des aires protégées. WWF, Gland.
Perrier de la Bathie. 1921. La végétation malgache. Correspondant institute, 256 p.
Petter, J.-J.; Peyrieras, A. 1970. Observations éco-éthologiques sur les lémuriens malgaches du genre *Hapalemur*. La Terre et la Vie 24: 356-382.

Projet ZICOMA. 1999. Les zones d'importances pour la Conservation des Oiseaux à Madagascar. Projet ZICOMA, Antananarivo, Madagascar, 266 pp.
Tattersall, I. 1982. The Primates of Madagascar. Columbia University Press, New York.
Thalmann, U.; Müller, A.E.; Keloc'h, P.; Zaramody, A. 1999. A visit to the strict Nature Reserve Tsingy de Namoroka (NW Madagascar). Lemur News 4: 16-19.

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

## Observations on *Eulemur macaco macaco* and *Eulemur fulvus fulvus* in the Ramena River Valley, north west Madagascar

In October 1998, during reconnaissance for a planned botanical inventory of the Haut Ramena Classified Forest and the Tsaratanana Reserve, a team of botanists from Missouri Botanical Garden followed the River Ramena from Amboboka, close to its junction with the River Sambirano, to the River Besahona inside Tsaratanana Reserve. On several occasions groups of *Eulemur macaco macaco* (local name – ankomba joby) and *Eulemur fulvus fulvus* (local name – borimihitoko) were seen and on one occasion a confrontation between groups of the two species was observed. Further information on the distribution of these two species in the Ramena Valley was sought by questioning local people. This information together with information on the location of groups that had been observed was used to map the distribution of the two species in the valley (Fig. 1). It would appear that the two species are sympatric along the Ramena Valley except for the western end around Ambokaka and Benavony, where only *E. macaco* is found. *E. macaco* and *E. fulvus* are also reported to be sympatric in the Galoka Mountains and in Manongarivo Special Reserve (8 km north and 25 km south-west of the Ramena Valley respectively) (Harcourt and Thornback 1990).
It is unclear why *E. macaco* is present and *E. fulvus* absent in the west of the Ramena Valley. However, compared to the rest of the valley, the west end has a high human population density and the forest is more degraded, therefore this distribution could be explained if *E. fulvus* is more sensitive to hunting and/or less able to inhabit degraded forest than *E. macaco*. Certainly, lemurs are hunted in the Ramena Valley and, judging by the number of lemur traps observed, this hunting may be intense. Lemur traps were particularly abundant around salty rock pools (fasira) adjacent to the Ramena River where, according to local people, *E. macaco* and *E. fulvus* frequently drink. Alternatively, the absence of *E. fulvus* at the west end of the Ramena Valley could be explained if this species was later at colonising this area than *E. macaco*.

### References

Hartcourt, C.; Thornback, J. 1990. Lemurs of Madagascar and the Comores. The IUCN Red Data Book. IUCN. Gland & Cambridge.

**Chris Birkinshaw, Johny Rabenantoandro, Richard Randrianaivo, Patrice Antilahimena**
Missouri Botanical Garden, Madagascar Research and Conservation Program, BP3391, Antananarivo 101, Madagascar. **birkinsh@mbg.mbg.mg**

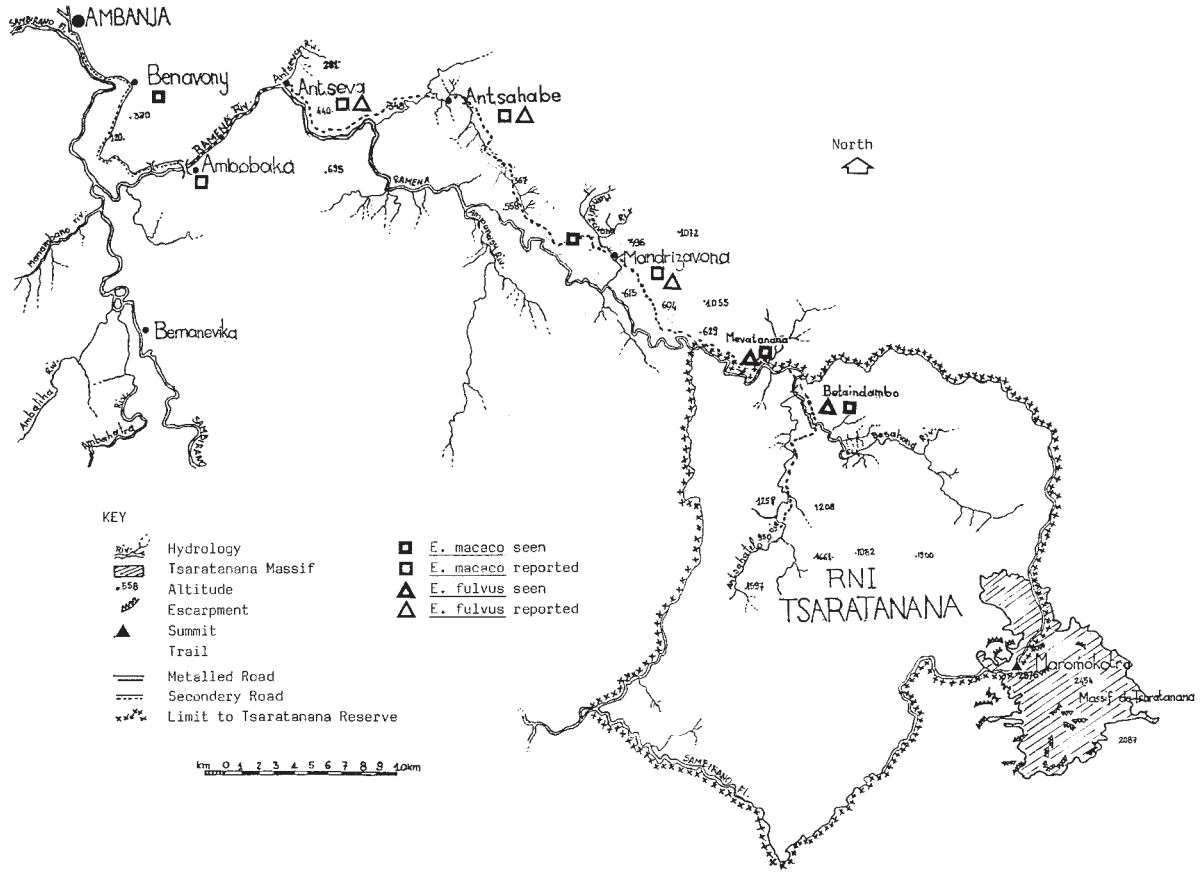


Fig. 1: Distribution of *Eulemur macaco* and *Eulemur fulvus* along the Ramena River Valley.

# Census of Three Eastern Rainforest Sites North of Ranomafana National Park: Preliminary Results and Implications for Lemur Conservation

Madagascar's eastern rainforests have been subjected to extensive destruction in recent historic times, and such destruction continues to occur (Green and Sussman 1990). The thoughtful establishment and management of National Parks and other protected areas is one important part of conservation efforts, but the vulnerable corridors between protected areas should also be assessed and monitored. The size and health of lemur populations in forest corridors hinges both on the extent (and connectivity) of forest cover, and the density of animals therein. Although the first component can be assessed remotely, the second must be ground-truthed.

The 260-km corridor between Ranomafana National Park (RNP) and Analamazaotra Special Reserve is currently the largest continuous stretch of Malagasy rainforest without formal protection (Nicoll and Langrand 1989). The purpose of this study was to directly assess lemur population densities at three study sites within this corridor (Fig. 1). The first two sites are in or near the northern part of RNP (~20 km from the main research station), and the third is approximately 100 km to the north. By seeking contiguous forest of similar structure and health, it was hoped that comparable density estimates could be made (and therefore, the effects of anthropogenic disturbance could be assessed). The three census expeditions took place between 2 June and 23 July 1999.

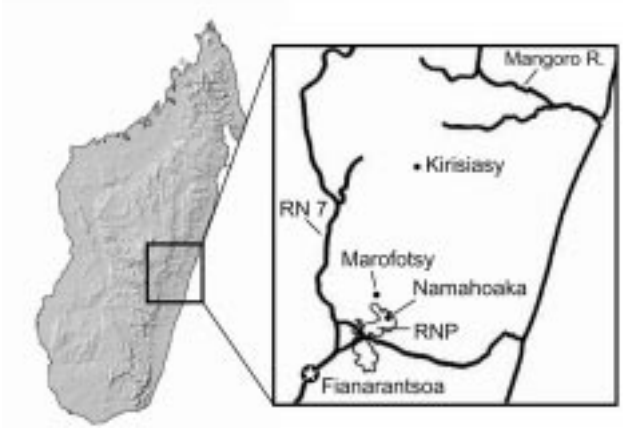


Fig. 1: Survey Locations. RNP: Ranomafana National Park; RN7: Route Nationale # 7.

**Study sites**

(1) Namahoaka: The village of Namahoaka (21°05.25'S, 47°32.75'E) is located 5.5 km SE of Ambohimiera (21°03.00'S, 47°30.50'E), and just north of the northern boundary of RNP. We established camp 3.5 km south of Namahoaka (21°07.49'S, 47°32.31'E, elevation approx. 1100-1200 m), within the Sahasomangana watershed. The site was accessed by driving to Sandrakely (21°06.30'S, 47°38.20'E) and hiking 13 km. This study area is within the northern parcel of RNP (Parcel I).

(2) Marofotsy: The village of Marofotsy (21°00.00'S, 47°29.70'E) is located 6 km NNW of Ambohimiera. We established camp 2.5 km W of Marofotsy (approx. 21°00'S, 47°28'E, elevation approx. 1000-1200 m). The site was accessed by driving to Sandrakely and hiking 22 km. This study area lies just outside RNP's peripheral zone, and is part of contiguous forest.

(3) Kirisiasy: The village of Kirisiasy (20°17.65'S, 47°38.05'E) is located 16 km SE of Miarinavaratra (20°12.90'S, 47°30.00'E) and approximately 75 km northeast of Ambositra. We established camp 6 km east of Kirisiasy (20°17.35'S, 47°41.38'E, elevation approx. 1200-1400 m), in the forest known locally as "Antsaona". The site was accessed by driving through Ambositra, Fandriana, and Miarinavaratra to Ampitsahandakana (20°15.30'S, 47°34.90'E). After crossing the Fisakana river, we hiked 7.5 km to Kirisiasy. This study area is contiguous with forest to the north and south, although our camp was situated in a fairly narrow strip (5-6 km wide). This region is very distant from the nearest protected forests, RNP (approx. 100 km to the south) and Analamazaotra Special Reserve (approx. 160 km to the north). As Kirisiasy is south of the Mangoro and Nosivolo rivers, this study does not address species range extents and hybrid zones. PCW previously conducted a 4-day informal survey of this region in November 1990 (see below).

**Methodology**

*Lemur Species Richness and Density*: At each study site, two 2-km trails were established and censused using standard line-transect census methodology (Struhsaker 1981, Whitesides *et al.* 1988; Johnson and Overdorff 1999). Existing trails were used whenever possible, because of time constraints and in order to minimize forest disturbance. Trails were walked slowly with the assistance of trained research guides from RNP. 19 to 26 diurnal censuses per site were conducted, evenly split between morning (8:00 to 10:00) and afternoon (14:00 to 16:00 / 15:00 to 17:00). In addition, 7 to 8 nocturnal censuses (18:00 to 20:00) per site were conducted. Sample size and summary data (sighting counts and minimum number of groups) are presented in this report (Tab. 1); further data analysis, including density estimates, is currently underway.

*Botanical Assessment*: Five 10 by 100 m botanical transects were established along each 2-km census trail, evenly spaced at 400 m intervals (total = 10 transects per survey site). For all trees over 10 cm diameter at breast height (dbh), the following data were recorded: local name, dbh, height and crown diameter. An additional 5 by 5 m plot was established within each botanical transect, in order to census smaller trees and lianas. This report includes brief qualitative forest assessments; data analysis currently underway will allow quantitative assessments and comparisons.

*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**

A summary of results is presented in Table 1.

Namahoaka: Four diurnal species were seen: *Propithecus diadema edwardsi*, *Eulemur fulvus rufus*, *Eulemur rubriventer* and *Hapalemur griseus*. In addition, *Varecia variegata variegata* was known to our local guides, but according to them, occurred only further south within RNP. *Hapalemur aureus* and *Hapalemur simus* were not reported to exist in the study area. Two nocturnal species were seen: *Microcebus rufus* and *Avahi laniger*. In addition, local guides testified that *Lepilemur microdon* exists in forests to the north. One possible aye-aye trace was found (approx. 1 year old).

Marofotsy: Four diurnal species were seen: *Propithecus diadema edwardsi*, *Eulemur fulvus rufus*, *Eulemur rubriventer* and *Hapalemur griseus*. Local guides reported that *Varecia v. variegata*, *Hapalemur aureus* and *H. simus* did not exist in the study area. Three nocturnal species were seen: *Microcebus rufus*, *Avahi laniger*, and *Lepilemur microdon*.

Table 1: Lemur species richness and abundance at census locations.

| Location: | **Namahoaka** | **Marofotsy** | **Kirisiasy** |
|---|---|---|---|
| Elevation: | 1100-1200 m | 1000-1200 m | 1200-1400 m |
| Sample (diurnal/ nocturnal): | 38.5 km/15.7 km | 52 km/15 km | 37.5 km/11.1 km |
| *Eulemur fulvus rufus* | 2 (2) | 7 (6) | 0 (3) |
| *Eulemur rubriventer* | 7 (3) | 7 (5) | 0 (1) |
| *Hapalemur aureus* | - | - | - |
| *Hapalemur griseus griseus* | 3 (2) | 3 (3) | 0 (1) |
| *Hapalemur simus* | - | - | - |
| *Propithecus diadema edwardsi* | 7 (5) | 9 (5) | 0 (present nearby) |
| *Varecia v. variegata* | - | - | - |
| *Avahi laniger* | 0 (1) | 11 (8) | 2 (3) |
| *Cheirogaleus major* | ? | ? | ? |
| *Daubentonia madagascariensis* | + | - | + |
| *Lepilemur microdon* | - | 3 (2) | 1 (1) |
| *Microcebus rufus* | 3 (2) | 3 (4) | - |
| Hunting | - | + | ++ |
| Census data = # census sightings (minimum # of groups detected in study area); Sightings indicates *group* sightings, not individual sightings | | | |

Kirisiasy: Only one species (*Eulemur rubriventer*) was seen on the census trails. *Eulemur fulvus rufus* exists in the study area, as calls were heard five times in three different places. *Hapalemur g. griseus* also likely exists in the study area, as one brief vocalization was heard, and feeding traces were found. However, the census data suggest that all three species exist at extremely low densities relative to the two other study sites. *Propithecus diadema edwardsi* and *Varecia v. variegata* were not encountered on the census trails, but local guides testified that they do exist in the area. Two nocturnal species were seen: *Avahi laniger* and *Lepilemur microdon*. In addition, local guides testified that *Microcebus rufus* and *Cheirogaleus major* exist in the study area. One aye-aye trace was found.

Because of the paucity of lemurs in the study area, we undertook two additional informal surveys: one south of the study area (approx. 20°19'S, 47°41'E; one survey team for one day) and one south of Kirisiasy (approx. 20°20'S, 47°37'E; two survey teams for one day). No lemurs were encountered on the first survey, although recent feeding traces of *Hapalemur griseus* were found. During the second survey, one team encountered *Propithecus diadema edwardsi*, and the other encountered *Eulemur rubriventer* and found two aye-aye traces (approx. 3 years and 1 year old). Local guides reported that this forest also contains *Eulemur fulvus rufus* and *Hapalemur griseus*, but these species were not seen.

During the brief survey of this region in 1990, PCW detected only *Eulemur fulvus rufus*, *E. rubriventer*, *Cheirogaleus major* and *Avahi laniger*.

Forest Use and Disturbance

Zebu (cattle) were common within the forest at both Namahoaka and Kirisiasy. Their absence in the Marofotsy forest was only because of recent thefts attributed to neighbouring villages.

Several forest trees were found to be exploited for local and regional use. At Namahoaka and Kirisiasy, large Rotra trees (*Eugenia/Syzygium* sp.) were found felled and/or stripped of bark, probably for use in flavoring locally-produced rum (tokagasy). At Namahoaka, three felled Rahiaka trees (*Chrysophyllum* sp.) were found on the census trails. Our local guides explained that this is done to harvest latex, which is used to construct traps which prevent birds (especially the forest fody, *Foudia madagascariensis*) from eating rice shoots (Turk 1995). One felled tree is reported to yield enough latex to fill approximately 10 hollow (Volosy) bamboo poles. It is possible to tap living trees, but felling trees and tapping along their length gives a more rapid yield (standing Rahiaka trees with cut marks were also encountered). This practice is especially disturbing because Rahiaka fruits and seeds are important foods for several birds and lemurs (including *Varecia* and *Propithecus*; Turk 1995). At Marofotsy, four felled Voamboana trees (*Dalbergia* sp.) were encountered on the census trails. At each location, there were two stakes driven into the ground, a discarded club fashioned from a nearby tree, and a great deal of wood debris. Local guides testified that the wood is split using clubs and wedges and stacked against the stakes before removal. *Dalbergia* is a very valuable wood, used extensively in wood carving (Turk 1995). The president and elders of Ambohimiera (the regional capital) were aware of this exploitation, and believed that the people responsible were from the Ambositra region (Ambositra is well-known for its wood carvings). Finally, at Kirisiasy, several large Tambonetra trees (*Tambourissa* sp.) had been felled and used for the production of bee boxes.

Evidence for hunting of lemurs was absent at Namahoaka, but present at Marofotsy and Kirisiasy. Two lemur traps were found at Marofotsy (one box trap and one snare) and five were found at Kirisiasy (all snares). Three snares set for fossa (*Cryptoprocta ferox*) were also encountered at Kirisiasy, two of which were set. At Kirisiasy, we also encountered local people in the forest with handmade blowguns, commonly used to hunt lemurs and/or large birds. Altogether, this evidence suggests that the Kirisiasy forest suffers the greatest hunting pressure, while Marofotsy suffers moderate hunting pressure.

Malagasy travellers were encountered at all three study sites; however, the human presence was noticeably higher at Kirisiasy than at Namahoaka or Marofotsy. Not only were more people encountered travelling through the forest, there was permanent habitation (700 m from our camp we encountered a family living in a house surrounded by rice fields), and several areas of old and new tavy (including one in the process of being cut).

**Discussion**

Four diurnal lemur species (*Propithecus diadema edwardsi*, *Eulemur fulvus rufus*, *E. rubriventer* and *Hapalemur griseus*) were found to exist at or near all three study sites. However, the census data suggest that they exist at much higher densities at Namahoaka and Marofotsy (within or close to RNP) than at Kirisiasy (approx. 100 km away). At Namahoaka and Marofotsy, *Propithecus* seems to exist at highest group densities, *Eulemur* species at medium densities, and *H. griseus* at somewhat lower densities.

*Hapalemur aureus* and *H. simus* were not found at any of the study sites. This supports previous reports (Mittermeier *et al.* 1994) though both species were found recently at Andringitra (Sterling and Ramaroson 1996) that these two species have a very limited distribution and underscores the need for continuing conservation efforts. *Varecia v. variegata* was also not encountered at any of the study sites. Other studies (White *et al.* 1995, Balko 1998) have shown that *Varecia*, as a specialized frugivore, relies more heavily upon primary forest than other eastern rainforest species; their absence in these three study sites may be due to low levels of forest disturbance which were not extreme enough to affect other lemur species. However, hunting pressure may be a more important factor. *Varecia*, weighing 3.5 kg (Smith & Jungers 1997), is larger than any other local lemur species except for *Propithecus*, and their loud territorial calls can be heard for several kilometers. In addition, *Varecia* is less like-

ly than *Propithecus* to be protected by local fady (as at Namahoaka), as they do not have the upright posture typical of *Propithecus* and therefore bear less resemblance to humans or human ancestors. These results support the assertion that, although *Varecia* has a very large geographic extent, its distribution may be highly discontinuous due to the combined effects of forest disturbance and hunting (Mittermeier *et al*. 1994). Great care should be taken in assessing this species' viability, as population estimates based on the size of its geographic range may be gross overestimates.

The nocturnal species *Avahi laniger*, *Lepilemur microdon* and *Microcebus rufus* probably exist at all three study sites, although *Lepilemur* may be absent at Namahoaka and *Microcebus* may be absent at Kirisiasy. *Cheirogaleus major* was not encountered, but this species is known to be inactive during the winter (Mittermeier *et al*. 1994); the lack of sightings therefore does not indicate that it is absent. Feeding traces indicate that aye-ayes (*Daubentonia madagascariensis*) are or have recently been present at Namahoaka and Kirisiasy, although they were not directly observed.

Botanically, the three study sites are very similar in species composition and canopy structure (further quantitative analyses may show subtle inter-site differences), and all were within continuous forest of reasonably large area. The bamboo species composition varied considerably between study sites; the lack of volosy bamboo at all three study sites may account for the absence of *Hapalemur aureus* and/or *H. simus* (Tan 1999). The presence of many common lemur foods, such as *Bakerella*, *Canarium madagascariensis*, *Chrysophyllum*, *Cryptocarya*, *Dombeya*, *Eugenia* (*Syzygium*), *Ficus*, *Ocotea*, and *Polyscias* at all three sites suggests that these forests are suitable lemur habitat.

However, of the three study sites examined, Kirisiasy seems to have experienced the most human disturbance. There was much more evidence of recent and current deforestation at Kirisiasy than at the other sites, as well as intense hunting and generally, more human presence. Because the Kirisiasy forest appears, based on qualitative assessments, to be botanically capable of supporting lemur populations, the extremely low lemur densities found there may be due to the effects of intense hunting and disturbance. This is much the same as the general impression of the 1990 survey, implying that these disturbing trends have been ongoing for some time.

Further surveys of corridor forests outside protected areas will be crucial in determining whether Kirisiasy is an exception, or the rule. If such disturbance and hunting is common, and lemurs exist at such low densities throughout the eastern rainforest, estimates of population size and genetic continuity will have to be adjusted accordingly. It is our hope that such surveys (in this and other forest corridors) will continue, and that these questions can be addressed. Currently, the 260 km corridor between Ranomafana and Analamazaotra is the largest continuous stretch of unprotected Malagasy rainforest (Nicoll and Langrand 1989); we recommend that the establishment of a special reserve or national park in this area should be made a priority.

Surveys such as this one should serve to temper the enthusiasm associated with successful parks and ecotourism regimes, such as Ranomafana. While these successes are crucial, it is important to persevere in the implementation of effective *regional* conservation plans which include (geographically) comprehensive assessments of species and ecosystem viability (see Goodman 1999). Otherwise, parks like Ranomafana will become biogeographic islands within a biogeographic island.

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**References**

Balko, E. 1998. The behavioral plasticity of *Varecia variegata* in Ranomafana National Park, Madagascar. PhD dissertation, Syracuse University, Syracuse, NY.

Goodman, S. 1999. Biological inventories of forest fragments and forest corridors in eastern and central Madagascar. Lemur News 4: 28-29.

Green, G.M; Sussman, R.W. 1990. Deforestation history of the eastern rain forests of Madagascar from satellite images. Science 248: 212-215.

Johnson, S.E.; Overdorff, D.J. 1999. Census of brown lemurs (*Eulemur fulvus* spp.) in southeastern Madagascar: Methods-testing and conservation implications. Amer. J. Primatol. 47: 51-60.

Mittermeier, R.A.; Tattersall, I.; Konstant, W.R.; Meyers, D.M.; Mast, R.B. 1994. Lemurs of Madagascar. Conservation International, Washington D.C.

Nicoll, M.E.; Langrand, O. 1989. Madagascar: Revue de la conservation et des Aires Protégées. WWF, Gland.

Smith, R.J.; Jungers, W.L. 1997. Body mass in comparative primatology. J. Hum. Evol. 32: 523-59.

Sterling, E.J.; Ramaroson, M.G. 1996. Rapid assessment of primate fauna of the eastern slopes of the RNI d'Andringitra, Madagascar. Pp. 293-305 in S. M. Goodman (ed.). A floral and faunal inventory of the eastern side of the Reserve Naturelle Intégrale d'Andringitra, Madagascar: with reference to elevational variation, Fieldiana: Zoology, Vol. 85. Field Museum Natural History, Chicago.

Struhsaker, T.T. 1981. Census methods for estimating densities. In: Techniques for the Study of Primate Population Ecology. National Academy Press. Washington D.C.

Tan, C. 1999. Group composition, home range size, and diet of three sympatric bamboo lemur species (genus *Hapalemur*) in Ranomafana National Park, Madagascar. Int. J. Primatol. 20: 547-566.

Turk, D. 1995. A Guide to Trees of Ranomafana National Park and Central Eastern Madagascar. Missouri: Missouri Botanical Garden.

White, F.J.; Overdorff, D.J.; Balko, E.A.; Wright, P.C. 1995. Distribution of ruffed lemurs (*Varecia variegata*) in Ranomafana National Park, Madagascar. Folia Primatol. 64: 124-131.

Whitesides, G.H.; Oates, J.F.; Green, S.M.; Kluberdanz, R.P. 1988. Estimating primate densities from transects in a West African rain forest: A comparison of techniques. J Anim. Ecol. 57: 345-367.

**Mitchell T. Irwin, Tanya M. Smith, and Patricia C. Wright**

Interdepartmental Doctoral Program in Anthropological Sciences and Department of Anthropology, SUNY at Stony Brook, Stony Brook, NY 11794-4364, USA.

**mirwin@ic.sunysb.edu**

# Preliminary Study of the Conservation Status of Lemur Communities in the Betsakafandrika Region of Eastern Madagascar

Regions where lemur subspecies are sympatric or hybridize are of great interest to scientists and conservation authorities. If two subspecies of lemur are sympatric and do not interbreed, then both may warrant recognition at the species level. Such taxonomic changes have important implications for conservation authorities. If the lemur subspecies interbreed, then they form a hybrid zone. There are, however, few published accounts of primate hybrid zones, and only two for lemurs (Meyers *et al.* 1989; Sterling and Ramaroson 1996; S. Johnson, pers. com.). Preliminary surveys by Goodman and Schütz (1999) north of the Onive River at Mahatsinjo forest observed the nominate form of diademed sifakas (*Propithecus diadema diadema*) nearly daily and no Milne-Edward's sifakas (*P. d. edwardsi*). However, the possibility of a sifaka hybrid zone in the region was suggested by a recent Duke expedition that captured two females and a male sifaka (K. Glander, pers. comm.). Rakotondraparany (1997) suggested that there may be a hybrid zone between common brown lemurs (*Eulemur fulvus fulvus*) and red-fronted brown lemurs (*E. f. rufus*) in his survey between Tsinjoarivo and Ambatolampy, while Goodman and Schütz (1999) observed only *E. f. fulvus* at both Mahatsinjo and Anilahila.

