# LEMUR NEWS

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

NUMBER 12, June 2007

CONSERVATION INTERNATIONAL

MARGOT MARSH BIODIVERSITY FOUNDATION

WWF

DPZ Deutsches Primatenzentrum

SPECIES SURVIVAL COMMISSION

Universität Hamburg

**Cover photo:** *Microcebus* sp. from Andasibe (photo by Ute Meede).

*LEMUR NEWS*

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

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# EDITORIAL

The last few months have brought exciting news. Madagascar's old and new president, Marc Ravalomanana, has made remarkable statements with respect to human population growth, new regulations for hunting have been established, many new forms of lemurs have been described, and last, but not least the regulations for doctoral candidates within the Malagasy university system have changed.

The wave of "new species" discoveries has generated a lively discussion about standards in species descriptions. One major concern is that many of these new species are described in publications which are not peer reviewed. Our future policy will be to have peer reviews for all manuscripts submitted to *Lemur News* which describe new species.

In line with this policy we think that the new regulation for doctoral candidates should also have consequences for the forthcoming publication of *Lemur News*. According to the new regulations doctoral candidates must have publications which can be submitted in partial fulfilment to receive a doctoral degree. We are proud that papers in *Lemur News* are considered acceptable for completion of a doctoral thesis and we are aware of the responsibility associated with the new regulation. In order to guarantee the appropriate standard for the doctoral theses and the international recognition, we will also send these manuscripts out for peer review. Starting with *Lemur News* Vol. 13 all the peer-reviewed articles will be published in the "Article" section. To avoid delays in the publication process, we list the criteria for the evaluation of manuscripts in the "Guidelines for Contributors".

Despite these new procedures for some manuscripts we want to keep *Lemur News* as a vehicle for the publication of news and ideas which are important but may not warrant a full-fledged scientific article. These contributions will not be sent out for review. They will be published under the "News" section. We hope that these modifications are in the interest of our contributors and readers.

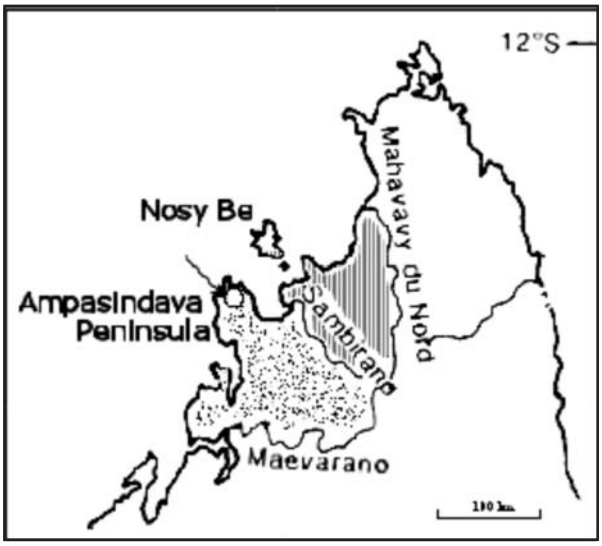
Contributors to Lemur News are very creative in terms of formats and very elaborate ways of assembling their manuscripts. About 75% of our workload consists to revise these formats. This is time we can not assign to suggestions on how the manuscripts could be improved. Please don't be fancy. Just follow the guidelines and do not add any special formatting options in your text. Also, we tend to receive two to three "final" versions of manuscripts. Take your time; but once you submitted a "final" manuscript, it will be "final".

Lemur News Vol. 3 was the first issue where we distinguished between "Aricles" and other contributions. Since then we were able to publish 121 articles, written by authors from 10 different countries. These articles have achieved more than 1000 entries according to "Google Scholar". We think we are on the right track.

**The Editors**

# ERRATUM

There is a mistake in the legend of Figure 1 in the article by Rabarivola *et al.*, Lemur News 11: page 46: we apologize to the authors and to the readers for not having paid better attention.



Legend as written in Vol. 11: Fig. 1. Assumed distribution of *Lepilemur dorsalis* (dotted) and *L. sahamalazensis* (hatched). Indicated is also the locality where the three specimens of the sportive lemurs from Ampasindava were captured (arrow).

Instead of the above legend please include the following legend: Fig. 1. Assumed distribution of *Lepilemur dorsalis* (hatched) and *L. sahamalazensis* (dotted). Indicated is also the locality where the three specimens of the sportive lemurs from Ampasindava were captured (arrow).

# NEWS and ANNOUNCEMENTS

## "Madagascar Naturellement": Birth control is my environmental priority

**Marc Ravalomanana**

*The article has been published in Worldview Magazine, Volume 19, Number 3, 2006. It is reprinted with permission from the Presidential Office.*

My country's strengths outnumber its weaknesses and we believe in our ability to succeed. Potentially, we are a rich country. We have important natural resources, a favorable climate, strong cultural values, hard-working farmers and opportunities in agriculture, livestock, fisheries, mining and wood.

We also have a unique and rich biodiversity. To the outside world, my country is best known for its natural wonders. For its size, Madagascar contributes more to earth's biodiversity than any other place. Eighty percent of our flora and fauna are unique to the island. We are best known for our lemurs. In fact, there are more than 70 varieties. But we boast other evolutionary oddities, as well: the tenrec, which is a miniature hedgehog-like animal; the fossa, which is a mongoose relative that looks like a cross between a puma and a dog; 223 known species of frogs; more than half the world's chameleon species; neon-green day geckos; three times as many kinds of palm trees as mainland Africa; and forests of endemic spiny plants.

Yes, we do have one of the most valued ecosystems; but it is also one of the most threatened. Why has this occurred? In a word, poverty. Madagascar is among the world's poorest countries: of 17 million Malagasy people, 13 million live on less than $1 a day. In fact, the average income is 41 cents per day. More than 75 percent live in rural areas, barely living off the land that surrounds them, using whatever resources they can find.

This poverty costs my people, our country and the world. Our traditional slash and burn method of agriculture is called tavy and it drives the Malagasy economy. We convert our tropical rainforests into rice fields, destroying plant and animal life and exhausting the soil, leaving behind nothing but scrub vegetation and alien grasses, eroded hillsides and the constant threat of landslides.

When you understand the farmer's dire need, you can see why he practices tavy. As long as there is forest land freely available for clearing, he may as well use the land before his neighbor does.

The damage is easily visible in the degraded and fragmented forests of the east and the cactus scrub invasion of the spiny forests to the south. You can see it in our rivers that run red with the soil of the central highlands. Each year, about one-third of the country burns. We have already lost about 90 percent of our forest and each year we lose one percent of what is left. We can't afford to let the land go up in smoke and ashes. Our forests will become desert. Our biodiversity destroyed. And my people will starve.

When I ask people in the countryside what they need, they always say, in this order: roads, schools and health centers. Health is paramount to my goals and their needs. Agriculture is the basis for most of the rural economy but for our own people to productively work in the fields, they must be healthy. Women work hard in this rural economy and time away from the fields to have babies, to take care of sick family members or to transport them to distant clinics is income lost. For the rural poor, time and money spent on health problems jeopardize the already tenuous levels of family and community food security.

The rapid growth of our population contributes to poor health and increased levels of poverty. Madagascar is not only one of the poorest populations in the world, it is also one of the fastest growing. Our rural population has nearly doubled since 1980 to 13.4 million last year. Studies conducted in selected rural areas show that as our population increases–actual numbers of people and rates of growth–the forest cover decreases.

I think you now see, as I do, how the causes of poverty are related. One way to attack these problems is family planning. We have to help couples have the size family they want and can provide for. In rural areas of the country, a woman will have five or six children in her lifetime. I see families struggling to feed nine to 10 children. I see their children–my country's future–weak from malnutrition and disease. I see farmers destroying their land in their effort to provide for their children. These sights hurt my heart.

I know we must help these families. Nearly half our population is under the age of 15 and now entering their reproductive years. There will be severe health risks for these children: early-age pregnancy, births too close together and high incidence of chronic maternal poor health. Out of every 100,000 women, 500 die from pregnancy-related causes each year; in the United States, only 8 die. Too-frequent births mean that children grow up without enough to eat and in poor health. In my country, 75 out of every 1,000 infants die in their first year of life; in your country the figure is 6.43. Family planning could prevent 25 percent of our infant deaths; safe water, childhood injections and other health interventions could prevent most of the remaining deaths.

Only if we focus our efforts where the poor people are–in rural communities–and on what their problems are will we be able to move from a subsistence to a market economy. Therefore, we have integrated programs to reach more people with new ideas. Such programs acknowledge population increases. All of what we do in Madagascar Naturellement blends programming from our Poverty Reduction Strategic Plan, the Politique Generale de l'Etat 2005 and the Madagascar Action Plan.

I asked the Ministry of Health to change its name to the Ministry of Health and Family Planning in 2004, making Madagascar one of the few nations where family planning is so explicitly recognized as a key health intervention. The ministry hosted a national family planning conference in December of last year and wrote a national strategy that has already achieved some impressive results. Malagasys now have six contraceptive methods to choose from instead of four. Contraceptives are on the country's list of essential drugs, and we have welcomed private companies to enter the distribution system. We have adopted innovative programs integrating family planning and environmental activities. We have created broad action plans for youth and adolescent health, safe motherhood and emergency obstetric care. In only a few years, the average number of children per family has decreased from 6.0 to 5.2 children per woman, one of the lowest rates among surveyed countries in Africa. Use of modern family planning methods has risen from 5 percent in 1992 to 18 percent, with rates even higher for urban women. This has occurred in a nation that has traditionally emphasized high birth rates–"a marriage blessed with many children." Having children is a good thing, but having information on when to have them is even better.

I announced a new environmental policy at the 2003 Durban World Parks congress. There, I pledged to increase by three times–from 1.6 million hectares to 6 million–over five years the amount of land under protected-area status in this "biodiversity hotspot". I further elaborated on this in 2004 with "Madagascar Naturellment" which underscores that our biodiversity is critical to the country's future economic growth and important to our national economic growth strategy.

To expedite economic growth, we launched a rapid results initiative with technical support from Harvard University advisors. And we got some other help from the United States. Just six months ago, the United States and Madagascar signed the first-ever Millennium Challenge Account compact. The Millennium Challenge Account is an aid initiative proposed by President Bush three years ago to reduce poverty in some of the poorest countries in the world. Over four years, the United States will contribute $110 million, roughly doubling the amount of development-related assistance the United States gives Madagascar each year. We are proud that Madagascar is the first country to sign the compact, and we are honored to be trusted by the U.S. government, Congress and the American people. We believe that the globalization of economies must be urgently followed by a globalization of responsibilities. Our people need water taps more than television sets.

Our success depends on crucial partnerships and strong national support. We have cultivated valuable partnerships with the U.S. Agency for International Development, the U.N. Population Fund and UNICEF to improve the use of modern contraceptives so that women are able to space their children for better health. We have also strengthened ties between our government, the private sector, many technical health partners and donors and the environmental and agricultural sectors. But our success depends on what we do at the community level.

We have introduced small, do-able actions through which mothers, fathers and children can improve their own behavior and their own health. With help from the U.S. Agency for International Development, we created what we call champion communities that empower local citizens to improve health standards and food security as they protect the environment. Village volunteers teach their neighbors about family planning, vaccines, hygiene and habitat, malaria prevention, nutritious cooking and treatment of their drinking water. Committees also address environmental degradation by focusing on the use of improved and intensive rice cultivation and on reforestation. We distribute educational materials that show how all of these needs are linked.

There is much more to be done but we are on the right road to better health and well-being and, at the same time, protecting the natural resources that God has entrusted to us. My government and I will not rest until the major cause of death is old age. This is the Malagasy dream. This is our vision, Madagascar, naturally.

## New address for Conservation International

Please note that as from 1st January 2007 – Conservation International US including the Center for Applied Biodiversity Science has a new address at:

Conservation International, 2011 Crystal Drive, Suite 500, Arlington, VA 22202, USA

## Homepage of the IUCN/SSC Primate Specialist Group

The IUCN/SSC Primate Specialist Group has a new homepage. Among other things it provides free access to various publications including Primate Conservation. The homepage is accessible at: www.primate-sg.org/pc.htm

**Anthony B. Rylands**
Center for Applied Biodiversity Science, Conservation International, 2011 Crystal Drive, Suite 500, Arlington, VA 22202, USA, a.rylands@conservation.org

## Websites for Marojejy National Park and Anjanaharibe-Sud Special Reserve

We would like to introduce two new websites created by Paul Atkinson and Eric Mathieu with the assistance of Erik R. Patel. The sites are for Marojejy National Park (www.marojejy.com) and Anjanaharibe-Sud Special Reserve (www.anjanaharibe.marojejy.com). The sites contain much factual information and periodically updated conservation threats for tourists, researchers, and conservationists alike. Much of this information can be downloaded as pdf files, including: Maps, Packing List, Fees, Bird Diversity Brochure, Lemur Diversity Brochure, Reptiles and Amphibians Brochure, Palms Brochure, Silky Sifaka Fact Sheet, Comprehensive Visitor's Guide Book. For more information contact: info@marojejy.com

## New website of the South East Asian Primatological Association

The South East Asian Primatological Association (SEAPA) has a new website for supporting primate conservation and related activities in South east Asia region. The site is at: www.aseanprimates.org

**Arif Setiawan and Agil Purusatama**

## New IPS vice-presidents for conservation and research

The IPS Council regrets to announce that Pierre Kakule has stepped down from being Vice-President of Conservation. We would like to take this opportunity to recognize Pierre for heading the Conservation activities of the Society since 2004. Pierre has inspired much interest in primatology and the IPS in the Democratic Republic of the Congo, and has become well-known to the many applicants for conservation and Galante awards with whom he has worked while Vice-President for Conservation. We wish him continuing success with his important commitments to conservation, education and the development of community reserves in DRC in general, and around the Tayna Gorilla Reserve in particular.

We are delighted to announce that Jonah Ratsimbazafy has accepted the Council's invitation to become the Interim Vice-President for Conservation. This change in the Vice-Presidency means that Jonah Ratsimbazafy will be handling all correspondence concerned with the Conservation and Galante awards prior to Edinburgh 2008. His email address is jonah.ratsimbazafy@durrell.org.

In 2006 Peter Kappeler has initiated to create a new section to promote research and to institutionalize it with in the IPS. Peter was appointed and now serves as the first Vice-President for research within the IPS. Congratulations to both of you!

## Report from the 21st Congress of IPS

The XXIst Congress of the International Primatological Society convened in Entebbe, Uganda, June 25-30, 2006. It was organized by wildlife management and research institutions in Uganda as well as by international wildlife NGOs working in Uganda and chaired by Dr. William Olupot of the Wildlife Conservation Society. The program included 2 satellite workshops held in Entebbe and Makerere University Biological Field Station in Kibale before and after the main congress respectively. There were 712 (same as the number in the 2004 congress in Turin) participants, representing 48 nations, including USA (34.6 %), Uganda (13.1 %), UK (9.3 %), Germany (6.1 %), Japan (3.8 %), Rwanda (2.7 %), Australia (2.2 %), Italy (2.2 %), Madagascar (2.0 %), Brazil (1.7 %), DRC (1.9 %). In addition, there were 39 registered guests.

There were 6 keynote lectures, including those by the renowned primatologist, Dr. Jane Goodall, and the Laureate, Dr. Tom Struhsaker, receiver of the 2006 IPS Lifetime Achievement Award. The opening session was belatedly attended by The President of the Republic of Uganda, His Excellency Yoweri K. Museveni who gave an enlightening speech focused on forest conservation in Uganda. Also at the opening was Uganda's Minister of Tourism, Trade, and Industry. There were 30 symposia, 4 roundtables, 3 workshops, approximately 425 oral presentations and 92 poster presentations. A pre-congress course on Primate Conservation for participants from habitat nations organized by Drs. Vernon Reynolds, Janette Wallis, and Klaus Zuberbuhler was attended by 17 participants. Other activities at the congress included revision of the list of the 25 most endangered primates, a Great Apes Survival Project (GRASP) meeting, and a meeting of the South East Asian Primatological Association (SEAPA).

**William Olupot**, Entebbe, Uganda, wolupot@yahoo.com

## International Primatological Society XXII Congress, 3 – 8 August 2008, Edinburgh, UK

On-line registration is now live for IPS 2008, which takes place in Scotland's capital city Edinburgh. Please click on www.ips2008.co.uk/Registration.html to register to attend this exciting congress.

The Executive Committee for IPS 2008 also invites authors to submit novel scientific work in any area of primatology for inclusion in the IPS 2008 Congress Programme. Oral presentations will be 15 minutes in duration plus 5 minutes of question time, and there will be two major dedicated poster sessions on different days. Those wishing to submit abstracts (for symposia, workshops, oral presentation or poster presentation) must be registered for the Congress before submission will be possible. Symposium submission deadline is 30th August 2007.

For further congress information, sponsorship or exhibition details please visit www.ips2008.co.uk or contact the Congress Secretariat on Tel: +44 (0) 141 434 1500 or info@ips2008.co.uk

## 6. Göttinger Freilandtage: Primate Behavior and Human Universals. Deutsches Primatenzentrum (DPZ), 11 – 14 December 2007, Göttingen, Germany

This conference aims to bring together primatologists, evolutionary anthropologists and psychologists to summarise our current state of knowledge concerning behavioural variation and its determinants within the order Primates, including humans. Specifically, it will focus on three aspects: (1) comparative studies of behavioural adaptations across (human and non-human) primates that examine evolutionary principles, (2) the ability and failures of evolutionary theory to explain human behavioural traits that affect survival and reproduction, and (3) to identify and explain human behavioural universals.

Confirmed Speakers: Laura Betzig, David Bjorklund, Monique Borgerhoff-Mulder, Robert Boyd, Dorothy Cheney, Robin Dunbar, Azar Gat, Michael Gurven, Chris Knight, Ryne Palombit, Joan Silk, Michael Tomasello, Robert Trivers, Carel van Schaik, Andrew Whiten and Richard Wrangham.

We cordially invite you to submit abstracts for relevant oral (15 min) and poster contributions. The conference is also open to guests without presentations. Deadline for registration and submission of abstracts is September 30, 2007.

Additional details: Prof. Dr. Peter Kappeler, gft@gwdg.de or www.soziobio.uni-goettingen.de/welcome.html

## New legislation for the protection of Malagasy species

I would like to draw your attention to a very significant piece of legislation passed recently in Madagascar giving legal protection to an updated and much more comprehensive list of Malagasy species.

Species listed in Categorie I, Class 1 receive absolute protection from hunting, capture or detention except for authorised scientific or management purposes. This list includes CITES Appendix 1 species AND endangered species that are not threatened by export but are or could be threatened by hunting for local consumption or use (eg A*nas bernieri*, *Threskiornis bernieri*, *Ardeola idae*, etc.)

Permits can be given for capture or hunting of species listed in Categorie I, Class 2, but must be within a national quota fixed by DGEF on advice from CITES Scientific Authority. These are CITES Appendix II species. This means, for example, that local hunting of *Erymnochelys madagascariensis* (without permits and significantly over quota) is now illegal.

Category II species, pests and can be caught all year. These are all introduced species (apart from the bush pig?).

Category III species are game and can be hunted or collected within open seasons.

The hunting seasons have also been defined differently for each taxonomic group.
Note that the list of species and the hunting season can be updated regularly (eg, annually). If you have any recommendations you could send them to CITES Management authority dgforets@wanadoo.mg and CITES scientific authority spcitesfaune@yahoo.fr

**Joanna Durbin**
ex Durrell Wildlife Conservation Trust, BP 8511, Antananarivo 101, Madagascar

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# REPOBLIKAN'I MADAGASIKARA

## Tanindrazana-Fahafahana-Fandrosoana

# MINISTERE DE L'ENVIRONNEMENT, DES EAUX ET FORETS

DECRET N° 2006 - 400

**portant classement des espèces de faune sauvage**

Le Premier Ministre, Chef du Gouvernement

Vu la Constitution,

Vu l'Ordonnance n° 60-126 du 3 octobre 1960 fixant le régime de la chasse, de la pêche et de la protection de la faune,

Vu l'Ordonnance n° 62-020 du 18 août 1962 sur la détention des lémuriens,

Vu l'Ordonnance n° 75-014 du 5 août 1973 ratifiant la Convention sur le commerce international des espèces de faune et de flore sauvages menacées d'extinction,

Vu la Loi n°2005-018 du 17 Octobre 2005 sur le commerce international des espèces de faune et de flore sauvages,

Vu le Décret n° 69-085 du 25 février 1969 réglementant la chasse au papillon,

Vu le Décret n° 94/700 du 8 novembre 1994 sur la gestion du crocodile du Nil,

Vu le Décret n° 2003-007 du 12 janvier 2003 portant nomination du Premier Ministre, Chef du Gouvernement,

Vu le Décret n°2003-008 du 12 janvier 2003 modifié par les décrets n°2004-001 du 5 janvier 2004, 2004-688 du 05 juillet 2004 n°2004-1076 du 07 décembre 2004 et n°2005-144 du 17 mars 2005, n°2005-700 du 19 octobre 2005 et n°2005-827 du 28 novembre 2005 portant nomination des membres du Gouvernement,

Vu le Décret n° 2005-334 du 31 mai 2005 fixant les attributions du Ministère de l'Environnement, des Eaux et Forêts ainsi que l'organisation générale de son Ministère,

Vu le Décret 2006-097 du 31 janvier 2006 fixant les modalités d'application de la loi sur le commerce international des espèces de faune et de flore sauvage,

Vu le Décret n°2006-098 du 31 janvier 2006 portant publication des annexes révisées de la Convention sur le commerce international des espèces de faune et de flore sauvages menacées d'extinction,

Sur proposition du Ministre de l'Environnement, des Eaux et Forêts,

En Conseil de Gouvernement,

DECRETE:

Article 1: l'article premier de l'ordonnance 60-126 du 3 Octobre 1960, les espèces de faune sauvage (oiseaux et autres animaux sauvages) sont réparties en trois catégories: espèces protégées, gibier et espèces nuisibles.

Article 2: Les espèces de faune sauvage relevant de la Catégorie I (espèces protégées) sont réparties en deux classes.

Les espèces de la Catégorie I, Classe I bénéficient d'une protection absolue sur tout le territoire de la République Malgache et ne peuvent ni être chassées, ni capturées, ni être détenues sauf dans les cas prévus par l'article 20 de l'ordonnance n°60-126 du 3 octobre 1960.

Les espèces de la Catégorie I, Classe II peuvent donner lieu à délivrance d'autorisation de chasse ou de capture, commerciale ou sportive dans les conditions réglementaires. Le quota de collecte pour chaque espèce de cette classe est fixé annuellement par l'Organe de Gestion CITES sur proposition de l'Autorité Scientifique CITES

Article 3: Les espèces animales relevant de la Catégorie II peuvent être chassées en tout temps en tant qu'espèces nuisibles.

Article 4: Les espèces sauvages constituant le gibier sont classées dans la Catégorie III. Elles peuvent être chassées ou capturées en vertu d'autorisation de chasse respectant les périodes de chasse.

Article 5: Les Annexes au présent décret contiennent les listes des espèces de faunes sauvages concernés. L'énumération des espèces des Catégories I et II est limitative, celle de la Catégorie III est indicative.

Article 6: La composition des catégories définies aux articles 2, 3 et 4 ci-dessus sera périodiquement mise àjour par arrêté du Ministre chargé des Eaux et Forêts sur proposition de l'Autorité Scientifique CITES.

Article 7: Le présent décret abroge le décret n°61-096 du 16 février 1961 modifié par le décret n° 88-243 du 15 juin 1988 répartissant en trois catégories, les oiseaux et autres animaux sauvages vivant sur le territoire de la République Malgache et toutes les dispositions antérieures contraires.

Article 8: Le Ministre de l'Environnement, des Eaux et Forêts et le Ministre de l'Education Nationale et de la Recherche Scientifique, sont chargés, chacun en ce qui le concerne, de l'exécution du présent décret qui sera publié au Journal Officiel, diffusé et communiqué partout où besoin sera.

Antananarivo, le 13 juin 2006

Par le Premier Ministre, Chef du Gouvernement
**Jacques SYLLA**

Le Ministre de l'Environnement, des Eaux et Forêt
**Charles Sylvain RABOTOARISON**

Le Ministre de l'Education Nationale et de la Recherche Scientifique
**Haja RAZAFINJATOVO**

**PERIODE DE CHASSE ET DE COLLECTE**

| Espèces | Periode |
|---|---|
| Amphibiens | 1 Février - 30 Avril |
| Reptiles | 1 Février - 30 Avril |
| Carnivores | 1 Avril - 30 Juin |
| Chiroptères (*Pteropus rufus, Eidolon dupreanum, Rousettus madagascarensis*) | 1 Mai - 1 Septembre |
| Microchiroptères (*Hippisideros commersoni*) | 1 Février - 1 Mai |
| Insectivores (Tenrecinae: *Tenrec, Hemicentetes, Echinops* et *Setifer* | 1 Avril - 31 Mai |
| Insectes | Toute l'année |
| Oiseaux aquatiques | 15 Mai - 30 Septembre |
| Oiseaux forestiers | 1 Mai - 30 Septembre |

# IUCN/SSC PRIMATE SPECIALIST GROUP: A summary of activities 2004-2006

## Structure

There has been some restructuring of the PSG over the last two years. Regional representation has been expanded to reflect the considerable activity in primate research and conservation so that we can keep in closer touch with regional issues. One of the most important changes has been the retirement of Rebecca Kormos, who did such an excellent job structuring and starting up the Section on Great Apes (SGA). Liz Williamson, Stirling University, UK, has taken over and is now coordinating the activities of the SGA. The current officers are as follows:

**Chairman** Russell A. Mittermeier, Conservation International, Washington, DC, USA

**Deputy Chair** Anthony B. Rylands, Center for Applied Biodiversity Science, Conservation International, Washington, DC, USA

**Coordinator Section on Great Apes** Liz Williamson, Stirling University, Stirling, Scotland, UK

**General Coordinator**: John M. Aguiar, Center for Applied Biodiversity Science, Conservation International, Washington, DC, USA.

*Regional Coordinators – Neotropics*

Mesoamerica – Ernesto Rodríguez-Luna, Instituto de Neuroetología, Universidad Veracruzana, Xalapa, Mexica

Andean Countries – Erwin Palacios, Conservation International Colombia, Bogotá, Colombia, and Eckhard W. Heymann, Deutsches Primatenzentrum, Göttingen, Germany

Brazil and the Guianas – M. Cecília M. Kierulff, Fundação Parque Zoológico de São Paulo, São Paulo, Brazil

*Regional Coordinators – Africa*

West Africa – John F. Oates, Hunter College, City University of New York (CUNY), New York, NY, USA

East Africa – David Mbora, Dartmouth College Hanover, New Hampshire, USA

*Regional Coordinator – Madagascar*

Jörg U. Ganzhorn, Hamburg University, Hamburg, Germany

*Regional Coordinators – Asia*

China – Long Yongcheng, Kunming Insitute of Zoology, Yunnan, China

Southeast Asia – Jatna Supriatna, Conservation International Indonesia Program, Jakarta, Indonesia, and Christian Roos, Deutsches Primatenzentrum, Göttingen, Germany

South Asia – Sally Walker, Zoo Outreach Organization, Coimbatore, India

## Taxonomy

The PSG continues to pay special attention to the taxonomy and systematics of the primates—understanding diversity is fundamental for conservation action. At present we maintain a list of:

| | Family | Genus | Species | Species & Subspecies |
|---|---|---|---|---|
| **Africa** | 4 | 22 | 79 | 169 |
| **Madagascar** | 5 | 15 | 72 | 75 |
| **Asia** | 5 | 16 | 79 | 186 |
| **Neotropics** | 5 | 19 | 133 | 202 |
| **Total** | 16 | 71 | 363 | 632 |

We do not pretend to have a definitive taxonomy, of course, merely a working list of primates based on such as:

Brandon-Jones, D. 2004. A taxonomic revision of the langurs and leaf monkeys (Primates: Colobinae) of the Indian Subcontinent. Zoos' Print Journal 19: 1552-1594.

Brandon-Jones, D.; Eudey, A.A.; Geissmann, T.; Groves, C.P.; Melnick, D.J.; Morales, J.C.; Shekelle, M.; Stewart C.-B. 2004. Asian primate classification. Int. J. Primatol. 25: 97-164.

Gonder, M.K.; Oates, J.F.; Disotell, T.R.; Forstner, M. R.J.; Morales, J.C.; Melnick, D.J. 1997. A new West African chimpanzee subspecies? Nature 388: 337.

Groves, C.P. 2001. Primate Taxonomy. Smithsonian Institution Press, Washington, DC.

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## New Species

Ten lemurs (Kappeler *et al.*, 2005; Thalmann and Geissmann, 2005; Andriaholinirina *et al.*, 2006; Louis *et al.*, 2006; Rabarivola *et al.*, 2006), a tarsier (Merker and Groves, 2006), a mangabey (Jones *et al.*, 2005), a macaque (Sinha *et al.*, 2005), and a titi monkey (Wallace *et al.*, 2006) have been described since the beginning of 2005, totaling 14 new species till July 2006. Fifty-four primates have been described since 1990. Two new genera were created. The highland mangabey was described in the genus *Lophocebus*, but subsequently placed in its own genus *Rungwecebus* Davenport *et al.*, 2006. Mootnick and Groves (2005) provided a new generic name for the hoolock gibbon, replacing *Bunopithecus* Matthew and Granger, 1923 (found to be unavailable) with *Hoolock*. Notable too was the rediscovery of a capuchin monkey in Northeast Brazil. The blonde capuchin was first described as *Simia flavia* Schreber, 1774 (Oliveira and Langguth, 2006).

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| **Madagascar** | |
|---|---|
| *Microcebus lehilahytsara* Roos & Kappeler in Kappeler, Rasoloarison, Razafimanantsoa, Walter & Roos, 2005 | Goodman's mouse lemur |
| *Microcebus mittermeieri* Louis Jr., Coles, Andriantompohavana, Sommer, Engberg, Zaonarivelo, Mayor & Brenneman, 2006 | Mittermeier's mouse lemur |
| *Microcebus jollyae* Louis Jr., Coles, Andriantompohavana, Sommer, Engberg, Zaonarivelo, Mayor & Brenneman, 2006 | Jolly's mouse lemur |
| *Microcebus simmonsi* Louis Jr., Coles, Andriantompohavana, Sommer, Engberg, Zaonarivelo, Mayor & Brenneman, 2006 | Simmons's mouse lemur |
| *Mirza zaza* Kappeler and Roos in Kappeler, Rasoloarison, Razafimanantsoa, Walter and Roos, 2005 | Northern giant mouse lemur |
| *Lepilemur aeeclis* Andriaholinirina *et al.*, 2006 | Antafia sportive lemur |
| *Lepilemur randrinanasoli* Andriaholinirina *et al.*, 2006 | Randrianasolo's sportive lemur |
| *Lepilemur sahamalazensis* Andriaholinirina *et al.*, 2006 | Sahamalaza Peninsula sportive lemur |
| *Lepilemur mittermeieri* Rabarivola *et al.*, 2006 | Mittermeier's sportive lemur |
| *Avahi cleesei* Thalmann & Geissmann, 2005 | Bemaraha woolly lemur |
| **Africa** | |
| *Lophocebus kipunji* Ehardt, Butynski, Jones & Davenport, 2005 in Jones, Ehardt, Butynski, Davenport, Mpunga, Machaga & De Luca, 2005 | Highland mangabey |
| *Rungwecebus* Davenport *et al.*, 2006 | Highland mangabey (new genus) |
| **Asia** | |
| *Tarsius lariang* Merker and Groves, 2006 | Palu tarsier |
| *Macaca munzala* Sinha, Datta, Madhusudan and Mishra, 2005 | Arunachal macaque |
| *Hoolock* Mootnick & Groves, 2005 | Hoolock gibbon (new genus) |
| **Neotropics** | |
| *Callicebus aureipalatii* Wallace, Gómez, A.M. Felton and A. Felton, 2006 | Madidi titi |

## Red List Assessments

All of the primates are currently being reassessed under the IUCN Red List Categories and Criteria Version 3.1 as part of the IUCN/SSC Global Mammal Assessment. The assessment includes the collection of data on certain life-history variables, taxonomic issues, populations, geographic distributions (including a map) and threats. This is being done through workshops:

**Africa:** Status Assessment Workshop for African Primates, IUCN/SSC Global Mammal Assessment (GMA), Disney Institute, Orlando, Florida, 26-31 January 2005.
**Madagascar:** Status Assessment Workshop for Lemurs of Madagascar, IUCN/SSC Global Mammal Assessment (GMA), April 2005.
**Asia**: Status Assessment Workshop for Asian Primates, IUCN/SSC Global Mammal Assessment (GMA), 8-12 September 2006, in Phnom Penh, Cambodia.
**Neotropical Primates**: All, except for two species (*Oreonax flavicauda* and *Saguinus oedipus*) were reassessed in 2002/2003. Strategy for reassessment has yet to be decided.

South Asian primate species were assessed during a Conservation Breeding Specialist Group CAMP workshop held in Coimbatore, India, 5-9 March 2002.
Molur, S.; Brandon-Jones, D.; Dittus, W.; Eudey, A.; Kumar, A.; Singh, M.; Feeroz, M.M.; Chalise, M.; Priya, P.; Walker, S. 2003. Status of South Asian Primates: Conservation Assessment and Management Plan (C.A.M.P.) Workshop Report, 2002. Zoo Outreach Organisation, Conservation Breeding Specialist Group (CBSG) South Asia, Coimbatore, India, 432 pp.

## Publications

*IUCN/SSC Primate Specialist Group journal Primate Conservation*
Editors: Russell A. Mittermeier, Conservation International, Washington, DC, and Anthony B. Rylands, Center for Applied Biodiversity Science, Conservation International, Washington, DC.
This journal is annual, but plans are underway to increases it frequency and regularity. The most recent issue (20) was published in May 2006. A second issue (21) for 2006 is in preparation.
Website: www.biodiversityscience.org/xp/CABS/publications/periodicals/primate_conservation/primatecons.xml

*IUCN/SSC Primate Specialist Group Regional Newsletters*
The IUCN/SSC Primate Specialist Group produces regional newsletters cum journals which include short articles and notes on general and specific aspects of primate ecology, taxonomy, distributions, behavior and conservation, tropical forest ecology and conservation, forest destruction, and protected areas.

Madagascar – *Lemur News*
Jörg Ganzhorn, Dept. of Animal Ecology and Conservation, Martin Luther King Platz 3, 20146 Hamburg, Germany, ganzhorn@zoologie.uni-hamburg.de

Asian Region – *Asian Primates*
Ardith A. Eudey, 164 Dayton Street, Upland, California 91786, USA, eudey@aol.com

Neotropical Region – *Neotropical Primates*
Anthony B. Rylands, Center for Applied Biodiversity Science, Conservation International, 2011 Crystal Drive, Suite 500, Arlington, VA 22202, USA.
a.rylands@conservation.org

African Region – *African Primates*
formerly Thomas M. Butynski.
Currently searching for new editor

*Primate Field Guides*
The second edition of the *Lemurs of Madagascar* was published, and work is still underway for similar publications for the primates of the Guianas, the marmosets and tamarins, the primates of the Brazilian Atlantic forest, and the primates of West Africa.
Mittermeier, R.A.; Konstant, W. R.; Hawkins, F.; Louis Jr., E. E.; Langrand, O.; Ratsimbazafy, J.; Rasoloarison, R.; Ganzhorn, J.U.; Rajaobelina, S.; Tattersall, I.; Meyers, D.M. 2006. Lemurs of Madagascar. $2^{nd}$ edition. Tropical Field Guide Series, Conservation International, Washington, DC. 520pp.; Available from Jill Lucena (j.lucena@conservation.org), for $25.00 + p&p.

### IUCN/SSC Section for Great Apes

The role of the Section on Great Apes of the IUCN/SSC Primate Specialist Group is to promote conservation action on behalf of the great apes based on the best scientific information available. The SGA serves as a forum for discussion and information exchange; it establishes guidelines for best practices in research and conservation; and it formulates action plans and advises on the effective protection of great ape populations in the wild.
The 1st meeting of the Executive Committee of the Section on Great Apes was held April 17-19, 2005, hosted by The Lester E. Fisher Center for the Study and Conservation of Apes, Lincoln Park Zoo, Chicago, Illinois, USA. It now counts on close to 100 members including some of the world's most distinguished and experienced great ape researchers—the combined expertise of the SGA spans the scientific, social and ethical aspects of great ape conservation, providing a comprehensive perspective on the challenges and solutions available. It is principally involved in the following activities:

- *IUCN Red List assessments*. The SGA is responsible for reviewing the Red List assessments and making any recommendations for change in status and providing the necessary documentation. The western gorillas have been reassessed and assessments of the other great apes are in progress.
- *Status Survey and Conservation Action Plans*. To date the SGA has sponsored regional workshops on chimpanzees in West Africa (Kormos *et al.* 2002) and on both chimpanzees and gorillas in Western Equatorial Africa (Tutin *et al*., 2005). The latter resulted from a workshop held in Brazzaville, Republic of Congo in 2005 with over 70 participants.
  Kormos, R.; Boesch, C.; Bakarr, M.I.; Butynski, T.M. 2002. West African Chimpanzees. Status Survey and Conservation Action Plan. IUCN/SSC Primate Specialist Group. IUCN, Gland, Switzerland and Cambridge, UK. (also available in French).
  Tutin, C.; Stokes, E.; Boeasch, C.; Morgan, D.; Sanz, C.; Reed, T.; Blom, A.; Walsh, P.; Blake, S.; Kormos, R. 2005. Regional Action Plan for the Conservation of Chimpanzees and Gorillas in Western Equatorial Africa. IUCN/SSC Primate Specialist Group, Section on Great Apes (SGA) & Conservation International, Washington, DC. 36pp (also available in French).
  The SGA has also participated in the "Action Planning for Cross River Gorilla Conservation Third International Workshop and Conference", 26-29 April 2006, Calabar, Nigeria, hosted by the Wildlife Conservation Society and the Nigerian Conservation Foundation and, in 2004, a Conservation Breeding

Specialist Group (CBSG) "PHVA Workshop for the Orangutan", 15-18 January 2004, Jakarta, Indonesia. Workshops for action plans are being prepared for the bonobo and apes of east-central Africa (2007) and the Gulf of Guinea chimpanzee (possibly 2008). The PSG/SGA will take an active role in supporting these workshops.

- *Establishing guidelines for specific research and conservation practices*. A "best practices" series which provide guidance to field scientists, governments, donors and development organizations involved in great ape conservation. Priority topics now in preparation include: Tourism and great apes; Methods for monitoring and surveying great ape populations; Reintroducing great apes to the wild from sanctuaries. These have been commissioned and are in preparation.
- *Fund-raising for research and conservation in the field.* A major element of the SGA's work plan is to find the financial resources to support needed conservation actions in the field, working in close collaboration with numerous partner organizations to implement recommendations from the Action Plans. Part of this fund-raising initiative will stock the Great Ape Emergency Fund, to provide small grants to emergency and worthy endeavors in research and conservation of the great apes.
- *Great Ape Emergency Fund.* Funds currently available through the Great Ape Emergency Conservation Fund have been provided by the Critical Ecosystem Partnership Fund (CEPF). The focus of CEPF in this case is on the Upper Guinean Forest Ecosystem, extending from Guinea to western Togo. Until new funds are available, awards will be geographically restricted to target emergencies in Côte d'Ivoire, Ghana, Guinea, Liberia and Sierra Leone. The Critical Ecosystem Partnership Fund (CEPF) is a joint initiative of Conservation International, the Global Environment Facility, the Government of Japan, the John D. and Catherine T. MacArthur Foundation and the World Bank.
  See: www.cepf.net/xp/cepf/where_we_work/guinean_forest/guinean_forest_info.xml, and also www.primate-sg.org/apes.htm for more information.
- *Databases for Monitoring Great Ape Populations.* These are being established through collaboration with the Max Planck Institute for Evolutionary Anthropology, Leipzig, Lincoln Park Zoo, Chicago, Wood's Hole Research Center, Massachusetts, and the Jane Goodall Institute, Washington, DC, with the participation and leadership of a number of SGA researchers.

The SGA works closely with the Great Ape Survival Project (GrASP) of UNEP/UNESCO, including, most particularly membership of the Scientific Commission, and participation in their major meetings, including, recently:

- 1st Intergovernmental Meeting on Great Apes and the Great Apes Survival Project (GRASP) and the first GRASP Council Meeting, Kinshasa, Democratic Republic of the Congo (DRC), 5-9 September 2005
- Scientific Workshop on Great Ape Priority Populations and Habitats, Paris, 18-29 April 2006.

With the gorillas being placed on the Convention on Migratory Species (CMS) of UNEP, the SGA also participated in the:

- Eighth meeting of the Conference to the Parties to CMS (COP 8), Nairobi, Kenya, 20-25 November, 2005.

## World's 25 Most Endangered Primates

*IUCN/SSC Primate Specialist Group and International Primatological Society*

To promote the public awareness of the critical situation of numerous primate species around the world, in 2000 the IUCN/SSC Primate Specialist Group, together with Conservation International, drew up a list of the 25 primates they considered were most endangered and most in need of attention for conservation and research. An updated Top 25 list was released in 2002, following a special open discussion-meeting at the 19th Congress of the International Primatological Society (IPS) in Beijing, China. The revision culminated in the official endorsement of the list by the IPS, which is now a joint endeavor of the Primate Specialist Group, the IPS and Conservation International. In August 2004, at the 20th Congress of the IPS in Torino, Italy, nearly two hundred primatologists attended a second open session, which developed this most recent list of the top 25 most endangered primates. The species and subspecies which appear in the 2004-2006 list were chosen not only for the degree of threat to their populations, but also as representatives of a region, ecosystem or taxonomic group. A report and subsequent article in Primate Conservation provided a brief summary of the conservation status of each:

**Madagascar** – *Prolemur simus*, *Eulemur albocollaris*, *Propithecus candidus*, *P. perrieri*;

**Africa** – Mt. Rungwe galago (*Galagoides* sp.), *Procolobus pennantii pennantii*, *Procolobus rufomitratus*, *Cercocebus atys lunulatus*, *Cercocebus sanjei*, *Gorilla beringei*, *Gorilla gorilla diehli*;

**Asia** – *Loris lydekkerianus nycticeboides*, *Simias concolor*, *Presbytis hosei canicrus*, *Trachypithecus delacouri, Trachypithecus poliocephalus poliocephalus, Semnopithecus vetulus nestor*, *Pygathrix nemaeus cinerea*, *Rhinopithecus avunculus*, *Nomascus nasutus hainanus*, *Pongo abelii*;

**Neotropics** – *Leontopithecus caissara*, *Cebus xanthosternos*, *Ateles hybridus brunneus*, and *Brachyteles hypoxanthus.*

Mittermeier, R.A.; Valladares-Pádua, C.; Rylands, A. B.; Eudey, A.A.; Butynski, T.M.; Ganzhorn, J.U.; Kormos, R.; Aguiar, J.M.; Walker, S. (eds.). 2006. Primates in Peril: The World's 25 Most Endangered Primates 2004-2006. Primate Cons. (20): 1-28.

Contributors to the report, providing profiles for each of the species, were: Alexandre T. Amaral, Simon K. Bearder, Jean Philippe Boubli, Douglas Brandon-Jones, Gustavo Canale, Camila Cassano, Tim R. B. Davenport, Thomas R. Defler, Jinie Dela, Luiz Gustavo Dias, Carolyn L. Ehardt, Susie Ellis, Agustin Fuentes, Carlos Eduardo Guidorizzi, Frank Hawkins, Steig Johnson, Maria Cecília M. Kierulff, William R. Konstant, Annette Lanjouw, Mark Leighton, Jean-Marc Lernould, Lindsay Magnuson, W. Scott McGraw, Sérgio Lucena Mendes, David Meyers, Alan R. Mootnick, Alba Lucia Morales-Jiménez, Tilo Nadler, K. Anna I. Nekaris, John F. Oates, Lisa Paciulli, Andrew Perkin, Fabiana Prado, Martina Raffel, José Vicente Rodríguez-Mahecha, Noel

Rowe, Gabriel Rodrigues dos Santos, Ian Singleton, Roswitha Stenke, Jacqui L. Sunderland-Groves, Karen B. Strier, Thomas T. Struhsaker, Roland Wirth and Zhaoyuan Li.

A special meeting held during the 21st Congress of the International Primatological Society, Entebbe, 25-30 June, 2006 which resulted in the revised list of the World's 25 Most Endangered Primates (see table below). Those with an asterisk are new to the list. The following species were taken off the list of the previous two years (2004-2006): *Propithecus perrieri*, the Mt. Rungwe galago (*Galagoides* sp.), *Cercocebus atys lunulatus*, *Cercocebus sanjei*, *Gorilla beringei*, *Presbytis hosei canicrus*, *Leontopithecus caissara*, *Cebus xanthosternos*, and *Brachyteles hypoxanthus*.