Survey data in the Onive River basin are also of interest because it has been suggested that this river limits the range of Indri (*Indri indri*), two subspecies of brown lemur (*E. f. fulvus* and *E. f. rufus*), red-bellied lemurs (*Eulemur rubriventer*), and *P. d. diadema* and *P. d. edwardsi* (e.g., Tattersall 1982; Mittermeier *et al.* 1994; Garbutt 1999; Goodman and Schütz 1999). Although surveys have been conducted north of the Onive River (Goodman and Schütz 1999) and 35 km south of the Onive River (Irwin *et al.*, this volume), there are few data on lemur communities in the forest region immediately south of the Onive River. Given the seemingly conflicting status of the Onive River as either an area of lemur sympatry/hybridization or barrier to lemur distribution, survey data are needed to help resolve some of the issues associated with this region.

The goal of our project was to determine the community structure of primates in forests south of the Onive River. Specifically, we wanted to: (1) document the diversity of sifakas and other lemurs and (2) determine if there are hybrid zones or areas of sympatry for *P. d. diadema* and *P. d. edwardsi* as well as other lemur species.

## Methods

We conducted surveys from October 19 to November 3 1999 in the Betsakafandrika region of eastern Madagascar (Fig. 1). The Betsakafandrika region lies between the Onive and Nosivolo Rivers, and is located approximately 25 km NW of Marolambo. Steep mountainous slopes, many of which exceed 45°, and deep gorges, characterize this region. A narrow logging road along the west bank of the Impotaka River descends from the central high plateau down to the village of Ambinanindrano (19°54'26"S, 47°45'58"E, elevation 868 m). This village is located near the confluence of the Impotaka and Manorika Rivers and served as a base for lemur surveys.

Two camps were established in forests slopes above Ambinanindrano. Camp Jangajilo (19°54'22"S, 47°47'15"E, 1277 m elevation) was set up along the southern flank of Mt. Jangajilo, 2.2 km NE of the village. Two transects were established at Camp Jangajilo. Transect 1 ran 1.5 km at 53? from Camp Jangajilo along the east slopes of Mt. Jangajilo.

Fig. 1: Locations of study sites in Betsakafandrika Region of eastern Madagascar.

Transect 2 (2.0 km) ran 220° from the camp along the south ridge of the mountain. Surveys along these transects revealed extensive forest destruction and many lemur traps (Lehman and Wright, in prep). Because of these perturbations, we decided to limit surveys at Camp Jangajilo to only 4 days (Oct 22-25 1999) and focus on locating less disturbed habitats on the opposite side of the valley. The second camp, Bezavona (19°55'02"S, 47°45'21"E, 1223 m elevation), was located 1.6 km south of Ambinanindrano. Three 2.0 km transects were established at Camp Bezavona: transect 3 ran 310° from Camp Bezavona; transect 4 (271° from the camp) traversed a mountainous ridge SW of the camp; and transect 5 ran south along the eastern slopes of Mt. Sahanamanika.

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 (0800-1100 hours and 1400-1700 hours). Only one night survey, along transect 3, could be conducted due to torrential evening rain showers as well as extremely steep and muddy slopes. The following data were collected whenever a lemur group was seen: date, time, transect number, participants, latitude/longitude/elevation using a Garmin GPS 12, 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. We noted lemur groups sighted during travel to and from the camps. Contact was maintained with all lemur groups for as long as possible to determine species and subspecies identification. Species and subspecies characteristics described in Mittermeier *et al.* (1994) and Garbutt (1999) were used for field identifications. No animals were captured. Density estimates were not made because the number of census walks was low (Whitesides *et al.* 1988). Following Schmid and Smolker (1998), the number of lemur groups per kilometer censused were calculated for each species or subspecies sighted during surveys.

## Results

Table 1 shows the number of primate groups and the sighting rates for each species or subspecies sighted during surveys. A total of 28 primate groups were seen during surveys at Camp Jangajilo (N= 1 group) and Camp Bezavona (N= 27 groups). Notes and observations for each species or subspecies are given below.

*Cheirogaleus major*: Four individuals were observed during the night survey at Camp Bezavona. Local people did not recognize pictures of this primate.

*Daubentonia madagascariensis* were not observed during surveys. Bite marks (all less than 2 weeks old) on vines and tree stumps were found along transects at both camps. Local guides recognized pictures of this species and reported that the animals were killed if they were found near the village.

Table 1. Number of primate species sighted and sighting rates (groups sighted/km) along five transects in the Betsakafandrika Region of eastern Madagascar.

| | Number of groups sighted | | | | | | |
|---|---|---|---|---|---|---|---|
| **Species** | **Transect 1** | **Transect 2** | **Transect 3** | **Transect 4** | **Transect 5** | **Total** | **Sighting Rate** |
| *Cheirogaleus major* | 0 | 0 | 0 | 4 | 0 | 4 | 2,00[a] |
| *Eulemur fulvus fulvus* | 0 | 0 | 0 | 0 | 4 | 4 | 0.10 |
| *Eulemur fulvus* hybrid? | 0 | 0 | 0 | 2 | 0 | 2 | 0.05 |
| *Eulemur rubriventer* | 1 | 0 | 1 | 4 | 5 | 11 | 0.25 |
| *Microcebus rufus* | 0 | 0 | 0 | 7 | 0 | 7 | 3.50[a] |
| Total Nocturnal | 0 | 0 | 0 | 11 | 0 | 11 | 5.50[a] |
| Total Diurnal | 1 | 0 | 1 | 6 | 9 | 17 | 0.43 |
| Census distance (m) | 1,500 | 4,0000 | 10,000 | 12,000 | 12,000 | 39,500 | |
| [a] = Sighting rate based on one night census of transect 4 | | | | | | | |

*Eulemur fulvus fulvus* were not seen during surveys at Camp Jangajilo but four groups were censused along transects at Camp Bezavona. Group size ranged from 4-5 individuals, composed of 1-2 males and 2-4 females (Table 2). Each group also contained one infant, which was observed to ride dorsally on a female. Local guides informed us that this species was the most common one among the local lemur community.

Table 2: Size and composition of *Eulemur* groups seen during surveys in the Betsakafandrika Region of eastern Madagascar.

| | **N** | **Mean±SD** | **Range** | **Adult Males** | **Adult females** | **Adult females with infants** |
|---|---|---|---|---|---|---|
| *Eulemur f. fulvus* | 3 | 5.3 ± 0.6 | 5-6 | 1-2 | 2-4 | 1 |
| *Eulemur rubriventer* | 11 | 3.7 ± 1.1 | 3-5 | 1-3 | 1-3 | 0-1 |
| *Eulemur fulvus* hybrid? | 2 | 4.5 | 4-5 | 2 | 1 | 1,2 |

*Eulemur fulvus* hybrid: Two groups of what appeared to be a hybrid form of *E. f. fulvus* and *E. f. rufus* were observed at Camp Bezavona (Table 2). The body pelage of both the males and females was a light rufus color, easily distinguishable from the brown to the gray-brown color of *E. f. fulvus* seen in the area, but lighter in color than that seen in *E. f. rufus*. The coat of male *E. f. fulvus* and *E. f. rufus* is brown to gray (Mittermeier *et al.* 1994; Garbutt 1999). The black facial and head fur of these males was similar to that seen in *E. f. fulvus*, but the collar resembled that of *E. f. rufus*, being considerably fuller and whiter. None of the animals had red crowns, as in *E. f. rufus*. The males and females also had white eye patches similar to but slightly lighter in color than those seen in common brown lemurs. None of the *E. f. fulvus* seen in the area had discernible eye patches, as had been suggested by Mittermeier *et al.* (1994).

*Eulemur rubriventer*: A total of eleven groups of this species were seen during surveys at Camp Jangajilo (N=1 groups) and Camp Bezavona (N=10 groups). Group size ranged from 2-5 individuals, and was composed of 1-3 males and 1-3 females (Table 2). One female in the group from Camp Jangajilo and a female in each of the nine groups from Camp Bezavona carried an infant. The infants were estimated to be at least three weeks old due to their size and position on the females (riding dorsally). The body pelage of the male *E. rubriventer* at both camps was a darker brown and the under-eye spots whiter than for conspecifics at Ranomafana National Park.

*Hapalemur aureus*: The highly distinctive loud call of this species was heard by Rajeriarson Emile, Ratsimbazafy Raymond, and Solo Justin at 0510 hours on 10/24/99 approximately 50m from Camp Jangajilo. These guides have extensive experience working with *H. aureus* in Ranomafana National Park . Most bamboo patches near the camp had fresh signs of feeding by *H. aureus*. Although local people reported frequent sightings of bamboo lemurs, they could not distinguish between pictures of *H. aureus* and eastern grey bamboo lemurs (*Hapalemur griseus griseus*).

*Hapalemur griseus griseus*: There were no sightings of this species. However, fresh remains of feeding bouts by *H. g. griseus* were found in many of the bamboo patches near both camps as well as along the road to Ambinanindrano.

*Microcebus rufus* were seen frequently (N=7 individuals) during the one night survey. Local people reported that this species is abundant throughout the region.

## Discussion

Although we did not census sportive lemurs (*Lepilemur*) and eastern woolly lemurs (*Avahi laniger*), it is possible that they exist in the region and were not seen due to limited night surveys (N=1 night). The composition of the lemur community in Betsakafandrika is broadly similar to that seen by Goodman and Schütz (1999) north of the Onive River and by Irwin and colleagues (this volume) SW of Marolambo, with a few notable and important exceptions (Table 3). *P. d. diadema* were seen at the sites north of the Onive River (Goodman and Schütz 1999) but absent in forests south of the Onive River (this study, Irwin *et al.*, this volume). *P. d. edwardsi* were not seen during the present study and only once by Irwin *et al.* (this volume). Local guides for both studies reported that *P. d. edwardsi* exist in the areas. None of the people from Ambinanindrano described *fady* (taboos) against hunting lemurs.

Table 3: Species composition of lemur communities at five sites in eastern Madagascar.

| **Species** | **Bezavona** | **Jangajilo** | **Mahatsinjo** [1] | **Ankilahila** [1] | **Kirisiasy** [2] |
|---|---|---|---|---|---|
| *Avahi laniger* | ? | ? | + | - | + |
| *Cheirogaleus major* | + | ? | + | + | ? |
| *Daubentonia madagascarsiensis* | + | + | - | + | + |
| *Eulemur fulvus fulvus* | + | - | + | + | - |
| *Eulemur fulvus rufus* | - | - | - | - | + |
| *Eulemur fulvus* hybrid? | ? | - | - | - | - |
| *Eulemur rubriventer* | + | + | - | + | + |
| *Hapalemur aureus* | - | ? | - | - | - |
| *Hapalemur griseus griseus* | + | + | + | + | + |
| *Hapalemur sinus* | - | - | - | - | - |
| *Lepilemur mustelinus* | ? | ? | + | + | + |
| *Microcebus rufus* | + | ? | + | + | ? |
| *Propithecus diadema diadema* | - | - | + | + | - |
| *Propithecus diadema edwardsi* | - | - | - | - | + |
| *Varecia variegata variegata* | - | - | ? | ? | ? |
| Total | 6 | 3 | 7 | 8 | 7 |
| Sources of Information: [1] Goodman and Schütz (1999), [2] Irwin *et al.* (this volume) | | | | | |

The presence of the *E. f. fulvus* in the Betsakafandrika region is noteworthy. The Onive River has been suggested to form the southern limit to the geographic distribution of *E. f. fulvus* (Tattersall 1982; Mittermeier *et al.* 1994; Garbutt 1999). These sightings of *E. f. fulvus* at Camp Bezavona extend the southern range for this subspecies across the Onive and Manorika Rivers.

Sightings of what appears to be a hybrid form of *E. f. fulvus* and *E. f. rufus* may represent only the third documented hybrid zone for lemurs. The other lemur hybrid zones are for black lemurs (*Eulemur macaco macaco*) and Sclater's black

lemurs (*E. m. flavifrons*) near Maromandia in NW Madagascar (Meyers *et al.* 1989), and a hybrid form of *E. f. albocollaris* and *E. f. rufus* NE of Andringitra National Park (Sterling and Ramaroson 1996; Johnson and Wyner, in prep.). Although it has been suggested that hybrid forms of *E. f. fulvus* may exist in eastern Madagascar (Mittermeier *et al.* 1994), the Mangoro and Onive Rivers were thought to separate *E. f. fulvus* and *E. f. rufus*. Based on the surveys we conducted in the Betsakafandrika region, the Onive River may not serve as an effective barrier to dispersal for *E. f. fulvus*, and this subspecies may have hybridized with *E. f. rufus*.

Perhaps the most important finding made during the project was the possible presence of *H. aureus* in the survey region. The critically endangered *H. aureus* is known to occur only in Ranomafana and Andringitra National Parks (Wright *et al.* 1987; Meier *et al.* 1987; Meier and Rumpler 1987; Ganzhorn *et al.* 1996/1997; Sterling and Ramaroson 1996; Tan 1999). The lack of sightings during our surveys is not surprising given the cryptic and shy nature of *H. aureus* (Wright and Randriamanantena 1989). Steig Johnson (in prep.) on 22-27 replicates of three transect walks (0.775-2.5 km) at Andringitra National Park sighted *H. aureus* only once on a transect; yet, he observed them frequently when doing all-day follows of *Eulemur*. The conservation status of this population cannot be ascertained at this time. Therefore, the Betsakafandrika region requires immediate attention from conservation authorities and forest managers because it represents only the third reported natural hybrid zone for lemurs and may contain a population of *H. aureus*.

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**Bibliography**

Ganzhorn, J.U.; Langrand, O.; Wright, P.C.; O'Connor, S.O.; Rakotosamimanana, B.; Feistner, A.T.C.; Rumpler, Y. 1996/1997. The state of lemur conservation in Madagascar. Primate Cons. 17: 70-86.

Garbutt, N. 1999. Mammals of Madagascar. Pica Press, Sussex.

Goodman, S.; Schütz, H. 1999. Observations of lemurs in the forest east of Tsinjoarivo, Ambatolampy. Lemur News 4: 14-16.

Irwin, M.T.; Smith, T.M.; Wright, P.C. 2000. Census of three eastern rainforest sites north of Ranomafana National Park: Preliminary results and implications for lemur conservation. Lemur News 5.

Johnson, S.E.; Overdorff, D.J. 1999. Census of brown lemurs (*Eulemur fulvus* spp.) in Southeastern Madagascar: Methods-testing and conservation implications. Amer. J. Primatol. 47: 51-60.

Meier, B.; Albignac, R.; Peyrieras, A.; Rumpler, Y.; Wright, P. 1987. A new species of *Hapalemur* (Primates) from southeast Madagascar. Folia Primatol. 48: 211-215.

Meier, B.; Rumpler, Y. 1987. A preliminary survey of *Hapalemur simus* and a new species of Hapalemur in Eastern Betsileo, Madagascar. Primate Cons. 8: 40-43.

Meyers, D.; Rabarivola, C.; Rumpler, Y. 1989. Distribution and conservation of Sclater's lemur: implications of a morphological cline. Primate. Cons. 10: 78-82.

Mittermeier, R.A.; Tattersall, I.; Konstant, W.R.; Meyers, D.M.; Mast, R.B. 1994. Lemurs of Madagascar. Conservation International. Washington, DC.

Rakotondraparany, F. 1997. Inventaire faunistique de la Foret Naturelle de Tsinjoarivo-Ambatolampy. Projet de Developpement Forestier Intégré dans la region du Vakinankaratra. GTZ, Antananarivo.

Schmid, J.; Smolker, R. 1998. Lemurs of the Reserve Speciale d'Anjanaharibe-Sud, Madagascar. In Goodman S.M. (ed.) A Floral and Faunal Inventory of the Reserve Speciale d'Anjanaharibe-Sud, Madagascar: With Reference to Elevational Variation. Fieldiana: Zoology, new series 90: 227-238.

Sterling, E.J.; Ramaroson, M.G. 1996. Rapid assessment of the primate fauna of the eastern slopes of the Reserve Naturelle Intégrale d'Andringitra, Madagascar. In Goodman S.M. (ed.) A Floral and Faunal Inventory of the Eastern Slopes of the Reserve Naturelle Intégrale d'Andringitra, Madagascar: With Reference to Elevational Variation. Fieldiana: Zoology, new series 85: 293-305.

Tan, C. 1999. Group composition, home range size, and diet of three sympatric bamboo lemur species (Genus *Hapalemur*) in Ranomafana National Park, Madagascar. Int. J. Primatol. 20: 547-566.

Tattersall, I. 1982. The Primates of Madagascar. Columbia University Press. New York.

Whitesides, G.H.; Oates, J.F.; Green, S.M.; Kluberdanz, R.P. 1988. Estimating primate densities from transects in a West African rain forest: A comparison of techniques. J. Anim. Ecol. 57: 345-367.

Wright, P.C., Randriamanantena, M. 1989. Comparative ecology of three sympatric bamboo lemurs in Madagascar. Amer. J. Phys. Anth. 78: 327.

Wright, P.C.; Daniels, P.S.; Overdorff, D.J.; Meyers, D.M.; Rabasoa, B. 1987. A census and study of *Hapalemur* and *Propithecus* in southeastern Madagascar. Primate Cons. 8: 84-88.

**Shawn M. Lehman and Patricia C. Wright**

Department of Anthropology & Institute for the Conservation of Tropical Environments, SUNY-Stony Brook, Stony Brook, NY 11794-4364, **slehman@notes.cc.sunysb.edu**

## Notes on the Biogeography of *Eulemur fulvus albocollaris*

The brown lemur (*Eulemur fulvus*) is among the most widespread of the Malagasy lemurs (Jolly 1986; Mittermeier *et al.* 1994). However, this diverse species has several threatened subspecies, including the white-collared lemur (*E. f. albocollaris*) (Harcourt and Thornback 1990). The population densities of *E. f. albocollaris* appear to be low in several sites relative to neighboring brown lemur subspecies (Johnson and Overdorff 1999). Moreover, this subspecies maintains a highly restricted range in southeastern Madagascar (Tattersall 1982). Like all lemurs, these populations are threatened primarily by the conversion of suitable habitats into agricultural land (Jolly 1986; Harcourt and Thornback 1990), potentially exacerbated locally by selective logging and hunting practices (Harcourt and Thornback 1990; Johnson and Overdorff 1999).

Also like most lemurs, the range limits of *E. f. albocollaris* are not entirely resolved. Many earlier reports indicate the subspecies is restricted to the eastern rain forest corridor, from the Faraony River in the north (bordered by *E. f. rufus*)

to the Mananara River in the south (bordered by *E. f. collaris*) (e.g. Tattersall 1982). However, more recent authors cite the Manampatrana River (approximately 150 km south of the Faraony) as the northern limit (Mittermeier *et al.* 1994). Tattersall (pers. comm. to P.C. Wright) notes that the provenance of museum specimens is often unclear.

The lack of precise data on distribution is confounded by uncertainty over *E. f. albocollaris*' taxonomy. Recent evidence from cytogenetic and mtDNA analyses indicate that *E. f. alobocollaris* (as well as *E. f. collaris*) should be reclassified as separate species (Djlelati *et al.* 1997; Wyner *et al.* 1999). However, fertile hybrid offspring are reported from crosses between northern *E. fulvus* subspecies and *E. f. collaris* and *E. f. albocollaris* (Rumpler *et al.* 1985; D. Harring, DUPC records, pers. comm.), although *E. f. albocollaris* X *E. f. collaris* hybrids are sterile (Dutrillaux and Rumpler 1977). Furthermore, during the 1993 inventory of Andringitra National Park, Sterling and Ramarason (1996) observed apparent *E. fulvus* hybrids. Based on pelage characteristics, they suggested there could be interbreeding between *E. f. rufus*, *E. f. collaris*, and *E. f. albocollaris*, with the latter being more prevalent in the population (Sterling and Ramarason 1996). It should be noted that the various lines of evidence from the laboratory and the field are not necessarily contradictory. The existence of natural hybridization does not necessarily indicate conspecificity. Even partial reproductive impairment or reduced fitness in hybrids may limit gene flow and maintain the overall separation of parental populations. As such, the extent and dynamics of natural hybridization are often the definitive indicators of species-level classifications in many species concepts (Godfrey and Marks 1991).

In this report, we present data collected during censuses in the Manampatrana River region to help clarify the distribution of *E. f. albocollaris*. Moreover, we present a summary of the genetics of these populations, indicating hybridization at the subspecies boundary.

## Methods

### Research Sites

Census data were collected from June-July 1997, and April-September 1999. Rapid assessments of *E. f. albocollaris* (and hybrid) populations were conducted in 1997 at Vevembe (22º47'44"S, 47º11'19"E), Evendra (22º26'7"S, 47º13'46"E), and Korokoto (22 11' 44"S, 47 1' 57"E). More extensive censuses were conducted in 1999 in two sites in Andringitra National Park (22º13'8"S, 47º1'11"E).

The Manampatrana River orignates in the Andringitra Mountains. At this point it is known locally as the Iantara River. It flows south through Andringitra National Park and exits the eastern forest corridor just northeast of Ivohibe. Near Maropaika, the Manapatrana turns east, bisecting the forest corridor before terminating at the Indian Ocean at Farafangana. Vevembe is south of the Manampatrana and west of Vondrozo, in the center the corridor and of *E. f. albocollaris*' range. Evendra is east of the river (where the river flows north-south), due west of Karianga and roughly 30 km southeast of Andringitra National Park. Thus, Evendra is north of where the Manampatrana could form the northern boundary of *E. f. albocollaris* (e.g., Mittermeier *et al.* 1994).

The remaining sites are located in the Andringitra National Park region. Korokoto lies at the northeast boundary of the park. Moreover, this location is at the headwaters of the Manampatrana. Two small rivers (the Korokoto and the Iantara) converge at this site to form an effective barrier to lemur dispersal. Thus, Korokoto likely lies at the center of migration for populations from the east and west banks of the Manampatrana (known locally as the Iantara). The two 1999 survey sites are located on opposite banks of the Iantara, downstream from Korokoto. The main site, Ambarongy, is on the eastern bank, 3.2 km from Korokoto; an additional survey area was established 3.3 km from Korokoto on the western bank, inside the reserve (the "Parc" site).

### Census Methods

Populations were estimated using transect methods (Struhsaker 1981; Brockelman and Ali 1987; Chapman *et al.* 1988; Whitesides *et al.* 1988). Topography and time considerations precluded straight compass-line transects; moreover, we wanted to limit the impact on the habitats caused by the cutting of new trails. Consequently, we used existing trail systems (where present) that traversed various microhabitats and altitudes. In rapid assessment sites (Vevembe, Evendra, and Korokoto), transects were 3 km in length and were surveyed 4-6 times (Tab. 1). While such brief censuses are far from ideal, test transects using identical methods obtained reasonably accurate estimates for *E. fulvus* (Johnson and Overdorff 1999). At Ambarongy, three transects were established, ranging in length from 0.775 km-2.5 km; each was surveyed 22-27 times; at the Parc site, a 2.375 km transect was surveyed 10 times (Tab. 1). Densities of individuals were obtained using both perpendicular animal-transect (PE) and observer-animal (OA) distances; the histogram inspection technique was used to calculate transect width, with a 50% criterion for fall-off distance (see Whitesides *et al.* 1988).

Table 1: Transects, number of individuals samples for genetic analyses, individual densities (per ha), based on estimates obtained from perpendicular animal-transect (PE) and observer-animal (OA) distances.

| Site | Individuals Sampled for Genetic Analyses | Transect Length [km] | Number of Surveys | PE±SDE | OA |
|---|---|---|---|---|---|
| Vevembe | 11 | 3.0 | 4 | 0.32±0.10 | 0.23±0.07 |
| Evendra | 4 | 3.0 | 5 | | |
| Korokoto | 5 | 3.0 | 6 | 0.28±0.10 | 0.20±0.07 |
| Ambarongy A | | 2.5 | 27 | 0.76±0.12 | 0.55±0.09 |
| Ambarongy B | | 0.775 | 22 | 0.65±0.25 | 0.47±0.18 |
| Ambarongy C | | 0.875 | 25 | 0.37±0.13 | 0.27±0.09 |
| Ambarongy (Total) | 12 | | | 0.66 | 0.48 |
| Parc | 4 | 2.375 | 10 | 0.13±0.83 | 0.09±0.06 |

### Genetic sampling

*E. fulvus* individuals were captured in each site to obtain blood samples. Capture methods followed Glander *et al.* (1992). Sample sizes are included in Table 1. Previously collected samples of *E. f. albocollaris* and *E. f. rufus* were also included in the analysis to determine subspecific markers (see Wyner *et al.* 1999; Wyner *et al.* MS.). We sequenced both mitochondrial and nuclear markers. These sequences were used to develop diagnostic sites, private sites, and private alleles for *E. fulvus* parental and hybrid populations. More details of genetic analyses are presented elsewhere (Wyner *et al.* MS.).

## Results

### Population Estimates

Results from rapid assessments at Vevembe, Korokoto, and Ambarongy are presented in Table 1. Generally, estimated densities were high relative to other southeastern *E. fulvus* sites (Johnson and Overdorff 1999; but see Sterling and Ramarason (1996) for comparable estimates from Andringitra). In addition, populations at Vevembe were larger than previously reported (Johnson and Overdorff 1999). *E. fulvus* was most numerous at Ambarongy (PE=0.66 individuals/ha; OA=0.55 individuals/ha). Although, animals were sighted (and captured) at Evendra, no *E. fulvus* individuals were sighted during transect surveys. Densities were also relatively low at the Parc site (PE=0.12 individuals/ha; OA=0.09 individuals/ha). These results demonstrates potential local

heterogeneity, as this site is only 3.3 km from Korokoto and 0.2 km from Ambarongy (although the Iantara River divides the sites, and therefore the dispersal distance between *E. fulvus* groups from the two sites – via Korokoto – is 6.5 km).

Genetic Sampling

The genetics of the southeastern *E. fulvus* populations are presented in greater detail elsewhere (Wyner *et al.* 1999; Wyner *et al.* MS.). However, we summarize the results here to demonstrate aspects relevant to the biogeography of *E. f. albocollaris*.

All individuals sampled from Vevembe contain the diagnostic markers for *E. f. albocollaris*. This site lies in the center of the contiguous portion of *E. f. albocollaris*' range. In addition, all Evendra individuals possess the diagnostics for *E. f. albocollaris*. This result unambiguously shifts the northern boundary for *E. f. albocollaris* to north of the Manampatrana River (contra Mittermeier *et al.* 1994). In contrast, most individuals from the three sites in the Andringitra region demonstrate genetic characteristics of both *E. f. albocollaris* and *E. f. rufus*. In addition, some of the individuals contain mitochondrial and nuclear markers found only in the hybrid population. Three individuals from the Ambarongy site have only *E. f. albocollaris* markers and do not have any *E. f. rufus* markers. It should be noted however, that these three individuals resemble other hybrids more than they resemble pure *E. f. albocollaris* populations elsewhere.

**Discussion**

This study serves to confirm the presence of *E. f. albocollaris* north of the Manampatrana River in the eastern rain forest corridor of Madagascar. Moreover, the existence of both *E. f. rufus* and *E. f. albocollaris* genetic markers in most individuals from Andringitra confirms the hybrid zone in this area originally suggested by Sterling and Ramarason (1996).

Based on the location of dividing rivers, the Korokoto site likely lies at the center of the zone. The zone extends at least 3.2 km along both banks of the Iantara, and more likely beyond that (due to the widespread hybridization in the area sampled). The presence of only pure *E. f. albocollaris* at Evendra suggests the contact zone does not extend to this forest 30 km to the southeast (however, sampling was limited at this site). The zone is undoubtedly formed by *E. f. albocollaris* populations originating in the corridor south of Andringitra. There are no known natural barriers dividing the zone from apparently pure *E. f. albocollaris* populations at Evendra.

The migration vectors for *E. f. rufus* populations into the zone may be more complex. At Pic d' Ivohibe Special Reserve (directly south of Andringitra, but west of the Iantara/Manampatrana River) *E. f. rufus* is reportedly the only brown lemur subspecies present (Mittermeier *et al.* 1994). This area is likely a source for *E. f. rufus* populations entering the zone, as the two reserves are joined by a continuous forest corridor. Moreover, the hybrids on the western bank of the Iantara resemble *E. f. rufus* in phenotype more than individuals on the opposite bank. However, an additional forest corridor extends from Andringitra to the northeast. *E. f. rufus* exists further north in this corridor (e.g., Ranomafana National Park). Therefore, this corridor may also be a source for *E. f. rufus* gene flow into the contact zone. Unfortunately, it is not currently known if *E. f. rufus* populations from this region extend as far south as the Andringitra region. Indeed early distribution maps indicate *E. f. albocollaris* as far north as the Faraony River (just south of Ranomfana). If this is the case, the zone is formed by an isolated western *E. f. rufus* population. Census and genetic sampling research is currently underway to help clarify which *E. fulvus* subspecies occupies the Ranomafana-Andringitra corridor.

To understand the dynamics of the hybrid zone, further research is critical. However, some preliminary evidence presented here will be useful for indicating directions of future research. For example, *E. fulvus* population densities in the hybrid zone appear to be much greater than in other eastern rain forests. Moreover, the presence of novel alleles restricted to the hybrid zone may indicate that the zone is relatively old and gene flow from the zone outward may be restricted. Furthermore, the zone is relatively large, extending at least 6.5 km (and likely much further). As noted, there are also no apparent geographic barriers to migration between the contact zone and pure populations.

In aggregate, these lines of evidence suggest that Andringitra may be a particularly productive habitat for brown lemurs. The large local population may provide increased opportunities for gene flow that do not exist in less favorable habitats (e.g., sparsely-populated Evendra). Alternatively, the brown lemurs at Andringitra may be locally adapted, and ecotones may define the limits of the hybrid zone. We are currently conducting more long-term behavioral, ecological, and genetic studies in Andringitra and surrounding areas to provide further insight into these questions.

The current study also serves to underscore the extreme importance of conservation measures in this region. *E. f. albocollaris* is clearly threatened in much of its range, including the Evendra site. Perhaps more importantly, fragmentation and isolation of existing habitats will certainly impact the population dynamics of this endangered taxon. The interface with *E. f. rufus* populations, and the resulting hybrid zone, can only exist if the eastern rain forest corridors remain intact. In the Andringitra system, it appears that three separate corridors are necessary for the maintenance of the hybrid zone. When these migration vectors are lost, we lose hope of understanding the complexity of this population. As "windows on the evolutionary process" (Harrison 1990), hybrid zones provide a natural laboratory for understanding the formation of new species. The presence of novel alleles in the Andringitra population itself is suggestive of such processes. Without a better understanding of how gene flow with *E. f. rufus* impacts the diversity of *E. f. albocollaris* populations, it is imperative to maintain continuous forest habitats.

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**References**

Brockelman, W.Y.; Ali, R. 1987. Methods of sruveying and sampling forest primate populations. Pp. 23-62 in: Primate Conservation in the Tropical Rain Forest. C.W. Marsh; R.A. Mittermeier (eds.). Alan R. Liss, New York

Chapman, C.; Fedigan, L.M.; Fedigan, L. 1988. A comparison of transect methods of estimating populations densities of Costa Rican primates. Brenesia 30: 67-80.

Djlelati, R.; Brun, B.; Rumpler, Y. 1997. Meiotic study of hybrids in the genus *Eulemur* and taxonomic considerations. Amer. J. Primatol. 42: 235-245.

Dutrillaux, B.; Rumpler, Y. 1977. Chromosomal evolution in Malagasy lemurs. II. Meiosis in intra- and interspecific hybrids in the genus *Lemur*. Cytogenetics and cell genetics 18: 197-211.

Glander, K.E.; Wright, P.C.; Daniels, P.S.; Merenlender, A.M. 1992. Morphometrics and testicle size of rain forest lemur species from southeastern Madagascar. J. Hum. Evol. 11: 1-17.

Godfrey, L.; Marks, J. 1991. The nature and origin of primate species. Yearbook Phys. Anthropol. 34: 39-68.

Harcourt, C.; Thornback, J. 1990. Lemurs of Madagascar and the Comoros. The IUCN Red Data Book. Gland, Switzerland and Cambridge, U.K.:IUCN.

Harrison, R.G. 1990. Hybrid zones: windows on evolutionary processes. Pp. 111-133 in: Speciation and Its Consequences. J. Antonovics; D. Futuyama (eds.): Sinauer Associates. Sunderland, Mass.

Johnson, S.E.; Overdorff, D.J. 1999. Census of brown lemurs (*Eulemur fulvus* spp.) in southeastern Madagascar: methods-testing and conservation implications. Amer. J. Primatol. 47: 51-60.

Jolly, A. 1986. Lemur survival. Pp. 71-98 in: Primates: The Road to Self-sustaining Populations. K. Benirschke (ed.) Springer-Verlag. New York.

Mittermeier, R.; Tattersall, I.; Konstant, W.; Meyers, D.; Mast, R. 1994. Lemurs of Madagascar. Conservation International. Washington, D.C.

Rumpler, Y.; Warter, S.; Ratomponirina, C.; Hauwy, M.; Iscak, B. 1985. Cytogenetic study of complex hybrids in the genus *Lemur* (Primates Prosimians). Folia Primatol. 44: 108-116.

Sterling, E.; Ramarason, M. 1996. Rapid assessment of the primate fauna of the eastern slope of the Reserve Naturelle Intergrale d'Andringitra, Madagascar. Fieldiana: Zoology 85: 293-305.

Struhsaker, T.T. 1981. Census methods for estimating densities. In Subcommittee on Conservation of Natural Populations (eds.): Techniques for the Study of Primate Population Ecology. Washington, D.C.: National Academy Press.

Tattersall, I. 1982. The Primates of Madagascar. Columbia University Press. New York.

Whitesides, G.; Oates, J.; Green S.; Kluberdanz, R. 1988. Estimating primate densities from transects in a West African rain forest: a comparison of techniques. J. Anim. Ecol. 57: 345-367.

Wyner, Y.; Absher, R.; Amato, G.; Sterling, E.; Stumpf, R.; Rumpler, Y.; DeSalle, R. 1999. Species concepts and the determination of historic gene flow patterns in the *Eulemur fulvus* (Brown Lemur) complex. Biol. J. Linn. Soc. 66: 39-56.

Wyner, Y.; Johnson, S.; DeSalle, R. submitted. A genetic assessment of a white-collared/red-fronted lemur hybrid zone at Andringitra, Madagascar.

**Steig E. Johnson**
Dept. of Anthropology, University of Texas at Austin, Austin, TX 78712, USA

**Yael Wyner**
Dept. of Biology, New York University, 1009 Main Building, 100 Washington Square East, New York, NY 10003, USA and Dept. of Entomology, American Museum of Natural History, Central Park West at 79th Street, New York, NY 10024 USA, Tel: 212-769-5608, wyner@amnh.org.

## Changes in Forest Cover from 1993/94 – 1997/98 in Target Zones around Protected Areas

This change detection study was carried out to determine the rate of change in forest cover for selected target zones around protected areas. Under technical direction from the Tropical Research & Development (TR&D) organization, a method for forest cover monitoring was designed and implemented for six priority protected areas using the following time periods and data sets:

- 1950 DEF forest cover maps
- 1991/92 black and white aerial photography 1:40,000 (visually interpreted)
- 1993/94 Landsat TM (visually interpreted)

It was decided that with this method, forest cover change should be monitored every four years. The last monitoring period was approximately1993/94.

**Description of the data sets used**

Landsat Thematic Mapper (TM) imagery was used for the 1993/94 and 1997/98 data sets, with the exception of Masoala where SPOT XS data were used for the first time period. Although the original data set has seven bands, only bands 2,3, and 4 were used to create the images that were visually interpreted. The data for the earlier image dates came from ANGAP's image archive. Information about the earlier images is presented in the Table 1. The details of the imagery for the most recent date are summed in the Table 2.

Table 1: Information about the 1993/1994 TM images.

| Protected Area | Acquisition Date | TM path / row | Projection |
|---|---|---|---|
| Andasibe | 15-Sept-1993 | 158/73 | Laborde |
| Andohahela | 21-Nov-1994 | 158/77 | Laborde |
| Montagne d'Ambre | 28-Nov-1994 | 159/69 | UTM Zone 39 |
| Ranomafana | 15-Sept-1993 | 158/75 | Laborde |
| Masoala | 12-July-1995 | 2 –SPOT XS scenes | Laborde |

Table 2: Information about the 1997/1998 TM images.

| Protected Area | Acquisition Date | TM path / row | Projection |
|---|---|---|---|
| Andasibe | 26-Sept-1997 | 158/73 | UTM Zone 39 |
| Andohahela | 29-Sept-1998 | 158/77 | UTM Zone 38 |
| Montagne d'Ambre | 2-July-1998 | 159/69 | UTM Zone 39 |
| Ranomafana | 8-May-1998 | 158/75 | UTM Zone 39 |
| Masoala | 22-August-1996 | 158/71 | UTM Zone 39 |

The resolution of the original data for the more recent date had a resolution of 25 meters. However, this was reduced to 30 meters during the re-sampling/transformation process (20 meters in the case of Masoala since the SPOT data was 20 meters) to make identical the resolution between the two image dates. A SPOT PAN image (10 meter resolution panchromatic) was also used for one site in Masoala. However, this site was not part of the R4 subset of target zones.

**Methods**

For this study, forest was defined as an area of trees greater than 7 meters in height with greater than 30% crown closure. Because Landsat TM satellite images were used for the change detection, it was decided to only delineate two categories: change from forest to non-forest, and no change. This was because the 30-meter resolution and radiometric characteristics of the TM images were not sufficient to detect the change from non-forest to forest in a period of four years.

The identification and delineation of changes in forest cover were carried out in several steps. All image processing and visualization was performed using ENVI (Research Systems, Boulder, Colorado) and vector processing was done using PCArcInfo (Environmental Systems Research Institute Inc., Redlands, California).

Metadata for the image and vector products of this study were entered using the software MetaLite 1.7.2 which was created by the United States Geological Study (USGS) and the United Nations Environment Programme. For more information about MetaLite and to download the free software

go to the URL: **edcnts2.cr.usgs.gov/MetaLite/MetaLite.htm.**
This software can be used in English or French. Metalite creates its database using a Microsoft Access file format so the database can be viewed and queried using Access. In the future it is possible Metalite will include browsing capabilities.
The first step was to review the TM image from the time period 1993/94 to see if it was properly geo-referenced to the Laborde projection. If the image was not in the Laborde or Oblique Mercator projecting, the image was transformed to either the Laborde or Oblique Mercator projection using image-to-map registration techniques. Map coordinates (Laborde X and Y) were selected from FTM BDScan 400dpi images. These FTM products are digital copies of the FTM 1:100,000 topographic maps that were scanned at a resolution of 400 dpi. Although there were positional errors in the DBScan images it was thought that these were the best data easily available for geo-referencing features that could be located in the satellite imagery.
Next, a portion of the TM image from the time period 1997/98 which covered all of the target zones for the particular protected area was registered to the earlier image using image-to-image registration techniques. This was accomplished by selecting a pixel in the 1993/94 image and then selecting the corresponding pixel in the 1997/98 image. More than 10 pixels were selected from each image and then the more recent image was warped using a 1st degree polynomial function. RMS errors less than 1 pixel were realized for all of the images.
With the two images (early and most recent date) geo-referenced, it was possible to overlay portions of the one image over the other. By rapidly switching between the two images it was possible to detect areas of forest change. When there appeared to be a change from forest to non-forest the area was located on aerial photographs to see if it was likely forested during the 1993/94 time period. If it was, the area was delineated using on-screen digitizing. When all of the change polygons were digitized, the vector file was saved in the ESRI Shapefile format.
Using PCArcInfo, the ESRI Shapefile vector polygons were converted to ArcInfo coverages. These coverages were then CLIPPED to cutout only the portion that corresponded with the target zone. The next step was to enter the attributes for each polygon using ArcEdit. After the attributes were added, the vector coverages were checked with the original images to verify the accuracy of the attributes.
The last step was to use PCArcInfo to generate the surface area for the two classes: change from forest to non-forest and no change. The figure representing the change from forest to non-forest was then subtracted from the total forest cover for the period 1993/94 as reported in the R4 document in 1998.

Table 3: 1993/94 – 1997/98 deforestation rate depending on how forest was defined.

| Forest classification | Total forest area in 1994 | Annual deforestation rate |
|---|---|---|
| Primary & secondary forest | 63342 hectares | 0.11% |
| Primary forest (secondary forest included with non-forest class) | 47515 hectares | 0.15% |

In the R4 document, the area of forest included both the primary and secondary forest classes as classified from the 1993/94 data. This unfortunately provided an overestimate of the actual area covered by forest, since the secondary forest class was a mix of forest and non-forest. This, in turn, resulted in a slower deforestation rate. For example, the annual rate of deforestation calculated for the R4 sites using the 1993/94 forest area calculated by combining primary and secondary forest was 0.11%. When only primary forest was used to define the forest area in 1993/94 the deforestation rate was 0.15% (Table 3). In actuality, since the secondary forest class was a mix of forest and non-forest, the deforestation rate is likely between these two figures. For this report, the first case is presented in the "Results" section to adhere to the convention used by USAID/Madagascar.

**Limitations of this study**
In all likelihood, areas of contiguous change less than 0.5 ha in uniform forest and less than 1.0 ha in patchy forest or hilly terrain can not be reliably detected. There are about 11 pixels per hectare. These figures are very approximate and are provided simply to give an idea of what scale of deforestation can be detected.
In areas with a mosaic of forest patches, secondary regrowth, and other cover types, it was difficult to reliably detect deforestation unless the deforestation covered a significant area (approximately 1 hectare). This is because of the mixed pixel effect. The mixed pixel effect occurs when the 30m x 30m TM pixel covers more than one cover type. When this happens, the value of a pixel is actually an average of the reflectance for the different cover types. With small patch sizes this effect can become severe. In addition to this effect, the terrain can compound the problem. In hilly terrain, illumination can vary tremendously across the scene and this may give misleading information about the land cover.
It is expected that the change polygons delineated are probably an overestimate of the actual change in most cases. However, there is some change that can not be detected due to small patch size, mixed pixels, and obscuration. The overestimate is due to the interpreter bias of delineating entire pixels as if the entire pixel covered an area that was deforested. In reality it is unlikely that the entire pixel along the edge of a delineated polygon would be entirely a change pixel. In most cases the pixel would only be partially deforested although it was delineated as entirely deforested.
Differences in shadows due to the images being acquired at different times of the year probably reduced the accuracy of the interpretation for some of the sites. This is because the illumination of the scene can change dramatically when the one image is acquired at one time of the year and the other image is acquired at another time. This is due to the changing solar zenith and azimuth angle throughout the seasons. This change in illumination can give the interpreter misleading information of the area being interpreted.
Another problem when the two image dates are significantly different is that the growing season can be very different. For example, in the Ankarana region the earlier image was acquired during the wet season and it was very difficult to differentiate between forest and shrub.

**Results**
As discussed above, there are several factors that effected the accuracy of this study. Most of these were a result of using Landsat TM satellite imagery with 30m resolution. An accuracy assessment of the final product was not permitted in this study so it is not possible to quantify the effect that these problems had on the resulting deforestation rates. An educated guess is that the accuracy figures for the area of forest cleared for each target zone are better than +/-20% at a 95% confidence interval. The effect this has on the result is presented in Table 3. The results are summed up in Tables 4 and 5. Table 4 lists all of the target zones that were interpreted for this study and Table 5 includes only those target zones that were included in the R4 report.

This reported summarizes a study financed by USAID/ Madagascar.

Table 4: Results from the 1993/94 - 1997/98 change detection study for all target zones

| Zone name | Protected area | R4 | 1st date | Forest T1 | Non-forest T1 | 2nd date | Forest T2 | Non-forest T2 | Forest loss | No change | Forest loss % | Weighted % | Annual forest loss % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Andasibe | Andasibe | No | 15-Sep-93 | 667 | 409 | 26-Sep-97 | 518 | 559 | 150 | 927 | 22,41 | 0,05 | 5,56 |
| Antsampannana | Andasibe | Yes | 15-Sep-93 | 217 | 211 | 26-Sep-97 | 208 | 220 | 9 | 419 | 4,06 | 0,00 | 1,01 |
| Falierana | Andasibe | Yes | 15-Sep-93 | 254 | 1238 | 26-Sep-97 | 244 | 1248 | 10 | 1482 | 3,86 | 0,00 | 0,96 |
| Vohibazaha | Andasibe | Yes | 15-Sep-93 | 428 | 2339 | 26-Sep-97 | 403 | 2365 | 26 | 2742 | 5,96 | 0,01 | 1,48 |
| Manarinony | Ranomafana | Yes | 15-Sep-93 | 647 | 347 | 05-Aug-98 | 554 | 440 | 93 | 901 | 14,31 | 0,03 | 2,93 |
| Ranomafana | Ranomafana | Yes | 15-Sep-93 | 597 | 401 | 05-Aug-98 | 574 | 424 | 23 | 975 | 3,85 | 0,01 | 0,79 |
| Vohiparara | Ranomafana | No | 15-Sep-93 | 827 | 173 | 05-Aug-98 | 826 | 174 | 1 | 999 | 0,08 | 0,00 | 0,02 |
| Andasibe | Amber Mtn. | Yes | 28-Nov-94 | 3738 | 5103 | 02-Jul-98 | 3738 | 5103 | 0 | 8841 | 0,00 | 0,00 | 0,00 |
| Bobakilandy | Amber Mtn. | Yes | 28-Nov-94 | 3662 | 6563 | 02-Jul-98 | 3662 | 6563 | 0 | 10225 | 0,00 | 0,00 | 0,00 |
| Joffre-Ville | Amber Mtn. | Yes | 28-Nov-94 | 6821 | 3178 | 02-Jul-98 | 6817 | 3182 | 4 | 9995 | 0,06 | 0,00 | 0,02 |
| Mahamasina | Amber Mtn. | Yes | 28-Nov-94 | 3126 | 4061 | 02-Jul-98 | 3099 | 4088 | 27 | 7160 | 0,85 | 0,01 | 0,24 |
| Sakaramy | Amber Mtn. | Yes | 28-Nov-94 | 2404 | 4242 | 02-Jul-98 | 2404 | 4242 | 0 | 6646 | 0,00 | 0,00 | 0,00 |
| Mahamavo | Andohahela | Yes | 21-Nov-94 | 2297 | 1488 | 29-Sep-98 | 2293 | 1492 | 4 | 3781 | 0,17 | 0,00 | 0,05 |
| Ebaketra | Andohahela | Yes | 21-Nov-94 | 2637 | 1283 | 29-Sep-98 | 2571 | 1349 | 66 | 3854 | 2,49 | 0,02 | 0,64 |
| Tsimelahy | Andohahela | Yes | 21-Nov-94 | 3281 | 1929 | 29-Sep-98 | 3281 | 1929 | 0 | 5210 | 0,00 | 0,00 | 0,00 |
| Antseva | Andohahela | Yes | 21-Nov-94 | 1146 | 2101 | 29-Sep-98 | 1132 | 2115 | 14 | 3233 | 1,19 | 0,00 | 0,31 |
| Ianobe | Masoala | No | 21-Nov-94 | 9545 | 671 | 22-Aug-96 | 9433 | 783 | 112 | 10104 | 1,18 | 0,03 | 0,23 |
| Anaovandrano | Masoala | Yes | 12-Jul-95 | 14949 | 9999 | 22-Aug-96 | 14943 | 10005 | 6 | 24942 | 0,04 | 0,01 | 0,04 |
| Ambanizana | Masoala | Yes | 12-Jul-95 | 17138 | 920 | 22-Aug-96 | 17138 | 920 | 0 | 18058 | 0,00 | 0,00 | 0,00 |
| **TOTAL** | | | | **74381** | **46656** | | **73839** | **47198** | **542** | **120495** | | | **0,17** |

**Notes:**
1 - Forest, nonforest, no change, and forest loss are given in hectares.
2 - Percent forest loss is given in terms of forest cover at T2 relative to the forest cover at T1

**Formulae:**
% Forest loss = Forest loss / Forest T1 * 100
Annual forest loss = % Forest loss / ((2nd date - 1st date) / 365)
Weighted % = Annual forest loss * (Forest T1 / Total Forest T1)

Table 5: Results from the 1993/94 - 1997/98 change detection study for only the R4 target zones

| Zone name | Protected area | R4 | 1st date | Forest T1 | Non-forest T1 | 2nd date | Forest T2 | Non-forest T2 | Forest loss | No change | Forest loss % | Weighted % | Annual forest loss % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Antsampannana | Andasibe | Yes | 15-Sep-93 | 217 | 211 | 26-Sep-97 | 208 | 220 | 9 | 419 | 4,06 | 0,00 | 1,01 |
| Falierana | Andasibe | Yes | 15-Sep-93 | 254 | 1238 | 26-Sep-97 | 244 | 1248 | 10 | 1482 | 3,86 | 0,00 | 0,96 |
| Vohibazaha | Andasibe | Yes | 15-Sep-93 | 428 | 2339 | 26-Sep-97 | 403 | 2365 | 26 | 2742 | 5,96 | 0,01 | 1,48 |
| Manarinony | Ranomafana | Yes | 15-Sep-93 | 647 | 347 | 26-Sep-97 | 554 | 440 | 93 | 901 | 14,31 | 0,03 | 2,93 |
| Ranomafana | Ranomafana | Yes | 15-Sep-93 | 597 | 401 | 05-Aug-98 | 574 | 424 | 23 | 975 | 3,85 | 0,01 | 0,79 |
| Andasibe | Amber Mtn. | Yes | 28-Nov-94 | 3738 | 5103 | 05-Aug-98 | 3738 | 5103 | 0 | 8841 | 0,00 | 0,00 | 0,00 |
| Bobakilandy | Amber Mtn. | Yes | 28-Nov-94 | 3662 | 6563 | 02-Jul-98 | 3662 | 6563 | 0 | 10225 | 0,00 | 0,00 | 0,00 |
| Joffre-Ville | Amber Mtn. | Yes | 28-Nov-94 | 6821 | 3178 | 02-Jul-98 | 6817 | 3182 | 4 | 9995 | 0,06 | 0,00 | 0,02 |
| Mahamasina | Amber Mtn. | Yes | 28-Nov-94 | 3126 | 4061 | 02-Jul-98 | 3099 | 4088 | 27 | 7160 | 0,85 | 0,01 | 0,24 |
| Sakaramy | Amber Mtn. | Yes | 28-Nov-94 | 2404 | 4242 | 02-Jul-98 | 2404 | 4242 | 0 | 6646 | 0,00 | 0,00 | 0,00 |
| Mahamavo | Andohahela | Yes | 21-Nov-94 | 2297 | 1488 | 02-Jul-98 | 2293 | 1492 | 4 | 3781 | 0,17 | 0,00 | 0,05 |
| Ebaketra | Andohahela | Yes | 21-Nov-94 | 2637 | 1283 | 29-Sep-98 | 2571 | 1349 | 66 | 3854 | 2,49 | 0,03 | 0,64 |
| Tsimelahy | Andohahela | Yes | 21-Nov-94 | 3281 | 1929 | 29-Sep-98 | 3281 | 1929 | 0 | 5210 | 0,00 | 0,00 | 0,00 |
| Antseva | Andohahela | Yes | 21-Nov-94 | 1146 | 2101 | 29-Sep-98 | 1132 | 2115 | 14 | 3233 | 1,19 | 0,01 | 0,31 |
| Anaovandrano | Masoala | Yes | 12-Jul-95 | 14949 | 9999 | 29-Sep-98 | 14943 | 10005 | 6 | 24942 | 0,04 | 0,01 | 0,04 |
| Ambanizana | Masoala | Yes | 12-Jul-95 | 17138 | 920 | 29-Sep-98 | 17138 | 920 | 0 | 18058 | 0,00 | 0,00 | 0,00 |
| **TOTAL** | | | | **63342** | **45403** | | **63063** | **45683** | **280** | **108466** | | | **0,11** |

**Notes:**
1 - Forest, nonforest, no change, and forest loss are given in hectares
2 - Percent forest loss is given in terms of forest cover at T2 relative to the forest cover at T1

**Formulae**:
% Forest loss = Forest loss / Forest T1 * 100
Annual forest loss = % Forest loss / ((2nd date - 1st date) / 365)
Weighted % = Annual forest loss * (Forest T1 / Total Forest T1)
Total annual forest loss = SUM(Weighted %)
Forest T2 = Forest T1 - Forest loss
Non forest T2 = Non-forest T1 + Forest loss

Annual deforestation assuming 20% overestimate of forest loss = 0.09%
Annual deforestation assuming 10% overestimate of forest loss = 0.10%
Annual deforestation assuming 10% underestimate of forest loss = 0.12%
Annual deforestation assuming 20% underestimate of forest loss = 0.13%

**Ned Horning**
Remote Sensing Consultant**,** 1993 School Road, Cambridge, VT 05444, USA

## The Lemurs of the Northeastern Slopes of the Réserve Spéciale de Manongarivo

The region of northwestern Madagascar, often referred to as the Sambirano Region, is zoologically poorly known. The forests in this area, particularly at lower elevations, represent a transitional zone between the humid forest formations of the eastern portion of the island and the deciduous forests of the west. Two principal massifs occur in the Sambirano region, Tsaratanana located towards the interior and Manongarivo closer to the coast and not far from Ambanja. At least portions of both of these two sites are part of the protected areas system of the Malagasy Government.

Published information from the Tsaratanana Massif is largely restricted to observations made along the southern slopes of this mountain during a 1966 biological expedition to the site (Albignac 1970). Further, knowledge of the lemurs of the Manongarivo Massif is based on an expedition to the western slopes of this mountain in late 1987 and early 1988 (Quansah 1988). Subsequently published primate species lists for these two massifs (e.g. Nicoll and Langrand 1989;

Mittermeier *et al.* 1994) are based largely on the Albignac and Quansah references. Given that there is considerable variation in the rainfall patterns and vegetational structure of different orientated slopes on the larger mountains of Madagascar, particularly east and west facing slopes, it might be expected that the composition of vertebrate communities occurring on opposite sides of these mountains might be different. To further complete information on the biota living on the northeastern slopes of the Réserve Spéciale (RS) de Manongarivo, a multidisciplinary elevational transect to this site was made in late 1998 and early 1999. The primate results of this inventory are presented here.