**World's 25 Most Endangered Primates 2006-2008**
(* = new to the list)

| **Madagascar** | |
|---|---|
| *Prolemur simus* | Greater bamboo lemur |
| *Eulemur albocollaris* | White-collared lemur |
| *Propithecus candidus* | Silky sifaka |
| *Lepilemur sahamalazensis** | Sahamalaza Peninsula sportive lemur |
| **Africa** | |
| *Galagoides rondoensis** | Rondo dwarf galago |
| *Procolobus pennantii pennantii* | Pennant's red colobus |
| *Procolobus rufomitratus* | Tana River red colobus |
| *Procolobus badius waldroni** | Miss Waldron's red colobus |
| *Rungwecebus kipunji** | Highland mangabey |
| *Cercopithecus diana roloway** | Roloway monkey |
| *Gorilla gorilla diehli* | Cross River gorilla |
| **Asia** | |
| *Tarsius* sp.* | Siau Island tarsier |
| *Loris lydekkerianus nycticeboides* | Horton Plains slender loris |
| *Simias concolor* | Pig-tailed langur |
| *Trachypithecus delacouri* | Delacour's langur |
| *Trachypithecus p. poliocephalus* | Tonkin hooded black langur |
| *Semnopithecus vetulus nestor* | Western purple-faced langur |
| *Pygathrix nemaeus cinerea* | Grey-shanked douc |
| *Rhinopithecus avunculus* | Tonkin snub-nosed monkey |
| *Nomascus nasutus hainanus* | Hainan black-crested gibbon |
| *Hoolock hoolock hoolock** | Western Hoolock gibbon |
| *Pongo abelii* | Sumatran orangutan |
| **Neotropics** | |
| *Ateles hybridus* | Variegated spider monkey |
| *Ateles fusciceps** | Brown-headed spider monkey |
| *Oreonax flavicauda** | Yellow-tailed woolly monkey |

**IUCN/SSC Primate Specialist Group on the Web**

Progress has been made regarding the creation of a website for the PSG. The aim is to have an information source for PSG activities, meetings and publications, besides listings of all primate species and subspecies and their status according to the IUCN Red List of Threatened Species. A special page will provide information on the World's 25 Most Endangered Primates. Particular emphasis will be given to taxonomic aspects and as well informing of new species. We also pretend to provide listings and bibliographies for each primate habitat country as well for Conservation International's hotspots and high biodiversity wilderness areas. This will become a source for downloading, free of charge, the regional newsletters and Primate Conservation, besides action plans. Information is also available regarding the Great Ape Emergency Fund of the SGA. John M. Aguiar, General PSG Coordinator has created the site and will be maintaining it. j.aguiar@conservation.org, www.primate-sg.org

**Funding Primate Research and Conservation**

The PSG is closely involved in two funding sources for surveys, field research, publications and conservation measures for threatened primates.

The Margot Marsh Biodiversity Foundation provides funding to US-based institutions, allowing for grants of up $25,000. Deadlines for submission of applications are 1st March and 1st September each year. Applications can be sent to: Dr. William R. Konstant, 403 Poplar Road, Flourtown, Pennsylvania 19031, USA, bkonstant@houstonzoo.org.

The Primate Action Fund provides awards of up to $5,000. Proposals are considered when they are received. In this case payments can be made through any organization worldwide, such as NGOs, zoos or universities, but not to individuals. Applications for these grants can be sent to Anthony B. Rylands at the Center for Applied Biodiversity Science, Conservation International, and preferably by a.rylands@conservation.org.

From March 2004 to March 2005 the Primate Action Fund supported 44 projects, averaging $2,914 per grant, and during the period March 2005-March 2006 a further 35 grants were given out, averaging $3,723 per grant. The maximum single award given was $5000.

**Russell A. Mittermeier – PSG Chair**
**Anthony B. Rylands – PSG Deputy Chair**
**Liz Williamson – Coordinator PSG/SGA**
Washington, DC, 30 July 2006

## New Journal for Madagascar

Madagascar Wildlife Conservation and the Jane Goodall Institute Switzerland proudly present Issue 1 of the new journal "Madagascar Conservation & Development". The whole issue is available for free at www.mwc-info.net/en/services/journal.htm

### Content of Issue 1

**Editorial**

Combining Conservation & Development (Waeber, P.O. and Haenni, D.C.)
A warm welcome to the MCD journal (Ratsirarson, J.)
Sharing the information with locals (Goodall, J.)

**Conservation articles**

Lemurs: Ambassadors for Madagascar (Thalmann, U.)
Short Communication on the Alaotra gentle lemur: Population estimation and subsequent implications (Ralainasolo, F.B.; Waeber, P.O.; Ratsimbazafy, J.; Durbin, J.; Lewis, R.)
Comic strips as environmental educative tools for the Alaotra region (Maminirina, C.P.; Girod, P.; Waeber, P.O.)
Aspects de la Conservation des Reptiles et des Amphibiens dans la Région de Daraina (Rakotondravony, H. A.)
Communautés locales et gibiers dans la région de Daraina, extrème Nord-Est de Madagascar (Rakotondravony, H.A.)

**Development articles**

Solar Cooking in Madagascar (Vetter, H.)

Establishing Solar Water Disinfection as a Water Treatment Method at Household Level (Meierhofer, R.)

Scientific Bases for a Participatory Forest Landscape Management: A new Research Project in Central Menabe (Dirac, C.; Andriambelo, L.H.; Sorg, J.-P.)

Indigenous silk moth farming as a means to support Ranomafana National Park: report on a feasibility study (Razafimanantosoa, T.; Ravoahangimalala, O.R.; Craig, C.L.)

**MCD-interview**

Three women engaged in the CPALI Wild Silk Project

**Essays**

Preserving Madagascar's Natural Heritage: The Importance of keeping the island's vertebrate fossils in the public domain (Krause, D.W.; O'Connor, P.M.; Rasoamiaramanana, A.H.; Buckley, G.A.; Burney, D.; Carrano, M.T.; Chatrath, P.S.; Flynn, J.J.; Forster, C.A.; Godfrey, L.R.; Jungers, W.L.; Rogers, R.R.; Samonds, K.E.; Simons, E.L.; Wyss, A.R.)

Roots & Shoots – a Model for Active Environmental Protection (Waeber, P.O.)

Madagascar moving towards sustainable development: was the preparation of the National Environmental Action Plan (NEAP) a false start? (Mercier, J.-R.)

**Miscellaneous**

Lost World: The past, present and future of biodiversity in Madagascar (Benham, P.B.; Ratsimbazafy, J.)

**EAZA**

Symposium

Pictures by Eric Matson

## *Lemur catta* and hunting around Andohahela

**Nina Moniac and Anna Heitmann**
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On October 4, 2006 we found the remains of two *Lemur catta* in a pit together with a nearby fireplace east of Tsimelahy (Fig. 1). The place was located on the western border of Andohahela National Park, Parcel 1 at 24.94608° S 046.67470° E [WGS 84] at an altitude of 413 m above sea level, outside the national park. We assume that the lemurs have been killed in the vicinity of the place where they were found. This indicates that *Lemur catta* still exists very close to the evergreen humid forest of southern Madagascar and that lemur hunting remains a problem as indicated earlier (Raharivololona and Ranaivosoa, 2000; ANGAP, 2003).

Fig. 1: Remains of two *Lemur catta* at the border of Andohahela National Park. Photo: Anna Heitmann

**References**

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## Rural development projects and transport links: A case study from southern Madagascar

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If you were to hear a mention of southern Madagascar and controversial corporate investments supported by the World Bank in the same breath you would be forgiven for thinking of the high profile titanium mine that Rio Tinto is starting in the town of Fort Dauphin with the backing of the World Bank and the Malagasy Government. But southern Madagascar harbours another less known project of the Bank. It isn't British Mining Giant being brought into the spotlight this time, but a large French Construction Company. French construction conglomerate VINCI, the World Bank and the Malagasy Government have collaborated on a road building project to link an isolated agricultural area to the national road network in Madagascar.

On the face of it one might think this a laudable venture, even more so when one considers that southern Madagascar is one of the poorest areas of the Indian Ocean Island which in turn is one of the poorest nations on the planet. The road (World Bank Project P073689), links Amboasary and Anadabolava, rural towns 105 km apart in the deep south of the island and home to the Antandroy people. Anadabolava, the final port of call for this part of the road is found in the high basin of the Mandrare river and is part of a $31.5M project of the International Fund for Agricultural Development (IFAD) to promote rural agricultural production. Presumably this large IFAD project is part of the justification for the road improvement.

It certainly seems sensible for the World Bank to invest in an improved road to allow the producers in the Mandrare Basin to get their rice harvest out to market. However when one delves a little deeper into this project it is seen how the project has done less than it set out to, and how VINCI have not performed well in terms of managing environmental impacts.

First off, a 58 km portion of the road linking the villages of Behara and Tranomaro cuts through one of the region's most important areas of forest. The south of Madagascar is home to the spiny forest, where hundreds of cactus like plants which are found nowhere else on earth survive, the spiny forest ecoregion is one of the planet's highest conservation priorities. The fact that this road bisects the forest is not in itself an issue, as roads of one form or other have been there since Madagascar's colonial era. The problem comes when we look at the road construction itself.

In 2004 the World Bank and Madagascar's government appointed SOGEA-SATOM, subsidiary of French Giant VINCI to renew this 105 km stretch of road, a contract to the tune of US$2.83M (siteresources. worldbank.org/INTPROCUREMENT/Resources/FRANCE_FY04-05.xls). However, in a region where the rainy season sees downpours which leave the soils as a sticky red mud, locally known as '*Fotaka',* it was decided that the project should consist of a road largely of compacted earth. Madagascar has one of the worst road networks in the African region and needless to say this road hasn't lasted long, not even a year in fact.

At a cost of almost US$27,000 per kilometer VINCI has created something of a linear mudbath. Considering that most of the estimated 300 or so labourers they employed cost less than $3 a day and that the project lasted only a matter of 5 or 6 months this was yet again a big profit from the developing world for a western corporation.

The 'bad practice' doesn't stop there, the compacted earth had to come from somewhere. VINCI decided that rather than travel an extra 20 km to open areas near Amboasary to obtain the aggregate, they would cut down primary forest to get to the earth. This is a forest which has been internationally identified as a conservation priority, less than 10 km from the globally renowned Andohahela National Park, and a forest earmarked to become the islands 4th largest conservation site in the third phase of Madagascar's Environment Programme.

A simple scan of the forest using Google Earth shows 9 areas adjacent to the road where VINCI took the earth from. The very fact that this deforestation went on immediately beside the road itself makes the whole affair hurt all the more. In a district where the local government forester actively pursues poverty stricken villagers for converting forest into agricultural land, a huge international company was actually paid to bulldoze the forest. Sadly the National Forest Observatory who has been presented written evidence of the ongoing corruption has been unable to oust the infamous Amboasary forester or his assistant and have not ensured an appropriate reforestation effort occurred.

Looking at VINCI's 2004 Annual Report, one would think that they are another great example of corporate leadership or 'Corporate Social Responsibility' as it is now fashionably known. For example page 18 of the report boasts a photograph of a road building project in NIGER, part of their $20BN annual sales, where they proudly declare that they rehabilitate the quarries and replant vegetation along the road. Indeed in Madagascar they made a token attempt to replanting the forest, which originally had been home more than a hundred plant species, with a monoculture of a native tree '*Fantiolotse*'. A year later, less than 1 % of these trees are still alive and the local population stare the corporate deforestation in the face as the invasive prickly pear cactus (*Opuntia* sp.) begins to invade.

So not only does substantial agricultural development project lose a decent road, but the local people are insulted by corporate driven deforestation and a wealthy French company takes a huge profit from the venture. Perhaps this article will make 'the authorities' sit up and pay attention.

# ARTICLES

## Lemur diversity: A recent efflorescence of species

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A basic understanding of the taxonomy, diversity, and distributions of primates is essential for their conservation. The field guide to the lemurs of Madagascar, published in 1994, listed 32 species and 50 taxa in all (Mittermeier *et al*., 1994). The second edition of this guide listed 71 taxa, 68 of which were considered species (Mittermeier *et al*., 2006). A recent re-evaluation of the diversity of lemurs (Mittermeier *et al*., submitted) has now listed 93 taxa, 90 of which are considered to be species (just three subspecific forms) (Table 1).

The numbers of lemur taxa have increased over this time due to taxonomic revisions that have resurrected forms previously considered junior synonyms, and because morphological and (mostly) genetic studies have been bringing to light populations considered sufficiently distinct as to warrant their classification as separate "new" species. Mittermeier e*t al*. (1994) listed two dwarf lemurs (*Cheirogaleus*), for example, but the revision carried out by Groves (2000) recognized the validity of three forms considered at the time to be junior synonyms, and described a further two for the first time. More recently, research by Groves (2006) found evidence sufficient for the recognition of *Eulemur rufifrons* as a distinct form rather than just as a pelage color variant of *E. rufus*. The second driving force behind the proliferation of lemur taxa is the discovery of "new" species. In the large majority of cases, these have been identified though molecular genetic and cytogenetic studies. Forty-eight, just over half, of the taxa listed in Table 1 were described prior to 1975. The remaining 45 have been described since then, starting off with five being published in that year by Yves Rumpler and Roland Albignac (Rumpler, 1975; Rumpler and Albignac, 1975). Thirty-three new taxa were described just between 2000 and 2006, 24 of which were in 2006 alone (Table 2). Influential too has been the explicit adoption of the Phylogenetic Species Concept (see Groves, 2001, 2004; Tattersall, 2007), which is the reason why the ratio of species to subspecies changed so considerably in favor of the former when comparing the taxonomies of the first and second editions of the field guides published by Mittermeier *et al*. (1994 and 2006). Mittermeier *et al*. (2006) followed Groves (2001, 2005; see also Groves and Helgen, in press) in raising subspecies of *Phaner furcifer*, *Hapalemur griseus*, *Eulemur fulvus*, *Varecia* variegata, *Propithecus verreauxi*, and *Propithecus diadema*

Table 1: A list of the species and subspecies of lemurs (from Mittermeier *et al*., submitted).

| **Species** | **Genus** | **Species** | **Common name** | **References & notes** |
|---|---|---|---|---|
| **Family Cheirogaleidae Gray, 1873** | | | | |
| 1. *Microcebus murinus* (J. F. Miller, 1777) | 1 | 1 | Grey mouse lemur | |
| 2. *Microcebus rufus* (Lesson, 1840) | | 2 | Rufous mouse lemur | |
| 3. *Microcebus myoxinus* Peters, 1852 | | 3 | Mouse lemur | |
| 4. *Microcebus griseorufus* Kollman, 1910 | | 4 | Rufous-grey mouse lemur | |
| 5. *Microcebus ravelobensis* Zimmermann *et al*., 1998 | | 5 | Lac Ravelobe or golden-brown mouse lemur | 1 |
| 6. *Microcebus berthae* Rasoloarison *et al*., 2000 | | 6 | Madame Berthe's or pygmy mouse lemur | 2 |
| 7. *Microcebus sambiranensis* Rasoloarison *et al*., 2000 | | 7 | Sambirano mouse lemur | 2 |
| 8. *Microcebus tavaratra* Rasoloarison *et al*., 2000 | | 8 | Northern rufous mouse lemur | 2 |
| 9. *Microcebus lehilahytsara* Roos & Kappeler in Kappeler *et al*., 2005 | | 9 | Goodman's mouse lemur | 3 |
| 10. *Microcebus mittermeieri* Louis Jr. *et al*., 2006 | | 10 | Mittermeier's mouse lemur | 4 |
| 11. *Microcebus jollyae* Louis Jr. *et al*. 2006 | | 11 | Jolly's mouse lemur | 4 |
| 12. *Microcebus simmonsi* Louis Jr. *et al*. 2006 | | 12 | Simmons's mouse lemur | 4 |
| 13. *Microcebus mamiratra* Andriantompohavana *et al*., 2006 | | 13 | Claire's Mouse Lemur | 5 |
| 14. *Microcebus bongolavensis* Olivieri *et al*., 2007 | | 14 | Bongolava mouse lemur | 6 |
| 15. *Microcebus danfossi* Olivieri *et al*., 2007 | | 15 | Danfoss' mouse lemur | 6 |
| 16. *Mirza coquereli* (Grandidier, 1867) | 2 | 16 | Coquerel's mouse lemur | |
| 17. *Mirza zaza* Kappeler & Roos in Kappeler *et al*., 2005 | | 17 | Northern giant mouse lemur | 3 |
| 18. *Allocebus trichotis* (Günther, 1875) | 3 | 18 | Hairy-eared mouse lemur, hairy eared dwarf lemur | 7 |
| 19. *Cheirogaleus medius* É. Geoffroy, 1812 | 4 | 19 | Lesser dwarf lemur, fat-tailed dwarf lemur | 8 |
| 20. *Cheirogaleus adipicaudatus* Grandidier, 1868 | | 20 | Spiny desert dwarf lemur | 8 |
| 21. *Cheirogaleus major* É. Geoffroy, 1812 | | 21 | Greater dwarf lemur | 8 |
| 22. *Cheirogaleus crossleyei* Grandidier, 1870 | | 22 | Furry-eared dwarf lemur | 8 |
| 23. *Cheirogaleus sibreei* (Forsyth Major, 1896) | | 23 | Sibree's dwarf lemur | 8 |
| 24. *Cheirogaleus ravus* Groves, 2000 | | 24 | Large iron-grey dwarf lemur | 8 |
| 25. *Cheirogaleus minusculus* Groves, 2000 | | 25 | Small iron-grey dwarf lemur | 8 |
| 26. *Phaner furcifer* (de Blainville, 1839) | 5 | 26 | Masoala fork-marked lemur | 9 |
| 27. *Phaner pallescens* Groves & Tattersall, 1991 | | 27 | Western fork-marked lemur | 9 |
| 28. *Phaner parienti* Groves & Tattersall, 1991 | | 28 | Sambirano fork-marked lemur | 9 |
| 29. *Phaner electromontis* Groves & Tattersall, 1991 | | 29 | Montagne d'Ambre fork-marked lemur | 9 |
| **Family Lepilemuridae** | | | | |
| 31. *Lepilemur mustelinus* I. Geoffroy, 1865 | 6 | 30 | Weasel lemur | |
| 32. *Lepilemur microdon* (Forsyth Major, 1894) | | 31 | Small-toothed sportive lemur | |
| 33. *Lepilemur leucopus* (Forsyth Major, 1894) | | 32 | White-footed sportive lemur | |
| 34. *Lepilemur ruficaudatus* Grandidier, 1867 | | 33 | Red-tailed sportive lemur | |
| 35. *Lepilemur edwardsi* (Forsyth Major, 1894) | | 34 | Milne-Edwards' sportive lemur | |
| 36. *Lepilemur dorsalis* Gray, 1871 | | 35 | Nosy Be or Grey-backed sportive lemur | |
| 37. *Lepilemur septentrionalis* Rumpler & Albignac, 1975 | | 36 | Northern sportive lemur | 10 |
| 38. *Lepilemur ankaranensis* Rumpler & Albignac, 1975 | | 37 | Ankarana sportive lemur | 10 |
| 39. *Lepilemur aeeclis* Andriaholinirina *et al*., 2006 | | 38 | Antafia sportive lemur | 11 |
| 40. *Lepilemur randrinanasoli* Andriaholinirina *et al*., 2006 | | 39 | Randrianasolo's sportive lemur | 11 |
| 41. *Lepilemur sahamalazensis* Andriaholinirina *et al*., 2006 | | 40 | Sahamalaza Peninsula sportive lemur | 11 |
| 42. *Lepilemur mittermeieri* Rabarivola *et al*., 2006 | | 41 | Mittermeier's sportive lemur | 12 |
| 43. *Lepilemur ahmansoni* Louis Jr. *et al*., 2006 | | 42 | Ahmanson's sportive lemur | 13 |
| 44. *Lepilemur betsileo* Louis Jr. *et al*., 2006 | | 43 | Betsileo sportive lemur | 13 |
| 45. *Lepilemur fleuretae* Louis Jr. *et al*., 2006 | | 44 | Fleurete's sportive lemur | 13 |
| 46. *Lepilemur grewcocki* Louis Jr. *et al*., 2006 | | 45 | Grewcock's sportive lemur | 13 |
| 47. *Lepilemur hubbardi* Louis Jr. *et al*., 2006 | | 46 | Hubbard's sportive lemur | 13 |
| 48. *Lepilemur jamesi* Louis Jr. *et al*., 2006 | | 47 | James' sportive lemur | 13,14 |
| 49. *Lepilemur milanoii* Louis Jr. *et al*., 2006 | | 48 | Dariana sportive lemur | 13 |
| 50. *Lepilemur petteri* Louis Jr. *et al*., 2006 | | 49 | Petter's sportive lemur | 13 |
| 51. *Lepilemur seali* Louis Jr. *et al*., 2006 | | 50 | Seal's sportive lemur | 13 |
| 52. *Lepilemur tymerlachsoni* Louis Jr. *et al*., 2006 | | 51 | Hawks' sportive lemur | 13 |
| 53. *Lepilemur wrighti* Louis Jr. *et al*., 2006 | | 52 | Wright's sportive lemur | 13 |

| Species | Genus | Species | Common name | References & notes |
|---|---|---|---|---|
| **Family Lemuridae** | | | | |
| 54. *Hapalemur griseus* (Link, 1795) | 7 | 53 | Grey bamboo lemur | 1 |
| 55. *Hapalemur occidentalis* Rumpler, 1975 | | 54 | Western bamboo lemur, Sambirano bamboo lemur | 15 |
| 56. *Hapalemur alaotrensis* Rumpler, 1975 | | 55 | Lac Alaotra bamboo lemur | 15 |
| 57. *Hapalemur meridionalis* Warter *et al.*, 1987 | | 56 | Southern bamboo lemur | 16 |
| 58. *Hapalemur aureus* Meier *et al.*, 1987 | | 57 | Golden bamboo lemur | 17 |
| 59. *Prolemur simus* (Gray, 1871) | 8 | 58 | Greater bamboo lemur, broad-nosed gentle lemur | |
| 30. *Lemur catta* Linnaeus, 1775 | 9 | 59 | Ring-tailed lemur | 18,19,20 |
| 60. *Eulemur macaco* (Linnaeus, 1766) | 10 | 60 | Black lemur | 21,22,23 |
| 61. *Eulemur flavifrons* (Gray, 1867) | | 61 | Sclater's lemur | 21.22.23 |
| 62. *Eulemur fulvus* Geoffroy, 1812) | | 62 | Brown lemur | |
| 63. *Eulemur sanfordi* (Archbold, 1932) | | 63 | Sanford's lemur | |
| 64. *Eulemur albifrons* (E. Geoffroy, 1796) | | 64 | White-fronted lemur | |
| 65. *Eulemur rufus* (Audebert, 1799) | | 65 | Red lemur | |
| 66. *Eulemur rufifrons* (Bennett, 1833) | | 66 | Red-fronted lemur | 24 |
| 67. *Eulemur collaris* (E. Geoffroy, 1812) | | 67 | Red-collared lemur | |
| 68. *Eulemur albocollaris* (Rumpler, 1975) | | 68 | White-collared lemur | |
| 69. *Eulemur coronatus* (Gray, 1842) | | 69 | Crowned lemur | |
| 70. *Eulemur rubriventer* (I. Geoffroy, 1850) | | 70 | Red-bellied lemur | |
| 71. *Eulemur mongoz* (Linnaeus, 1766) | | 71 | Mongoose lemur | |
| [*Eulemur cinereiceps* (Grandidier & Milne Edwards, 1890)] | | | [Gray-headed lemur] | 25 |
| *Varecia variegata* | 11 | | | |
| 72. *variegata* (Kerr, 1792) | | 72 | Black-and-white ruffed lemur | 26,27,28 |
| 73. *editorum* (O. Hill, 1953) | | 72 | White-girdled ruffed lemur | 26,27,28 |
| 74. *subcincta* (A. Smith, 1833) | | 72 | Brown ruffed lemur | 26,27,28 |
| 75. *Varecia rubra* (É. Geoffroy, 1812) | | 73 | Red ruffed lemur | 23 |
| **Family Indriidae** | | | | 29 |
| 76. *Avahi laniger* (Gmelin, 1788) | 12 | 74 | Eastern woolly lemur | |
| 77. *Avahi occidentalis* (Lorenz, 1898) | | 75 | Western woolly lemur | |
| 78. *Avahi unicolor* Thalmann & Geissmann, 2000 | | 76 | Sambirano woolly lemur | 30 |
| 79. *Avahi cleesei* Thalmann & Geissmann, 2005 | | 77 | Bemaraha woolly lemur | 31 |
| 80. *Avahi peyrierasi* Zaramody *et al.*, 2006 | | 78 | Peyrieras' woolly lemur | 32 |
| 81. *Avahi meridionalis meridionalis* Zaramody *et al.*, 2006 | | 79 | Southern woolly lemur | 32 |
| 82. *Avahi meridionalis ramantsoavani* Zaramody *et al.*, 2006 | | | Ramantsoavana's southern woolly lemur | 32 |
| 83. *Propithecus diadema* Bennett, 1832 | 13 | 80 | Diademed sifaka | 33 |
| 84. *Propithecus candidus* Grandidier, 1871 | | 81 | Silky sifaka | 33 |
| 85. *Propithecus edwardsi* Grandidier, 1871 | | 82 | Milne-Edward's sifaka | 33 |
| 86. *Propithecus perrieri* Lavauden, 1931 | | 83 | Perrier's sifaka | 33 |
| 87. *Propithecus verreauxi* Grandidier, 1867 | | 84 | Verreaux's sifaka | 33 |
| 88. *Propithecus deckenii* Peters, 1870 | | 85 | Decken's sifaka | 33 |
| 89. *Propithecus coronatus* Milne-Edwards, 1871 | | 86 | Crowned sifaka | 33 |
| 90. *Propithecus coquereli* (Grandidier, 1867) | | 87 | Coquerel's sifaka | 33 |
| 91. *Propithecus tattersalli* Simons, 1988 | | 88 | Tattersall's sifaka;<br>golden crowned sifaka | 34 |
| 92. *Indri indri* (Gmelin, 1788) | 14 | 89 | Indri | 35,36 |
| **Family Daubentoniidae** | | | | |
| 93. *Daubentonia madagascariensis* (Gmelin, 1788) | 15 | 90 | Aye-aye | |

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April 2006. *Eulemur rufifrons* was formerly considered a junior synonym of *E. rufus* (see Groves, 2001, 2005; refs. 36, 37).

25. Groves (2005; ref. 37) listed the little known, and evidently extremely rare gray-headed lemur, *Eulemur cinereiceps*, first described as a variant of *L. mongoz*. The type locality is Farafangana, and it is known also from Solohy. Groves (2005) pointed out that the two known specimens in the Paris Museum are somewhat different and unlike any other known taxon. Groves (2001; ref. 36) discussed the specimens and compared their pelage color patterns with other *Eulemur* species. The 19th century illustration and photographs of the two mounted specimens can be found in Mittermeier *et al.* (2006; ref. 38), along with a photograph of a captive animal taken by R. A. Mittermeier in Farafangana in 2005. It has not been observed in the wild, and its taxonomic status is still confused.
26. Groves (2001; ref. 36) had previously recognized *Varecia rubra* and *Varecia variegata* as distinct species and resurrected two subspecies, *editorum* and *subcincta*, based on differences in pelage coloration that he felt corresponded to distinct geographic populations, and also supported recognition of *rubra* as a full species status. Vasey and Tattersall (2002, ref. 27) examined variation in *variegata* in some detail, but concluded that the variants are not geographically exclusive, and could not, therefore, be considered subspecies. Recent genetic studies, however, have indicated that *three* distinct evolutionary significant units exist within *variegata*, and reaffirm the distinctiveness of *rubra* (Louis *et al*., 2005; ref. 28).
27. Vasey, N.; Tattersall, I. 2002. Do ruffed lemurs form a hybrid zone? Distribution and discovery of *Varecia*, with systematic and conservation implications. Am. Mus. Nov. 3376: 1-26.
28. Louis Jr., E.E.; Ratsimbazafy, J.H.; Razakamaharauo, V.R.; Pierson, D.J.; Barber, R.C.; Brenneman, R.A. 2005. Conservation genetics of black and white ruffed lemurs, *Varecia variegata*, from southeastern Madagascar. Anim. Cons. 8: 105-111.
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34. Simons, E.L. 1988. A new species of *Propithecus* (Primates) from northeast Madagascar. Folia Primatol. 50: 143-151.
35. Groves (2001; ref. 36) listed *I. indri variegatus* (Gray, 1872), a lighter form that occurs southward from the region of Mananara. It has a white occipital patch, a white collar extending up to and behind the ears, and the outside of its arms and legs are grayish or whitish, and is the variant present in the Analamazaotra Special Reserve at Andasibé (= Perinet). Differentiation between the two is not supported by genetic evidence, however, and it no longer appears to hold true in the field either, there being individuals of mixed color patterns in the Mananara region in the northern part of the range (Thalmann *et al*., 1993; ref. 35).
36. Thalmann, U.; Geissmann, T.; Simona, A.; Mutschler, T. 1993. The indris of Anjanaharibe-Sud, northeastern Madagascar. Int. J. Primatol. 14: 357-381.
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listed in Mittermeier *et al*. (1994) to full species. Mittermeier *et al*. (2006), in fact, went a bit further than Groves (2005) in their taxonomic elevations. They listed *Hapalemur meridionalis* (a subspecies of *H. griseus* in Groves [2005]), *Propithecus candidus* (a subspecies of *P. diadema* in Groves [2005]) and *Propithecus coronatus* (a subspecies of *P. deckenii* in Groves [2005]). The only other difference between Groves (2005) and Mittermeier *et al*. (2006) was the former's recognition of two subspecies of the indri: *Indri indri indri* and *I. i. variegatus*.

Table 2: New species and subspecies of lemurs described since 2000.

| |
|---|
| *Avahi unicolor* Thalmann & Geissmann, 2000 |
| *Avahi cleesei* Thalmann & Geissmann, 2005 |
| *Avahi peyrierasi Zaramody et al., 2006* |
| *Avahi meridionalis meridionalis* Zaramody *et al*., 2006 |
| *Avahi meridionalis ramantsoavani* Zaramody *et al*., 2006 |
| *Cheirogaleus ravus* Groves, 2000 |
| *Cheirogaleus minusculus* Groves, 2000 |
| *Microcebus berthae* Rasoloarison, Goodman & Ganzhorn, 2000 |
| *Microcebus sambiranensis* Rasoloarison, Goodman & Ganzhorn, 2000 |
| *Microcebus tavaratra* Rasoloarison, Goodman & Ganzhorn, 2000 |
| *Microcebus lehilahytsara* Roos & Kappeler in Kappeler *et al*., 2005 |
| *Microcebus mittermeieri* Louis Jr. *et al*., 2006 |
| *Microcebus jollyae* Louis Jr. *et al*., 2006 |
| *Microcebus simmonsi* Louis Jr. *et al*., 2006 |
| *Microcebus mamiratra* Andriantompohavana *et al*., 2006 |

| |
|---|
| *Microcebus bongolavensis* Olivieri *et al*., 2007 |
| *Microcebus danfossi* Olivieri *et al*., 2007 |
| *Mirza zaza* Kappeler & Roos in Kappeler *et al*., 2005 |
| *Lepilemur aeeclis* Andriaholinirina *et al.* 2006 |
| *Lepilemur randrinanasoli* Andriaholinirina *et al.* 2006 |
| *Lepilemur sahamalazensis* Andriaholinirina *et al.* 2006 |
| *Lepilemur mittermeieri* Rabarivola *et al*., 2006 |
| *Lepilemur ahmansoni* Louis Jr. *et al*., 2006 |
| *Lepilemur betsileo* Louis Jr. *et al*., 2006 |
| *Lepilemur fleuretae* Louis Jr. *et al*., 2006 |
| *Lepilemur grewcocki* Louis Jr. *et al*., 2006 |
| *Lepilemur hubbardi* Louis Jr. *et al*., 2006 |
| *Lepilemur jamesi* Louis Jr. *et al*., 2006 |
| *Lepilemur milanoii* Louis Jr. *et al*., 2006 |
| *Lepilemur petteri* Louis Jr. *et al*., 2006 |
| *Lepilemur seali* Louis Jr. *et al*., 2006 |
| *Lepilemur tymerlachsoni* Louis Jr. *et al*., 2006 |
| *Lepilemur wrighti* Louis Jr. *et al*., 2006 |

The surge in new species and the documentation of what is evidently a far greater diversity of lemurs than was previously recognized is extraordinary. It is at the same time, however, also bringing to the fore important questions regarding our methods and standards in cataloguing life around us. The questions are not trivial and go way beyond discussion and dispute of species concepts; extending as they do to the need for us to question the very rationale or rationales behind our efforts to give names to what we judge to be discrete biological populations of one sort or another (a minimum diagnosable unit equated with species: see Tattersall, 2007). The latin binomial is today (rightly) charged with a significance in our understanding of evolutionary (time) and biogeographical (space) processes, which places an onus on those who describe new species of a weight which is sometimes not recognized or acknowledged. The rapid loss of biodiversity is giving an unprecedented urgency to describe and document species that are evidently close to extinction all around the world, and molecular genetics, particularly, is providing the wherewithal to undertake this effort with a speed never before possible. Work continues on blood samples from lemur populations throughout Madagascar, and many more species' descriptions will be appearing in the near future. What this "efflorescence of lemur species" (Tattersall, 2007) means is not entirely clear. In the multiplication of "patients" requiring attention and treatment, it is certainly burdening efforts for their conservation, and it is certainly a warning against complacency concerning what is required for the preservation of evolutionary and biogeographic processes. It is also certain that Table 1 is not a definitive taxonomy, merely a list, reflecting our current understanding of the remarkable diversity of these primates with what we have in hand; and what we have in hand increased by 24 species in 2006.

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# Morphometric data for Indri (*Indri indri*) collected from ten forest fragments in eastern Madagascar

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The largest extant diurnal lemur is the Indri (*Indri indri*) or Babakoto as it is known in most of eastern Madagascar. According to the IUCN Red List the Indri is listed as "Endangered". The Babakoto is currently threatened by the reduction and fragmentation of habitat and from hunting pressure as a source of bush meat in some regions (Golden, 2005). The species is currently classified into two subspecies. The *Indri indri indri* (Gmelin, 1788) is characterized by a heavy textured predominantly solid black hair coat (Fig. 1). *Indri i. variegatus* (Gray, 1872) is characterized by a lighter textured hair coat mixed black and white in color and a white head cap (Fig. 2). In Thalmann *et al*. (1993), the distribution of *Indri i. indri* is located in the northern part of the range whereas the distribution of *Indri i. variegatus*

Fig. 1: Indri from the northern range: Mananara Nord National Park. Photo: R. A. Brenneman

Fig. 2: Indri from the southern range: Analamazoatra Special Reserve. Photo: E. E. Louis, Jr.

is from the southern extent of the range with Mananara-Nord (16°23’ S) as the area of potential overlap based on mixing of pelage pattern (Groves, 2001). There is considerable doubt that the subspecific classifications are valid due to overlap of pelage pattern in many of the forest fragments and preliminary genetic evidence does not appear to support two subspecies (Mittermeier *et al*., 2006). We present morphological data gathered from 105 adult Indri at 10 sites distributed across this species range (Fig. 3).

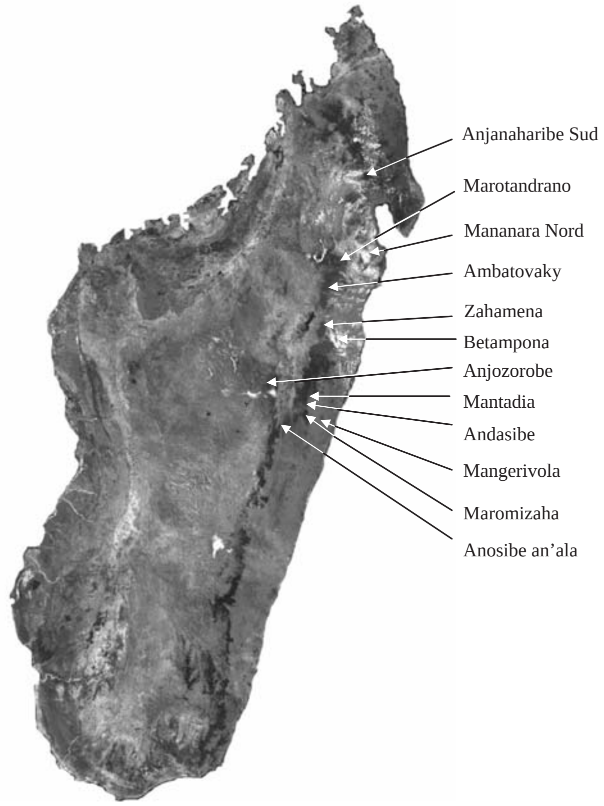

Fig. 3: Locations of forest fragments in eastern Madagascar harboring *Indri indri* populations sampled in this study.

**Methods**

Study sites are shown in Figure 3.

*Immobilization and collection*
All lemurs investigated in this study were free-ranging and were immobilized with a $CO_2$ powered DAN-INJECT (Brrkop, Denmark) Model JM rifle propelling Pneu-Darts (Williamsport, PA) loaded with 10 mg/kg estimated body weight of Telazol® (Fort Dodge). We recorded the location of all of the immobilized lemurs using a global positioning system (GPS). Each individual was transported back to the base camp where complete morphometric data was taken. Whole blood (1.0 ml/ kg) and 2.0 mm skin biopsies were collected from each sedated lemur. The samples were collected from 105 animals from 10 sites across the geographical range of Indri. A Home Again® (Home Again Pet Recovery Service, East Syracuse, NY) microchip was placed subcutaneously between the scapulae of each lemur. This procedure was used to field catalog each animal with a unique recognition code to provide for the capability to positively identify individuals re-captured during any future immobilizations.

*Measurements*
The measurements were taken on the sedated animals following Smith and Jungers (1997). Abbreviations are listed in brackets.
Weight (Wt): kilograms (± 0.01 kg);
Measurements in centimeters (± 0.1 cm):
  Head crown (Head): total length from tip of the nose (excluding the soft tissue) to the occipital crown.
  Body length (Body): total length of body from the occipital crown of the head to the base of tail.
  Tail length (Tail): total length from base of tail to the end of the last caudal vertebra.
Forelimb measurements:
  Thumb (FT): total length of the thumb (proximal, middle, and distal phalanges) from the distal tip to proximal point of the last phalange of the thumb (claw not included).
  Longest digit (FLD): total length of the phalange only (proximal, middle, and distal phalanges, claw and metacarpal not included).
  Hand (Hand): total length of hand (phalanges and metacarpals included to the carpal joint).
  Radius/ulna (Rad): carpal joint (styloid process of the radius) to the olecarnon tip of the ulna.
  Humerus (Hum): greater tubercle of humerus to the end of the lateral condyle of the humerus.
Hindlimb measurements:
  Toe (HT): total length of the toe (proximal, middle, and distal phalanges not including claw) from tip to insertion point of the last bone of the hind toe.
  Longest digit (HLD): total length of the phalange only (claw and metatarsal not included).
  Foot (Foot): total length of hand (phalanges and metacarpals included to the tarsal joint, not including claw).
  Tibia (Tibia): calcaneal tuber to the proximal tibial tuberosity.

Femur (Femur): greater trochanter of the femur to the distal point of the lateral condyle of the femur.

Measurements in millimeters (± 0.1 mm):

Upper and lower canines (UC, LC): length of the upper and lower right canines from the tip to the gum line.

Following data and sample collection, an injection of lactated Ringer's solution (LRS) was administered subcutaneously to dissipate the effect of the Telazol and to support maintenance requirements. After a period of monitoring post recovery (approximately three hours), the animals were released at their capture site during their active time of the day.

## Results and Discussion

Morphometric data were compiled by location (Tables 1 and 2) and tested for significance using analysis of variance (ANOVA). The measurements that tested significant are presented in Figure 4. Data were also pooled by 1) latitudes as suggested by Thalmann (1993) and Groves (2001) and 2) noted pelage pattern, eliminating locations that have been suggested to harbor individuals of both solid and variegated types (Thalmann, 1993; Groves, 2001; Mittermeier *et al*., 2006). Differences between means were tested for significance with Student's t-test (Table 3).

Table 1: Morphological parameter means (and standard deviations) for adult *Indri* (weight, head crown, body and tail length). Altitude is given for the elevation of the immobilization site from the sea level.

| **Site** | **Altitude (m)** | **N** | **Wt** | **Head** | **Body** | **Tail** |
|---|---|---|---|---|---|---|
| Anjozorobe | 1400 | 9 | 6.7 (0.7) | 14.8 (2.9) | 47.7 (4.1) | 5.7 (1.4) |
| Anjanaharibe-Sud | 900 | 4 | 6.5 (1.3) | 11.6 (1.7) | 54.9 (1.2) | 5.6 (1.8) |
| Anosibe an'ala | 855 | 8 | 6.0 (1.0) | 12.6 (0.6) | 50.5 (3.2) | 5.1 (2.2) |
| Andasibe | 900 | 10 | 7.3 (0.8) | 11.5 (0.2) | 52.4 (2.9) | 5.0 (1.3) |
| Ambatovaky | 550 | 10 | 6.0 (0.9) | 12.3 (0.6) | 46.0 (1.7) | 4.3 (1.3) |
| Betampona | 416 | 8 | 6.8 (1.0) | 11.0 (1.4) | 50.2 (2.3) | 4.5 (1.3) |
| Mantadia | 1100 | 9 | 5.7 (1.7) | 11.9 (1.3) | 48.7 (2.4) | 5.1 (1.1) |
| Marotandrano | 1100 | 8 | 8.1 (0.7) | 11.8 (0.8) | 53.0 (2.8) | 5.0 (1.2) |
| Maromizaha | 1000 | 2 | 7.6 (0.7) | 10.8 (0.3) | 49.7 (2.3) | 5.8 (0.8) |
| Zahamena | 1050 | 10 | 7.0 (0.7) | 13.8 (1.2) | 51.0 (2.7) | 6.4 (1.1) |
| Mean (SD) | | | 6.8 (0.7) | 12.2 (1.1) | 50.4 (2.4) | 5.3 (0.5) |

Among eight measurements that were significant among populations, no population was consistently larger or smaller for correlated traits. By location comparisons, heavier weight (Marotandrano) did not correlate with larger measurements such as body length (Anjanaharibe-Sud). Statistical significances in long bones were not correlated. Data pooled by latitude were significant such that the northern population (Anjanaharibe-Sud) had longer body length (4.55 cm; P<0.0001) but had shorter fore long digits and femurs (2.12 and 1.60 cm respectively; P<0.05) than the southern sampled populations. We recognize that in pooling the data, a single population of putative *Indri i. indri* confounds location environmental error with subspecies and again with data collection error. Data pooled by pattern (black vs. variegated) but not including populations where both solid and variegated have been observed together indicated that the solid individuals might be 0.84 kg heavier (P<0.001) with 4.46 cm longer bodies (P<0.0001) but with 1.18 cm shorter heads (P<0.05) and 1.24 cm shorter toes (P<0.001). Thalmann *et al*. (1993) found that the populations at Mananara-Nord harbored individuals of black and variegated types. We found the same in Mantadia; hence the samples collected in this location were dropped from analysis of the pooling data. The apparent covariance of weight and body length is due to pooling the heavier Anjanaharibe-Sud-Sud population with the heavier Marotandrano population. None of the analyses suggest diagnostic morphometric differences between the two putative subspecies of *Indri*. These morphometric data contribute to other baseline (biomedical) data for Indri (Junge and Louis, 2002) hopefully expanding the knowledge base for the *Indri* species.