**Study sites and survey techniques**

To our knowledge, no information was previously available on the primates occurring along the northeastern slope of the Manongarivo Massif. Four different sites, centered on our camps and each encompassing an elevational range of ± 75 m with respect to the camp, were visited during our survey of this reserve. All of these localities are in the Province d'Antsiranana and in the RS de Manongarivo:

**400 m zone** – 10.8 km (229°) southwest of Antanamabo, 13°57.7'S. 48°26.0'E –disturbed lowland forest near a tributary of the Ambaratra River

**800 m zone** – 12.8 km (228°) southwest of Antanambao, 13°58.6'S, 48°25.4'E – relatively intact lowland forest, not far from an abandoned tavy.

**1250 m zone** – 14.5 km (220°) southwest of Antanambao, 14°0.0'S, 48°25.7'E – intact montane forest.

**1600 m zone** – 17.3 km (218°) southwest of Antanambao, 14°1.3'S, 48°25.1'E – intact montane forest with heavy moss and epiphytic plant cover. This site was near the source of the Andranomalaza River.

During the course of these inventories no primatologist *per se* was part of the research group, but many of the expedition members have considerable knowledge of Malagasy lemurs. The group of researchers spent much of the day and many hours during the night in the forest. For primates no quantitative survey or transect techniques were used during this project. HS compiled the records from the October/November 1998 survey of the reserve, which visited each of the four elevational zones for a minimum of five days. SMG was responsible for the records from the February/March 1999 inventory, which revisited the upper three zones for a minimum of nine days at each site.

**Results**

Eight species of lemurs, evenly split between diurnal and nocturnal species, were recorded in the RS de Manongarivo during our survey (Tab. 1). The highest diversity of lemurs was seven species in the 800 and 1250 m zones, followed by five species in the 1600 m zone, and finally three species in the 400 m zone.

*Microcebus* sp. – Mouse lemurs were distinctly uncommon on the northeastern slopes of the reserve. Only a few individuals were observed at the 800, 1250, and 1600 m sites. Recent work along the western slopes of the RS de Manongarivo has found that an undescribed species of *Microcebus* occurs locally (Rasoloarison *et al.* in prep.). On the basis of the phenotypic characters of specimens of this new form and close observations of the mouse lemurs occurring on the northeastern slopes of the Manongarivo Massif, we strongly suspect these individuals are all the same species. According to the current literature, mouse lemurs from the Sambirano are referable to *M. rufus* (Tattersall 1982; Mittermeier *et al.* 1994).

*Cheirogaleus major* – This species was noted in the lower three zones of the elevational transect. In the forest at 800 m, particularly at the edge of an abandoned tavy, it was abundant. Phenotypically the *Cheirogaleus* occurring in the reserve appear to be *C. major*, which is the form reported from the Sambirano (Tattersall 1982).

Table 1: Elevational distribution of lemurs along the northeastern slopes of the Réserve Spéciale de Manongarivo.

| | 400 m | 800 m | 1250 m | 1600 m |
|---|---|---|---|---|
| *Microcebus* sp. [1] | - | + | + | + |
| *Cheirogaleus major* | + | + | + | - |
| *Lepilemur dorsalis* | + | + | + | - |
| *Hapalemur griseus* | - | + | + | + |
| *Eulemur fulvus* | - | + | + | + |
| *Eulemur macaco* | + | + | + | + |
| *Eulemur rubriventer* | - | - | - | + |
| *Daubentonia madagascariensis* | - | + | +[2] | - |
| Total number of species | 3 | 7 | 7 | 5 |

[1] The specific status of these animals is unclear. R. Rasoloarison has clear evidence that the population of *Microcebus* occurring along the western slopes is an undescribed species which will soon be named.
[2] Occurrence in elevational zone based on feeding signs.

*Lepilemur dorsalis* – This species was common in the transect zones between 400 and 1250 m and was not recorded at 1600 m. The current understanding of the relationships and species limits of western *Lepilemur* are far from being resolved (Ishak *et al.* 1992; Tomiuk *et al.* 1997). However, on the basis of geographic range and external characters (Tattersall 1982; Mittermeier *et al.* 1994) we tentatively assign the individuals of this genus we observed in the RS de Manongarivo to *L. dorsalis*.

*Hapalemur griseus* – Although never common, we observed this species in the upper three elevational zones. It was generally found in small groups (single animals and up to four individuals) in areas with dense climbing bamboo. This is in direct parallel to the types of habitats it was found on the western side of the massif (Raxworthy and Rakotondraparany 1988).

It has been previously noted that the form of bamboo lemur occurring in the reserve is *H. g. occidentalis* (Raxworthy and Rakotondraparany 1988; Mittermeier *et al.* 1994). We did not have sufficiently good views of the individuals we observed to assess if their pelage coloration was indeed more uniformly gray-brown, typical of *H. g. occidentalis*, than in the nominate form from the eastern humid forest.

*Eulemur fulvus* – This species was relatively common in the upper three elevational zones of the RS de Manongarivo; however, it was less frequently observed than *E. macaco*. In the 1250 m zone *E. macaco* and *E. fulvus* were regularly observed in the same trees feeding on fruits. These food plants included *Dypsis* (Arecaceae), *Ficus* (Moraceae), and *Calophyllum* and *Garcinia* (Gutteriferae). On the basis of pelage characters we would assign the Manongarivo population to *E. f. fulvus*.

*Eulemur macaco* – Of all of the diurnal and nocturnal lemurs observed during our survey of the RS de Manongarivo, *E. macaco* was without question the most frequently noted. It was the only species recorded across the complete elevational transect.

Recent work on the *E. macaco* species complex has shown that the RS de Manongarivo is a zone of hybridization between *E. m. macaco* occurring further to the north and *E. m. flavifrons* to the south (Meyers *et al.* 1989). As Meyers *et al.* pointed out, this zone is one of intergradation between these two forms. In order to quantify clinal variation between these two forms and their hybrids, we noted the subspecific identifications or hybrid features of all well viewed individuals encountered during our elevational transect of Manongarivo. We used the pelage and eye color characters defined by Mittermeier *et al.* (1994, particularly plates 19 and 21) to classify these observations. Although our data certainly includes numerous cases of multiple samples of the same individuals, the overall pattern seems informative about the relative proportions of *E. macaco* phenotypes.

As far as we can determine no "pure" individuals of *E. m. flavifrons* occur on the northeastern slopes of the reserve. The ratio of *E. m. macaco* to intermediate or hybird forms was: 800 m zone (n=28) – 8:20, 1250 m zone (n=21) – 11:10; and 1600 m zone (n=15) – 13:2. Thus, with increasing elevation there appears to be a decline in the number of hybrids. It is interesting to note that our transect, which passed from low-lying areas to the upper elevations of the massif, followed a north-south course, which is towards the direction of the range of *E. m. flavifrons*.

*Eulemur rubriventer* – A single adult male *E. rubriventer* was observed at about 1675 m; this is our only record of this species in the reserve. It had been previously reported from the Tsaratanana Massif at about 2,300 m (Albignac 1970). The occurrence of this animal in the RS de Manongarivo extends its geographical range further to the west than previously known.

*Daubentonia madagascariensis* – This species was observed in the 800 m zone and distinct traces of it feeding on *Canarium* (Burseraceae) seeds (Goodman and Sterling 1996) were found at this elevation as well as at 1250 m. The individual viewed in the 800 m zone was in a large fruiting *Canarium* tree growing next to our camp. It was actively feeding at night in the canopy on the seeds of this tree.

After the termination of the autumn 1998 visit to the reserve the survey group found two dead *Daubentonia* on the outskirts of the village of Bemanivika, on the opposite bank of the Sambirano River from Antanambao. The two animals had been killed several weeks earlier, not far from the village, and their carcasses suspended from a tree branch by a rope attached to their necks.

On the basis of discussion with several local people working with us during the inventory, the following information on local beliefs and traditions concerning aye-ayes was gathered. For most of the Sakalava living in this region, the aye-aye is an extremely dangerous animal. It attacks, kills, and eats chickens living in villages. Further, it is reputed to enter houses during the night through thatched roofs and murder the sleeping human occupants. It apparently uses the elongated finger to cut the aortic vein of its victims. It is for this reason, as explained by our colleagues, that the Sakalava kill aye-ayes. Thus, a simple educational program on the real life-history tactics and food habits of this primate might make important advances in how local people view it and in return aid considerably to conservation efforts for this animal.

**Discussion**

The records presented in this paper provide new data on the primates occurring along the northeastern slopes of the RS de Manongarivo. There are few field reports on the vertebrate fauna of the Sambirano region as a whole and in particular this reserve. Further, observations from this side of the Manongarivo Massif provide insight into the geographic ranges of several humid forest primates into the Sambirano region that are generally considered eastern in their range. In several cases, the distribution of these animals span the zone from the northern portion of the eastern humid forest across a series of mountains running from the Marojejy and Anjanaharibe-Sud massifs near Andapa, to Tsaratanana, and finally to Manongarivo; a zone that has been previously referred to as the northern highlands. Extensive primate surveys have been previously conducted along the slopes of the Marojejy and Anjanaharibe-Sud massifs. However, information from Tsaratanana is certainly not complete, which hampers comparisons of these three mountains to Manongarivo.

Primate diversity on the Anjanaharibe-Sud and Marojejy massifs is higher (11 and 10 species, respectively) than on the Manongarivo and Tsaratanana massifs (8 and 7 species, respectively; Tab. 2). In total 15 species of primates have been recorded across this zone, of which four have apparently continuous distributions (*Cheirogaleus major*, *Hapalemur griseus*, *Eulemur fulvus*, and *E. rubriventer*). None of these species are strictly lowland, and most have broad elevational distributions on these mountains. Their utilization of a range of different habitats probably is directly related to this broad distribution. In a few cases species only occur in the eastern portion of this region (*Allocebus trichotis*, *Propithecus diadema*, *Indri indri*), in one case in the western portion (*Eulemur macaco*), or there is replacement of congeners across this zone (e.g., *Microcebus*, *Lepilemur*). With further exploration of the Tsaratanana Massif a few primate species will almost certainly be added to the local list (e.g. *Daubentonia madagascariensis*). However, we strongly suspect that the diversity will not reach that found on the massifs in the eastern portion of the northern highlands.

Table 2: Known elevational occurrence of lemurs on mountains in the Sambirano and the northern highlands.

| Site | Manongarivo | Tsaratanana | Anjanaharibe-Sud | Marojejy |
|---|---|---|---|---|
| Sources of information | 1 | 2 | 3, 4 | 5 |
| Zone inventoried | 400-1600 m | 1500-2500 m | 865-1950 m | |
| *Microcebus* sp.[1] | 800-1600 m | - | - | - |
| *Microcebus rufus* | - | - | 865-1550 m | 450-1875 m |
| *Cheirogaleus major* | 400-1250 m | +[2] | 865-1550 m | 450-1625 m |
| *Allocebus trichotis* | - | - | 865-1260 m | - |
| *Avahi laniger* | -[3] | - | 865-1260 m | 450-1225 m |
| *Phaner furcifer* | -[4] | +[2] | - | 450 m |
| *Lepilemur* sp.[5] | - | 1500, 2300 m | - | - |
| *Lepilemur dorsalis* | 400-1250 m | - | - | - |
| *Lepilemur mustelinus* | - | - | 865-1550 m | 450-1625 m |
| *Hapalemur griseus* | 800-1600 m | 2050 m | 865-1950 m | 450-1625 m |
| *Eulemur fulvus* | 800-1600 m | +[2] | 865-1550 m | 450-1625 m |
| *Eulemur macaco* | 400-1600 m | +[2] | - | - |
| *Eulemur rubriventer* | 1600 m | 2300 m | 1260-1550 m | 450-1625 m |
| *Indri indri* | - | - | 865 m | - |
| *Propithecus diadema* | - | - | 865-1550 m | 1225-1875 m |
| *Daubentonia madagascariensis* | 800-1250 m | - | 865 m | 450-1875 m |
| Total number of species | 8 | 7 | 11 | 10 |

Sources of information: 1– this study; 2 – Albignac (1970); 3 – Schmid and Smolker (1998); 4 – Schütz and Goodman (1998); Sterling and McFadden (in press).

[1] The specific status of these animals is unclear. R. Rasoloarison has clear evidence that the population of *Microcebus* occurring along the western slopes is an undescribed species which will soon be named.

[2]Not recorded by Albignac (1970) on the higher slopes of the mountain but noted for the reserve by Nicoll and Langrand (1989).

[3]This species has been previously reported from the western portion of the massif. See discussion section for further details.

[4]This species was recorded outside of the reserve in lowland, areas such as near Antanambao, but not within the reserve boundaries. It is not included in the total number of species for the site.

[5]Albignac (1970) reported an unidentified *Lepilemur* from Tsaratanana which is probably referable to *L. dorsalis*.

A comparison of the primates recorded along the western slopes of the Manongarivo Massif by Raxworthy and Rakotondraparany (1988) to those we found on the northeastern slopes during our survey reveals few differences. One *Avahi* was observed on the western slopes during many weeks of fieldwork. This is a species we did not record in the northeastern portion of the reserve. It is unclear if the *Avahi* observed by Raxworthy and Rakotondraparany is referable to the eastern form *A. laniger* or the western form *A. occidentalis*.

In contrast, we observed in the mossy forest a single individual of *Eulemur rubriventer*, an animal unknown from the western slopes of the massif. Thus in general, except for rarely observed species, the primate forms occurring on the northern and western sides of the mountain are identical.

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**References**
Albignac, R. 1970. Mammifères et oiseaux du Massif du Tsaratanana. Mémoires ORSTOM 37: 220-229.
Goodman, S.M.; Sterling, E.J. 1996. The utilization of *Canarium* (Burseraceae) seeds by vertebrates in the Réserve Naturelle Intégrale d'Andringitra, Madagascar. In: Goodman, S.M. (ed.) A floral and faunal inventory of the eastern slopes of the Réserve Naturelle Intégrale d'Andringitra, Madagascar: with reference to elevational variation. Fieldiana: Zoology, new series 85: 83-92.
Ishak, B.; Warter, S.; Dutrillaux, B.; Rumpler, Y. 1992. Chromosomal rearrangements and speciation of sportive lemurs (*Lepilemur* species). Folia Primatol. 58: 121-130.
Meyers, D.M.; Raberivola, C.; Rumpler, Y. 1989. Distribution and conservation of Sclater's Lemur: implications of a morphological cline. Primate Cons. 10: 77-81.
Mittermeier, R.A.; Tattersall, I.; Konstant, W.R.; Meyers, D.M.; Mast, R.B. 1994. Lemurs of Madagascar. Conservation International, Washington D.C.
Nicoll, M.E.; Langrand, O. 1989. Madagascar: Revue de la conservation et des aires protégées. WWF, Gland.
Quansah, N. 1988. Manongarivo Special Reserve (Madagascar) 1987/88 Expedition report. MERG, London.
Raxworthy, C.J.; Rakotondraparany, F. 1988. Mammals report, pp. 122-130. In: Quansah, N. (ed.) Manongarivo Special Reserve (Madagascar) 1987/88 Expedition report. MERG, London.
Schmid, J.; Smolker, R. 1998. Lemurs of the Réserve Spéciale d'Anjanaharibe-Sud, Madagascar. In: Goodman, S. M. (ed.) A floral and faunal inventory of the Réserve Spéciale d'Anjanaharibe-Sud, Madagascar: with reference to elevational variation. Fieldiana: Zoology, new series 90: 227-238.
Schütz, H.; Goodman, S.M. 1998. Photographic evidence of *Allocebus trichotis* in the Réserve Spéciale d'Anjanaharibe-Sud. Lemur News 3: 21-22.
Sterling, E.; McFadden, K. in press. Rapid census of lemur populations in the Parc National de Marojejy, Madagascar. In: Goodman, S.M. (ed.). A floral and faunal inventory of the Parc National de Marojejy, Madagascar: with reference to elevational variation. Fieldiana: Zoology, new series.
Tattersall, I. 1982. The primates of Madagascar. Columbia University Press, New York.
Tomiuk, J.; Bachmann, J.; Leipoldt, M.; Ganzhorn, J.U.; Ries, R., Weis, M.; Loeschcke, V. 1997. Genetic diversity of *Lepilemur mustelinus ruficaudatus*, a nocturnal lemur of Madagascar. Cons. Biol. 11: 491-497.

**Steve Goodman**
Field Museum of Natural History, Roosevelt Road at Lake Shore Drive, Chicago, Illinois 60605, USA and WWF, B.P. 738, Antananarivo (101), Madagascar

**Harald Schütz**
Neuhauserstrasse 30, 78052 VS-Obereschach, Germany

## Greater Dwarf Lemurs from the Bongolava (Central Western Madagascar)

A previously unknown population of greater dwarf lemurs was reported for the first time by Petter *et al.* (1977) from as far west as the Bongolava region near the Manambolo River west of Tsiroanomandidy (Fig. 1). In his distribution map, Tattersall (1982: Fig. 3.31) figured this population as *Cheirogaleus major*. Harcourt and Thornback (1990) did not show the population in their distribution map (Harcourt and Thornback 1990: p. 52), despite citing a publication by Petter and Andriatsarafara (1987) in which a recent capture of *Cheirogaleus major* in the Bongolava region is mentioned. The population is also missing from subsequently published maps (Mittermeier *et al.* 1994; Rowe 1996). Populations of what seem to be greater dwarf lemurs have also been reported to occur even further to the west, in the Bemaraha region to the north and south of the Manambolo river (Ausilio 1993; Thalmann and Rakotoarison 1994; Ausilio and Raveloanrinoro 1998) but remain unstudied to date.

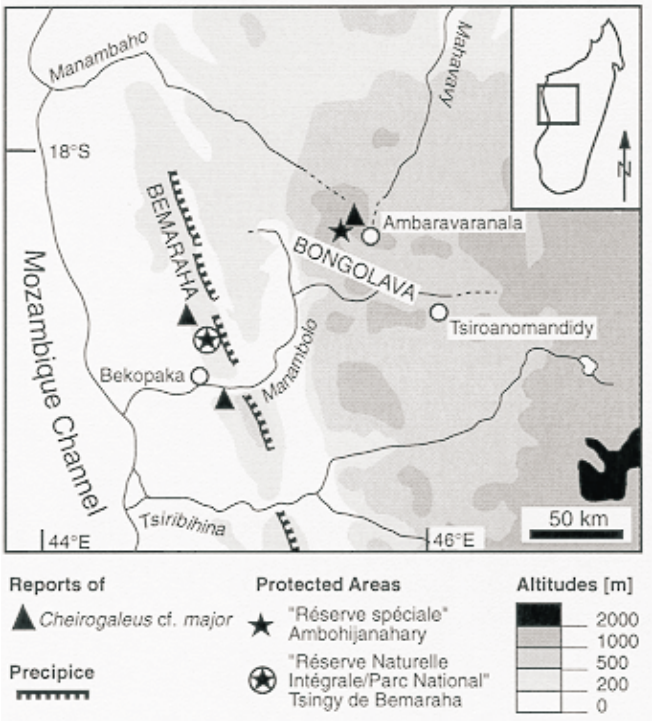


Fig. 1: Map of the region, and sightings of western greater dwarf lemurs *Cheirogaleus* cf. *major*. The exact locality for sightings by Petter *et al.* (1977), Petter and Andriatsarafara (1987) is unknown and not shown. Inset map: Madagascar.

The present contribution intends to draw attention to the virtually unknown greater dwarf lemurs of the Bongolava and the Bemaraha region. It confirms and emphasises the existence of these populations, documents an individual with a photograph (Fig. 2) and measurements (Tab. 1), and lists differences between this individual and a typical eastern representative of *Cheirogaleus major*.
In May 1994, the late Nasolo Rakotoarison and I transferred a female greater dwarf lemur with two offspring from the Bongolava region to the Parc Botanique and Zoologique Tsimbazaza (PBZT) in Antananarivo for further studies. The animals had been kept in the village of Ambaravaranala having reportedly been captured in the surroundings of that same village. For an initial morphological assessment, the adult female was compared at PBZT with a male *Cheirogaleus major* from Andasibe (Eastern Madagascar; Fig. 2). Unfortunately, all animals from the Bongolava died in the

Fig. 2: Greater dwarf lemur female from the Bongolava (left), and a male greater dwarf lemur from Andasibe (right).

course of 1995, before further investigations could be undertaken. The cadavers were stored in alcohol, but disappeared after Nasolo Rakotoarison succumbed to a fatal accident in 1996. The whereabouts of the specimens are currently unknown, and to my knowledge the data presented here are the only available on the greater dwarf lemurs from the Bongolava.

Table 1: Basic measurements for adult greater dwarf lemurs from the Bongolava (1 captive female), Andasibe (1 captive male), and from the literature. Body mass in grams, other measurements in mm.

| | **Bongolava** | **Andasibe** | **Literature** |
|---|---|---|---|
| Body mass | 302 | 383 | 408 (n=4; 277-490) [1] |
| Head-Body Length | 250 | 240 | 239 (n=4; 216-264) [2] |
| Tail Length | 240 | 240 | 278 (n=4; 224-310) [2] |
| Skull Length | 44 | 48 | - |
| Skull Width | 29 | 32 | - |
| Ear Length | 22 | 23 | 25 (n=4; 23-27) [2] |

[1]Bauchot and Stephan (1966: p. 169): Only wild-caught animals included.
[2]Tattersall (1982: p.116).

There was no marked difference in either body-size or body proportions between the adult female from the Bongolava and the male individual from Andasibe, although the Bongolava female appeared of more slender built. The difference in body mass (Tab. 1) could be due to several factors such as motherhood in the female from the Bongolava, and/or differing conditions of captivity between the two animals. In addition, seasonal body mass variation is very high in dwarf lemurs (Tattersall 1982; Müller 1998 for *Cheirgaleus medius*), which commonly hibernate for prolonged periods during the austral winter. In the wet season they store fat and increase their body mass to overcome hibernation. During hibernation, body mass drops considerably. For all of those reasons, the body weights reported here should be considered with caution. Investigation of a larger sample though will probably reveal significant differences between representatives of the two regions. In other realms, the two animals were clearly distinct: The individual from the Bongolava had a considerably darker reddish fur and shorter hair than the individual from Andasibe and the face mask was markedly more pronounced in the individual from the Bongolava: The fur of the face is more clearly demarcated from the surrounding fur, and the black eye-circles are relatively larger. Figure 2 may give a different impression, but this is due to the overall lighter coloration, notably of the face, in the individual from Andasibe, and the conditions under which the picture had been taken. In fact, there was no clear cut demarcation of the face mask from the rest of the fur in the individual from Andasibe. But most importantly, there were differences in the head (skull) morphology with the head being smaller and less spherical in the individual from the Bongolava, and the snout more pointed. These differences were so obvious in the direct comparison that they are highly unlikely to be the result of mere individual variation.

Petter *et al.* (1977) considered the greater dwarf lemurs from the Bongolava to be a third group beside the two subspecies they recognised (*C. major major* and *C. major crossleyi*). They did not however provide a detailed morphological description or define a new taxon. They interpreted the animals as being apparently "intermediate between *C. major crossleyi* and *C. medius*" (Petter *et al.* 1977: p. 81). If consistent differences between eastern and central-western populations will be demonstrated through more extensive investigations, there are two possible systematic interpretations: Western greater dwarf lemurs are either a distinct subspecies, or an entirely new species. As long as within-population variation is not better documented, interpretations of the taxonomic status of the western populations will have to remain tentative. It should be kept in mind though, that recent studies have confirmed the existence of additional distinct taxa of *Microcebus* in western Madagascar beside the grey mouse lemur *Microcebus murinus* (Schmid and Kappeler 1994; Martin 1995; Zimmermann *et al.* 1998; S. Goodman, pers. comm.; own obs.). At least some of these western 'rufous' *Microcebus* are not only full species, but also more closely related to eastern *M. rufus* than to *M. murinus*. It is possible that the conditions, which lead to the evolution of different species of western 'rufous' mouse lemurs would also have influenced the evolution of other lemur populations. By analogy with the western 'rufous' mouse lemurs it seems likely that the western greater dwarf lemurs will prove to be an as yet undescribed new species.

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**References**

Ausilio, E. 1993. unpubl. Le projet UNESCO 507/INT/40 de la région du Bemaraha (Madagascar) - Etude d'analyse d'un projet de developpement intégré et de conservation - Participation au diagnostique écologique par l'inventaire des fôrets de Tsimembo, de l'Antsingy et de la région de Tsiandro. Paris: Univ. Paris VII/UNESCO.

Ausilio, E.; Raveloanrinoro, G. 1998. Les lémuriens de la région de Bemaraha: Forêts de Tsimembo, de l'Antsingy et de la région de Tsiandro. Lemur News 3: 4-7.

Bauchot, R.; Stephan, H. 1966. Données nouvelles sur l'encéphalisation des insectivores et des prosimiens. Mammalia 30: 160-196.

Harcourt, C.; Thornback, J. 1990. Lemurs of Madagascar and the Comoros. The IUCN Red Data Book. IUCN, Gland & Cambridge.

Martin, R.D. 1995. Prosimians: From obscurity to extinction? Pp. 535-563 in: Creatures of the Dark: The Nocturnal Prosimians. L. Alterman; G.A. Doyle; M.K. Izard (eds.) Plenum Press, New York.

Mittermeier, R.A.; Tattersall, I.; Konstant, W.R.; Meyers, D.M.; Mast, R.B. 1994. Lemurs of Madagascar. Conservation International, Washington D.C.

Müller, A. E. 1999. Aspects of social life in the fat-tailed dwarf lemur (*Cheirogaleus medius*): Inferences from bo-

dy weights and trapping data. Amer. J. Primatol. 49: 265-280.
Petter, J.-J.; Albignac, R.; Rumpler, Y. 1977. Mammifères Lémuriens (Primates Prosimiens).Vol. 44, Faune de Madagascar. Paris: ORSTOM/CNRS.
Petter, J.-J.; Andriatsarafara, S. 1987. Les lémuriens de l'ouest de Madagascar. Pp. 71-73 in: Priorités en Matière de Conservation des Espèces à Madagascar. Mittermeier, R.A.; Rakotovao, L.H.; Randrianasolo, V.; Sterling, E.J.; Devitre, D. (eds.). Gland (Switzerland): IUCN/UICN.
Rowe, N. 1996. The Pictorial Guide to the Living Primates. East Hampton, New York: Pogonias Press.
Schmid, J.; Kappeler, P.M. 1994. Sympatric mouse lemurs (*Microcebus* spp.) in Western Madagascar. Folia Primatol. 63: 162-170.
Tattersall, I. 1982. The Primates of Madagascar. Columbia University Press. New York.
Thalmann, U.; Rakotoarison, N. 1994. Distribution of lemurs in central western Madagascar, with a distribution hypothesis. Folia Primatol. 63: 156-161.
Zimmermann, E.; Cepok, S.; Rakotoarison, N.; Zietemann, V.; Radespiel, U. 1998. Sympatric mouse lemurs in northwest Madagascar: A new rufous mouse lemur species (*Microcebus ravelobensis*). Folia Primatol. 69: 106-111.