Table 2: Forelimb, hindlimb and canine measurement averages (and standard deviations) from adult Indri sampled at 10 locations of eastern Madagascar.

| | **FT** | **FLD** | **Hand** | **Rad** | **Hum** | **HT** | **HLD** | **Foot** | **Tibia** | **Femur** | **UC** | **LC** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Anjozorobe | 7.9 (0.6) | 6.8 (0.7) | 15.5 (0.5) | 17.0 (1.5) | 16.3 (2.6) | 11.0 (0.4) | 6.2 (0.4) | 19.4 (0.8) | 22.6 (1.4) | 25.1 (1.9) | 7.5 (1.1) | 5.8 (0.4) |
| Anjanaharibe-Sud | 7.2 (1.2) | 7.9 (2.7) | 15.4 (0.7) | 18.6 (2.3) | 14.0 (1.8) | 11.8 (2.3) | 6.2 (0.8) | 19.1 (0.5) | 22.8 (1.3) | 23.2 (1.4) | 6.2 (0.5) | 5.0 (1.2) |
| Anosibe an'ala | 8.0 (0.8) | 7.2 (0.7) | 13.5 (2.6) | 17.7 (2.0) | 14.1 (2.0) | 11.0 (0.8) | 6.3 (0.6) | 17.1 (2.5) | 22.8 (2.3) | 25.4 (2.2) | 7.0 (0.5) | 5.0 (1.8) |
| Andasibe | 7.9 (0.5) | 6.9 (0.5) | 15.4 (0.6) | 19.0 (1.4) | 13.1 (1.4) | 11.1 (0.6) | 6.0 (0.3) | 19.7 (0.7) | 21.4 (1.5) | 24.2 (1.1) | 6.9 (0.5) | 5.2 (0.7) |
| Ambatovaky | 7.8 (1.3) | 7.1 (0.3) | 15.5 (0.7) | 18.9 (0.9) | 12.9 (0.5) | 11.2 (0.7) | 5.7 (0.7) | 19.9 (1.2) | 22.3 (0.8) | 26.0 (1.3) | 6.5 (2.6) | 5.5 (0.5) |
| Betampona | 7.7 (0.7) | 6.7 (0.6) | 15.3 (0.6) | 19.1 (0.9) | 14.0 (1.3) | 11.0 (1.6) | 5.8 (1.2) | 20.1 (0.4) | 22.8 (0.9) | 23.9 (1.7) | 6.8 (1.7) | 5.2 (0.8) |
| Mantadia | 7.3 (1.1) | 6.4 (1.4) | 13.8 (2.1) | 18.4 (2.5) | 13.4 (1.7) | 10.1 (1.6) | 5.6 (0.4) | 18.2 (2.2) | 20.9 (1.8) | 23.6 (2.1) | 5.9 (1.6) | 5.1 (0.8) |
| Marotandrano | 7.9 (1.1) | 7.4 (0.6) | 14.9 (1.1) | 16.9 (1.9) | 14.6 (2.5) | 8.7 (2.3) | 7.4 (2.2) | 19.0 (2.7) | 23.0 (2.5) | 25.8 (1.6) | 6.7 (1.0) | 5.5 (1.2) |
| Maromizaha | 6.2 (0.7) | 6.7 (0.5) | 14.1 (1.0) | 19.7 (0.4) | 13.2 (0.5) | 9.6 (1.7) | 6.1 (2.7) | 19.9 (0.2) | 22.5 (1.4) | 25.4 (2.6) | 6.5 (0.1) | 5.4 (0.5) |
| Zahamena | 8.3 (0.7) | N/A | 16.2 (0.1) | 18.6 (0.8) | 14.5 (0.8) | N/A | N/A | 20.3 (1.0) | 22.5 (1.2) | 25.7 (1.3) | 6.2 (1.9) | 5.5 (0.4) |
| Mean (SD) | 7.6 (0.5) | 7.0 (0.8) | 15.0 (0.8) | 18.4 (0.8) | 14.0 (0.9) | 10.6 (1.0) | 6.0 (0.7) | 19.3 (0.9) | 22.4 (0.6) | 24.8 (0.9) | 6.6 (0.4) | 5.3 (0.2) |

Table 3: Possible pooling strategies to identify subspecific characteristics between *Indri indri indri* and *I. i. variegatus* using morphometric data. NS = not significant

| | **Wt** | **Head** | **Body** | **Tail** | **FT** | **FLD** | **Hand** | **Radius** | **Hum** | **HT** | **HLD** | **Foot** | **Tibia** | **Femur** | **UC** | **LC** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| North and south of 16°23'S | NS | NS | P<0.001 | NS | NS | P<0.05 | NS | NS | NS | NS | NS | NS | NS | P<0.05 | NS | NS |
| Black vs. Variegated | P<0.001 | P<0.05 | P<0.0001 | NS | NS | NS | NS | NS | NS | P<0.001 | NS | NS | NS | NS | P<0.05 | NS |

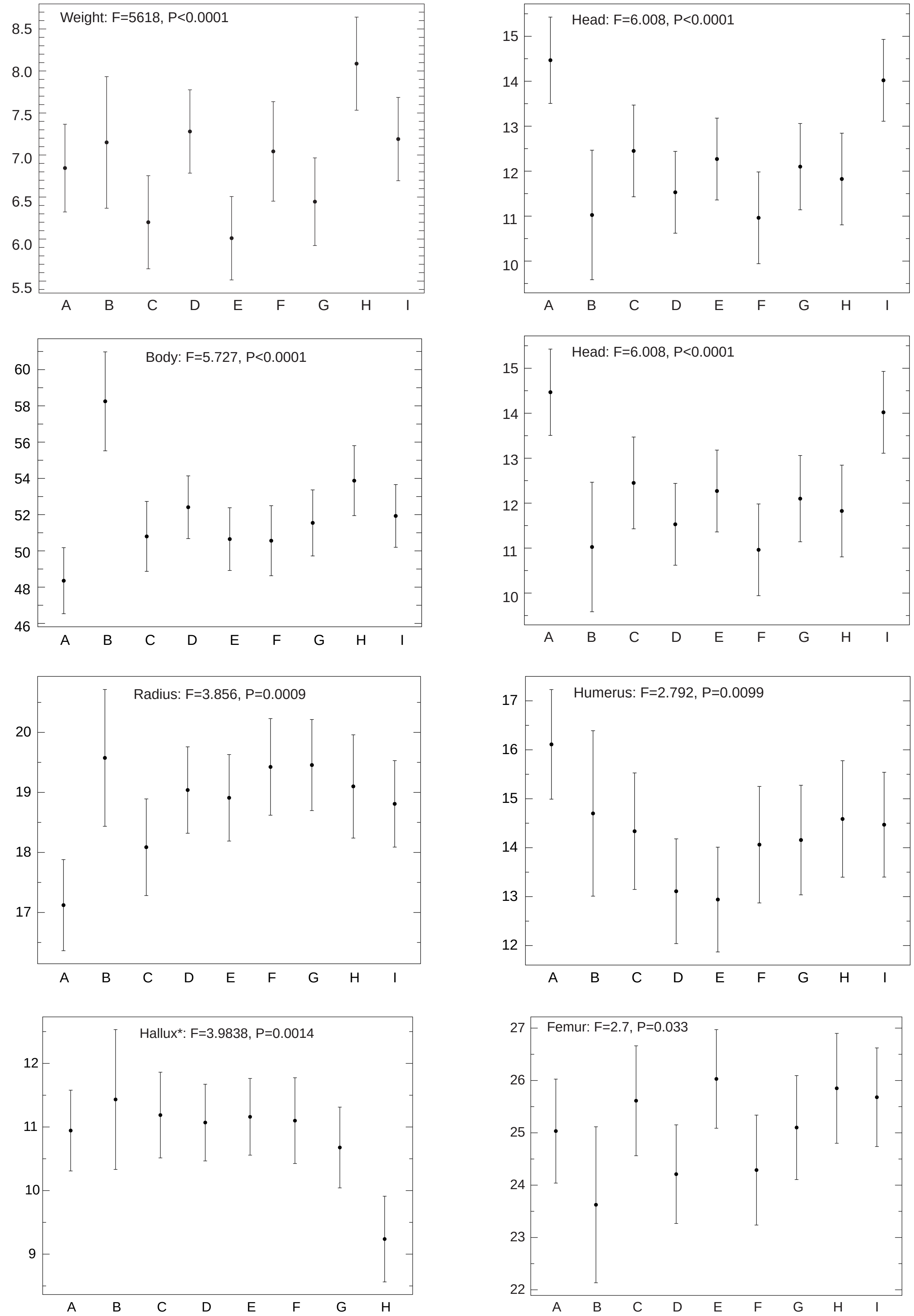

Fig. 4: Means and 95 % confidence intervals for significant morphometric parameters from Tables 1 and 2 tested with ANOVA for Indri individuals measured at A, Anjozorobe; B, Anjanaharibe-Sud; C, Anosibe an'ala; D, Andasibe; E, Ambatovaky; F, Betampona; G, Mantadia; H, Marotandrano; I, Zahamena. Maromizaha was not tested with ANOVA as a minimum of three samples are required for statistical threshold.*Zahamena was excluded from digit measurements due to data error.

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We acknowledge the Ministry of Environnement and Eaux & Forets (CAFF/CORE), the Association Nationale pour la Gestion des Aires Protégées (ANGAP), Association Fanamby, and the Department of Biological Anthropology, University of Antananarivo for their help. This project would not have been possible without the support of the staff, guides, and drivers of Henry Doorly Zoo's Madagascar Biodiversity and Biogeography Project (MBP-HDZ), as well as, Parc Botanique et Zoologique de Tsimbazaza, U. S. Fish & Wildlife, and Bill and Berniece Grewcock, the Ahmanson Foundation, the Theodore F. and Claire M. Hubbard Family Foundation, and the James Family. We thank Omaha's Henry Doorly Zoo for financial and logistical support for this project.

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## Morphological characterization of a population of Sambirano woolly lemur (*Avahi unicolor*) from the Anaborano Forest in northwestern Madagascar

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**Key words**: Lemurs, *Avahi unicolor*, Anaborano, Madagascar

For almost a century, the two initially recognized forms of the woolly lemur were regarded as subspecies: *Avahi laniger laniger* (Gmelin, 1788; Fig. 1) and *A. l. occidentalis* (Lorenz, 1898; Fig. 2). The cytogenetic study by Rumpler *et al*. (1990) elevated the two from subspecies to species (*A. laniger* and *A. occidentalis*). Subsequently, two additional species have been described: *A. unicolor* (Thalmann and Geissmann, 2000; Fig. 3) and more recently *A. cleesei* (Thalmann and Geissmann, 2005). Milne-Edward and Grandidier (1875a) noticed *Avahi* in the northern Ampasindava area in the late the 19th century and remarked that this *Avahi* from northwest was different and smaller than other *A. laniger* but did not characterize it at that time (Milne-Edward and Grandidier, 1875b). The western woolly lemurs are distributed in three different areas in western Madagascar. *Avahi cleesei* is found in Bemaraha National Park. *Avahi occidentalis* is found in the region of Ankarafantsika National Park and Mariarano Classified Forest (Andriantompohavana *et al*., 2006). The *A. unicolor* is described along and south of the Sambirano River (Thalmann and Geissmann, 2000).

Fig. 1: *Avahi laniger* in Anjanaharibe-Sud Special Reserve. Photo: E.E. Louis, Jr.

The *A. unicolor*, or Sambirano woolly lemurs, are known to have a geographic range from Sambirano River to the north, the western part of the Manongarivo Special Reserve (Raxworthy and Rakotondramparany, 1988) on the east side of the distribution range and the Ampasindava Peninsula (Thalmann and Geissmann, 2000) to the west. The southern limit has yet to be defined although it is suspected that the Andranomalaza River or Maevarano River is likely barriers to be explored (Mittermeier *et al*., 2006). The holotype of the *Avahi unicolor* is described from museum specimen (Thalmann and Geissmann, 2000) but no information about their morphology or their biology is known (Mittermeier *et al*., 2006). The newly described *Avahi unicolor* is not yet categorized in the IUCN conservation status of lemur species and subspecies (Mittermeier *et al*., 2006).

Fig. 2: *Avahi occidentalis* in Mariarano Classified Forest. Photo: E. E. Louis, Jr.

Fig. 3: *Avahi unicolor* in Anaborano Classified Forest. Photo: E. E. Louis, Jr.

## Methods

We surveyed the Anaborano Classified Forest (S14º 02’44", 048º13’23E") located 10 km east of Ankaramibe village in the Fokontany of Beraty, Commune Ankaramibe, District of Ambanja, Region Sava in northwestern Madagascar (Fig. 4). This is an isolated forest fragment south of the Maromiandra forest next to the Antafondro Classified Forest alongside but not within the boundaries of the Manongarivo Special Reserve.

Methods for the immobilization of animals, the collection of tissues and measurements taken are described in Zaonarivelo *et al*. (2007). Measurements taken follow Smith and Jungers (1997). Abbreviations are: Weight in kg (± 0.01 kg) (Wt); morphometric measurements in cm (± 0.1 cm): Head crown (Head); Body length (Body); Tail length (Tail); forelimb measurements: Thumb (FT); Longest digit (FLD); Hand (Hand); Radius/ulna (Rad); Humerus (Hum); hind limb measurements: Toe (HT); Longest digit (HLD); Foot (Foot); Tibia (Tibia); Femur (Femur).

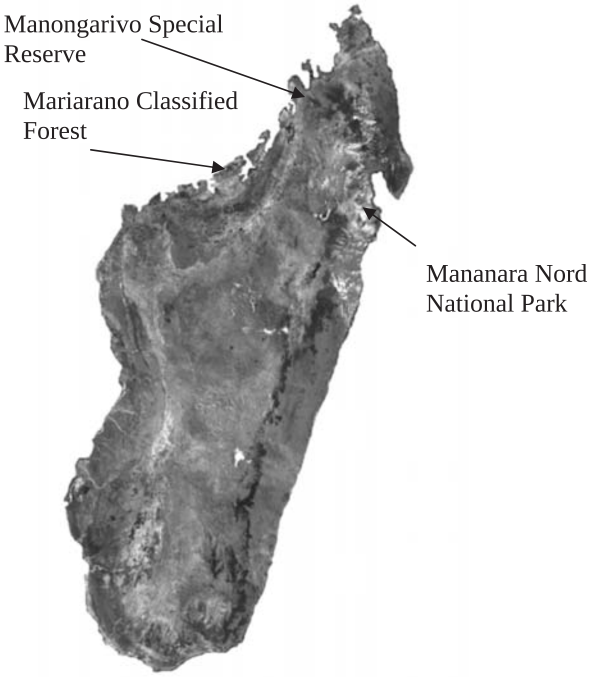

Fig. 4: Locations of sampling locations for *Avahi unicolor* (Anaborano Forest bordering the Manongarivo SR), *A. occidentalis* (Mariarano Classified Forest), and *A. laniger* (Mananara Nord National Park).

## Results

Morphometric measurements (Table 1) were taken from six *Avahi unicolor* from the Anaborano Forest, 10 *Avahi occidentalis* from the Mariarano Classified Forest and 10 *Avahi laniger* from Mananara-Nord National Park (Fig. 4). Weights and measurements were tested for significance with ANOVA (Table 1; Fig 5). The comparison of *Avahi unicolor* with the two other *Avahi* species (A. *occidentalis* and *A. laniger*) showed no significant differences in head, body, tail or long bone except the tibia (P<0.05). *Avahi laniger* are significantly heavier and have longer thumbs, long digits, hands, and feet than the western species (*A. occidentalis* and *A. unicolor*).

Table 1: Weight (in kg) and morphometric (in cm) means (std dev) for *Avahi laniger* (n=10; Mananara-Nord), *A. unicolor* (n=6; Anaborano), and *A. occidentalis* (n=10; Mariarano). F-values for inter-specific differences are based on ANOVA; ns not significant, * p < 0.05, ** p < 0.01, *** p < 0.001.

| | ***A. laniger*** | ***A. unicolor*** | ***A. occidentalis*** | **F-values** |
|---|---|---|---|---|
| Wt | 1.09 (0.12) | 0.84 (0.134) | 0.94 (0.11) | 8.89** |
| Head | 6.77 (0.75) | 6.47 (0.18) | 6.25 (0.55) | ns |
| Body | 21.58 (1.19) | 21.95 (1.75) | 23.45 (1.24) | ns |
| Tail | 33.74 (2.81) | 33.33 (2.33) | 35.00 (3.5) | ns |
| FT | 2.56 (0.24) | 2.30 (0.24) | 1.85 (0.25) | 10.46*** |
| FLD | 3.5 (0.28) | 3.18 (0.12) | 2.70 (0.26) | 23.44*** |
| Hand | 7.34 (0.39) | 6.35 (0.32) | 6.45 (0.41) | 21.34*** |
| Rad | 8.32 (0.87) | 8.10 (0.18) | 7.95 (0.42) | ns |
| Hum | 6.24 (0.59) | 5.88 (0.61) | 6.20 (0.63) | ns |
| HT | 5.03 (0.39) | 3.88 (0.49) | 4.00 (0.87) | ns |
| HLD | 3.21 (0.25) | 3.02 (0.18) | 2.20 (0.52) | ns |
| Foot | 9.76 (0.44) | 8.72 (0.28) | 8.40 (0.35) | 37.75*** |
| Tibia | 11.17 (0.65) | 10.28 (0.37) | 10.00 (0.94) | 4.79* |
| Femur | 12.52 (0.89) | 12.78 (0.58) | 12.65 (0.34) | ns |

Abbreviations: Weight in kg (Wt); morphometric measurements (in cm ± 0.1 cm): Head crown (Head); Body length (Body); Tail length (Tail); Forelimb measurements: Thumb (FT); Longest digit (FLD); Hand (Hand); Radius/ulna (Rad); Humerus (Hum); Hind limb measurements: Toe (HT); Longest digit (HLD); Foot (Foot); Tibia (Tibia); Femur (Femur).

## Discussion

Both the Antafondro and Anaborano Classified Forests were surveyed during this expedition. While individuals of *Avahi unicolor* might be found outside the Manongarivo Special Reserve in the larger Maromiandra and Antafondro Classified Forests, no *Avahi unicolor* were found in the Antafondro Classified Forest. According to the local guides, the only members of this species in the area are found isolated in this 4-5 ha fragmented forest

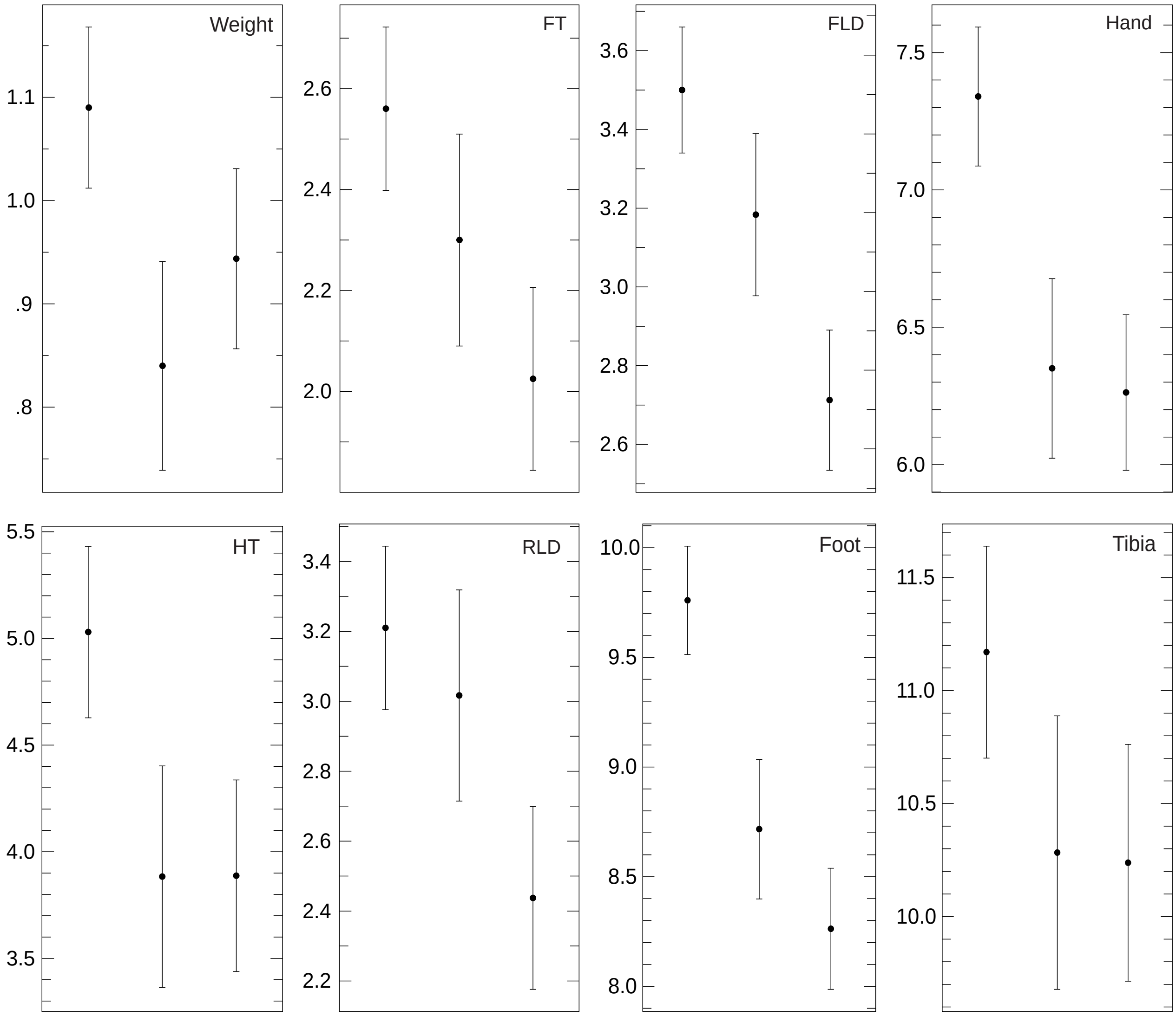

Fig. 5: Significant ANOVA results by means and 95 % confidence intervals for weight and measurements of *Avahi laniger* (column 1), *A. unicolor* (column 2), and *A. occidentalis* (column 3). Abbreviations for the measurements and associated F and p- values for inter-specific differences are listed in Table 1.

east of Ankaramibe village. This forest and its inhabitants are under a local protection agreement to end deforestation in the area. This particular forest is considered somewhat sacred as it is used as a local cemetery. Local villagers indicated that even in the Manongarivo Special Reserve, the only strictly protected area to contain *A. unicolor*, it is rare to find.

The morphometric data confirm Milne-Edwards' and Grandidier's (1875a) observation of size differences between the eastern and western woolly lemur types. Certainly, more populations of *A. unicolor* should be located and sampled to establish reliable estimates of this species and its relationship with all other *Avahi* species described. We hope that this baseline morphometric information will help to eventually elevate *Avahi unicolor* from the IUCN Red List Data Deficient assessment.

## Acknowledgements

We acknowledge the Ministry of Environment and Eaux et Forêts (CAFF/CORE) to deliver us the permit for this research; we thank the CIREEF Antsohihy, the Mayor of Ankaramibe, the villagers from Beraty, Marcellin and his family for their assistance in the field. This project would not have been possible without the support of the staff, guides, and drivers of Henry Doorly Zoo's Madagascar Biodiversity and Biogeography Project (MBP-HDZ), as well as, Parc Botanique et Zoologique de Tsimbazaza, U.S. Fish & Wildlife, and Bill and Berniece Grewcock, the Ahmanson Foundation, the Theodore F. and Claire M. Hubbard Family Foundation, and the James Family. We give recognition to the Department of Biological Anthropology, University of Antananarivo for their help. We acknowledge the Henry Doorly Zoo for their financial and logistical support to this project.

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# Rapid survey of white-collared brown lemurs (*Eulemur albocollaris*) in three forest fragments in southeastern Madagascar

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From May 11 - 22, 2006, we conducted a rapid survey of *Eulemur albocollaris* in the Manombo vicinity of southeastern Madagascar. The white-collared brown lemur (*Eulemur albocollaris*; Rumpler, 1975) is listed among the 25 most endangered primates in the world (Mittermeier *et al.*, 2006). The species has possibly the most restricted geographic range of all lemurs, found between the Manampatrana River to the north and the Mananara River to the south. They range from the coastal forests on the east to the Iantara River on the west (Garbutt, 1999; Mittermeier *et al.*, 2006). Habitat fragmentation has significantly disrupted ecological corridors resulting in populations significantly devoid of gene flow (Johnson *et al.*, 2003). The Andringitra region provides a contact zone where they are often seen mixed with *E. rufus* and where a hybridization event has been documented (Johnson, 2002; Wyner *et al.*, 2002). The species is sexually dichromatic with male coat color tending towards grey and females appearing more brownish to rufous. The collar is distinctively white in the males and reddish in the females. The crown on the male is dark grey then lightening as it tapers down the back opposed to a rufous crown on the females. Males are also noted by a white to cream bushy beard; females have cream to rufous cheek patches.
Here, we report baseline morphometric data from the Manombo region in south-east Madagascar.

## Methods

Individuals were sampled from three locations (Fig. 1): the Manombo Classified Forest near Rapaoly's Botanical Garden (47°41'38"E, 23°01'15"S), the Manombo Special Reserve (47°43'28"E, 23°00'36"S) and the Agnalazaha Forest of the Mahabo Classified Forest (47°43'07"E, 23°11'12"S).