**Urs Thalmann**
Anthropological Institute University of Zurich, Winterthurerstr. 190, 8057 Zürich, Switzerland, uthal@aim.unizh.ch

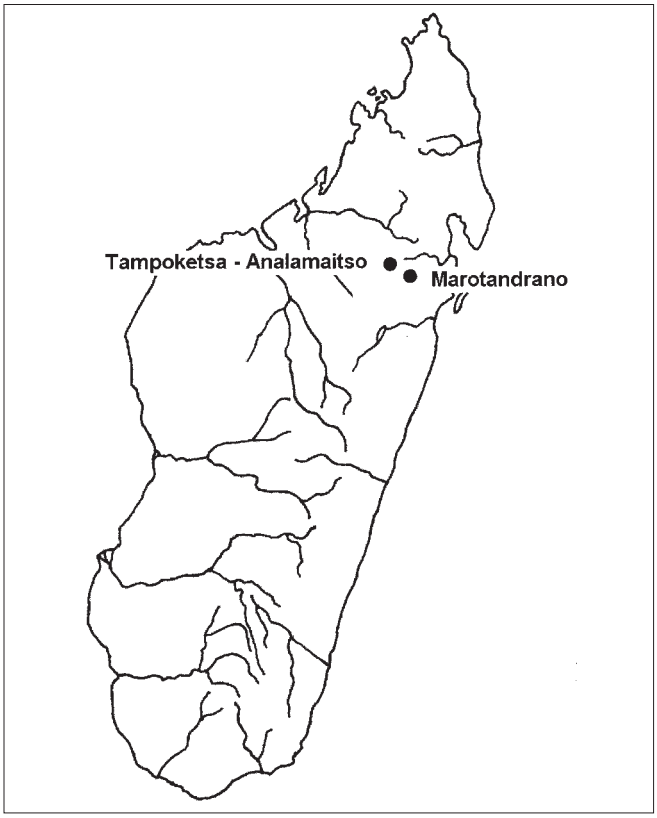
## Observations of Lemurs in the Reserve Spéciale du Tampoketsa-Analamaitso

Over the last few years lemur surveys have concentrated on forests in the peripheral belt of forests around Madagascar. Little information is available on the lemur fauna of the remaining forest fragments on the high plateau. Yet, these remnant forests on the high plateau might help to reconstract the biogeographic evolution of lemur species distributions over the island. Between July 15 and 23 Conservation International organized a rapid assessment of the Reserve Spéciale du Tampoketsa-Analamaitso. The results are being summarized and presented in a report to ONE. Only a brief summary concerning the lemurs of the sites is given here.
Three forest fragments have been surveyed for three days and nights each. The fragments are: Andohanimarovato (A), Betrandraka (B), and Mafaipandrama (C). *Eulemur fulvus fulvus* has been sighted in A and B. *Microcebus rufus* has been seen once in A. The presence of *Cheirogaleus* sp. has been indicated by local villagers, but this species was in hibernation at the time of the survey. Thus, the species composition of lemurs in the Reserve Spéciale du Tampoketsa-Analamaitso approaches the situation at Ambohitantely (Goodman and Rakotondravony 1998), though *Avahi laniger* has not been found in the RS du Tampoketsa-Analamaitso.

**References**

Goodman, S. M.; Rakotondravony, D. 1998. Les lémuriens. Pp. 213-222 in: Inventaire biologique de la forêt littorale de Tampolo (Fenoarivo Atsinanana). Ratsirarson, J. Goodman, S.M. (eds.), Recherches pour le Développement. Série Sciences Biologiques, 14. Centre d'Information et de Documentation Scientifique et Technique, Antananarivo.

**José M. Ralison**
Dépt. Biologie Animale, BP 906, Université d'Antananarivo, Madagascar.




Carte des Aives protégées surveillées par J. M. Ralison et par S. Tombomiadana & R. Rakotondravony.

## Inventaire des Lémuriens de la Réserve Spéciale de Marotandrano

Peu de données sont disponibles sur les lémuriens de la Réserve Spéciale de Marotandrano à par de celles du Projet ZICOMA dans la partie Nord de la réserve en 1998 (ZICOMA 1999). Notre article présente des informations sur les lémuriens qui se rencontrent actuellement dans la forêt d'Ambiniviny, ainsi que les différentes pressions anthropiques et naturelles qui menacent ces animaux.

**Méthodologie**

Les méthodes de transect et de piégeage (spécialement pour les petits mammifères) ont été utilisées. Les gens locaux familiers avec la forêt étaient aussi questionnés sur les lémuriens qui existent dans la région.
Une piste a été choisie à travers chaque site à étudier. Deux aller et retour sur chaque piste à une vitesse de 1 km par heure, 1 le jour et 1 la nuit, ont été effectués en enregistrant et répertoriant les individus de chaque espèce de primates observés. Au cours de l'aller, notre observation est concentré sur un côté de la piste et l'autre pendant le retours.
Les descriptions de chaque transect sont les suivantes:

- Site AA: piste choisie de long d'une montagne assez étroite où il est possible d'enregistrer les individus jusqu'aux vallées de part et d'autres du transect. La longueur de ce dernier est de 500 m;
- Site BB: nous avons choisi un transect de 500 m traversant la crête, allant du fond de la vallée d'un côté jusqu'au fond de celle de l'autre côte;
- Site CC: une piste de 500 m a été choisie le long de la crêté en traversant trois types distincts de formation végétale de la basse à la haute altitude: une formation à grands arbres, une autre à bambous très denses et un milieu rupicole dominé par des arbustes.
- Site DD: même choix que dans le site BB.

**Résultats**
En total, 11 espèces de lémuriens ont été répertoriées au cours de cette étude dans la forêt d'Ambiniviny (Tableau 1). *Avahi laniger* a été observé en dehors des nos quatre sites. *Eulemur fulvus* et *Hapalemur g. griseus* ont été observés par l'équipe de ZICOMA au nord de la réserve (Octobre 1998). La présence de *Cheirogaleus major* et *Daubentonia madagascariensis* a été signalée par la population riveraine. Ces lémuriens sont soumis à un braconnage par la population riveraine. En effet, *Varecia v. variegata* et *Indri indri* sont lourdement chassés pour l'alimentation.

Tableau 1. Liste des lémuriens recensés dans la Réserve Spéciale de Marotandrano

| | Espèces | Cet étude | Enquétes des populations riveraines |
|---|---|---|---|
| Diurne | *Varecia variegata variegata* | + | + |
| | *Propithecus diadema diadema* | + | + |
| | *Indri Indri* | + | + |
| | *Eulemur fulvus albifrons* | - | + [1] |
| | *Eulemur rubriventer* | + | + |
| | *Hapalemur griseus griseus* | - | + [1] |
| Nocturne | *Lepilemur microdon* | + | + |
| | *Avahi laniger* | + [2] | + |
| | *Microcebus rufus* | + | + |
| | *Cheirogaleus major* | - | + |
| | *Daubentonia madagascariensis* | - | + |

[1] d'après ZICOMA (1999)
[2] présence en dehors des quatre sites inventoriées mais dans la Réserve.

**Bibliographie**
ZICOMA 1999. Les Zones d'Importances pour la Conservation des Oiseaux à Madagascar. Projet ZICOMA, Antananarivo.

**Sabine Tombomiadana et Romule Rakotondravony**
Département de Paléontologie et d'Anthropologie Biologique, BP 906, Université d'Antananarivo, Madagascar

## Ruffed lemur re-stocking and conservation program update

As previously reported (Britt *et al.* 1998) an experimental re-stocking programme for the Black-and-white ruffed lemur (*Varecia variegata variegata*) is ongoing at the Betampona Natural Reserve in eastern Madagascar. The project, co-ordinated by the Madagascar Fauna Group, is currently in its third year. To date nine captive-bred *V. v. variegata* have been released into the 2228 ha lowland rain forest reserve, in an effort to reinforce the existing small wild population and to assess the ability of captive-bred individuals to adapt to a natural existence. This paper provides a review of the current status of the animals released, comments on their adaptation and a general overview of project activities. The first release took place in November 1997. Five *V. v. variegata* (3 males, 2 females) from the Duke University Primate Center were released at a site 1.5 km into the reserve. In November 1998 an additional four individuals were released. Two females from the Hogle Zoo, Utah and one male from the Wildlife Conservation Society's St. Catherine's Island were released 4 km into the reserve. The remaining female (also from St. Catherine's Island) was released with one of the males from the first group at the original release site.

**The releasees**

**Male 1** was discovered in a malnourished condition in September 1998. He was removed from the forest, held in a cage at the project's base camp and provisioned with monkey chow and fruit until he regained strength. He was re-released in the reserve four weeks later. Male 1 is currently occupying an area 1 - 2.5 km north-west of the original release site with Female 1 and their three offspring, born in October 1999.
**Male 2** was re-captured in the reserve in October 1998 and introduced to Female 3 at the base camp. The pair were released together on 25 November 1998 at the first release site 1.5 km into the reserve. Male 2 was recaptured 7 km south of the reserve boundary in November 1998 - he was re-released in the reserve, but disappeared again in December. It was assumed that he had left the reserve again and travelled out of radio-tracking range, until he was sighted one year later in the north-west of the reserve in November 1999, fully integrated into a wild group! It appears that his radio-collar was faulty, giving only a very faint signal at close range. Thus Male 2 has lived for one year in the reserve completely independent of support by project personnel, having last received chow provisioning from September to November 1998.
**Male 3** was discovered dead in August 1998 - he appeared to have broken his neck following a fall. However, subsequent histopathology examinations indicate that he was in a malnourished condition when he died, and this is likely to have contributed to his demise.
**Male 4** was re-captured seven times in the first two months post-release, persistently leaving the reserve and travelling through highly degraded secondary vegetation and cultivated land. He is currently remaining near the Km 4 release site with females 4 & 5. Male 4 has been reliant on provisioning since release.
**Female 1** was re-captured outside of the reserve in the first week post-release. Following this incident she remained within the reserve and almost certainly gave birth in October 1998, but the infant(s) were never seen. In October 1999 she gave birth to triplets - all currently thriving after four months. Female 1 received chow provisioning from September to December 1998 and again October to December 1999.
**Female 2** was killed and eaten by a Fosa (*Cryptoprocta ferox*) in March 1998.
**Female 3** remained around her release site following the disappearance of Male 2. During this period she began to attempt to associate with groups of *Eulemur fulvus albifrons*. In March 1999 she travelled into the north-west of the reserve and was last sighted close to the reserve boundary. Despite extensive searching no radio collar signal has been received since the last sighting. Her fate remains a mystery.
**Females 4 & 5** have remained in close proximity to their release site and are still reliant on provisioning more than one year post-release.

Although there is considerable individual variation in response immediately following release certain observations are common:
1. Rapid movement away from the release site;
2. Disorientation;
3. Extensive use of the ground (in comparison to the resident wild population);
4. Poor locomotion skills in the canopy (in comparison to the resident wild population);
5. Frequent falls.

In general, ground use decreases after the first few weeks, locomotion skills improve and individuals become established in a particular area where they become familiar with navigating between resources.

Table 1: Summary of the status of the nine captive-bred *V. v. variegata* released into Betampona.

| Individual | Studbook # | Date of birth | Institution | Date of release | Status |
|---|---|---|---|---|---|
| Male 1 | 536 | 24 April 85 | D.U.P.C. | 10 Nov. 97 | Surviving |
| Male 2 | 1322 | 31 March 93 | D.U.P.C. | 10 Nov. 97 | Surviving |
| Male 3 | 1745 | 14 April 96 | D.U.P.C. | 10 Nov. 97 | Dead |
| Male 4 | 1169 | 29 April 91 | St. Catherine's | 25 Nov. 98 | Surviving |
| Female 1 | 591 | 8 April 86 | D.U.P.C. | 10 Nov. 97 | Surviving |
| Female 2 | 1120 | 3 April 91 | D.U.P.C. | 10 Nov. 97 | Dead |
| Female 3 | 1376 | 1 May 93 | St. Catherine's | 20 Nov. 98 | Missing |
| Female 4 | 1170 | 1 May 91 | Hogle Zoo | 25 Nov. 98 | Surviving |
| Female 5 | 1171 | 1 May 91 | Hogle Zoo | 25 Nov. 98 | Surviving |

D.U.P.C. - Duke University Primate Center, North Carolina, St. Catherine's - Wildlife Conservation Society, St. Catherine's Island, Georgia, Hogle Zoo, Salt Lake City, Utah.

**Provisioning**

Following a soft release philosophy, all animals are provided with commercial monkey chow after release. Chow is provided in wire baskets suspended in the forest canopy. Figure 1 illustrates the importance of chow in the diets of the two release groups. Group 1 fed heavily on wild fruits immediately post-release and began to ignore the chow provided as early as December 1997- one month post-release. Provisioning was therefore discontinued in January 1998. However, following the death of Male 3 and the discovery of Male 1 in a malnourished state, provisioning was re-started in September 1998. Once again the releasees began to ignore the chow in December and it was possible to cease provisioning. No further provisioning was provided until October 1999, after the capture of Male 1 indicated a low body weight and poor condition. Provisioning was introduced again as a precautionary measure given that Female 1 was known to be pregnant. Following the birth of triplets provisioning continued until early December when the pair began to ignore the chow once more. It should be noted that Male 2 has received no provisioning since December 1998, provisioning at the end of 1999 was only for Male1 and Female 1.

Data for Group 2 show a continued reliance on provisioning one year post-release. From March 1999 the data are solely from the group released 4 km into the reserve, following the disappearance of Female 3. The trio do not range far from their release site and as a result are not encountering sufficient food resources. Reliance on provisioning decreased only at times when large quantities of fruit were available in their immediate vicinity. However, in December 1999 ranging began to increase, and it was possible to considerably reduce the amount of chow given. It is hoped that this trend will continue.

The data presented in Figure 1 indicate that released captive-bred *V. v. variegata* require support in the form of supplemental feeding at particular times of the year. Group 1 animals lost condition during the winter period (July - September) when fruit availability was poor, so provisioning was indicated. During both years Female 1's pregnancy was another factor in the team's decision to offer supplemental feeding. However, Male 2 demonstrates that unassisted survival after release is possible for this species. The continued reliance on provisioning by the second release group is in sharp contrast to the situation with Group 1. The members of release Group 2 have been remarkably reluctant to travel in search of food. Various strategies have been employed to encourage increased ranging, including delaying provisioning until the end of the day, regularly moving feeding baskets and reducing the amount of chow provided. These strategies have had only limited effect.

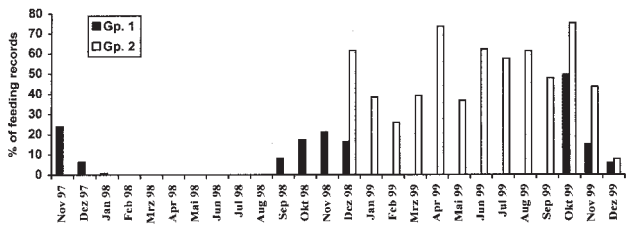



Fig. 1: Provisioning of the two release groups. Bars represent feeding observations on chow as a percentage of total feeding observations each month.

**Integration with wild groups**

To date only one of the nine released animals has integrated with the wild population. Male 2 was re-discovered in the north of the reserve (over 4 km from original release site) one year after he vanished following a radio-collar failure. He was first sighted with a young female and has subsequently been sighted with two other adults. Interactions observed have been affiliative. In February a female and one young were also sighted in the same area where Male 2 is regularly located.

Most other interactions with the wild population have been agonistic, the exception being the observation of a brief episode of mutual grooming between Female 1 and a wild adult female in 1999. Male 1 has had a number of aggressive encounters with wild males, including driving a wild male away from Female 1 when she came into oestrus in July 1999. If Male 1 had not been present it is probable that there would have been mating between the wild and released lemurs. Female 1 had a number of fights with wild females in the first few months following her release, and Male 4 was attacked by a wild group when he strayed into their territory. Females 4 & 5 have not been observed in any contact with wild individuals.

**Additional research**

The project team are involved in a number of other studies in addition to the collection of behavioural and habitat use data from the released and wild *V. v. variegata*. Survey work is underway in the north of the reserve to obtain an accurate estimate of the size of the *V. v. variegata* population there. Data on group size and composition, plus habitat use are collected opportunistically on all the lemur species present at Betampona. The phenophases of the most important 35 food source tree species are recorded monthly. Analysis of the first 12 months of phenology data is in progress, and it will be very interesting to look more closely at the correlation between monthly fruiting patterns and the reliance of the released *V. v. variegata* on provisioning. Further botanical studies are also in progress to enable a better understanding of the habitat requirements of *V. v. variegata*.

A grant awarded from the St. Louis Zoo Conservation Fund has enabled an American student, Kellie Glasscock, to carry out a survey of the *Indri indri* population at Betampona, and to begin preliminary behavioural and habitat use studies of a number of groups. Also funded by St. Louis Zoo is a project to carry out a nutritional analysis of *V. v. variegata* diet, in collaboration with nutritionists at the University of Missouri-Columbia. This involves the collection, preparation, drying and packaging of up to 100 fruits consumed by *V. v. variegata* at Betampona and their nutrient analysis.

**Other project activities**

The project is collaborating closely with the Association Nationale pour la Gestion des Aires Protegées (ANGAP) to ensure the continued protection and sound management of the Betampona reserve. Close links are also maintained with the local community, through an environmental education programme and an agricultural development programme organised by the Environmental Education Centre of Parc Zoologique Ivoloina. The aim of both these initiatives is to

reduce human pressure on the reserve and encourage the adoption of sustainable land use practices.
Other activities include the establishment of a tree nursery for rain forest species and a demonstration plantation plot at the project base camp. The aim of this is to identify tree species that are relatively easy to grow, that grow rapidly, and provide wood that is useful for a variety of local needs. It is hoped to encourage local people to begin reforestation using endemic tree species. This work will also be extended in the future to attempt to regenerate degraded areas within the reserve in collaboration with ANGAP and the Ministère des Eaux et Forêts.

**Conclusion**
The project has demonstrated that captive-bred *V. v. variegata* can adapt to a wild existence, although close monitoring and occasional intervention in the form of additional feeding are necessary. As yet it is unclear how long such intervention will be required. The collection of data for at least several more years will be necessary to truly evaluate both reproductive success and wild feeding adaptation by the released individuals and their offspring. The encouraging sign is that Male 2 has existed without any assistance for more than a year now. It is likely that he has benefited greatly from the experience of the members of the wild group into which he has integrated. Although the successful birth and rearing of triplets by Female 1 did involve supplemental feeding during her pregnancy and early lactation, it is still very encouraging that all three infants have survived past weaning, given the high infant mortality characteristic of this species. The progress of the triplets will be followed with interest in years to come. Unfortunately, the second release group have been much slower to adapt to their natural habitat, although the first positive signs that they are beginning to become more efficient at locating food have been observed in the last few months. The third and last release of captive-bred *V.v.variegata* in this phase of the project is planned for November 2000.

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**Reference**
Britt, A.; Welch, C.; Katz, A. 1998. The first release of captive-bred lemurs into their natural habitat. Lemur News 3: 8-11.

**Adam Britt**
Research Co-ordinator, Madagascar Fauna Group, B.P. 442, Tamatave (501), Madagascar

**Charles Welch**
Betampona Project Director and Technical Advisor, Madagascar Fauna Group and the Duke University Primate Center, B.P. 442, Tamatave (501), Madagascar

**Andrea Katz**
Technical Advisor, Madagascar Fauna Group and the Duke University Primate Center, B.P. 442, Tamatave (501), Madagascar

## Encounter Rate Estimates on *Lepilemur leucopus* and *Microcebus murinus* at Beza Mahafaly Special Reserve, Southwestern Madagascar

*Lepilemur leucopus*, has previously been studied only in southeast Madagascar, at Berenty, where population densities were found to be higher in the gallery forest than in the spiny forest (Charles-Dominique and Hladik 1971; Russell 1978). This report provides systematic censuses for this species and the sympatric *Microcebus murinus* in the southwest, at Beza Mahafaly Special Reserve, about 35 km north east of Betioky. The forest of Parcel 1 at Beza shows a habitat gradient moving away from a river from more to less moist soils, with associated vegetation differences. The density of the frugivorous ring-tailed lemurs (*Lemur catta*) is higher in the moister end of the reserve and groups have smaller ranges (Sussman 1991). It was expected that neither the folivorous *Lepilemur* nor the more insectivorous *Microcebus* would respond to the habitat gradient in the same fashion. This study also contrasted encounter rates for both species inside the fenced reserve and in adjacent areas outside the fence, since the latter probably has higher habitat disturbance.
Since increased moonlight may increase the activity, and thus detectability, of nocturnal primates (Nash 1986), the effect of moon phase on census results was examined. *Lepilemur* is less active in the cool, dry season than in the warm, wet season at Beza (Nash 1998) and elsewhere *Microcebus* may show torpor in the cool season (Atsalis 1998; Ganzhorn and Schmid 1998), so the effect of season on census results was also tested.

**Methods**
Parcel 1 is about 100 ha of gallery forest with its narrow eastern border at the Sakamena River and extending about 1.2 km to the west. Compared to the west end of the reserve, tree density, number of tree species, and tree species diversity of the eastern end is lower while large trees (dbh >25 cm) are over twice as frequent in the east (Sussman and Rakotozafy 1994). Rainfall seasonality has been described in detail elsewhere during the period of this study (September, 1992 - July, 1993) (Nash 1998). A warm, wet season ran from October to mid-April and a cool, dry season for the remaining period.
Within the reserve, nine census walks were conducted during the study on the established 100m square grid of trails (*Microcebus* data were collected on the final eight walks). The mean path length was 1.4 km (SD = 0.2 km). Walks (c. 1.4 km each) began at dusk, when *Lepilemur* first left it's sleeping place, and had an average walking pace of 385 m/hr. Four of the walks were conducted in the drier west end; five were conducted in the moister east end. Eight of walks were paired to match them for season and moon phase. One walk

was conducted in late November, four were in March, two were in mid-June, and two were in early July. Two other walks (0.75 and 0.92 km long) were conducted in early July just outside of but within 200 m of the southeast edge of the fenced reserve on established trails. The impact of human disturbance was qualitatively much higher there, as cattle and goats were frequently in this area and were excluded from the reserve by the fence.

Each side of the path was scanned with the help of an assistant using headlamps which revealed the eye shine of the nocturnal prosimians at distances of up to 100 m. Species were identified by sight of the body or based on their very different patterns of eye shine (eye size, quality of movement). The presence of either species was measured as abundance or "encounter rate", i.e. the number of individuals seen per km of census. This estimate of the population can be compared across sites, e.g. Ganzhorn (1995). For *Lepilemur* only, notations were made of a distinctive loud call (Hladik and Charles-Dopminique 1974). Within each 100 m path segment, on a one/zero basis, calls occurrence was were noted at each of the four cardinal directions, or direction unclear, and at three subjective loudnesses (distance: near, medium, far) giving a maximum score of 15/m. Results would have been the same for only calls heard 'near'.

Analyses of differences between seasons, moon phases, and the two areas of the reserve were done using randomization (permutation) tests of the difference between the medians of the relevant census walks (Adams and Anthony 1996; Edgington 1980). Given the small sample sizes, the tests necessarily have relatively low power, so these results should be considered as tentative.

## Results

With the exception of slightly higher encounter rate of *Lepilemur* in the full moon, moon phase and season did not seem to effect census results (Tab. 1).

Table 1: Relationship of Season, Moon Phase, and Habitat Gradient with *Lepilemur* and *Microcebus* Encounter Rates (# / km) and with *Lepilemur* Calling Incidence.

| | **Seasons** | | | | |
|---|---|---|---|---|---|
| | **Warm/wet** | | **Cool/dry** | | |
| | **median** | **range** | **median** | **range** | **p** |
| *Lepilemur* / km | 14.3 | 7.5 - 15.3 | 10.0 | 8.1 - 16.4 | 0.267 |
| *Microcebus* / km | 10.3 | 6.7 - 17.3 | 9.6 | 5.3 - 13.6 | 0.736 |
| | **Moon phase** | | | | |
| | **Dark** | | **Full** | | |
| | **median** | **range** | **median** | **range** | **p** |
| *Lepilemur* / km | 9.3 | 7.5 - 14.5 | 14.8 | 10.7 - 16.4 | 0.093 |
| *Lepilemur* calls | 3.6 | 2.8 - 4.9 | 4.9 | 2.0 - 8.1 | 0.532 |
| *Microcebus* / km | 9.6 | 6.7 - 17.3 | 10.3 | 5.3 - 13.6 | 0.743 |
| | **Habitat gradient** | | | | |
| | **West/dry** | | **East/moist** | | |
| | **median** | **range** | **median** | **range** | **p** |
| *Lepilemur* / km | 14.3 | 8.1 - 16.4 | 10.0 | 9.3 - 15.3 | 0.275 |
| *Lepilemur* calls | 4.3 | 2.4 - 7.4 | 3.2 | 2.0 - 8.1 | 0.652 |
| *Microcebus* / km | 13.3 | 12.5 - 17.3 | 6.7 | 5.3 - 7.6 | 0.055 |

Concerning the vegetation gradient, when encounter rates and calling incidence of *Lepilemur* did not differ for the two ends of the reserve (Tab. 1). However, *Microcebus* showed a trend toward larger encounter rates in the drier half of the reserve with no overlap of values from the two ends of the reserve. Also, for each north-south 'strip' of the reserve demarcated by the grid of paths, the *Microcebus* encounter rate was positively related to the strip's distance away from the river (Spearman rank correlation: $r_s = 0.30$, $p = 0.002$, $N=126$).

The measures on *Lepilemur* suggest that its presence was higher within the reserve than in the degraded area just outside the fenced reserve. The median encounter rate from outside the reserve, 8.75/km, falls below the within-reserve median, 11.7/km, and near the low end of the range (Tab. 1). *Lepilemur* calling incidence showed the same pattern. In marked contrast, *Microcebus* appeared to have a higher presence *outside* the reserve than inside it. Median and maximum encounter rates for *Microcebus* within the reserve were 10.1/km and 17.3 km, respectively, while the median rate from outside the reserve was 17.5/km.

## Discussion

These results must be considered as preliminary because the available sample size (number of censuses) was low. Even though there is a seasonal shift in activity level in *Lepilemur* (Nash 1998), there was no seasonal shift in the ability to detect them during the surveys. This is probably because *Lepilemur* were usually detected sitting, not moving. The absence of a seasonal shift in detectability in *Microcebus* was found elsewhere but not here (Fietz 1998). This may be because censuses were in the early dry season, prior to the onset of torpor (Schmid 1998).