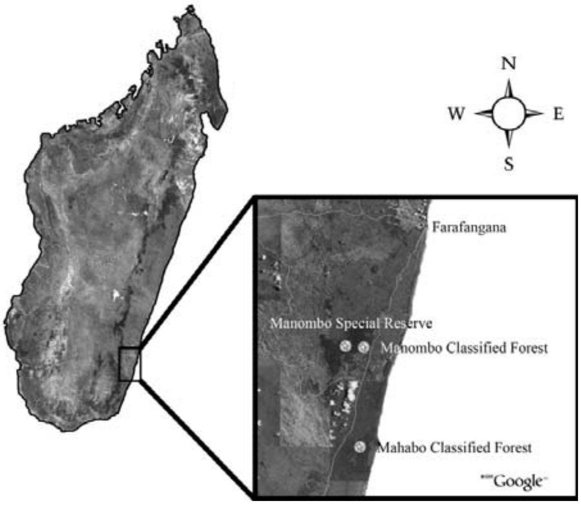

Fig. 1: *Eulemur albocollaris* study region encompassing three locations in the Manombo area of southeastern Madagascar.

Methods for the immobilization of animals, the collection of tissues and measurements taken are described in Zaonarivelo *et al.* (2007). Measurements taken follow Smith and Jungers (1997). Only adult individuals are considered. Abbreviations are: Weight in kg (± 0.01 kg) (Wt); morphometric measurements in cm (± 0.1 cm): Head crown (Head); Body length (Body); Tail length (Tail); forelimb measurements: Thumb (FT); Longest digit (FLD); Hand (Hand); Radius/ulna (Rad); Humerus (Hum); hind limb measurements: Toe (HT); Longest digit (HLD); Foot (Foot); Tibia (Tibia); Femur (Femur); Upper and lower canines (UC, LC). In addition to these measurements we also recorded the width and length of the right and left testis. With these measurements we calculated the gonadosomatic index (GI) with the same testicular measures from mid-May (breeding season) sampling as described in Johnson *et al*. (2005) to compare Manombo and Vevembe males (Table 1). We converted the testicular dimensions (length $L$ and width $W$) to volume ($V$) using the formula:

$$V = 4/3\ \pi\ (1/2)L\ (1/2)W^2$$

We then divided the mean volume (cm$^3$) for both testes by the body mass (kg) to generate the GI for each male (Glander *et al*., 1992; Kappeler, 1997; Johnson *et al*., 2005).

Data were compared among the three sample locations and then pooled by sex.

Table 1: Weight and measurement averages and standard deviations for adult white-collared brown lemur (*Eulemur albocollaris*) males (n=9) and females (n=6) in the Manombo region of southeastern Madagascar. Trends and significant differences between sexes are marked as (*) p<0.1, * p<0.05.

| | Females | SD | Males | SD |
|---|---|---|---|---|
| Wt | 1.97 | 0.11 | 1.93 | 0.10 |
| Head | 10.40 | 0.47 | 10.53 | 0.47 |
| Body | 32.92 | 1.06 | 32.40 | 2.03 |
| Tail | 49.72 | 3.74 | 48.79 | 3.22 |
| FT | 2.67 | 0.29 | 2.58 | 0.23 |
| FLD | 3.12 (*) | 0.42 | 2.89 | 0.19 |
| Hand | 7.65 | 0.36 | 7.54 | 0.29 |
| Rad | 11.20 | 0.52 | 10.80 | 0.51 |
| Hum | 9.28 | 0.37 | 9.10 | 0.29 |
| Hallux | 3.60 | 0.31 | 3.65 | 0.26 |
| HLD | 2.87 | 0.16 | 2.93 | 0.18 |
| Foot | 10.62 (*) | 0.37 | 10.93 | 0.37 |
| Tibia | 13.12 (*) | 0.71 | 12.58 | 0.45 |
| Femur | 14.37 | 0.68 | 13.96 | 0.69 |
| UC | 9.18 * | 1.02 | 10.56 | 1.38 |
| LC | 4.67 | 0.42 | 4.66 | 0.62 |

## Results

No significant differences were detected between sample locations. In comparing male (n=9) to female (n=6) morphometrics, only the upper canine measurements were significant with males having a mean difference of +1.47 mm (P<0.05). This is in agreement with Johnson's *et al*. (2005) samples collected at Vevembe (1996-2000); however the dimorphic difference at Vevembe appears to be greater than what we observed at Manombo (Johnson *et al*., 2005: their Fig. 3). With sexes and sample locations pooled, Manombo individuals were lighter (mean = 1.96 kg) than those sampled at Vevembe (mean = 2.19 kg) but Manombo males had higher Gonadosomatic indices (mean: 3.14; range 1.72 - 5.14; N = 9) than Vevembe males (mean: 2.70; range: 1.24 - 4.28; N = 15).

Additional sampling and study of these populations and other *E. albocollaris* populations should be undertaken to determine if such differences are year effect, location effect or random. These results should be understood as preliminary baseline values for the *E. albocollaris* groups in the Manombo region.

## Acknowledgments

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# Preliminary lemur survey of Andavakoera Classified Forest and regional forest fragments of Madagascar

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**Key words:** Lemurs, Andavakoera, Perrier's Sifaka, *Propithecus perrieri*, hunting

Madagascar, with its unique biodiversity under continual threat of anthropogenic stochastic changes, has been designated as a hotspot at the top of conservation priority lists (Myers *et al*. 2000). Lemurs are endemic to Madagascar existing in relatively small and fragmented geographic ranges, making them especially susceptible to extinction risks (Jernvall and Wright, 1998). All lemurs are protected under the Convention of International Trade of Endangered Species (CITES) and are designated by the IUCN/SSC Red List Categories from critically endangered to threatened depending on the species (IUCN/ SSC, 1999). Thus, there is a pressing need to understand the taxonomy and phylogeny of lemurs so that a scientifically rational approach to their conservation and management can be developed and implemented. The taxonomic revision and distributions of species warrants the effort to periodically re-evaluate the conservation protection status of lemurs as new information becomes available (Martin, 2000). The Malagasy government has a plan to triple the amount of protected area over the next 5 years (1.7 millions ha to 6 millions ha). One of the classified forests selected to become a newly protected area is the Andavakoera Classified Forest with an extension on the Andrafiamena range. The Andavakoera mountain chain is situated with a south-west north-east orientation in the Commune Rurale Betsiaka and the Commune Rurale Ambatoharana, Sous-Préfecture Ambilobe, Region Daraina. Although the northern aspect of the Andavakoera range still maintains good quality gallery forest, the southern slopes are heavily impacted with only small trees and bush remaining. It has been suggested that Perrier's sifaka, *Propithecus perrieri* (Lavauden, 1931), is found in this forest (Mittermeier *et al*., 2006). Perrier's sifaka is classified as critically endangered and is considered one of the 25 most endangered primate species (Mittermeier *et al.*, 2006). The geographic range of Perrier's sifaka is between Irodo River to the north and Loky River to the south, with its range extended recently to the Andrafiamena range forests, located southwest of Analamerana Special Reserve (Ranaivoarisoa *et al*., 2006). In May 2006, the authors directed a census to create an updated inventory of lemurs in the Andavakoera Classified Forest and surrounding forest fragments (Fig. 1). This survey was conducted by actively canvassing the entire Andavakoera Classified Forest (Fig. 2) and the surrounding forest fragments (Fig. 3) and passively conducting interviews of local long-term residents of the area (including showing photographs of Perrier's sifaka). Although several species of lemurs were noted, Perrier's sifaka was not observed at Andavakoera. Long-term residents have no recollection of having seen it in this forest or having heard of such presence through the stories of village elders.

## Methods

All gallery forests and all trails were transected by multiple independent teams, staggered over different periods of the day for ten days (Fig. 1). The free-ranging lemurs were immobilized using a $CO_2$ powered rifle or a blowpipe propelling light weight darts (Type C; Pneu-Dart, Williamsport, Pennsylvania 177091, USA), loaded for a delivery of Telazol® (Dodge, Iowa; 10 mg per kilogram). The exceptions to the use of the immobilization techniques are any species of the genus *Microcebus* which are routinely hand-caught then later sedated per protocol for data collection. All lemur species were noted

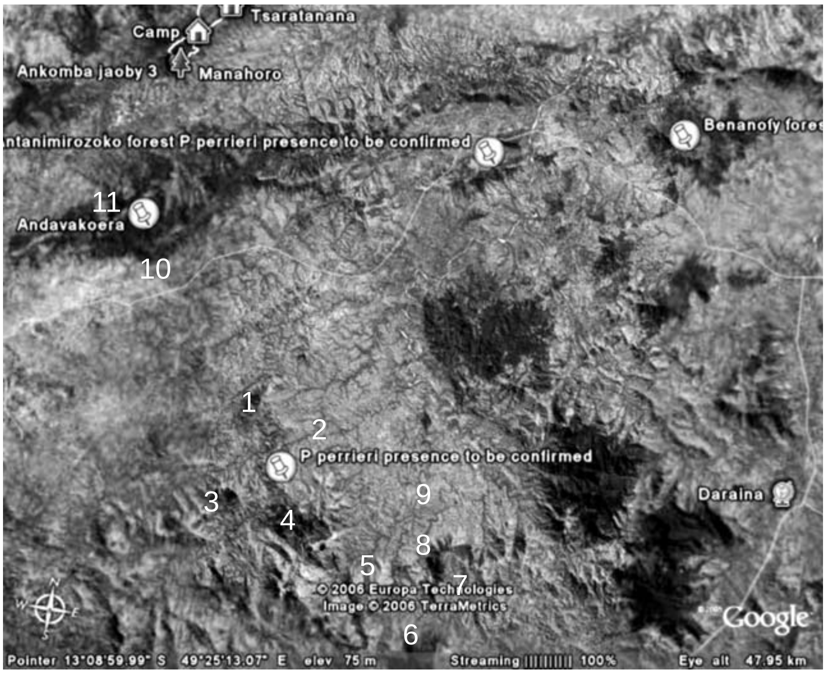

Fig. 1: Map of study area, width of image scales to 55 km. Map legend: 1. Ahipoana Forest, 2. Morafeno village, 3. Ambatomitsangana Forest, 4. Ambohitsimaherivy Forest, 5. Ampasivelona Forest, 6. Analavelona Forest, 7. Sambatioka village, 8. Menamiongana Forest, 9. Ampasimaty village, 10. Betsiaka village, 11. Andavakoera Classified Forest.

Fig. 2: Southern slope of the Andavakoera range viewed over rice field from Betsiaka Village. Photo: R.A. Brenneman

Fig. 3: Distant view of the region designated 1-9 (Fig. 1) from the Andavakoera range. Photo: R.A. Brenneman

Fig. 4: Forest edge on the north face of the Andavakoera range showing remnant evidence of the slash and burn activities from 2003-4 and the invasive regrowth. Photo: R.A. Brenneman

whether individuals were immobilized or not using a global positioning system (data available). Two ear biopsies punches (2 mm) were collected from each ear for all lemurs and 1 ml of blood (except *Microcebus* spp.) per kilogram from the femoral vein and stored in room temperature storage buffer (Longmire *et al*. 1992). A Home Again® (Home Again Poet Recovery, East Syracuse, NY) microchip was placed subcutaneously between the scapulae for easy identification of individuals in later studies by our group or by other researchers. Measurements were taken on all immobilized lemurs (Smith and Jungers, 1997; Louis *et al*., 2006; Ranaivoarisoa *et al*., 2006; Andriantompohavana *et al*., 2006a,b).

## Results

Five species were observed including *Cheirogaleus medius, Eulemur sanfordi*, *E. coronatus, Lepilemur* sp. (identified as *Lepilemur* cf. *ankaranensis* tentative to molecular data evaluation) and *Microcebus tavaratra.* Two of the five species, *E. coronatus* (n=2) and *L. ankaranensis* (n=10) were immobilized and one *M. tavaratra* was hand-caught for sampling. Two lemur species were observed but not immobilized: *C. medius* (n=2) and *E. sanfordi* (n=4). Morphometric averages are presented in Table 1 for the two species where multiple individuals were sampled and for the single *M. travaratra*.

## Discussion

We set camp north of Betsiaka village (13°07'06"S, 49°13'46"E; Elevation: 412 m) on the northern slope of the Andavakoera range. From May 3-10, 2006, we dispersed multiple independent teams daily into the forest that spanned the length of the range from approximately 5.2 km north east to approximately 2 km west of the camp site. The teams used every available trail to transect the area and make observations of the forest and conditions. The northern region of the Andavakoera forest was inhabited by immigrants approximately 20 years ago who carried out slash and burn practise, resulting in the small fragments seen today. This remaining forest is still threatened by logging and recent very intensive uncontrolled fires (Fig. 4).

Two groups (n=2, n=3) of *E. sanfordi* and three groups (n=4, n=3, n=3) of crowned lemurs (*E. coronatus*) were observed. We noted that these group sizes are much smaller than what is usually expected for these two species. Sanford's brown lemur can be expect to range in group sizes up to 15 individuals (Wilson *et al*., 1989) while the crowned lemur has a somewhat smaller average group size of five or six individuals (Mittermeier *et al*., 2006). The field assistants also noted on two separate occasions observing a raptor, *Polyboroides radiatus*, eating a freshly killed crowned lemur. All of the diurnal species observed reacted to human presence by immediately fleeing the area. The impact of hunting pressure is considerable and the local residents remarked that the lemurs are easily hunted using dogs and slingshot propelled stones. Limited numbers of small groups of *E. coronatus* and *E. sanfordi* exist but are in danger of being exterminated in the near future. In addition, we noticed numerous cut marks on trees where the nocturnal sportive lemurs were cut from hollow trees. Vocalizations by *Lepilemur* (spp.) individuals seemed to be numerous in the two hours following sunset but even they were extremely wary of human presence compared to many other locations recently worked. No *Lepilemur* individuals were sampled from the night surveys but 10 were captured while sleeping during the day. Even though this region is a noted for gold mining, the authors felt that gold miners did not impact or threaten the lemur population. There was no evidence of mining activities recent or past in the mountain areas. There was, however, notable evidence from past mining activities and current panning in low-lying areas (Fig. 5).

Table 1: Measurements for lemurs sampled in the Andavakoera Classified Forest.

| | | | | | **Forelimb** | | | | | **Hindlimb** | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Weight (kg)** | **Head (cm)** | **Body (cm)** | **Tail (cm)** | **Thumb (cm)** | **Longest digit (cm)** | **Hand (cm)** | **Radius (cm)** | **Hume-rus (cm)** | **Thumb (cm)** | **Longest digit (cm)** | **Foot (cm)** | **Tibia (cm)** | **Femur (cm)** |
| **Ankarana Sportive Lemur, *Lepilemur* cf. *ankaranensis*** | | | | | | | | | | | | | | |
| Total Average (n=10) | 0.7±0.2 | 6.1±0.1 | 21.1±1.3 | 27.9±1.4 | 1.7±0.1 | 3.1±0.2 | 5.5±0.3 | 6.2±0.6 | 5.0±0.6 | 2.4±0.6 | 3.0±0.2 | 7.7±0.8 | 7.7±0.7 | 8.8±0.8 |
| Male Average (n=7) | 0.7±0.2 | 6.1±0.1 | 20.8±1.3 | 27.6±1.4 | 1.7±0.1 | 3.1±0.2 | 5.5±0.4 | 6.2±0.6 | 5.0±0.6 | 2.4±0.4 | 2.0±0.3 | 7.5±0.8 | 7.57±0.8 | 8.6±0.8 |
| Female Average (n=3) | 0.9±0.3 | 6.2±0.1 | 21.8±1.4 | 28.6±1.2 | 1.6±0.1 | 3.1±0.3 | 5.6±0.3 | 6.0±0.6 | 5.1±0.6 | 2.5±0.4 | 3.1±0.1 | 8.0±0.7 | 8.0±0.6 | 9.3±0.6 |
| **Crowned Lemur, *Eulemur coronatus*** | | | | | | | | | | | | | | |
| Total Average (n=2) | 1.3±0.1 | 8.6±0.5 | 27.4±0.2 | 45.7±1.8 | 2.1±0.1 | 3.3±0.3 | 6.1±0.1 | 8.0±0.9 | 6.7±0.2 | 2.4±0.4 | 3.6±0.1 | 9.4±0.7 | 9.8±0.5 | 11.3±0.3 |
| **Northern Mouse Lemur, *Microcebus tavaratra*** | | | | | | | | | | | | | | |
| | **Weight (g)** | **Head Length (mm)** | **Head width (mm)** | **Body Length (mm)** | **Tail Length (mm)** | **Ear length (mm)** | **Ear width (mm)** | **Muzzle Length (mm)** | | | | | | |
| Total (n=1) | 63.5 | 36.0 | 20.0 | 89.0 | 147.0 | 7.4 | 12.3 | 7.4 | | | | | | |

A separate team with a local guide was sent into the mountains south of the Andavakoera Classified Forest (Fig. 3) between May 10-14, 2006, to engage in dialogue with and show photographs of Perrier's sifaka to the locals of this region. The Ahipoana, Analavelona and Menamiongana forests (Fig. 1) were highly fragmented and significantly damaged forest fragments. The Ambohitsimaherivy forest was noted simply as a "good forest" with steep and rocky terrain; both *Eulemur coronatus* and *E. sanfordi* were confirmed in this location. The Ampasivelona and Ambatomitsangana forests were noted as a high quality gallery forests.

Fig. 5: Children in the Betsiaka area panning for gold on the edge of a rice field. Photo: R.A. Brenneman

Conversations with the residents of Betsiaka and our local guides (born circa 1960) revealed no recollection of any *P. perrieri* south of Andrafiamena (photos of *P. perrieri* were shown). Similarly, conversations in the villages of Morafeno, Sambatioka and Ampasimaty indicated no knowledge of Perrier's sifaka in the forests south of Betsiaka.

Previous suggestions of Perrier's sifaka in the Andavakoera region could have arisen from the local name, "akomba joby" being used for two different species. In the Analamerana Special Reserve and Andrafiamena range (Anjakely), *P. perrieri* is locally referred to as "akomba joby" which translates in English to "black lemur." In the Betsiaka area, "akomba joby" refers to Sanford's brown lemur, *E. sanfordi*. In conclusion, the results of the interviews with the local residents indicate that *P. perrieri* has not been observed in the Andavakoera Classified Forest or the forests south of this area. Currently, we place the geographic range of *P. perrieri* from the Irodo River in the north to Mount Manahoro on the Andrafiamena range in the south. Further field work needs to be conducted to confirm the south-western extent of Perrier's Sifaka in the Andrafiamena mountain range.

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# Forest fragment and range survey of the Ambararata-Maromokotra Loky River Locale of northeastern Madagascar for Golden-crowned Sifaka (*Propithecus tattersalli*)

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**Key words:** Lemurs, *Propithecus tattersalli*, Golden-crowned sifaka, range extension, Loky River

The Golden-crowned Sifaka*, Propithecus tattersalli* (Simons, 1988), is classified as an Endangered Species according to the IUCN/SSC Red List (World Conservation Union/ Species Survival Commission). Populations of *P. tattersalli* occupy the patchwork of gallery forest in the northeastern tip of Madagascar (Mittermeier *et al.*, 2006) with the easiest location to observe the Golden-crowned Sifaka being the Andranotsimaty gallery forest (Garbutt, 1999) north of Daraina. The range has been described as north and west to the Loky River and to the Manambato River to the south and east. In an earlier survey, Vargas *et al.* (2002) reported the presence of *P. tattersalli* outside this range in a forest cluster west of the Loky River and south of Maromokotra village. That population had never been validated or sampled for scientific study. A collaborative effort was established between Madagascar Biodiversity and Biogeography Project/Henry Doorly Zoo (MBP-HDZ) and Association Fanamby to identify likely undocumented forest fragments in this region and to set exploratory expeditions into those fragments including the forest labeled as "Antanimorozoka" in Vargas *et al*. (2002). The objectives of the study were to (i) establish the known range of the Golden-crowned Sifaka in this region along the Loky River and (ii) obtain morphometric data and genetic samples of the species where found.

## Study sites and Methods

Potential locations were identified by comparing regional color consistency with habitats in the Daraina area harbouring known and studied *P. tattersalli* populations from satellite imagery (Fig. 1). Two forests were

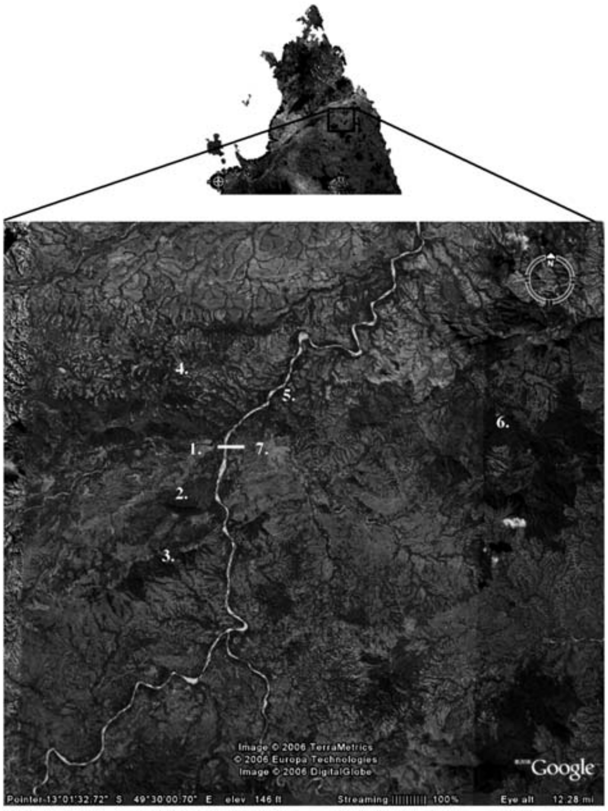

Fig. 1: Close-up satellite image of the study area indicating the forest fragments and significant landmarks in the immediate region numbered: 1) Ambararata Village, Betsiaka Community; 2) Matsaborimilanja Forest; 3) Mahabenofy Forest; 4) Asavelona Forest; 5) Ambatovaky Forest; 6) Antobinitsimihety Forest; 7) Maromokotra Village and the connecting Madagascar National Highway 1 bridge (scaling image at 1 km) over the Loky River to Ambararata Village.

Fig. 2: Juvenile female *Propithecus tattersalli* from Mahabenofy Forest.

each) were observed. A total of 10 individuals (8 adults and 2 juveniles) were immobilized. The averages for morphometric measurements from the 8 adults are compared to the averages from 47 adults sampled from four forests east of the Loky River from Antobinitsmihety Forest south to Daraina (Table 1). One individual from the Mahabenofy population is presented here (Fig. 2) for reference; no differences in pelage were noted among the individuals observed or sampled.

identified from the satellite imagery and three additional forest fragments were identified through conversations with local villagers as potential habitats for *P. tattersalli*. In all, five forests or fragments were surveyed to validate the existence or absence of sifaka species and assess forest quality.