The absence of a difference in detection of both species relative to moon phase might suggest that moon phase does not influence activity levels. In contrast, galagos are more active at night during the brighter time of the moon (Nash 1986). This hypothesis will be tested against more direct observations of individually radio-tracked individuals for *Lepilemur* at Beza.

The habitat gradient at Beza seems to affect *Lemur catta*, *Lepilemur* and *Microcebus* differently. This deserves further study given the sample sizes here, but is likely related to differences in diet between these species relative to the vegetation at Beza. Like *Lepilemur*, *Propithecus verreauxi verreauxi* is highly folivorous. However, at Beza it may have larger groups, smaller ranges, and higher population density in the west end of the reserve (Sussman and Rakotozafy 1994; Kubzdela pers. comm.). More information for both *Propithecus* and mouse lemur on both abundance and resource use in the two ends of the reserve at Beza would be of interest.

Habitat degradation adversely impacting *Lepilemur* populations has been shown by Ganzhorn (Ganzhorn 1993; 1995; Ganzhorn *et al*. 1997). In contrast, the higher abundance of *Microcebus* in the west end of the reserve and outside the reserve is similar to other studies suggesting this species tolerates some disturbance (e.g. low intensity logging) or forest edges (Ganzhorn 1995; Hladik *et al*. 1980). Homopteran secretions, an important dry season resource for *Microcebus*, may be more available in such areas (Corbin and Schmid 1995). However, *Microcebus* may decrease in abundance in secondary forests, possibly because they have more difficulty entering torpor and reproducing there (Ganzhorn and Schmid 1998; Schmid 1998). Thus, habitat factors influencing their abundance are complex.

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## References

Adams, D.; Anthony, C. 1996. Using randomization techniques to analyze behavioral data. Anim. Behav. 51: 733-738.

Atsalis, S. 1998. Feeding Ecology and Aspects of Life History in *Microcebus rufus* (Family Cheirogaleidae, Order Primates) Unpub. Ph.D. dissertation, City Univ. of New York.

Charles-Dominique, P.; Hladik, C. 1971. Le *Lepilemur* du sud de Madagascar: ecologie, alimentation et vie sociale. Terre et la Vie 1: 1-66.

Corbin, G.D.; Schmid, J. 1995. Insect secretions determine habitat use patterns by a female lesser mouse lemur (*Microcebus murinus*). Amer. J. Primatol. 37: 317-324.

Edgington, E. 1980. Randomization Tests. Marcel Dekker, Inc. New York.

Fietz, J. 1998. Body mass in wild *Microcebus murinus* over the dry season. Folia Primatol. 69, Suppl. 1: 183-190.

Ganzhorn, J.U. 1993. Flexibility and constraints of *Lepilemur* ecology. Pp. 153-165 in: Lemur social systems and their ecological basis. P.M. Kappeler, J.U. Ganzhorn (eds.). Plenum Press. New York.

Ganzhorn, J.U. 1995. Low-level forest disturbance effects on primary production, leaf chemistry, and lemur populations. Ecology 76: 2084-2096.

Ganzhorn, J.U.; Malcomber, S.; Andrianantoanina, O.; Goodman, S.M. 1997. Habitat characteristics and lemur species richness in Madagascar. Biotropica 29: 331-343.

Ganzhorn, J.U.; Schmid, J. 1998. Different population dynamics of *Microcebus murinus* in primary and secondary deciduous dry forests of Madagascar. Int. J. Primatol. 19: 785-796.

Hladik, C.M.; Charles-Dominique, P. 1974. The behavior and ecology of the sportive lemur (*Lepilemur mustelinus*) in relation to its dietary peculiarities. Pp. 23-27 in: Prosimian Biology. R. Martin; G. Doyle; A. Walker (eds). Duckworth. London.

Hladik, C.M.; Charles-Dominique, P.; Petter, J-J. 1980. Feeding strategies of five nocturnal prosimians in the dry forest of the west coast of Madagascar. Pp. 41-73 in: Nocturnal Malagasy Primates. P. Charles-Dominique (ed.). Academic Press. New York.

Nash, L.T. 1986. Influence of moonlight level on traveling and calling patterns in two sympatric species of Galago in Kenya. Pp. 357-367 in: Current Perspectives in Primate Social Dynamics. D. Taub; F. King (eds.). Van Nostrand Reinhold Co. New York.

Nash, L.T. 1998. Vertical clingers and sleepers: Seasonal influences on the activities and substrate use of *Lepilemur leucopus* at Beza Mahafaly Special Reserve, Madagascar. Folia Primatol. 69, Suppl.1: 2 04-217.

Russell, R. 1978. The behavior, ecology and environmental physiology of a nocturnal primate, *Lepilemur mustelinus* (Strepsirhini, Lemuriformes, Lepilemuridae) Unpub. Ph.D. dissertation, Duke University.

Schmid, J. 1998. Tree holes used for resting by gray mouse lemurs (*Microcebus murinus*) in Madagascar: Insulation capacities and energetic consequences. Int. J.Primatol. 19: 797-810.

Sussman, R.W. 1991. Demography and social organization of free-ranging *Lemur catta* in the Beza Mahafaly Reserve, Madagascar. Amer. J. Phys. Anthropol. 84: 43-58.

Sussman, R.W.; Rakotozafy, A. 1994. Plant diversity and structural analysis of a tropical dry forest in southwestern Madagascar. Biotropica 26: 241-254.

**Leanne Nash**
Department of Anthropology, Arizona State University, Box 872402, Tempe, AZ 85287-2402 USA, **leanne.nash@asu.edu**

# FUNDING AND TRAINING

## Primate Conservation Incorporated - Call for Grant Proposals

Primate Conservation, Incorporated (PCI) is a non-profit foundation which funds field research that supports conservation programs for wild populations of primates. Priority will be given to projects that study, in their natural habitat, the least known and most endangered species. The involvement of citizens from the country in which the primates are found will be a plus. The intent is to provide support for original research that can be used to formulate and to implement conservation plans for the species studied. Eligibility: Primate Conservation, Inc. will grant seed FUNDING monies or provide matching grants for graduate students, qualified conservationists and primatologists to study rare and endangered primates and their conservation in their natural habitat. Grants have averaged approximately $2,200, with a maximum grant of $5,000. We do not support conferences, travel to scientific meetings, legal actions, tuitions or salaries at institutions, and overhead costs. Selection Criteria: Proposals are evaluated on a competitive basis. Applications are screened by outside reviewers and the Board of Directors of PCI. All appropriate projects will be considered, but the regions of current interest are Asia and west Africa. Application Procedure: Grant applicants should write for applications materials. Application materials are updated from time to time, contact the office for the most recent applications and guidelines. Please submit five copies of our standard cover sheet and your proposal. Proposals are to be submitted typed, double spaced, in English. Deadlines: Please note the following changes in the deadlines for grant applications. All applications for consideration must be at PCI on 20 September for the Fall granting period or 10 February for the Spring. In fairness to other applicants please do not ask for exceptions to these deadlines. Awards will be given May 15 and December 15. For an application or more information please contact Noel Rowe or Abigail Barber at: Primate Conservation Inc., 163 Town Lane, East Hampton, New York 11937-5000 USA, Tel: 516 267 6856, Fax 516 267 6856, **74225.2342@compuserve.com**.

## The Lincoln Park Zoo Scott Neotropic and Africa/Asia Fund

The Lincoln Park Zoo Scott Neotropic and Africa/Asia Funds support field research in conservation biology around the world. The Scott Neotropic fund focuses on projects undertaken in Latin America and the Caribbean. The fund emphasizes the support of graduate students and other young researchers, particularly those from Latin America. Since 1986, the fund has awarded over 126 grants in 19 countries. The Africa/Asia fund, launched in 1997, focuses on projects throughout Africa, Asia, and the Pacific. Each fund supports projects of young conservation biologists and between five and 15 projects for each fund are supported each year. The fund awards are seldom greater than US$7500, and most awards fall in the range of $3000-$6000. Initial support is for up to 12 months from the date of award, and the maximum duration of support is two years. For additional information and application procedures go to **www.lpzoo.com; steveed@ix.netcom.com**, or write to: LINCOLN PARK ZOO SNF/AA FUNDS, c/o Director of Conservation and Science, Lincoln Park Zoo, Chicago, IL 60614.

## Master's Course in Primate Conservation

Oxford Brookes University, Oxford, UK, is planning a Master's Course in Primate Conservation to begin in September 2000. The one-year Master of Science course will involve the School of Social Sciences and Law and the School of Biological and Molecular Sciences, combining the expertise of anthropologists and biologists to examine primate conservation biology in a broad context, with particular emphasis on the interrelationships between humans and wildlife in forest and woodland environments. Topics include: Primate diversity and biogeography; Socio-political aspects of conservation; Conservation education; Primate conservation genetics; Habitat protection and sustainable use; Fieldwork training and methodology; Museum studies; Primates in captivity.

If you are interested in this programme and would like to receive further information, please contact Prof. Simon Bearder (address below) or Dr. Helen Lantsbury, hlantsbury@brookes.ac.uk.

**Simon Bearder**, Professor of Anthropology, School of Social Sciences and Law, Oxford Brookes University, Oxford OX3 0BP, UK, Tel: +44 (0)1865 483760; Fax: +44 (0)1869 483937 (work), skbearder@brookes.ac.uk.

# MEETINGS

**Animal Behavior Society 2000**, 5-10 August 2000, Moorhouse Colleg, Atlanta, Georgia. For further information: www.cisab.indiana.edu/animal_behavior.html.

**3rd International Symposium-Workshop on Frugivores and Seed Dispersal**: **Biodiversity and Conservation Perspectives**, 6-11 August, 2000, Hotel Fazenda Fonte Colina Verde, São Pedro, São Paulo, Brazil. Contact: Dr. Wesley Silva or Dr. Mauro Galetti, frug2000@unicamp.br. http://www.unicamp.br/ib/f2000.

**Measuring Behavior 2000 - 3rd International Conference on Methods and Techniques in Behavioral Research**, 15-18 August, 2000, Nijmegen, The Netherlands. For more information: Wineke Schoo, Measuring Behavior 2000, PO Box 268 6700, AG Wageningen, The Netherlands, Tel: +31 317 497677, Fax: +31 317 424496, mb2000@noldus.nl, or w.schoo@noldus.nl; www/noldus.com/events/mb2000/.

**Integrating Ecological and Evolutionary Processes**, 29-31 August 2000, Royal Holloway College, London, UK. Organized by the British Ecological Society. For more information: British Ecological Society, 26 Blades Court, Deodar Road, Putney, London SW15 2NU, England, UK.

**Association for the Study of Animal Behaviour - Winter Meeting**, 30 November - 1 December, 2000, Zoological Society of London Meeting Rooms, London, UK. Organised by André Gilburn. Theme: "Sexual Conflict". For further information: Dr. André S. Gilburn, Department of Biology, University of Leicester, Adrian Building, University Road, Leicester LE1 7RH, England, UK, Tel: +44 (0)116 252 3488, Fax: +44 (0)116 252 3330.

**British Ecological Society '2000' Winter Meeting**, 3-5 January 2001, University of Birmingham, England, UK. For more information: British Ecological Society, 26 Blades Court, Deodar Road, Putney, London SW15 2NU, England, UK.

**XVIIIth Congress of the International Primatological Society**, 7-12 January 2001, Adelaide, Australia. Hosted by the Australasian Primate Society, President Mr. John Lemon, Western Plains Zoo, Dubbo, NSW. Theme: "Primates in the New Millenium". Mr. Graeme Crook is Chairman of the Organizing Committee. *Symposia* - Participants wishing to register a symposium title must submit a 200 word abstract by 31 July 1999. E-mail to Carla Litchfield aclitch@terra.net.au. Titles of accepted symposia will be published on the webpage from August 1999. *Papers* - An abstract of 100 words is required. E-mail to Carla Litchfield aclitch@terra.net.au. Closing date for first call for papers: 31 January 2000. Closing date for second call for papers: 31 May 2000. A final list of papers will be published on the Internet by 30 June 2000. For more information, and to be put onto the Congress Organizer's mailing list, write to: Conventions Worldwide, PO Box 44, Rundle Mall, SA 5000, Australia, Tel: +61 8 8363 0068, Fax: +61 8 8363 0354, satconv@camtech.net.au, sending your postal address.

**Association for the Study of Animal Behaviour - Spring Meeting 2001**, University of Liverpool, Liverpool, UK. Organized by Jane Hurst. For more information.: Prof. J. Hurst, Division of Animal Husbandry, Faculty of Veterinary Science, University of Liverpool, Leahurst, Neston, South Wirral L64 7TE, England, UK,
Tel: +44 (0)151 7946100, Fax: +44 (0)151 7946107,
jane.hurst@liv.ac.uk.

**Association for the Study of Animal Behaviour - Summer Meeting 2001**, University of Glasgow, Scotland, UK. Organized by Felicity Huntingford. Theme: "Interfacing Behaviour with Other Disciplines". For more information: Prof. F. A. Huntingford, Division of Environmental and Evolutionary Biology, Graham Kerr Building, Glasgow University, Glasgow G12 8QQ, Scotland, UK,
Tel: +44 (0)141 330 5968, Fax: +44 (0)141 330 5971,
f.huntingford@bio.gla.ac.uk.

# RECENT PUBLICATIONS

### Books on Lemurs

**New Directions in Lemur Studies**, edited by B. Rakotosamimanana, H. Rasamimanana, J.U. Ganzhorn, S.M. Goodman 1999. 295 pp. Kluwer/Plenum. ISBN 0-306-46187-0. This book assembles a series of chapters that are based on papers presented at the XVIIth International Primatology Society (IPS) Congress held in Antananarivo in August 1998. Chapters cover: Ancient DNA in Subfossil Lemurs: Methodological Challenges and their Solutions (A.D. Yoder, B. Rakotosamimanana, T.J. Parsons); Past and Present Distributions of Lemurs in Madagascar (L.R. Godfrey, W.L. Jungers, E.L. Simons, P.S. Chatrath, B. Rakotosamimanana); Skeletal Morphology and the Phylogeny of the Lemuridae: A Cladistic Analysis (G.F.N. Randria); Support Preference of Two Sympatric Lemur Species: *Propithecus v. verreauxi* and *Eulemur fulvus rufus* (L. Razafimanantsoa); Field Metabolic Rate and the Cost of Ranging of the Red-tailed Sportive Lemur (*Lepilemur ruficaudatus*) (S. Drack, S. Ortmann, N. Bührmann, J. Schmid, R.D. Warren, G. Heldmaier, J.U. Ganzhorn); Metabolic Strategy and Social Behavior in Lemuridae (M.E. Pereira, R.A. Strohecker, S.A. Cavigelli, C.L. Hughes, D.D. Pearson); Cathemeral Activity of Red-fronted Brown Lemurs (*Eulemur fulvus rufus*) in the Kirindy Forest/CFPF (G. Donati, A. Lunardini, P. M. Kappe-

ler); Social Organization of the Fat-tailed Dwarf Lemur (*Cheirogaleus medius*) in Northwestern Madagascar (A.E. Müller); Demography and Floating Males in a Population of *Cheirogaleus medius* (J. Fietz); Influence of Social Organization Patterns on Food Intake of *Lemur catta* in the Berenty Reserve (H. Rasamimanana); The Importance of the Black Lemur (*Eulemur macaco*) for Seed Dispersal in Lokobe Forest, Nosy Be (Ch.R. Birkinshaw); Taste Discrimination in Lemurs and other Primates, and the Relationships to Distribution of Plant Allelochemicals in Different Habitats of Madagascar (B. Simmen, A. Hladik, P.L. Ramasiarisoa, S. Iaconelli, C.M. Hladik); Folivory in a Small-bodied Lemur: The Nutrition of the Alaotran Gentle Lemur (*Hapalemur griseus alaotrensis)* (T. Mutschler); Conservation of the Alaotran Gentle Lemur: A Multi-disciplinary Approach (A.T.C. Feistner); Teaching Primatology at the Université de Mahajanga (NW Madagascar): Experiences, Results, and Evaluation of a Pilot Project (U. Thalmann, A. Zaramody); Lemurs as Flagships for Conservation in Madagascar (J.C. Durbin).

**Primate Ecology and Social Structure. Vol. 1: Lorisis, Lemurs and Tarsiers**, by R.W. Sussman 1999. Pearson Costum Publishing (**www.pearson.com**) US$ 41.95. In this book R.W. Sussman reviews the literature on free-ranging prosimians. First, these animals are characterized as they exist in their most undisturbed state. These features are compared to behavior in disturbed situations and captivity, when relevant. This pseudoexperimental approach is taken to gain a better understanding of the reasons primates behave as they do and the ways they fit into the communities in which they live. Chapter 1 discusses the concept of an ecosystem and describe some of the general types of interactions that occur between the various components of ecosytems. Primates are highly social animals and the way animals space themselves in the environment and reproduce is related to other aspects of their ecology. The study of these relationships is referred to as socioecolgy. Some of the terms and theories used in socioecology are discussed at the end of the chapter and further explored in later chapters. The second chapter gives overviews over the taxonomy of primates, their morphological characteristics, and the evolutionary history of the earliest primates. The following chapters review the literature on the galagos and lorises, nocturnal Malagasy lemurs, diurnal Malagasy lemurs, and the tarsiers. The general organization of each of these review chapters is similar in order to facilitate comparisons. It includes aspects of activity cycles, habitat and locomotion, diet, predation, social organization, ranging behavior and conservation. In the final chapter, cross-taxonomic comparisons are made of each of the topics discussed in the review chapters. A second volume **Primate Ecology and Social Structure. Vol. 2: New World Monkeys** also is available, with much the same organization. A forthcoming third volume will cover the Old World Monkeys and Apes.

**Books and Journal volumes of General Interest**

**Inventaire biologique de La réserve Spéciale du Pic d'Ivohibe et du Couloir Forestier qui la relie au Parc National d'Andringitra**, by S. M. Goodman; Rasolonandrasana, B.P.N., 1999. Recherches pour le Developpement. Série Sciences Biologiques Vol. 15, Antananarivo. 181 pp.

**A Floral and faunal Inventory of the Réserve Naturelle Intégrale d'Andohahela, Madagascar**: With Reference to Elevational variation, edited by S.M. Goodman, 1999. Fieldiana, Zoology New Series N° 94. Field Museum of Natural History, Chicago.

**Plantes utiles des hautes terres de Madagascar**, by J.-M. Samyn, 1999. Graphoprint, Antananarivo. The book presents a collection of 75 plant species used for various purposes by people on the high plateau. All species are illustrated nicely with photographs. Available through J.-M. Samyn, Programme FDP, BP 3044, Antananarivo 101, **fdp@dts.mg**, or two bookshops in Switzerland and Germany: **www.koeltz.com** or **www.krypto.ch**.

**Walker's Primates of the World**, by Ronald M. Nowak, 1999, 272pp., 179 photos. The Johns Hopkins University Press, Baltimore. ISBN 0-8018-6251-5. US$19.95 (paperback). Introduction by PSG Chairman R.A. Mittermeier, A.B. Rylands and W.R. Konstant. A comprehensive guide to the primates, includes scientific and common names, the number and distribution of species, measurements and physical traits, habitat, daily and seasonal activity, population dynamics, home range, social life, reproduction, longevity, and status of threatened species. Recently extinct genera, such as the giant lemurs of Madagascar, are covered in full. Textual summaries present accurate,well-documented descriptions of the physical characteristics and living habits of primates in every part of the world. The introduction discusses the diversity, taxonomy and distributions of primates as well as their distinguishing characteristics, special adaptations and particularly striking features, such as sociality. Also discussed are conservation efforts, past and future, and the factors that are threatening many species with extinction. Available from: The Johns Hopkins University Press, Sales Department, 2715 N. Charles Street, Baltimore, MD 21218-4319,USA, Tel: +1 410 516 3864, Fax: +1 410 516-6998, **jpigza@mail.press.jhu.edu**.

**Primate Communities**, edited by J.F. Fleagle; C.H. Janson and K. Reed 1999, 329pp. Cambridge University Press, Cambridge. ISBN 0-521-62967-5 (paperback, also available as hardback), US$ 29.75. Contributers to the book compare the composition, behavior and ecology of primate communities around the world. They examine the factors underlying the similarities and differences between these communities, including phylogenetic history, climate, rainfall, soil type, forest composition, competition with other vertebrates and human activities.

**Lucy's Legacy: Sex and Intelligence in Human Evolution**, by A. Jolly, 1999, 518pp. Harvard University Press, Cambridge. ISBN 0-674-00069-2. US$29.95 (hard cover). This book describes everything (or almost everything) you ever wanted and ought to know about the evolution of sex and intelligence in primates. It is not a textbook but you will memorize much more of this book than from any more formal text. It is Alison Jolly at her best.

**International Zoo Yearbook**, edited by P.J.S. Olney and F.A. Fisken, The Zoological Society of London, is an international forum for the exchange of information amongst zoos. Section 1 of Volume 36 (663pp., 23 plates, 50 figures) has been published recently. As in all the Yearbooks published to date, there is a special section which in this volume is dedicated to Old World Primates. It contains 17 articles relating to husbandry, management and status of Old World primates, including reviews of behavioural studies. Management of gentle lemurs, husbandry and breeding of douc langurs, and the conservation and management of orang-utans are reported, and a practical model of the possible form and content of a husbandry manual, using slender loris as an example, is provided. A review on behavioural studies of guenons, observations on hand modulation of vocalization in siamangs, the behavioural response of a group of western lowland gorillas to the death of the silverback male and the ef-

fects of group structure ad rearing strategy on personality in chimpanzees are presented. Individual reports are also given on the status of three threatened species, gelada baboon, moloch gibbon and orang-utans. Exhibit design is examined in articles on the redevelopment of a disused enclosure to make it suitable for Sulawesi crested macaques, and a mixed-species exhibit which provides an appropriate social and physical environment for both an arboreal and a terrestrial species, the eastern black-and-white colobus and patas monkeys, respectively. Section 1 ends with articles on environmental enrichment and nutritional management, with special consideration for vitamin D.

Section 2 begins with an innovative paper on the development of key performance indicators as bench-marks for progress in order to improve overall organizational management in zoos. The other 12 articles cover a wide range of non-primate species. Section 3 comprises a list of Zoos and Aquariums of the World, an updated list of national zoo associations, the list of vertebrate species bred in captivity in 1995 and 1996, the census of rare animals in captivity as at January 1996 and 1997 and the summary list of authorized international studbooks and registers. A list of taxonomic authorities consulted in the Yearbook, author and subject indexes complete the volume.

The Book is available from: The Zoological Society of London, Dept. IZY, Regent's Park, London NW1 4RY. UK, Fax: (0)171 449 6411. The price is £65.00 or US$120.00 (+ postage outside UK at £4.50 or US$9.00). Also available is an offprint of the List of Zoos and Aquariums of the World, price £18.50 or US$35.00 (+ postage outside UK at £1.50 or US$3.00).

**Biodiversity: An Introduction**, by K.J. Gaston and J.I. Spicer 1998, 128pp. 42 illustrations. Blackwell Science, Oxford. Paperback ISBN 0-63204-953-7. Price: £9.95. A student textbook - the ideal core text for short modular courses in biodiversity and conservation. Contents: What is biodiversity?; Biodiversity through time; Mapping biodiversity; Does biodiversity matter?; Maintaining biodiversity; Index. Available from: Anna Van Opstal, Blackwell Science Ltd., Osney Mead, Oxford OX2 0EL, UK, Tel: +44 (0)1865 206206, Fax: +44 (0)1865 721205. **www.blackwell-science.com.**

**Conservation of Biological Resources**, by E.J. Milner-Gulland and R. Mace (with contributors) 1998, 416pp., 114 illustrations. Blackwell Science, Oxford. Paperback ISBN 0-86554-2738-0. Price: £24.95. A student textbook presenting the issues surrounding the biological conservation of species and ecosystems used by humans. It is aimed at final year undergraduate and Master's level students as well conservation professionals, including managers, policy-makers and researchers. Contents: Part One. Introduction to Biological Conservation and Sustainable Use. Part Two. Theoretical Background. 1. The ecological and economic theory behind sustainable harvesting. 2. Harvesting and ecological realities. 3. Decision-making by users of natural resources. 4. Practical considerations when applying the theory. Part Three. Case Studies. Part Four. Making Conservation Work. Part 3 includes contributions by K. Mackinnon (Sustainable use as a conservation tool in the forests of South-east Asia), R. E. Gullison (Will bigleaf mahogany be conserved through sustainable use?), V. Solis Rivera and S. Edwards (Cosigüina, Nicaragua: A case study in community-based management of wildlife), S. des Clers (Sustainability of the Falkland Islands loligo squid fishery), A. Price, C. Roberts and J. Hawkins (Recreational use of coral reefs in the Maldives and Caribbean), J. Freehling and S.A. Marks (A century of change in the Central Luangwa Valley of Zambia), M. Norton-Griffiths (The economics of wildlife conservation policy in Kenya), T. Butynski and J. Kalina (Gorilla tourism: A critical look), A. Gunn (Caribou and muskox harvesting in the Northwest Territories), and L. Baskin (Hunting of game mammals in the Soviet Union). Available from: Anna Van Opstal, Blackwell Science Ltd., Osney Mead, Oxford OX2 0EL, UK, Tel: +44 (0)1865 206206, Fax: +44 (0)1865 721205. **www.blackwell-science.com.**

**Developing a Social Psychology of Monkeys and Apes**, by J. Chadwick-Jones 1998. 208pp. Psychology Press, London. Hardback ISBN 0-86377-820-8. Price: £29.95. Contents: Introduction: social psychology and primates; Intentionality, deception and social intelligence; Primate communication and social psychology; Facial expressions; Gestures, postures and touch; Vocal signals: apes; Vocal signals: monkeys; Tactics and social devices; Social exchange and grooming partnerships; Sexuality in monkeys and apes; Dominance and social relationships; Primate studies and social psychology. Appendices. Available from: Afterhurst Ltd. Mail Order Service, c/o The Book Ordering Dept., Taylor and Francis Ltd., Rankine Road, Basingstoke, Hants RG24 8PR, UK, Tel: +44 (0)1256 813000, Fax: +44 (0)1256 479438, **book.orders@tandf.co.uk.**

**Species Coexistence**, by M. Tokeshi 1998, 464pp. 159 illustrations. Blackwell Science, Oxford. Paperback ISBN 0-86542-744-5. Price: £37.50. Contents: Introduction: conceptual threads; Origination: the basis of coexistence; Origination and evolution of communities; Patterns in species richness: temporal dimension; Patterns in species richness: spatial dimension; The niche, resources and species assembly; Niche apportionment and relative abundances of coexisting species; Competition, co-operation and coexistence; Agent-mediated coexistence: predation and disturbance; Patchiness, heterogeneity and stochasticity; Traits and coexistence; Stability and conservation of coexisting species; Concluding remarks. Availalble from: Anna Van Opstal, Blackwell Science Ltd., Osney Mead, Oxford OX2 0EL, UK, Tel: +44 (0)1865 206206, Fax: +44 (0)1865 721205. **www.blackwell-science.com.**

**Primate Behavioral Ecology**, by K.B. Strier 2000. Allyn and Bacon, Boston. $36 plus $4 shipping and handling. This book is an introduction to the field of primate behavioral ecology and its applications to primate conservation. It integrates the basics of evolutionary and ecological approaches to the study of behavior with up-to-date coverage of how different primates actually behave. Examples are drawn from the "classic" primate field studies and more recent studies on previously neglected species to illustrate the vast behavioral variations that we now know exist, and the gaps in our knowledge that future studies will fill. Some of the most exciting discoveries about primatesand the researchers responsible for making them are described in boxes in each of the chapters. Throughout the book, the interplay among theory, observations, and conservation issues is emphasized. Available from Allyn and Bacon, 160 Gould Street, Needham Heights, MA 02494, USA; **absales@abacon.com**

**International Environmental Consulting Practice: How and Where to Take Advantage of Global Opportunities,** by P.A. Sam 1998. John Wiley & Sons, Chichester, UK. ISBN 0-47117-984-1. Price: US$69.95. This book provides the reader with a broad framework of global environmental management. It provides the reader with comprehensive information about international environmental opportunities and market. It uses a guided approach on how to set up an international environmental consulting practice and includes a comprehensive approach and information on a carefully constructed, step-by-step methodology to setting up an individual, a corporation or a company in internatio-

nal environmental practice. Between the covers is an in-depth background of international environmental consulting practice giving the reader an understanding of the evolution of global environmental management problems, issues, treaties and agreements. Analyses and trends which shape the present international environmental consulting market are provided to give the reader a broader view of the fields in future market certainties and uncertainties. As environmental management becomes an increasingly important element in forging each nation's economic, social and human development, the need for environmental experts increases, especially in nations where environmental technologies and experts are lacking. Nations classified under developing countries criteria typically demand foreign environmental consultants. The demand for international environmental consultants has steadily risen in the past ten years due to the complex dimension of environmental management in these countries. The complexity arises from the integral role of socio-economic development considerations in environmental management and the overall sustainable development. In retrospect, the reader is presented with in-depth literature on consulting market opportunities as they reflect the complex socio-economic development dimensions of environmental management in each continent. It is understood that developing countries present unique socio-economic, poverty, population explosion, economic inefficiencies that play a vital impact on natural resources. In developed nations although there are similar synergies between development and natural resources, there have been specific and rapid interventions over the years to institute stringent environmental policies and management. In an earlier period of environmental management policy development in most of the industrialized countries, we witnessed drastic increase in demand for environmental practitioners, especially in the United States. As the environmental field in developed nations has become saturated and highest priority environmental problems get addressed, we have started to witness a decreasing need for environmental consulting and services in those industrialized countries. Available from: John Wiley & Sons, 605 3rd Street, New York, NY.10158-0012, USA, or John Wiley & Sons, Baffins Lane, Chichester, Sussex PO19 1UD, UK, Tel: 1-800-225-5945. **www.Amazon.com** or **www.Barnesandnobles.com** or **www.wiley.com.**

***Regional Environmental Change* - A New Journal**

In 1999, the Dutch publisher Springer launched a new quarterly journal - **Regional Environmental Change**, ISSN 1436-3798. The aim is to focus on the interactions of human and natural systems at the regional level within the context of global change. Regions considered are river catchments, estuaries, deltas, adjacent seas and wetlands as well as the interactions between cities and their environments. Disciplinary, but in particular multidisciplinary, approaches to the study of these systems are considered. The Editor-in-Chief is Dr. Wim Salomans, GKSS Research Centre and Free University Amsterdam, Max-Planck-Strasse, D21502 Geesthacht, Germany. More information from: Springer for Science, PO Box 503 1970 AM Ijmuiden, The Netherlands, Fax: +49 30 82787 448, **subscriptions@springer.de.** **www.springer.de.**

**Publications of the IUCN/SSC Primate Specialist Groups**

**Primate Conservation**, the journal of the IUCN/SSC Primate Specialist Group has published the volume N° 18 (1998). It includes the following papers: Baseline Range Size Distribution in Primates– C.B. Jones; Ecological Responses of Spider Monkeys to Temporal Variation in Fruit Abundance: The Importance of Flooded Forest as a Keystone Habitat-J.A. Ahumada, P.R. Stevenson and Marcela J. Quinones; Primates of the Tropical Forest of the Pacific Coast of Peru: The Tumbes Reserved Zone-F. Encarnación and A.G. Cook; Some Observations on the Ecology of *Cacajao culvus ucayalii* in the Peruvian Amazon-R. Aquino; Notes on the Distribution and Conservation Status of Spider and Howler Monkeys in the State of Quintana Roo, Mexico-A. del Campo Parra Lara and J.P. Jorgensen; Distribution and Status of the Primates of Guatemala-G. Silva-López; Dietary Choices in *Cebus olivaceus*: A Comparison of Data from Hato Pinero and Hato Masaguaral-L.E. Miller; The Zanzibar Red Colobus Monkey: Conservation Status of an Endangered Island Endemic-T.T. Struhsaker and K.S. Siex; Conservation Status of Primates in Cameroon-L. Usongo; Conservation Status of Primates in the Proposed Lobéké Forest Reserve, South-East Cameroon-L. Usongo; Notes on Two Dwarf Galagos (*Galagoides udzngwensis* and *Galagoides orinus*) in the Udzungwa Mountains, Tanzania-T.M. Butynski, C.L. Ehardt and T.T. Struhsaker; A Brief Report on Yunnan Snub-nosed Monkeys, *Rhinopithecus* (R.)*bieti*, at Bamei in Northern Yunnan Province-China-T. Zhong, L. Xiao, R.C. Kirkpatrick and Y.C. Long; Current Status and Conservation Strategies of Primates in China-Shu-Yi Zhang; Behaviour of Two Groups of Hanuman Langur (*Semnopithecus entellus*) during a Solar Eclipse in 1995 at Medinipur, West Bengal, India-A. Murmu, S. Chaudhuri and J.R.B. Alfred; The Conservation Status of Two Sulawesian Tarsier Species: *Tarsius spectrum* and *Tarsius Dianae*-S. Gursky.

A bumper issue, Volume 3 (1-2) (1997-1998), of the IUCN/SSC Primate Specialist Group newsletter, **African Primates**, has been published (Editors, Thomas M. Butynski and Debra L. Forthman). It was sponsored by the Zoo Atlanta's Conservation Action Resource Center (ARC), the National Museums of Kenya's Institute of Primate Research and Centre for Biodiversity, and the Dian Fossey Gorilla Fund-International, Atlanta, Georgia. Published with this issue is a supplement of a Report for the Ape Alliance by E. Bowen-Jones - "A Review of the Commercial Bushmeat Trade with Emphasis on Central/West Africa and the Great Apes". *Contents - Articles*: Conservation in Central Africa: Time for a more business like approach - K. Amman, Growing commerce in bushmeat destroys great apes and threatens humanity - A. L. Rose, The drill - integrated *in situ* and *ex situ* conservation - E. L. Gadsby & P. D. Jenkins Jr., De Brazza's monkeys *Cercopithecus neglectus* in the Kisere National Reserve, Kenya - J. Chism & M.Cords, Survey of endangered primates in the forest reserves of eastern Côte d'Ivoire - W. S. McGraw, I. T. Monah &M. Abedi-Lartey, Demography of chimpanzees *Pan troglodytes schweinfurthii* in Budongo Forest, Uganda - V. Reynolds, Pygmy chimpanzees, bonobo, or gracile chimpanzee: What's in a name? - A. Kortlandt, *Notes*: Human relations with chimpanzees: A proposed code of conduct - G. Teleki, Lessons in self-medication from great apeas?, Précision de la situation du chimpanzé (*Pan troglodytes verus*) en Guinée Bissau: Une enquete en cours - E. Féron & F. Correia, Birth of a wild gorilla - W. Betunga, Elephant dung: A food source for the crested mangabey *Cercobus galeritus* - A. Gautier-Hion, *Pseudopotto martini*: A new potto? - C. Groves, *Pseudopotto*: When is a potto not a potto? - S. K. Bearder, The validity of "*Pseudopotto martini*" - E. Sarmiento, The problem of sub-species: a further comment - V. Birstein, How to define a subspecies? - P. Leyhausen, Baboon nomenclature - C. Jolly, Current problems with *Papio* taxonomies - E. Sarmiento, Foreign aid and conservation of tropical forests: An action plan for change - T. T. Struhsaker & C. Oren, Convention Africaine pour la Conservation de la Nature et des Ressources Naturelles.

**Journals and Book chapters on lemurs (without abstracts)**

More book chapters on lemurs are listed in the section on "Books".
For compiling this list we search for keywords: *lemurs, prosimians, Madagascar.* Often, this does not catch publications in books, regional journals or articles with much more specific key words. We apologize for these omissions. To make sure that your papers are listed here, please send reprints or at least the title of your publication(s) to J. Ganzhorn.


Anderson, J.R.; Mitchell, R.W. 1999. Macaques but not lemurs co-orient visually with humans. Folia Primatol. 70: 17-22.

Anonymous 1999. Black and white ruffed lemur twins born at Zoo Atlanta. AZA Communique (Aug): 40.

Anonymous 1999. Dealers receiving zoo surplus primates. IPPL NEWS 26: 25.

Archie, E.A; Digby, L.J. 1999. Juvenile dominance in *Eulemur macaco flavifrons*: The influence of sex and maternal rank. Folia Primatol. 70: 277-281.

Atsalis, S. 2000. Seasonal fluctuations in body fat and activity levels in a rain-forest species of mouse lemur, *Microcebus rufus.*Int. J. Primatol. 20: 883-910.

Atsalis, S. 1999. Diet of the brown mouse lemur (*Microcebus rufus*) in Ranomafana National Park, Madagascar. Int. J. Primatol. 20: 193-229.

Barton, R. 1999. The evolutionary ecology of the primate brain. Pp. 167-203 in: Comparative Primate Socioecology. P.C. Lee ( ed.) Cambridge, Cambridge Univ Press.

Bearder, S.K. 1999. Physical and social diversity among nocturnal primates: A new view based on long term research. Primates 40: 267-282.

Birkinshaw, C.R. 1999. The importance of the black lemur (*Eulemur macaco*) for seed dispersal in Lokobe Forest, Nosy Be. Pp. 189-199 in: New Directions in Lemur Studies. B. Rakotosamimanana; H. Rasamimanana; J.U. Ganzhorn; S.M. Goodman (eds.) New York, Kluwer Acad/ Plenum.

Birkinshaw, C.R. 1999. Use of millipedes by black lemurs to anoint their bodies. Folia Primatol. 70: 170-171.

Blurton Jones, N.; Hawkes, K.; O'Connell, J.F. 1999. Some current ideas about the evolution of the human life history. Pp. 140-166 in: Comparative Primate Socioecology. P.C. Lee (ed.) Cambridge, Cambridge Univ. Press.

Bons, N.; Mestre-Frances, N.; Belli, P.; Cathala, F.; Gajdusek, D.C.; Brown, P. 1999. Natural and experimental oral infection of nonhuman primates by bovine spongiform encephalopathy agents. Proceedings of the National Academy of Sciences of the USA 96: 4046-4051.

Catlow, G.; Clifford, R.; Dickie, L.; Wren, C. 1999. Development of a new ring-tailed lemur (*Lemur catta*) exhibit at Edinburgh Zoo. Laboratory Primate Newsletter 38: 22-23.

Cavigelli, S.A. 1999. Behavioural patterns associated with faecal cortisol levels in free-ranging female ring-tailed lemurs, *Lemur catta*. Animal Behaviour 57: 935-944.

Colas, S. 2000. Evidence for sex-biased behavioral maternal investment in the gray mouse lemur (*Microcebus murinus*). Int. J. Primatol. 20: 911-926.

Curtis, D.J; Zaramody, A. 1999. Social structure and seasonal variation in the behaviour of *Eulemur mongoz*. Folia Primatol. 70: 79-96.

Curtis, D.J; Zaramody, A.; Martin, R.D. 1999. Cathemerality in the mongoose lemur, *Eulemur mongoz*. Am. J. Primatol. 47: 279-298.

Davis, B.; Peterson, A. 1999. Zoo interns take on enrichment. Shape of Enrichment 8: 8-11.

Demes, B.; Fleagle, J.G.; Jungers, W.L. 1999. Takeoff and landing forces of leaping strepsirhine primates. J. Hum. Evol. 37: 279-292.

Digby, L.J. 1999. Targeting aggression in blue-eyed black lemurs (*Eulemur macaco flavifrons*). Primates 40: 613-617.

Donati, G.; Lunardini, A.; Kappeler, P.M. 1999. Cathemeral activity of red-fronted brown lemurs (*Eulemur fulvus rufus*) in the Kirindy Forest/CFPF. Pp. 119-137 in: New Directions in Lemur Studies. B. Rakotosamimanana; H. Rasamimanana; J.U. Ganzhorn; S.M. Goodman (eds.) New York, Kluwer Acad/Plenum.

Drack, S.; Ortmann, S.; Buehrmann, N.; Schmid, J.; Warren, R.D.; Heldmaier, G.; Ganzhorn, J.U. 1999. Field metabolic rate and the cost of ranging of the red-tailed sportive lemur (*Lepilemur ruficaudatus*). Pp. 83-91 in: New directions in lemur studies. B. Rakotosamimanana; H. Rasamimanana; J.U. Ganzhorn; S.M. Goodman (eds.) New York, Kluwer Acad/Plenum.

Durbin, J.C. 1999. Lemurs as flagships for conservation in Madagascar. Pp. 269-281 in: New directions in lemur studies. B. Rakotosamimanana; H. Rasamimanana; J.U. Ganzhorn; S.M. Goodman (eds.) New York, Kluwer Acad/ Plenum.

Dyer, N.W.; Greve, J.H. 1999. Severe *Cysticercus longicollis cysticercosis* in a black lemur (*Eulemur macaco macaco*). J. Zoo and Wildlife Medicine 30: 321-322.

Erhardt, E.M.; Overdorff, D.J. 2000. Female Coordination of Group Travel in Wild *Propithecus* and *Eulemur*. Int. J. Primatol. 20: 927-940.

Feistner, A.T.C.; Schmid, J. 1999. Lemurs of the Réserve Naturelle Intégrale d'Andohahela, Madagascar. Pp. 269-283 in: A Floral and faunal Inventory of the Réserve Naturelle Intégrale d'Andohahela, Madagascar: With Reference to Elevational Variation. S.M. Goodman (ed.). Fieldiana, Zoology New Series N° 94. Field Museum of Natural History, Chicago.

Fietz, J. 1999. Monogamy as a rule rather than exception in nocturnal lemurs: The case of the fat-tailed dwarf lemur, *Cheirogaleus medius*. Ethology 105: 259-272.

Fleagle, J.G. 1999. Primate Adaption and Evolution. 2nd edition. San Diego, Academic Press,, xviii, 596 pp.

Fleagle, J.G; Reed, K.E. 1999. Phylogenetic and temporal perspectives on primate ecology. Pp. 92-115 in: Primate Comunities. J.G. Fleagle; C.H. Janson; K.E. Reed (eds.) Cambridge, Cambridge Univ Press.

Freed, B.Z. 1999. An introduction to the ecology of daylight-active lemurs. Pp. 123-132 in: The Nonhuman Primates. Dolhinow, P.; Fuentes, A. (eds.) Mountain View, Mayfield Publ.

Gachot-Neveu, H.; Petit, M.; Roeder, J.J. 1999. Paternity determination in two groups of *Eulemur fulvus mayottensis*: Implications for understanding mating strategies. Int. J. Primatol. 20: 107-119.

Ganzhorn, J.U.; Fietz, J.; Rakotovao, E.; Schwab, D.; Zinner, D. 1999. Lemurs and the regeneration of dry deciduous forest in Madagascar. Cons. Biol. 13: 794-804.

Ganzhorn, J.U.; Wright, P.C.; Ratsimbazafy, J. 1999. Primate communities: Madagascar. Pp. 75-89 in: Primate Communities. J.G. Fleagle; C.H. Janson; K.E. Reed (eds.) Cambridge, Cambridge Univ Press.

Ganzhorn, J.U.; Goodman, S.M.; Ramanamanjato, J.-B.; Ralison, J.; Rakotondravony, D.; Rakotosamimanana, B. 1999. Effects of fragmentation and assessing minimum viable populations of lemurs in Madagascar. Pp. 263-272 in: Isolated Vertebrate Communities in the Tropics. G. Rheinwald (ed.), Bonn. zool. Monogr. 45. Museum Alexander Koenig, Bonn.

Gilissen, E.P.; Jacobs, R.E.; McGuinness, E.R.; Allman, J.M. 1999. Topographical localization of lipofuscin pigment in the brain of the aged fat-tailed dwarf lemur (*Cheirogaleus medius*) and grey lesser mouse lemur (*Microcebus murinus*): Comparison to iron localization. Am. J. Primatol. 49: 183-193.

Glaeser, B.; Myrtek, D.; Rumpler, Y.; Schiebel, K.; Hauwy, M.; Rappold, G.A.; Schempp, W. 1999. Transposition of SRY into the ancestral pseudoautosomal region creates a new pseudoautosomal boundary in a progenitor of simian primates. Human molecular Genetics 8: 2071-2078.

Godfrey, L.R.; Jungers, W.L.; Simons, E.L.; Chatrath, P.S.; Rakotosamimanana, B. 1999. Past and present distribu-

tions of lemurs in Madagascar. Pp. 19-53 in: New directions in lemur studies. B. Rakotosamimanana; H. Rasamimanana; J.U. Ganzhorn; S.M. Goodman (eds.) New York, Kluwer Acad/Plenum.

Goodman, M. 1999. Molecular evolution '99: The genomic record of humankind's evolutionary roots. Am. J. Human Genetics 64: 31-39.

Gore, M.A. 1999. PSGB winter meeting 1998 report: Contribution of zoos to primate biology and conservation. Primate Eye (67): 4-8.

Gould, L. 1999. How female dominance and reproductive seasonality affect the social lives of adult male ringtailed lemurs. Pp. 133-139 in: The Nonhuman Primates. Dolhinow, P.; Fuentes, A. (eds.) Mountain View, Mayfield Publ.

Gould, L.; Sussman, R.W.; Sauther, M.L. 1999. Natural disasters and primate populations: The effects of a 2-year drought on a naturally occurring population of ringtailed lemurs (*Lemur catta*) in southwestern Madagascar. Int. J. Primatol. 20: 69-84.

Haig, D. 1999. A brief history of human autosomes. Phil. Trans. Royal Soc. London B354(1388): 1447-1470.

Hamrick, M.W. 1999. Pattern and process in the evolution of primate nails and claws. J. Hum. Evol. 37: 293-297.

Hemingway, C.A. 1999. Time budgets and foraging in a Malagasy primate: Do sex differences reflect reproductive condition and female dominance? Behav. Ecol. Sociobiol. 45: 311-322.

Hemingway, C.A.; Overdorff, D.J. 1999. Sampling effects on food availability estimates: Phenological method, sample size, and species composition. Biotropica. 31: 354-364.

Hofmann, W.; Schubert, D.; LaBonte, J.; Munson, L.; Gibson, S.; Scammel, l.J.; Ferrigno, P.; Sodroski, J. 1999. Species-specific, postentry barriers to primate immunodeficiency virus infection. J. Virology 73: 10020-10028.

Hoskins, A.L. 1999. Lessons of 125 years. AZA Communique (Aug): 4.

Hugot, J.P. 1999. Primates and their pinworm parasites: The Cameron hypothesis revisited. Systematic Biology 48: 523-546.

Jekielek, J.; Strobeck, C. 1999. Characterization of polymorphic brown lemur (*Eulemur fulvus*) microsatellite loci and their amplification in the family Lemuridae. Molecular Biol. 8: 901-903.

Jolly, A.; Pride, E. 1999. Troop histories and range inertia of *Lemur catta* at Berenty, Madagascar: A 33-year perspective. Int. J. Primatol. 20: 359-373.

Jouffroy, F.K.; Stern, J.T. Jr; Medina, M.F; Larson, S.G. 1999. Function and cytochemical characteristics of postural limb muscles of the rhesus monkey: A telemetered EMG and immunofluorescence study. Folia Primatol. 70: 235-253.

Junge, R.E. 1999. Diseases of prosimians. Pp. 365-368 in: Zoo & Wild Animal Medicine: Current Therapy. 4TH ED. Fowler, M.E.; Miller, R.E. (eds.) Philadelphia, WB Saunders.

Kappeler, P.M. 1999. Convergence and divergence in primate social systems. Pp. 158-170 in: Primate Communities. J.G.Fleagle; C.H. Janson; K.E. Reed (eds.) Cambridge, Cambridge Univ Press.

Kappeler, P.M. 1999. Lemur social structure and convergence in primate socioecology. Pp. 273-299 in: Comparative Primate Socioecology. Lee, P.C. (ed.) Cambridge, Cambridge Univ Press.

Keith-Lucas, T.; White, F.J; Keith-Lucas, L.; Vick, L.G. 1999. Changes in behavior in free-ranging *Lemur catta* following release in a natural habitat. Amer. J. Primatol. 47: 15-28.

Kolnicki, R.L. 1999. Karyotypic fission theory applied: Kinetochore reproduction and lemur evolution. Symbiosis 26: 123-141. (Erratum: 26: 391)

Kupfermann, H.; Satta, Y.; Takahata, N.; Tichy, H.; Klein, J. 1999. Evolution of Mhc-DRB introns: Implications for the origin of primates. J. Molecular Evol. 48: 663-674.

Lambert, J.E. 1999. Primate color vision research. Evol. Anthropol. 8: 39-41.

Lapointe, F.J. Baron, G.; Legendre, P. 1999. Encephalization, adaptation and evolution of chiroptera: A statistical analysis with further evidence for bat monophyly. Brain, Behavior and Evolution 54: 119-126.

Maas, M.C; Dumont, E.R. 1999. Built to last: The structure, function, and evolution of primate dental enamel. Evol. Anthropol. 8: 133-152.

MacLarnon, A.M.; Hewitt, G.P. 1999. The evolution of human speech: The role of enhanced breathing control. Am. J. Phys. Anthropol. 109: 341-363.

Matano, S.; Ohta, H. 1999. Volumetric comparisons on some nuclei in the cerebellar complex of prosimians. Am. J. Primatol. 48: 31-48.

Matassi, G.; Cherif-Zahar, B.; Pesole, G.; Raynal, V.; Cartron, J.P. 1999. The members of the RH gene family (RH50 and RH30) followed different evolutionary pathways. J. Molecular Evol. 48: 151-159.

Milius, S. 1999. Attractive tree ISO lemur to start a family. Science News 156: 71.

Mittermeier, R.A.; Konstant, W.R. 1999. Primate conservation: A retrospective and a look into the 21st century. Australasian Primatology 13: 2-13.

Montini, E.; Buchner, G.; Spalluto, C.; Andolfi, G.; Caruso, A.; den Dunnen, J.T.; Trump, D.; Rocchi, M.; Ballabio, A.; Franco, B. 1999. Identification of SCML2, a second human gene homologous to the Drosophila sex comb on midleg (Scm): A new gene cluster on Xp22. Genomics 58: 65-72.

Morales, J.C.; Disotell, T.R.; Melnick, D.J. 1999. Molecular phylogenetic studies of nonhuman primates. Pp. 18-28 in: The Nonhuman Primates. P. Dolhinow.; A. Fuentes (eds.) Mountain View, Mayfield Publ.

Müller, A.E. 1999. Aspects of social life in the fat-tailed dwarf lemur (*Cheirogaleus medius*): Inferences from body weights and trapping data. Am. J. Primatol. 49: 265-280.

Müller, A.E. 1999. Social organization of the fat-tailed dwarf lemur (*Cheirogaleus medius*) in northwestern Madagascar. Pp. 139-157 in: New directions in lemur studies. B. Rakotosamimanana; H. Rasamimanana; J.U. Ganzhorn; S.M. Goodman (eds.) New York, Kluwer Acad/ Plenum.

Müller, S.; Stanyon, R.; O'Brien, P.C.M.; Ferguson-Smith, M.A.; Plesker, R.; Wienberg, J. 1999. Defining the ancestral karyotype of all primates by multidirectional chromosome painting between tree shrews, lemurs and humans. Chromosoma 108: 393-400.

Mutschler, T. 1999. Folivory in a small-bodied lemur: The nutrition of the Alaotran gentle lemur (*Hapalemur griseus alaotrensis*). Pp. 221-239 in: New directions in lemur studies. B. Rakotosamimanana; H. Rasamimanana; J.U. Ganzhorn; S.M. Goodman (eds.) New York, Kluwer Acad/ Plenum.

Mutschler, T.; Nievergelt, C.M.; Feistner, A.T.C. 2000. Social organization of the Alaotran gentle lemur (*Hapalemur griseus alaotrensis*). Am. J. Primatol. 50: 9-24.

Makamichi, M.; Koyama, N. 2000. Intra-troop affiliative relationships of females with newborn infants in wild ringtailed lemurs (*Lemur catta*). Am. J. Primatol. 50: 187-203.

Nielsen, L. 1999. Chemical Immobilization of Wild and Exotic Animals. Ames, Iowa State Univ Press,, xxiii, 342 pp.

Nimchinsky, E.A.; Gilissen, E.; Allman, J.M.; Perl, D.P.; Erwin, J.M.; Hof, P.R. 1999. A neuronal morphologic type unique to humans and great apes. Proc. Nat. Acad. Sci. USA 96: 5268-5273.

Nogge, G. 1999. [1998 annual report of the Cologne Zoological Garden.] Zeitschrift des Kölner Zoo 42: 1-32.

Nunn, C.L. 1999. The number of males in primate social groups: A comparative test of the socioecological model. Behav. Ecol. Sociobiol. 46: 1-13.

Oda, R. 1999. Scent marking and contact call production in ring-tailed lemurs (*Lemur catta*). Folia Primatol. 70: 121-124.

Oriol, R.; Mollicone, R.; Cailleau, A.; Balanzino, L.; Breton, C. 1999. Divergent evolution of fucosyltransferase genes

from vertebrates, invertebrates, and bacteria. Glycobiology 9: 323-334.

Ostner, J.; Kappeler, P.M. 1999. Central males instead of multiple pairs in redfronted lemurs, *Eulemur fulvus rufus* (Primates, Lemuridae)? Anim. Behav. 58: 1069-1078.

Ostner, J.; Schuelke, O.; Zinner, D. 1999. [West Madagascar tropical dry forest.] Zeitschrift des Kölner Zoo 42: 125-142.

Overdorff, D. 1999. American Society of Primatologists twenty-first annual meeting. Evol. Anthropol. 7: 153-154.

Overdorff, D.J.; Merenlender, A.M.; Talata, P.; Telo, A.; Forward, Z.A. 1999. Life history of *Eulemur fulvus rufus* from 1988-1998 in southeastern Madagascar. Amer. J. Phys. Anthropol. 108: 295-310.