Methods for the immobilization of animals, the collection of tissues and measurements taken are described in Zaonarivelo *et al*. (2007). All individuals wre released unharmed according to their respective GPS coordinates after recovery and observation.

Measurements taken follow Smith and Jungers (1997). Abbreviations are: Weight in kg (± 0.01 kg) (Wt); morphometric measurements in cm (± 0.1 cm): Head crown (Head); Body length (Body); Tail length (Tail); forelimb measurements: Thumb (FT); Longest digit (FLD); Hand (Hand); Radius/ulna (Rad); Humerus (Hum); hind limb measurements: Toe (HT); Longest digit (HLD); Foot (Foot); Tibia (Tibia); Femur (Femur). The means with standard deviations are presented in Table 1.

## Results

Golden-crowned sifaka groups were located in two of the five forest fragments surveyed, the Mahabenofy forest on the west side of Loky River and the Antobinitsmihety forest south and east of Maromokotra village (Fig. 1). The Mahabenofy forest population is located in the Fokontany of Ambararata, Betsiaka Community, District of Ambilobe, Region of Daraina approximately 3 km south of Maromokotra village and west of the Loky River. The forest lies in a northeast to southwest orientation bordered on the northwest by a mountain ridge (Fig. 1). The northern extent is a semi-deciduous dry forest with gallery forest following the ridge and edges recovering with brush. The northeastern area has a V-shaped crest and covered sparsely by vegetation. The majority of the trees up to 5 cm in diameter are cut. The southwest forest is recovering with secondary growth and appears to be less threatened than the northern forest. Five apparent social groups of *Propithecus tattersalli* were observed in the Mahabenofy forest. Two groups (n=6 each), one group (n=5), and two groups (n=2

Table 1: Morphometric measurements means and standard deviations (S.D.) with significance based on one-sided t-tests for *Propithecus tattersalli* adults sampled east of the Loky River in the Daraina region compared to the *P. tattersalli* adults sampled west of the Loky River in the Mahabenofy Forest. * $p < 0.05$, ** $p < 0.001$, *** $p < 0.0001$.

| | East of Loky River | West of Loky River |
|---|---|---|
| N | 47 | 8 |
| Wt | 3.41 (0.41) | 3.16 (0.47) |
| Head | 10.17 (0.39) | 10.33 (0.14) |
| Body | 35.20 (3.57) | 31.05 (1.48) *** |
| Tail | 48.32 (3.99) | 46.98 (3.12) |
| FT | 4.57 (0.58) | 3.85 (0.35) *** |
| FLD | 4.87 (0.42) | 4.84 (0.27) |
| Hand | 10.64 (0.69) | 10.53 (0.34) |
| Rad | 12.72 (1.23) | 11.50 (0.51) *** |
| Hum | 10.22 (1.03) | 9.98 (1.32) |
| HT | 6.91 (0.82) | 6.01 (0.53) ** |
| HLD | 4.37 (0.54) | 4.21 (0.24) |
| Foot | 14.80 (0.58) | 14.51 (0.36) |
| Tibia | 16.57 (1.00) | 15.65 (0.84) * |
| Femur | 19.46 (1.11) | 19.23 (0.98) |

## Discussion

The northwestern range limit for the *P. tattersalli* has been described as east or south of the Loky River with a single group noted to the west of the Loky River. We believe the Mahabenofy population described to us by the locals is synonymous with Vargas *et al*. (2002)'s "Antanimorozoka" population as it was previously described to their team. The description by Vargas *et al*. certainly appears to agree with the location where we found *P. tattersalli*. Exploratory trips into other potential forest fragments along the Loky River did not produce observations of *P. tattersalli*. The Matsaborimilanja Forest, Ambatovaky Forest and the Asavelona Forest (Fig. 1) have been severely damaged for apparent light lumber and certainly fuel wood use. Satellite imagery gives the impression of dense mature coverage but the forests are predominantly secondary recovery growth interspersed with large but young fast-growing trees. Conversations with local villagers and cattle farmers provided no further suggestion or rumor of potential forests that might harbor remote populations of this rare species north or west of the Loky River. We found no rumor or suggestion to imply or question that this population is introduced either purposely or accidentally by human actions. Since this species is entirely arboreal and the Loky River bed throughout the Ambararata-Maromokotra area is two hundred or more meters wide (Fig. 3), we believe that these observations imply that this population may be remnant of the inhabitants of the region when the forest was continuous around the source of the watershed perhaps a hundred kilometres to the south of this location.

Fig. 3: Taken from the Loky River bed viewing the north face of the distant mountain (center of photograph) hiding Mahabenofy Forest on its south face.

Morphometric comparisons demonstrated that the western (Mahabenofy) population may be smaller in certain measurements (body: -4.15 cm, fore thumb: -0.72 cm, radius: -1.22 cm, hind thumb: -0.90 cm, and tibia: -0.92 cm) than the representatives sampled from the eastern side of the river. But there was no significant difference for any of the morphometric measurement averages between sexes within populations on either side of the Loky River. Molecular genetic analysis of these samples will permit researchers to place these two newly located populations in relationship with known populations and potentially answer the questions related to the ancestral lineage of these Golden-crowned Sifaka populations.

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# Variation de la distribution de deux espèces de microcèbes dans le Parc National Ankarafantsika

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Les Microcèbes (*Microcebus* spp.), des petits primates nocturnes de Madagascar sont largement distribués à travers l'île. Ils habitent des forêts primaire, secondaire, et même des forêts très perturbées parfois avec une densité très haute pouvant atteindre 400 individus/$km^2$ (Hladik *et al.*, 1980; Harcourt et Thornback, 1990). Depuis 1931 jusqu'à ces jours, suite de recherches primatologiques de plus en plus poussées, le nombre d'espèces connues de ce genre est augmenté de un à 15 (Schwarz, 1931; Zimmermann *et al.*, 1998; Rasoloarison *et al.*, 2000; Yoder *et al.*, 2000; Louis *et al.* 2006; Olivieri *et al.*, 2007). En relation avec cette augmentation du nombre d'espèces connues, le risque d'extinction augmente sachant que la zone de distribution des espèces est plus restreinte que l'on a estimé (Mittermeier *et al.*, 2006; Razanahoera *et al.*, 2002). Une de ces espèces, *Microcebus ravelobensis*, est classées menacées par IUCN sans savoir en détails sa distribution dans son aire de répartition (Razanahoera-Rakotomalala *et al.*, 2002). Depuis sa découverte cette espèce a été connue habiter dans le Parc National Ankarafantsika, Nord-Ouest Madagascar, avec sa congénère *M. murinus* (Zimmermann *et al.*, 1998; Schmelting *et al.*, 2000). Ce Parc a subi des exploitations illicites (exploitation de raphia, chasse des animaux et collectes de tubercules) incessantes accompagnées des feux incontrôlés presque chaque année (ANGAP, comm. pers.), ce qui perturbe la forêt et pourrait diminuer les espaces habitables pour les lémuriens. Dans le but de fournir des informations nécessaires pour l'établissement d'un plan d'une effective conservation de *M. ravelobensis* et *M. murinus* dans le Parc, il est nécessaire d'étudier leur présence et leur distribution dans diverses localités du Parc. A la station forestière Ampijoroa (faisant partie du Parc), les deux espèces vivent ensemble dans une localité (JBA: Jardin Botanique A) tandis que *M. ravelobensis* vit exclusivement dans une autre localité (JBB). Cette étrange distribution a mené une équipe (Radespiel et Raveloson, 2001) à entreprendre une étude de l'abondance et de la distribution de ces deux espPces de microcèbes dans trois autres sites du Parc, notammment Sainte Marie, Ankarokaroka et Bevazaha. L'équipe a trouvé qu'il y a toujours de site exclusive pour *M. ravelobensis* et des sites communs pour les deux espèces, mais la distribution de ces espèces dans d'autres parties du Parc restait inconnue.

Pour avoir une vision plus générale et des données plus représentatives du Parc sur la présence et la distribution de ces espèces, un inventaire de ces deux espèces a été mené dans dix sites représentant 22 microhabitats (Fig. 1) entre les années 2002-2004.

## Sites d'étude

L'étude sur terrains a été effectuée dans 22 microhabitats repartis dans 10 sites lesquels diffèrent entre eux par leurs positions géographiques et les caractéristiques de la forêt (Tab. 1).

Tableau1: Localisation des sites et description des microhabitats.

| Site | N° du transect | Longueur du transect (m) | Description de l'habitat |
|---|---|---|---|
| Ampijoroa JBB (16°18'S,46°48'E) | 1 | 1000 | Forêt dense subhumide à espèce arbustive exotique (*Tectona grandis*), partiellement inondée au cours de la saison de pluie, peu dégradée |
| Ankoririka (16°16'S,47°03'E) | 2.1 | 1080 | Forêt sub-humide, très dégradée et perturbée, sur bas-fonds avec un sol humifère sableux, apparemment riche en fruits (pendant l'étude) |
|  | 2.2 | 1080 | Forêt sèche semi-caducifoliée secondaire, sur un versant avec un sol généralement gréseux, moyennement dégradée |
|  | 2.3 | 1080 | Forêt dense sèche sur un haut plateau sableux, subi par une exploitation sélective de bois, plus ou moins en bon état |
| Bevazaha (16°13'S,47°08'E) | 3.1 | 1080 | Forêt galerie sur grès argileux, généralement en bon état, avec des arbres relativement hauts |
|  | 3.2 | 1080 | Forêt sèche caducifoliée plus ou moins dégradée sur versant avec sable blanc, avec des arbres moins hauts |
| Komandria-Bealana (16°21'S,46°39'E) | 4.1 | 1000 | Forêt dense sèche semi-caducifoliée de basses-terres, dégradée |
|  | 4.2 | 1000 | Forêt dense sèche caducifoliée très dégradée, sur une pente d'une montagne gréseuse et sableuse |
| Beronono (16°00'S,47°09'E) | 5.1 | 1000 | Forêt dense sèche caducifoliée, dégradée à proximité du village Beronono |
|  | 5.2 | 1000 | Forêt dense sèche caducifoliée, dégradée à proximité du village Beronono |
| Ampatika-Antanimbary (16°02'S,47°08'E) | 6.1 | 1000 | Forêt dense sèche caducifoliée très dégradée sur un grès jaune et rouge, surune colline bordée d'un cours d'eau |
| Ampatika-Antanimbary (16°02'S,47°08'E) | 6.2 | 1000 | Forêt dense sèche caducifoliée sur sable et forêt subhumide en grande partie sur un sol hydromorphe, moins perturbées |
| Andoharano (16°17'S,47°00'E) | 7.1 | 1000 | Forêt dense sèche semi-caducifoliée sur sol humifère et sableux, très dégradée suite d'une ancienne exploitation de bois et par des anciens feux |
|  | 7.2 | 1000 | Forêt dense sèche caducifoliée dégradée par d'anciens feux, sur sol gréseux |
|  | 7.3 | 1000 | Forêt dense sèche caducifoliée en partie très dégradée par d'anciens feux, sur un plateau sableux |
| Ambanjakely-Mahatazana (16°11'S,46°53'E) | 8.1 | 1000 | Forêt dense sèche caducifoliée moyennement dégradée par d'anciens feux, sur sables blancs et sur grès jaune |
|  | 8.2 | 1000 | Forêt dense sub-humide et sèche caducifoliée en partie très dégradée par des feux |
|  | 8.3 | 1000 | Forêt sèche caducifoliée, très dégradée, sur grès latéritique et sur grès jaune |
| Andofombobe-Betrandraka | 9.1 | 1000 | Forêt dense sèche caducifoliée sur grès latéritique et sur sables blancs, relativement en bon état |
|  | 9.2 | 1000 | Forêt dense sPche semi-caducifoliée sur grès jaune à rouge-brun du versant, relativement en bon état |
|  | 9.3 | 1000 | Forêt galerie en grande partie dégradée longeant un cours d'eau, subie par une ancienne exploitation de bois, une exploitation de raphia |
| Forêt Intelomiakatra-Ambodimanga | 10 | 1000 | Forêt dense sèche caducifolié sur sables blancs et sur sol gréseux, très dégradée suite d'une exploitation humaine et un passage de feux |

## Méthodes

Nous avons installé 1 à 3 transects linéaires de 1000-1080 m de longueur dans chaque site. Les pistes préexistantes ont été utilisées autant que possible. Chaque transect traverse un microhabitat bien défini (type de forêt, position topographique, sol, perturbation; Tab. 1). Nous avons mené deux méthodes de recensements sur chaque transect: observation systématique (comptage) sur transect et capture/recapture.

### *1. Observation systématique sur transect*

Sur chaque transect, 3-5 observations nocturnes se sont faites au début de la nuit, entre 18 à 21h. A Komandria (le site n°4, Fig. 1), nous avons seulement fait un recensement nocturne par transect à cause de l'insécurité et l'enclavement du site. Pendant le recensement nocturne, deux personnes équipées avec des lampes frontales parcourent silencieusement le transect avec une vitesse de 0,5 km/h environ, tout en recherchant et notant les signes de présence de microcèbes dans la forêt visitée. Les lémuriens sont detectés facilement a cause du reflet de la lumière de la lampe dans ses yeux (à travers le *tapetum lucidum*). Nous avons changé la direction entre deux recensements nocturnes consécu-

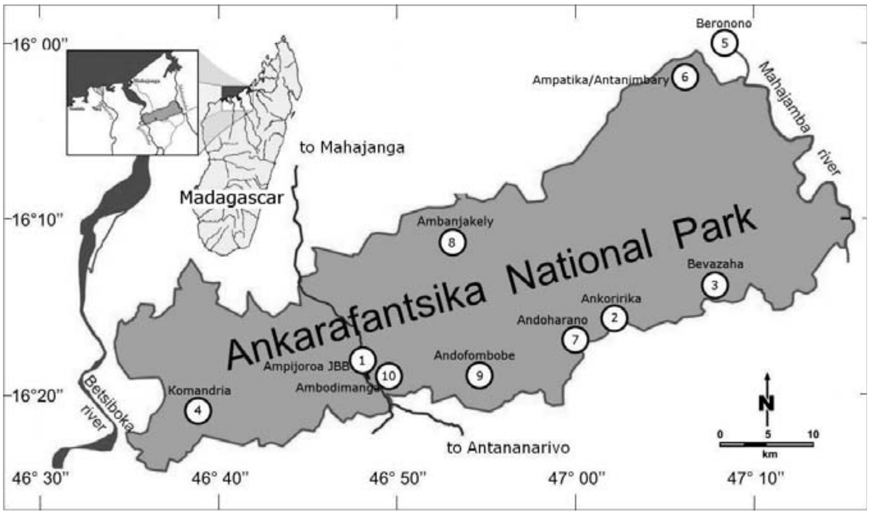

Fig. 1: Carte du Parc National Ankarafantsika avec les 10 sites d'étude (représentés par les cercles blancs).

tifs. Nous n'avons pas fait en même temps le recensement nocturne et la capture sur un même transect pour ne pas perturber le piégeage. Comme nous n'avons pas pu toujours distinguer les deux espèces pendant les observations nocturnes, nous avons englobé tous les microcèbes dans une catégorie microcèbes. Les fréquences de rencontres; c'est-à-dire le nombre d'animaux rencontrés par km ont été calculées pour quantifier l'abondance de microcèbes dans chaque microhabitat.

*2. Capture / recapture*

Pour déterminer la présence et l'abondance de chaque espèce de microcèbes, 102-110 pièges ont été installés (selon la longueur du transect: 1000-1080 m) le long de chaque transect, pendant 3-4 nuits (à l'exception de l'habitat 6 et 7 avec 1 seule nuit de capture chacun; Tab. 2) avec 2 pièges tous les 20 m, un sur chaque côté du transect. Deux captures sont intercalées d'une journée pour donner du repos aux animaux. Chaque piège a été mis en place à 1 à 2 m au-dessus du sol. L'installation de pièges s'est faite le soir tandis que le contrôle se fait tôt le matin entre 6 et 7h. Après avoir fermé les pièges vides, nous avons transporté les pièges avec animaux au camp pour l'identification. Le soir du jour du contrôle, chaque individu a été relâché à l'endroit où on l'a capturé.

## Résultats et Discussion

Des microcèbes ont été recensés dans tous les sites visités. Le taux de rencontres pendant les visites nocturnes pourrait varier de 2 à 31 individus par kilomètre (Tab. 2).

Cette grande variation de rencontres entre les différents sites pourrait être, d'une part, expliqué par l'effet de lisière, comme on a observé chez *Microcebus rufus* (Lehman *et al.,* 2006). En effet, les plus hauts taux de rencontres avec les microcèbes ont été enregistrés à Beronono (site n°5), dans un reliquat forestier à la bordure de la forêt d'Ankarafantsika (Tab.1). D'autre part, cela pourrait être due à un effet saisonnier sur l'activité (Schmelting *et al.*, 2000) ou due aux différences écologiques entre les sites qui peuvent causer des différences dans la capacité des habitats.

*Microcebus ravelobensis* était largement distribué à travers le Parc National. Nous l'avons capturé dans la majorité des microhabitats forestiers visités: sur 86,4 % des transects (19 sur 22 transects, Tab. 3). Contrairement à *Microcebus ravelobensis, Microcebus murinus* était beaucoup moins abondant. On l'a capturé seulement sur 63,6 % des transects (14 sur 22 transects). Les deux espèces cohabitaient seulement dans 50 % des microhabitats (11 sur 22). Ces résultats montrent que les deux espéces sont différemment distribuées dans le Parc. En plus, il y a une corrélation négative entre le nombre de *M. ravelobensis* et *M. murinus* capturés dans les différents microhabitats (Corrélation de Spearman: $r_S=-0{,}66$; $p < 0{,}001$; N=22). Il est bien possible que ces différences reflètent des différences de préférences écologiques. Des études de la structure de la végétation, de la composition floristique ainsi que de l'alimentation sont en cours pour pouvoir expliquer ces différences de distribution et d'abondance.

Tableau 2: Résultats de recensements nocturnes: taux de rencontres avec les microcèbes

| Site | N° Transect | Rencontrés/km Médiane (min-max) |
|---|---|---|
| JBB | 1 | 9 (7-14) |
| Ankoririka | 2.1 | 15,7 (12-20) |
|  | 2.2 | 17,5 (12-20) |
|  | 2.3 | 2,3 (1,9-8,3) |
| Bevazaha | 3.1 | 3,7 (3,7-13) |
|  | 3.2 | 13 (9,7-13) |
| Komandria | 4.1 | 12 |
|  | 4.2 | 9 |
| Beronono | 5.1 | 26 (23-30) |
|  | 5.2 | 19 (13-31) |
| Ampatika/ Antanimbary | 6.1 | 2 (1-3) |
|  | 6.2 | 4 (2-6) |
| Andoharano | 7.1 | 10 (9-12) |
|  | 7.2 | 10 (8-14) |
|  | 7.3 | 5 (2-6) |
| Ambanjakely | 8.1 | 9,5 (4-12) |
|  | 8.2 | 2,5 (2-3) |
|  | 8.3 | 3 (3-4) |
| Andofombobe | 9.1 | 3 (2-4) |
|  | 9.2 | 7 (6-14) |
|  | 9.3 | 4 (4-7) |
| Ambodimanga | 10 | 3 (3-4) |

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rent que les deux espéces sont différemment distribuées dans le Parc. En plus, il y a une corrélation négative entre le nombre de *M. ravelobensis* et *M. murinus* capturés dans les différents microhabitats (Correlation de Spearman: $r_S$=-0,66; p < 0,001; N=22). Il est bien possible que ces différences reflètent des différences de préférences écologiques. Des études de la structure de la végétation, de la composition floristique ainsi que de l'alimentation sont en cours pour pouvoir expliquer ces différences de distribution et d'abondance.

Quant à la conservation des deux espèces, il est important à noter que tout les deux espèces étaient détectées dans des habitats dégradés et non-dégradés. Mais, comme l'abondance des deux espèces a changé entre des microhabitats, c'est difficile à estimer le nombre total d'individus de chaque espèce dans le Parc National. Pour le futur, c'est important à savoir la surface totale de chaque type de microhabitat pour donner une estimation plus ou moins précise de la taille totale de la population de chaque espèce.

Tableau 3: Résultats des captures: abondance relatives de *Microcebus ravelobensis* et de *M. murinus*.

| **Site** | **N° microhabitat** | **Nombre *Microcebus* sp. capturés** | ***M. ravelobensis* (%)** | ***M. murinus* (%)** |
|---|---|---|---|---|
| JBB | 1 | 30 | 100 | 0 |
| Ankoririka | 2.1 | 30 | 100 | 0 |
| | 2.2 | 14 | 71,4 | 28,6 |
| | 2.3 | 32 | 15,6 | 84,4 |
| Bevazaha | 3.1 | 22 | 100 | 0 |
| | 3.2 | 27 | 7,4 | 92,6 |
| Komandria | 4.1 | 5 | 80 | 20 |
| | 4.2 | 5 | 60 | 40 |
| Beronono | 5.1 | 12 | 100 | 0 |
| | 5.2 | 14 | 64,3 | 35,7 |
| Ampatika/ Antanimbary | 6.1 | 6 | 100 | 0 |
| | 6.2 | 6 | 33,3 | 66,7 |
| Andoharano | 7.1 | 22 | 100 | 0 |
| | 7.2 | 13 | 92,3 | 7,7 |
| | 7.3 | 21 | 0 | 100 |
| Ambanjakely | 8.1 | 13 | 46,2 | 53,8 |
| | 8.2 | 15 | 100 | 0 |
| | 8.3 | 14 | 42,9 | 57,1 |
| Andofombobe | 9.1 | 14 | 7,1 | 92,9 |
| | 9.2 | 11 | 0 | 100 |
| | 9.3 | 1 | 100 | 0 |
| Ambodimanga | 10 | 6 | 0 | 100 |

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# Lemur records at priority sites for plant conservation

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During a strategic planning meeting in 2002, the staff of the Missouri Botanic Garden's Madagascar Program decided to be more active in promoting plant conservation in Madagascar. As a result, the MBG team has lobbied for the inclusion of priority sites for plant conservation among the new protected areas to be designated as a result of President Ravalomanana's declaration at the fifth World Parks Congress at Durban in 2003. To facilitate this activity, biological inventories were made at a selection of these sites. The inventories were conducted by a team of biologists including a botanist, a primatologist, an ornithologist, a herpetologist, and a specialist in small mammals. The primate inventory was conducted during at least 2 weeks at the site and effected by means of observations along transects in a range of habitats during the day and night. Table 1 summarises the results of the primate inventories at 6 priority sites for plant conservation. The location of these sites is shown in Fig. 1.