Palombit, R.A. 1999. Infanticide and the evolution of pair bonds in nonhuman primates. Evol. Anthropol. 7: 117-129.

Paul, A. 1999. The socioecology of infant handling in primates: Is the current model convincing? Primates 40: 33-46.

Pellis, S.M.; Iwaniuk, A.N. 1999. The problem of adult play fighting: A comparative analysis of play and courtship in primates. Ethology 105: 783-806.

Pereira, M.E.; Strohecker, R.A.; Cavigelli, S.A.; Hughes, C.L.; Pearson, D.D. 1999. Metabolic strategy and social behavior in Lemuridae. Pp. 93-118 in: New Directions in Lemur Studies. B. Rakotosamimanana; H. Rasamimanana; J.U. Ganzhorn; S.M. Goodman (eds.) New York, Kluwer Acad/Plenum.

Plavcan, J.M. 1999. Mating systems, intrasexual competition and sexual dimorphism in primates. Pp. 241-260 in: Comparative Primate Socioecology. P.C. Lee (ed.) Cambridge, Cambridge Univ Press.

Purvis, A.; Webster, A.J. 1999. Phylogenetically independent comparisons and primate phylogeny. Pp. 44-70 in: Comparative Primate Socioecology. P.C. Lee (ed.) Cambridge, Cambridge Univ Press.

Randria, G.F.N. 1999. Skeletal morphology and the phylogeny of the Lemuridae: A cladistic analysis. Pp. 55-68 in: New Directions in Lemur Studies. B. Rakotosamimanana; H. Rasamimanana; J.U. Ganzhorn; S.M. Goodman (eds.) New York, Kluwer Acad/Plenum.

Rasamimanana, H. 1999. Influence of social organization patterns on food intake of *Lemur catta* in the Berenty Reserve. Pp. 173-188 in: New directions in lemur studies. B. Rakotosamimanana; H. Rasamimanana; J.U. Ganzhorn; S.M. Goodman (eds.) New York, Kluwer Acad/Plenum.

Rasoloarison, R.; Rasolonandrasana, B.P.N. 1999. Les lémuriens. Pp. 159-169 in: Inventaire biologique de La réserve Spéciale du Pic d'Ivohibe et du Couloir Forestier qui la relie au Parc National d'Andringitra, S M. Goodman; Rasolonandrasana, B.P.N. (eds.). Recherches pour le Developpement. Série Sciences Biologiques Vol. 15, Antananarivo.

Razafimanantsoa, L. 1999. Support utilization by two sympatric lemur species: *Propithecus verreauxi verreauxi* and *Eulemur fulvus rufus*. Pp. 69-81 in: New directions in lemur studies. B. Rakotosamimanana; H. Rasamimanana; J.U. Ganzhorn; S.M. Goodman (eds.) New York, Kluwer Acad/Plenum.

Robson-Brown, K. 1999. Cladistics as a tool in comparative analysis. Pp. 23-43 in: Comparative Primate Socioecology. P.C. Lee (ed.) Cambridge, Cambridge Univ Press.

Rose, K.D.; Silcox, M.T. 1999. Primate evolution at the Society of Vertebrate Paleontology. Evol. Anthropol. 8: 5-6.

Sauther, M.L;. Sussman, R.W.; Gould, L. 1999. The socioecology of the ringtailed lemur: Thirty-five years of research. Evol. Anthropol. 8: 120-132.

Schmid, J. 1999. Sex-specific differences in activity patterns and fattening in the gray mouse lemur (*Microcebus murinus*) in Madagascar. J. Mamm. 80: 749-757.

Schmid, J.; Ruf, T.; Heldmaier, G. 2000. Metabolism and temperature regulation during daily torpor in the smallest primate, thy pygmy mouse lemur (*Microcebus myoxinus*) in Madagascar. J. Comp. Physiol. B 170: 59-68.

Schmidt, M.; Fischer, M. 2000. Cineradiographic study of forelimb movements during quadrupedal walking in the brown lemur (*Eulemur fulvus*, Primates: Lemuridae). Am. J. Phys. Anthropol. 111: 245-262.

Simmen, B.; Hladik, A.; Ramasiarisoa, P.L.; Iaconelli, S.; Hladik, C.M. 1999. Taste discrimination in lemurs and other primates, and the relationships to distribution of plant allelochemicals in different habitats of Madagascar. Pp. 201-219 in: New directions in lemur studies. B. Rakotosamimanana; H. Rasamimanana; J.U. Ganzhorn; S.M. Goodman (eds.) New York, Kluwer Acad/Plenum.

Stait, D.S.; Ross, C.F. 1999. Kinematic data on primate head and neck posture: Implications for the evolution of basicranial flexion and an evaluation of registration planes used in paleoanthropology. Am. J. Phys. Anthropol. 108: 205-222.

Strait, D.S. 1999. The scaling of basicranial flexion and length. J. Hum. Evol. 37: 701-719.

Tan, C.L. 1999. Group composition, home range size, and diet of three sympatric bamboo lemur species (Genus *Hapalemur*) in Ranomafana National Park, Madagascar. Int. J. Primatol. 20: 547-566.

Treves, A. 1999. Has predation shaped the social systems of arboreal primates? Int. J. Primatol. 20: 35-67.

van Schaik, C.P.; van Noordwijk, M.A.; Nunn, C.L. 1999. Sex and social evolution in primates. Pp. 204-231 in: Comparative Primate Socioecology. P.C. Lee (ed.) Cambridge, Cambridge Univ Press.

Villers L.M. 1999. North American Regional Studbook for Ring-Tailed *Lemur Catta*. VOLUME 7. Indianapolis, Indianapolis Zoo, 89 pp.

Voisset, C.; Blancher, A.; Perron, H.; Mandrand, B.; Mallet, F.; Paranhos-Baccala, G. 1999. Phylogeny of a novel family of human endogenous retrovirus sequences, HERV-W, in humans and other primates. AIDS Research and Human Retroviruses 15: 1529-1533.

Walzer, C. 1999. Diabetes in primates. Pp. 397-400 in Zoo & Wild Animal Medicine: Current Therapy. 4th ed. M.E. Fowler; R.E. Miller (eds.) Philadelphia, WB Saunders.

Wang, N.; Chen, R.S. 1999. Comparison between phylogeny of introns and exons in primates. Chinese Science Bulletin 44: 1940-1946.

Willis, G.P; Kapustin, N.; Warrick, J.M.; Miller, L.L.; Stookey, G.K.; Hopkins, D.T.; Doan, E.J.; Ross, S.R. 1999. Preventing dental calculus formation in lemurs (*Lemur catta, Eulemur fulvus collaris*) and baboons (*Papio cynocephalus*). J. Zoo & Wildl. Med. 30: 377-382.

Wright, P.C. 1999. Lemur traits and Madagascar ecology: Coping with an island environment. Yearbook Phys. Anthropol. 42: 1-42.

Wright, P.C.; Jernvall, J.T. 1999. The future of primate communities: A reflection of the present? Pp. 295-309 in: Primate Communities. J.G. Fleagle; C.H. Janson; K.E. Reed (eds.) Cambridge University Press. Cambridge.

Wyner, Y.; Absher, R.; Amato, G.; Sterling, E.; Stumpf, R. Rumpler, Y.; Desalle, R. 1999. Species concepts and the determination of historic gene flow patterns in the *Eulemur fulvus* (Brown Lemur) complex. Biol. J. Linn. Soc. 66: 39-56.

Yang, Z.H; Yoder, A.D. 1999. Estimation of the transition/transversion rate bias and species sampling. J. Mol. Evol. 48: 274-283.

Yoder, A.D.; Irwin, J.A. 1999. Phylogeny of the Lemuridae: Effects of character and taxon sampling on resolution of species relationships within *Eulemur*. Cladistics 15: 351-361.

Yoder, A.D.; Rakotosamimanana, B.; Parsons, T.J. 1999. Ancient DNA in subfossil lemurs. Pp. 1-17 in: New directions in lemur studies. B. Rakotosamimanana; H. Rasamimanana; J.U. Ganzhorn; S.M. Goodman (eds.) New York, Kluwer Acad/Plenum.

**Ongoing lemur studies**

As in previous issues of *Lemur News*, we would have liked to summarize what is going on in "lemurology". The idea was that such a list could help to plan and coordinate future studies and to avoid redundancy and conflicts of interest among researchers. For the present volume we did not receive any feedback. Thus we assume that researchers do not wish to inform a wider audience of their activities before they have not been completed successfully. We respect this and certainly will not list projects we are aware of but that have not been authorized to be listed here.

Bollen, A. Fruit characteristics and seed dispersal in littoral forest of the Fort Dauphin region. PhD thesis, Univ. d'Antwerpen.

Donati, G. Activity pattern of *Eulemur fulvus collaris* in relation to environmental variation. PhD thesis, Pisa University.

Hapke, A. Population genetics and gene flow of isolated populations of *Cheirogaleus medius* in the littoral forests of the Fort Dauphin region. PhD, Univ. Hamburg.

Rakotondratsima, B. Effets de la dégradation des forêts littorales sur les populations de micromammifères dans la région de Fort Dauphin. DEA Dépt de Biologie Animale, Faculté des Sciences, Univ. d'Antananarivo.

Ralison, J. Effets de la fragmentation et dégradation des forêts littorales pour *Eulemur fulvus collaris* dans la région de Fort Dauphin. DEA Dépt de Biologie Animale, Faculté des Sciences, Univ. d'Antananarivo.

Ralison, J. Habitat requirements and feeding pattern of *Hapalemur griseus meridionalis* in the littoral forest of Mandena. Doctorat, Dépt de Biologie Animale, Faculté des Sciences, Univ. d'Antananarivo.

Rakotonirainy, E.O. Contribution à l'étude de communauté frugivore pour la dispersion et prédation des graines de *Ficus* dans la forêt littorale de Fort Dauphin. DEA, Dépt de Biologie Animale, Faculté des Sciences, Univ. d'Antananarivo.

Rasolofoharivelo, M.T. Effets des pressions humaines sur les populations de *Eulemur fulvus collaris*. DEA. Dept. d'Anthropologie et Biologie Evolutive. Univ. d'Antananarivo.

**Theses completed**

Müller, P.B.P. Ecology and Feeding Strategy of the Crowned Sifaka (*Propithecus verreauxi coronatus*). 1997. Diploma thesis, Athropologisches Institut & Museum, Zürich, Switzerland. *Propithecus verreauxi* is found in the western, deciduous forests as well as in the "spiny forest" in the South. The crowned sifaka (*P.v.coronatus*) is one of four subspecies (i.e., *P.v.deckeni*, *P.v.coquereli* and *P.v.verreauxi*) and is not known to be present in any protected area. The ecology and behaviour of other subspecies of *P.verreauxi* have been studied in detail at different study sites, and much work has been done on demography, group composition, social structure and ranging behaviour. Most of the studies have been carried out in the South and the West of the island. Studies in the North-west are all restricted to Ampijoroa (Ankarafantsika). This study is the first of its kind carried out on the crowned sifaka. Data was collected on the ecology and feeding strategy was studied in detail in respect to potentially available resources. In the first place, I focused on the assumptions and predictions of the "Marginal Value Theorem" (Charnov, 1978) for optimal foraging, a model for the use of a "patchy habitat" by an optimal predator. A key prediction is that marginal gain rates at the time of leaving the patch are equal across patch types. Therefore particular interest focused on the question wether crowned sifakas leave a food patch they are currently in in the manner predicted by the model. In addition I investigated a) what kind of patches crowned sifakas selected b) at what time of the day they foraged, and c) how they displaced between food patches. During a five month field study two neighbouring groups were studied using the "instantaneous sampling method" in deciduous, riverine forest at Anjamena, north-west Madagascar. Transect sampling was also carried out to assess the population density of all lemur species found on the eastern riverside of the Mahavavy. Data on vegetation was collected using the "point-centered-quadrant-method". An important assumption of the "Marginal Value Theorem" is that while a predator is in a patch, its food intake rate for that patch decreases with time spent there. As a consequence, the function of the intake rate approaches an asymptote. This is not the case with the collected data in this study. Contrary to the assumption of the theorem, intake rates were constant, accelerated or oscillated without approaching an asymptote. In addition, food patches were not encountered by chance, because some main food resources were not distributed at random but clumped - in space as well as in time. As a consequence, animals were forced to react to a habitat with "contagiously" distributed resources. On the other hand for a generalist like the sifaka, a large part of the food resources were more abundant and more evenly distributed throughout the habitat than for a specialist. Therefore, resources were more continuously distributed and not "patchy". In summary it seems likely that the "Marginal Value Theorem" is not the appropriate model to describe foraging behaviour of crowned sifakas. The dietary composition of the crowned sifakas in this study is comparable to that found in studies of other subspecies of *P.verreauxi*. In respect to certain plants the animals reacted highly selectively so that the potentially available and selected plant species did not correlate. Several plant species occured in both home ranges but were eaten only by one of the two groups and vice versa. Whether this is an effect of "tradition" or identical plant species were not equally attractive for both groups cannot be explained. The results are more comparable to those found in studies done in the South than, as was expected, in the North (i.e., Ampijoroa). These results imply that behavioural variation can not only be explained by biogeographical differences, climatic adaptations or genetical differences on the subspecies level but also on the basis of local factors. The crowned sifakas in Anjamena began daily activity earlier than described in previous studies. It might be an effect of thermoregulating factors (e.g., exposure to sunlight). Although the length of the daily activity period was similar for both study groups, peaks of certain activities like resting, feeding and moving were distributed differently throughout the day. In addition one group spent significantly more time on feeding in comparison to the other one. The patterns of ranging behaviour of the two groups were also different. This can be explained by the distribution of food resources and micro-structure of the two home ranges. Some food patches were encountered on the way to frequently used places or trees. This implies that the animals have to decide on which food patch to forage in and when to leave the previous one. Thus crowned sifakas include more or different information in their decisions than assumed in the model of the "Marginal Value Theorem". How broad their cognitive abilities are, remains a topic to be studied in further detail. However, it seems highly likely that they have been underestimated.

Razafy, Fara Lala 1999. Thése de 3e cycle de l'École Superieure des Sciences Agronomiques, Universite d'Antananarivo. Analyse de l'interface humain-foret et directives d'amenagement du bassin-versant de Vohidrazana: Falaise Est de Madagascar. Résumé: 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 des hypothèses en matière de la rationalité de la conversion des forêts dans l'optique paysanne, de la perte de la forêt par l'inefficacité de

l'application de la législation, de la faible potentialité de la forêt pour des bénéfices socio-économique et la faisabilité de l'aménagement intégral par différents groupes d'acteurs.

Une approche systémique embrassant la cartographie, les enquêtes socio-économiques, les inventaires et les tests des hypothèses a été adoptée pour cette étude. Les analyses et discussions sur les résultats sont utilisées pour tester ces hypothèses de travail avant les propositions de directives d'aménagement. 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.

En préambule, des travaux cartographiques sont effectués pour les zonages de l'aire d'étude à partir des photos aériennes. Ensuite des enquêtes socio-économiques et des travaux d'inventaires biologiques sont réalisés. La cartographie et les zonages ont été effectués 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 inventaires sont conduits pour connaître la potentialité de la forêt en ressources ligneuses et non ligneuses, ainsi que les accroissements de certaines espèces ligneuses. Ces différentes approches combinées sont de surcroît utilisées pour tester les hypothèses de travail avant les propositions de directives d'aménagement.

Des zonages, trois types de forêts sont définis : Forêt presque primaire, forêt sélectivement exploitée et forêt dégradée. Avant sa conversion en tavy, la forêt ne passe pas systématiquement par ces différents stades. Au cours des 34 années d'observation à partir des photos aériennes, il a même été trouvé que le pourcentage de forêt primaire convertie en tavy domine par rapport aux deux autres types. De même, il a été trouvé que la superficie de la forêt dans le bassin versant de Vohidrazana régresse annuellement à raison de 3,24 ha. La régression est en fonction de l'augmentation du nombre de la population.

Des enquêtes informelles et formelles quatre groupes d'acteurs sont identifiés comme ayant des influences et/ou impacts directs, indirects ou induits sur les ressources forestières. Ces groupes comprennent l'Etat, les différents Projets de recherche, de développement ou de protection, les exploitants légaux et illégaux et les paysans. Ces groupes d'acteurs exploitent les ressources naturelles dont l'intensité et la qualité sont différenciées par leurs objectifs.

Les inventaires ont révélé 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 études de croissance sur les accroissements moyens annuels en surface terrière de certaines espèces ligneuses montrent en général, la lenteur de ces accroissements 0.2 $m^2$/ha/an.

Eu égard aux restrictions législatives, les paysans n'exploitent pas le bois pour des fins monétaires. Ils en utilisent quand même une large gamme (une dizaine) pour la construction de leur case. Il arrive tout de même qu'ils exploitent les bois pour vendre : période de soudure ou sur commande par des revendeurs au bord de la route etc.

Les produits non ligneux commercialisés sont assez divergents : pots fangeons, orchidées, pandanus, produits aquatiques. Le revenu généré par la vente de ces produits est directement utilisé par les paysans pour assurer leur subsistance. Deux de ces produits (pots fangeons et orchidées) sont pourtant frappés d'interdit d'exploitation sinon requièrent une autorisation spéciale pour leur exploitation (surtout pour certaines variétés d'orchidées). Néanmoins, en cas de nécessité les paysans vendent directement ces produits à des intermédiaires.

L'hypothèse sur la rationalité de la conversion des forêts par les paysans est ainsi corroborée. Il a de ce fait été souligné que la rationalité des actions paysannes réside dans le fait 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 est ressorti que malgré leurs biens fondés, les textes législatifs ont péché 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.

La quatrième hypothèse est la faisabilité de l'aménagement intégral par les différents acteurs. Les critères établis pour tester cette hypothèse l'ont corroboré dans la majorité des cas. Tous les acteurs travaillant dans la zone sont intéressés à atteindre leurs objectifs. Les paysans sont conscients de la précarité de leur situation. Ils sont ainsi très ouverts à d'autres innovations et en cas de nécessité adoptent même des techniques qui ne leur sont pas familier. Les exploitants légaux cherchent à profiter au maximum de l'exploitation des forêts mais avec un contrôle étatique plus efficace, ils seront tenus de respecter les clauses et de conduire l'exploitation convenablement. Les projets de recherches sont aussi conscients de la nécessité de l'application et de la diffusion des résultats de recherches. Ces dernières s'orientent beaucoup plus maintenant vers des recherches appliquées en vue de faciliter la diffusion. Des concertations sont aussi notées au niveau des 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.

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 introduit des accords entre les acteurs. Les acteurs principaux sont généralement des gens de l'extérieur acceptant toutes les conditions écologiques à respecter. 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 à entreprendre. Dans ce cas, les principaux ac-

teurs sont les populations locales. Pourtant, ils sont encore assistés techniquement voire financièrement -du moins au départ- pour la bonne conduite des activités.

Pour le bassin versant de Vohidrazana, une option pour un aménagement intégral est choisie. Cet aménagement est ici défini comme un aménagement associant les éléments sociaux, économiques et écologique d'une zone donnée pour atteindre des objectifs déterminés. Il prend surtout 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. Les espaces déjà exploités par les paysans sont ainsi proposés à être exploités sans tenir compte des contraintes juridiques qui tendent à ramener les terrains à plus de 50 % de pente à des vocations forestières. Cependant, certaines techniques élémentaires doivent être respectées pour mieux protéger le sol contre les érosions. Dans ce cas, les utilisations paysannes des espaces comme le tanimboly sont à promouvoir moyennant une diversification des produits en ce qui concerne les cultures pérennes.

Des postulats sont faits pour mieux asseoir les directives d'aménagement proposées. Parmi ces postulats, il est important de souligner la nécessité de la continuation des activités d'aménagement quelles que soient les instabilités politiques à Madagascar, de la communication des différents acteurs œuvrant dans l'aménagement et du maintien de leur engagement, de la cohésion sociale (du moins pour ceux qui vont exploiter le bassin versant), de la subvention des prix des produits agricoles par l'Etat en cas d'instabilité de prix ainsi qu'en cas de calamité naturelle, de l'accessibilité du marché (national et international) par les paysans, du respect du cycle de la reproduction de la forêt etc.

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 voit ainsi dans l'obligation de conjuguer ses efforts afin de prolonger aussi longtemps que possible l'utilisation des ressources qui les intéressent.

Rakotoarisoa, S.V. 1999. Contribution à l'étude de l'adaptation de *Lemur catta* (Linnaeus, 1758) aux zones sommitales de la Réserve Naturelle Intégrale d'Andringitra. Mémoire de D.E.A, Dépt. de Paléontologie et d'Anthropologie Biologique. Faculté des Sciences, Université d'Antananarivo. Résumé: *Lemur catta* occupe la partie Sud et Sud Ouest de Madagascar dans une multitude d'habitats allant des zones forestières vers des régions rocheuses et montagnardes comme celle d'Andringitra. L'objectif de cette étude est de dégager les formes d'adaptation de Lemur catta dans ces conditions montagnardes du Parc et de la Réserve d'Andringitra. Pour ce faire, nous avons suivi deux groupes de *Lemur catta*: l'un fréquente en grande partie les zones sommitales à plus de 2000 m et l'autre évolue en grande partie en moins de 2000 m. Afin d'apprécier les variations observées, nous avons eu recours généralement au test de $chi^2$ pour la présente étude. Cependant, pour les analyses comparatives avec les études antérieures, nous utilisons le tableau de contingence. Les principales formes d'adaptation sont catégorisées en trois sortes: la morphologie, la structure et les comportements sociaux. Les variations morphologiques concernent la coloration du pelage qui devient plus sombre, la présence des poils touffus et plus dense et la réduction du nombre d'anneaux blancs et noirs de la queue. En ce qui concerne la structure de la population, les modifications les plus importantes se portent sur: 1) l'augmentation du domaine vital, plus de 100 ha et de la distance journalière parcourue, plus de 1900 m; 2) la réduction de la surface de l'aire de chevauchement du domaine vital, 14 à 26% de son domaine vital et da la densité de la population, avec sa valeur la plus basse connue 22,8 individus/$km^2$. Quant aux comportements sociaux, les variations significatives touchent d'une part l'utilisation des substrats qui est sous sa forme la plus terrestre connue,entre 59 à plus de 97% suivant le type d'activités. D'autre part, le comportement alimentaire présente une diversification maximale de la composition du régime alimentaire avec 48 espèces végétales et 2 espèces d'insectes et aussi un régime alimentaire à dominance frugivore qui varie entre 76 et plus de 82% des parties consommées. Mais malgré ces différentes formes d'adaptations développées, *Lemur catta* d'Andringitra appartient à la même espèce que ceux dans les zones forestières. Quant à son avenir, il semble être menacé par les activités anthropiques liées à l'exploitation socio-économique irrationnelle des ressources.

Raveloson, H. 1999. Etude de la séquence de la soudure des épiphyses à la diaphyse des os du stylopode et de leur croissance chez trois formes de Lémuroïdes malgaches: *Archaeolemur majori* (Filhol, 1895); *Pachylemur insignis* (Filhol, 1895); *Eulemur fulvus* (Geoffroy, 1796). Mémoire de D.E.A, Dépt. de Paléontologie et d'Anthropologie Biologique. Faculté des Sciences, Université d'Antananarivo. Résumé: L'ordre de la soudure des épiphyses à la diaphyse du stylopode chez les lémuriens de Madagascar commun. La première soudure est marquée par l'entrée de l'individu au stade subadulte et au cours de ce stade, il existe une croissance nette ou croissance différentielle. Elle est propre à chacune des trois espèces étudiées. Enfin, comparé à celui des autres primates, l'ordre de la soudure des épiphyses à la diaphyse des lémuriens est unique au monde.

von Engelhardt, N. 1999. Female dominance in *Lemur catta* (Primates: Lemuridae): Correlations with levels of testosterone in feces and saliva. Master's thesis. Univ. Bayreuth, Germany (in German).

Zaonarivelo, J.R. 1999. Analyse des modalités d'adaptation de *Varecia variegata variegata*, Kerr 1792, à un milieu perturbé. Cas de la forêt de Manombo, Farafangana (Madagascar). Mémoire de D.E.A, Dépt. de Paléontologie et d'Anthropologie Biologique. Faculté des Sciences, Université d'Antananarivo. Résumé: La forêt de Manombo-Farafangana est hautement perturbée due à la présence des différents types de pression anthropique (tavy, chasse, exploitation forestière), les cataclysmes naturels (cyclone, secheresse, inondation), et la pression naturelle (présence des prédateurs). L'étude de *Varecia variegata* dans la forêt de Manombo nous a permi de savoir l'adaptation de ces lémuriens face à la destruction de leurs habitats; la destruction de la forêt entraîne une conséquence grave sur la disponibilité alimentaire des *Varecia*, et ceci entraîne un grand bouleversement sur leur comportement habituel: augmentation de folivorie, réduction de la taille du groupe, augmentation de la fréquentation de la strate herbacée.

**Other Publications of the IUCN/SSC Primate Specialist Group**

Some twenty years ago *Primate Conservation* has been created to facilitate communication among people interested and working in primate conservation. Since then it has been published somewhat erratically but always containing high quality articles. For some time Anthony Rylands has now taken over status as Chief Editor of this publication and managed to get it out on a regular basis. Acoording to current plans *Primate Conservation* should be published once a year (around December). The 18th issue of *Primate Conservation* has just been published with articles from Africa, Asia and the Neotropics, but lacking Madagascar. We would like to encourage contributors to submit review articles as well as original papers of interest for a wider audience to *Primate Conservation*. Let people know that primatologists are still active in Madagascar!

**Primate Conservation**
Anthony B. Rylands and Russell A. Mittermeier
Conservation International
1015 18th Street, NW, Suite 1000
Washington, D.C. 20036
U.S.A.
Fax: +1 202 887 0192
**a.rylands@conservation.org** or **r.mittermeier@conservation.org**

**Regional Newsletters (other than Lemur News)**
Information on projects, research groups, events, recent publications, activities of primatological societies and NGOs, and other newsworthy items of interest to primate conservationists should be submitted directly to the editors of the IUCN/SSC Primate Specialist Group regional newsletters to the editors at the addresses below.

**Neotropical Region -** Neotropical Primates
Anthony B. Rylands
Conservation International
1015 18th Street, NW, Suite 1000
Washington, D.C. 20036
U.S.A.
Fax: +1 202 887 0192;
**a.rylands@conservation.org**

or, and for contributions in Spanish,
Ernesto Rodríguez-Luna
Instituto de Neuroetologia
Universidad Veracruzana
Apartado Postal 566
Xalapa
Veracruz 91000
Mexico
Fax: +52 2812 5748
**saraguat@speedy.coacade.uv.mx**

**Asian Region** – Asian Primates

Ardith A. Eudey
164 Dayton Street
Upland
California 91786
U.S.A.
Fax: +1 909 982 9832
**eudey@aol.com**

**African Region** – African Primates

Thomas M. Butynski
Zoo Atlanta
Africa Biodiversity Conservation Program
P.O. Box 24434
Nairobi
Kenya
Fax: +254 289 0615
**butynski@thorntree.com**

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