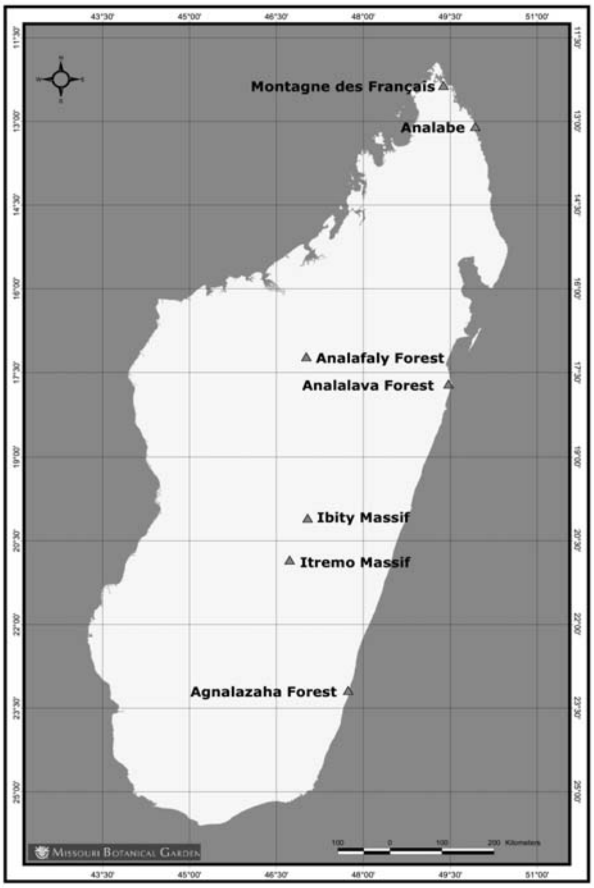

Fig. 1: Location of sites.

Table 1: Observations of lemurs at priority sites for plant conservation

| Dates | Site | Georeferences E,S | Vegetation types | Species | Comments |
|---|---|---|---|---|---|
| May/June 2003,<br>January 2004 | Ibity Massif, Antsirabe, Antananarivo | Loc. 1. 47.0191,20.0993<br>Loc. 2. 46.9828,20.1441 | gallery forest<br>sclerophyllous woodland<br>shrubland<br>grassland | None | |
| July/Aug. 2003<br>December 2003 | Itremo Massif, Ambatofindandrahana, Fianarantsoa | Loc. 1. 46.7066,20.8503<br>Loc. 2. 46.6005,20.6469<br>Loc. 3. 46.5383,20.4769<br>Loc. 4. 46.4005,20.542<br>Loc. 5. 46.5558,20.5947 | gallery forest<br>sclerophyllous woodland<br>shrubland<br>grassland | *Propithecus verreauxi*<br>*Microcebus* sp.<br>*Cheirogaleus* sp. | 5 individuals (including 2 young) of *Propithecus verreauxi* were seen in the gallery forest of Antsirakambiaty (Site 5). Local people report that this species travels large distances across savanna between forest fragments and that they are occasionally hunted.<br>*Cheirogaleus* sp. is very abundant in the gallery forest of Antsirakambiaty. |
| May 2005 | Analafaly Forest, Marotaolana, Mahajanga | 46.9950,17.2195 | gallery forest<br>dry deciduous forest<br>grassland | None | The apparent absence of lemur species in this forest is perhaps due to its location in the junction of the Betsiboka and Ikopa rivers. |
| April 2005 | Analalava Forest, Foulpointe, Toamasina | 49.4472,17.7094 | low elevation humid forest | *Eulemur albifrons*<br>*Avahi laniger*<br>*Cheirogaleus* sp.<br>*Microcebus rufus*<br>*Hapalemur griseus* | The population of *E. albifrons* in this small forest is dangerously low (c. 10 individuals) and is threatened by hunting.<br>*Hapalemur griseus* are kept as pets by villagers around this site. They are sometimes reported in rice fields. |
| November 2004 | Agnalazaha Forest, Mahabo Mananivo, Fianarantsoa | Loc. 1. 47.7165,23.1859<br>Loc. 2. 47.7342,23.1669 | littoral forest<br>marsh forest<br>marshland | *Avahi laniger*<br>*Cheirogaleus major*<br>*Eulemur albocollaris*<br>*Hapalemur griseus*<br>*Microcebus rufus* | *E. albocollaris*, *C. major* and *M. rufus* are eaten by the local people.<br>*E. albocollaris* is hunted with traps. We estimate that the total population at this site is around 75 individuals.<br>The presence of *H. griseus* at this site is unexpected because it apparently lacks bamboo. |
| December 2004 | Analabe Forest, Antsiranana | 49. 0002,13.0682 | littoral forest<br>marsh forest<br>marshland | *Eulemur coronatus*<br>*Lepilemur septentrionalis*<br>*Microcebus rufus*<br>*Propithecus tattersalli* | *E. coronatus* was seen in groups of up to 17 animals. It is hunted using blow pipes.<br>*L. septentrionalis* were encountered at a rate of 2-3 individuals per km of transect (walking at 1-1.5 km per hour).<br>*M. rufus* was seen most frequently in degraded forest.<br>According to local people several individuals of *Propithecus tattersalli* migrated to the forest in the early 90s but now just one individual remains. |

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# Lemur survey of the Andranomanitsy Forest, region of Besalampy, Province of Mahajanga

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**Key words**: Andranomanitsy dry deciduous forest, lemur diversity, future conservation.

I present here the first lemur survey of the dry deciduous of Andranomanitsy Forest (Province of Mahajanga), which was conducted between 18 and 24 October 2005. Using transects line method, general observations, and local assistant interviews, seven species of lemurs were surveyed during six consecutive days of inventories, including three diurnal species (*Propithecus deckenii*, *Eulemur rufus*, *Hapalemur occidentalis*) and four nocturnal lemur species (*Lepilemur ruficaudatus*, *Cheirogaleus medius*, *Microcebus* cf. *murinus*, *M.* cf. *myoxinus*). Thus, lemur diversity in Andranomanitsy is relatively high and most species expected to be found in this region are present. Even though the Andranomanitsy Forest is currently not severely threatened by human activities, the long-term viability of its lemur community is uncertain due to action of uncontrolled fires.

Central western Madagascar is a distinct zoogeographic region that has notable lemur diversity due to its biogeographic history associated with dispersal corridors from the Central Highlands (Thalmann, 2000). Lemur species richness in certain portions of this region is high (Rakotoarison *et al.*, 1993; Hawkins, 1999), reaching up to 11 species per site, and comparable to protected areas in the northern and eastern regions. Despite surveys at numerous localities in the central western to the northwestern part of Madagascar conducted since 1999 (e.g., Hawkins *et al.*, 1998; Thalmann *et al.*, 1999; Randrianarisoa *et al.*, 2000; Randriatahina and Rabarivola, 2004; Olivieri *et al.*, 2005; Rasamison *et al.*, 2005; Rasoloharijaona *et al.*, 2005), available information on lemur communities for the ecologically heterogeneous zone on the western dry forests is far from being complete.

The dry deciduous forests of Madagascar are among the most threatened biomes in the world (Pons and Wendenburg, 2005). This ecosystem had been reduced to approximately 3 % of their original extent (Smith, 1997). Fires are the main causes of this reduction and lead to isolation of forest fragments. In part associated with their habitat requirements, some diurnal lemur species cannot survive in small forest fragments (Ralison *et al.*, 2006). Ganzhorn *et al.* (1999) found a positive correlation between lemur species richness and forest sizes in the Menabe.

To advance available information on lemur communities in poorly known portions of the dry deciduous forests and to add information on western biogeography, a rapid survey was conducted in the Andranomanitsy Forest, Province of Mahajanga, between 18 and 24 October 2005. In addition, a visit for one day to the Réserve Spéciale de Bemarivo was made. The aim of this study was to identify zones requiring conservation action in the western part of Madagascar according to the Durban vision.

## Methods

Located in the western corner of Madagascar near Cap Saint André and to the north of the Sambao River, the forest of Andranomanitsy is located 24.5 km to the north of Besalampy town. Our base camp was installed at 16°31.2'S, 44°29.2'E at 20 m above sea level and just outside the forest limit. The zone sits on sandy soils and the dominant forest trees are *Dalbergia*, *Commiphora*, and *Hildegardia*, typical of the Western Domain subdivision between 0-800 m of altitude (Humbert and Cours-Darne, 1965). Within the forest, canopy height was approximately 8 m and the large trees, which reach 40 cm in diameter, are few. Bamboo was not observed in the forest. The savanna is dominated by palms (*Medemia nobilis*, *Hyphaene coriaceae*) and grasses. As in several dry deciduous ecosystems, the Andranomanitsy Forest suffers from uncontrolled savanna fires, which enter into the adjacent forest and is annually reduced in size.

One transect line of 2 km (start: 16°31.27'S,44°29.23'E; end: 16°30.29'S,44°30.10'E) was established. Survey effort lasted six consecutive days. Lemur observations were made during both the day and night, to detect the presence of lemur by direct sightings or by vocalizations. Diurnal censuses were conducted in the morning (07:00-10:30) and in the afternoon (15:00-17:30). Nocturnal censuses were made between 18:30 and 22:30 using maglite and a headlamp. Binoculars were used to identify species. All data corresponding to the transect method, as well as other information were recorded for each contact. Furthermore, active research outside of the transect periods across various portions of the forest, as well as interviews with local assistants were undertaken in order to maximize information on the primates of this forest. Lemur density was calculated using Whitesides *et al.* (1988) formula as follow: number of individuals / (length of the transects x 2 x mean distance perpendicular to the trail at which the individuals were sighted. Local assistants provided vernacular names. The lemur taxonomy proposed by Mittermeier *et al.* (2006) is followed here.

Live traps were used to better assess the identification of small nocturnal species. Fourty traps (Sherman and Tomahawk at a ratio of 3:1), were installed during six consecutive nights and baited with banana. The distance between two traps was about 10 m. Traps were exclusively arboreal sets, generally placed on tree trunks or lianas. Traps were checked at sunrise and once after sunset. Captured animals were released at the trap station and after a morphological description and measurements (ear, foot, and tail) were made. Tissue samples (ear and hair) were collected for future DNA analysis.

## Results

A part from *Hapalemur occidentalis* mentioned by local assistants, six lemur species (Table 1) were recorded during the survey, which include two diurnal species (*Propithecus deckenii*, *Eulemur rufus*) and four nocturnal lemur species (*Lepilemur ruficaudatus*, *Cheirogaleus medius*, *Microcebus* cf. *myoxinus*, *M.* cf. *murinus*).

*Species accounts*

*Propithecus deckenii*: Three observations of this species were made during the survey, which comprised groups of 2 to 4 individuals, including in each case one infant on the back of their mother (average of 2.7 ± 1.2, n = 3). All individuals had invariable cream-colored white fur. On average, groups were observed 6.7 ± 1.5 m above the ground.

*Eulemur rufus*: Six sightings were made in the Andranomanitsy Forest. Group size varied from 5 to 10 individuals, which in numerous cases included single infants on their mother's back (5.2 ± 2.1, n = 6). The height groups were observed was on average 10.6 m.

Lemur abundance and estimated values of lemur density (individuals/km$^2$) are summarized in Table 1. For nocturnal species, *Microcebus* was relatively abundant and the detection distance was small. The abundance of *C medius* was low in comparison to other nocturnal species. For diurnal species, although *E. rufus* was frequently observed, the detection distance was notable more distant than for *P. deckenii*; the abundance of this later species was very low. The density of *C. medius* was lower than the other two nocturnal species. For diurnal species, the density of *E. rufus* was higher than *P. deckenii*.

*Trap result*

During 240 night-traps, one individual of *Microcebus* was captured giving a rate of 0.41 %. It was trapped in the Sherman placed at 1.6 m off the ground in a dead tree. This individual fits the pelage coloration of *Microcebus myoxinus* described by Rasoloarison *et al.* (2000). Further, an individual referred to *M. murinus* was captured by another expedition member in a Sherman trap destined for rodents, placed 1.0 m off the ground, and baited with peanut butter.

During the quick visit to the Réserve Spéciale (RS) de Bemarivo, most of the forest had been destroyed by fire. Only the gallery forest persists. The three lemur species observed in the reserve included *P. deckenii*, *E. rufus*, and *H. occidentalis*. One group of *E. rufus* was seen moving across an area of open savanna to join mangos trees, one group of *H. occidentalis* was seen within a marshy zone, and *P. deckenii* was found in gallery forest.

Table 1: Lemur diversity and density in the Andranomanitsy Forest.

| Family | Species | Vernacular name | n | a | b |
|---|---|---|---|---|---|
| Cheirogaleidae | *Microcebus* spp. (*murinus* and *myoxinus*) | *tilitilivahy* | 27 | 5.3 (4.3±1.8) | 667 |
|  | *Cheirogaleus medius* | *kelibehohy* | 4 | 0.9 (5.3±0.6) | 50 |
| Lepilemuridae | *Lepilemur ruficaudatus* | *fitsidika* | 21 | 3.5 (4.5±2.9) | 416 |
| Lemuridae | *Hapalemur occidentalis* | *kofy* | # | no data | nd |
|  | *Eulemur rufus* | *gidro* | 6 | 3.3 (10.6±11.0) | 15 |
| Indriidae | *Propithecus deckenii* | *tsibahaka* | 3 | 0.3 (6.7±1.5) | 6 |

n: number of sightings; # according to interviews; a: Mean number of sightings per kilometer of transect (individuals/km). The values in parentheses represent the mean detection distance (m) with standard deviation. b: Lemur density (individuals/km$^2$) using the calculation of Whitesides *et al*. (1988);

## Discussion

A comparison of the Andranomanitsy Forest lemur species to protected areas in the western central region of the island (Table 2) indicates that this site has largely the same lemur community as the Parc National (PN) de Namoroka and the RS de Kasijy. The Andranomanitsy Forest holds a greater lemur species diversity than the three Réserve Spéciales de Bemarivo, Maningoza, and Ambohijanahary. However, its lemur diversity is lower than the PN de Baie de Baly.

Table 2: Comparison of lemur species richness around the dry deciduous forests from the central western part of Madagascar (1: presence; 0: absence).

| Species | A1 | A2 | A3 | A4 | A5 | A6 | A7 |
|---|---|---|---|---|---|---|---|
| *Propithecus deckenii* | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| *Propithecus coronatus* | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| *Eulemur rufus* | 1 | 1 | 1 | 1 | 1 | 0 | 1 |
| *Hapalemur occidentalis* | 1 | 1 | 1 | 1 | 1 | 0 | 1 |
| *Lepilemur edwardsi* | 0 | 1 | 1 | 1 | 1 | 0 | 0 |
| *Lepilemur ruficaudatus* | 1 | 0 | 0 | 0 | 0 | 0 | 1 |
| *Phaner pallescens* | 0 | 1 | 1 | 0 | 0 | 0 | 1 |
| *Cheirogaleus medius* | 1 | 1 | 1 | 1 | 1 | 0 | 1 |
| *Microcebus murinus* | 1 | 1 | 1 | 1 | 1 | 0 | 1 |
| *M.* cf. *myoxinus* | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| *Daubentonia madagascariensis* | 0 | 1 | 0 | 0 | 0 | 0 | 1 |
| Total no. of species | 7 | 8 | 8 | 6 | 6 | 1 | 8 |
| Reference source |  | a | b | c | d | e | f |

A1: Study site; A2: PN de Namoroka; A3: RS de Kasijy;
A4: RS de Bemarivo; A5: RS de Maningoza;
A6: RS d'Ambohijanahary; A7: PN de Baie de Baly.
a: Thalmann *et al*., 1999; b: Randrianarisoa *et al*., 2001b;
c: Randrianarisoa *et al*., 2000; d: Rasamison *et al*., 2005;
e: Randrianarisoa *et al*., 2001a; f: Hawkins *et al*., 1998.

Although *Propithecus deckenii* and *P. coronatus* live in sympatry at several localities between retreats-dispersion watersheds of the Betsiboka and Tsiribihina (Wilmé and Callmander, 2006), only individuals with the pelage coloration of *P. deckenii* were found in the Andranomanitsy Forest.

*Hapalemur occidentalis* was not encountered during the inventory. Interviews with local assistants revealed, however, its existence in the Andranomanitsy Forest. This species occurs also in numerous localities in western part of Madagascar (e.g., Hawkins *et al.*, 1998; Thalmann *et al.*, 1999; Randrianarisoa *et al.*, 2000, 2001b; Rasamison *et al.*, 2005). The proposed factors making this species locally rare maybe associated with the absence of forest bamboo and, possibly, the hunting pressure noted by local interviewees.

*Lepilemur ruficaudatus* was encountered during the survey. No sighting of *L. edwardsi* was made. Cytogenetic studies of *Lepilemur* for some localities in the middle west of Madagascar (Zaramody *et al.*, 2005) confirmed the role of Betsiboka River as a barrier for these two forms. Reported sightings of *L. edwardsi* made by several researchers (Thalmann *et al.*, 1999; Randrianarisoa *et al.*, 2000; 2001b; Rasamison *et al.*, 2005) to the south of Betsiboka River maybe in error.

*Cheirogaleus medius* is found in the western dry forests (Groves, 2000). This species occurs in relatively undisturbed and secondary forest habitats. The scarcity of sightings of *C. medius* in the Andranomanitsy Forest is best explained by the fact that this inventory was conducted during the period these animals were just coming out of their seasonal torpor.

Numerous individuals of *Microcebus* spp. were found feeding on insects in palm trees in the savanna. Their abundance on the savanna could result their preference to open area.

The presence of aye-aye (*Daubentonia madagascariensis*) was mentioned by several researchers in the western portions of Madagascar (Hawkins *et al*., 1998; Thalmann *et al*., 1999; Simons and Meyers, 2001; Rahajanirina and Dollar, 2004). This nocturnal species was not recorded in the Andranomanitsy Forest, nor were typical signs of this species, gnawed holes in the dead trees or nests, were found during the survey.

*Recommendations for the future lemur conservation*

The Andranomanitsy Forest contains seven lemur species. Even though levels of habitat perturbation is less alarming and uncontrolled fires are less frequent in the Andranomanitsy Forest as compared to the RS de Bemarivo, three recommendations can be advanced for future conservation steps in this forest block: (1) to provide information to local people about the negative effects of fire in forest habitat; (2) to inform people on the importance of the forest; (3) to undertake further surveys in surrounding fragments in order to increase available information on locally occurring lemurs. Fortunately, the presence of AQUALMA-UNIMA working on shrimp production in the immediate vicinity of this forest block provides local villagers with employment and a market to sell various agricultural products. This has an important positive bearing on the economic situation in the region.

## Conclusion

The Andranomanitsy Forest has notably high lemur diversity for a dry deciduous forest habitat. Currently, its conservation status is not defined. Given the local situation and the keen interest of AQUALMA-UNIMA in the future of this forest, a variety of positive actions can be taken for its conservation. Locally people must be very scrupulous of natural forest change in order to keep regional biodiversity, especially remnant living lemurs. For the Malagasy government, it is deemed necessary to include Andranomanitsy Forest within the countries protected areas network in order to increase the long-term viability of lemur species.

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# Non-maternal infant care in wild Silky Sifakas (*Propithecus candidus*)

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## Introduction

Four decades ago, Jolly (1966) in her classic field study, described "multiple parenting" or the extensive care of infants by non-mothers within Verreaux's sifaka groups. These observations represented the first evidence in prosimians of allocare, which among mammals is known to be most prevalent in canids (Moehlman and Hofer, 1997) and primates (Hrdy, 1970). Amongst primates, most reviews have focused on anthropoids, although there is increasing recognition that allocare is extensively practiced by prosimians (MacKinnon, 2007). The aims of this brief report are to review allocare in prosimians and provide new information on extensive non-maternal infant care in wild silky sifakas (*Propithecus candidus*). This report presents the first published description and photos of allocare in rainforest sifakas, although it is known to occur in these highly social, diurnal indriids (Wright, pers. comm.).

A current literature search revealed that non-maternal infant care occurs within all three prosimian Infraorders, and all prosimian families except the monotypic Daubentonidae and Megaladapidae (see Table 1). Prosimians within all major social systems and activity patterns (nocturnal, diurnal, and cathemeral) engage in allocare. Although grooming and play are the most common behaviors, extreme allocare, such as nursing and carrying, does occur in a wide variety of monotocous (single offspring) and polytocous (multiple offspring) or 'litter' producing prosimians. Allo-nursing has been observed in four diverse lemur species (*Lemur catta*, *Microcebus murinus*, *Propithecus candidus*, *Varecia variegata*), but not in any Asian or African prosimians. A detailed three year *Microcebus murinus* study found that kin-selection was the most well supported functional explanation for allo-nursing (Eberle and Kappeler, 2006). Infant carrying by non-mothers has been documented in *Tarsius spectrum* as well as four diverse lemur species (*Eulemur mongoz*, *Hapalemur griseus*, *Propithecus candidus*, *Propithecus diadema*). Extreme allocare has not been observed in any African prosimians.

Although infant carrying by prosimian allo-caregivers is less extensive than in callitrichids, adult male red-bellied lemurs (*Eulemur rubriventer*) have been observed to carry infants for up to 100 days (Mittermeier *et al*., 2006). Similarly, adult male lesser bamboo lemurs (*Hapalemur griseus*) carry infants for 20 % of the day from 3 weeks of age (Wright, 1990). Amongst anthropoids, female allocare is most often performed by nulliparous subadult and juvenile females (MacKinnon, 2007). Although this is also true of tarsiers (Gursky, 2000), a more varied pattern is apparent in prosimians (Table 1).

Previously, Patel *et al*. (2003) reported 230 occurrences of allocare with 2 infants during the first 6 months of life within a multi-male group of 8 wild silky sifakas. Nonmaternal infant care was performed by all age-sex classes on all infants from the first few weeks of life until 24 weeks of age. Grooming was by far the most frequent allocare behavior followed by playing, carrying, and nursing respectively. With increasing infant age, grooming declined while play increased. Allonursing was observed on two occasions during the fourth and fifth months when a multiparous adult female allowed the offspring of a primiparous young mother to nurse simultaneously alongside her own infant (on the other nipple). Allonursing has only been found in 17 of over 620 total primate taxa (Packer *et al*. 1992).

## Methods and Results

On September 26 2006, during my annual visit to this same group of sifakas at Camp 2 of Marojejy National Park, I observed substantial allocare of a very young infant. This single 158 min. episode began as the 6 week old (Wul Frank, ANGAP Chef Secteur) infant of a young multiparous mother (BP) completed a nursing bout, left her mother, and approached the oldest adult male in the group (PF). At 07:15 AM the infant began interacting with PF, and I began continuous focal animal sampling of this infant using an established silky sifaka ethogram (see Patel, 2005; Patel *et al*., 2003). For 108 continuous minutes, this old adult male engaged in much mutual playing, grooming, and resting with the infant. During almost half of this male allocare, the infant fell asleep in the lap of the male. Towards the end of their association, as the group began to move from this feeding site, the male actually carried the infant awkwardly on his ventrum for 4 min. as he traveled a short distance (Fig. 1, Fig. 3).

Table 1: Review of non-maternal infant care in prosimians.

| **Prosimian Taxon** | **Allocare Behavior** | **Non-Mother Age/Sex Class** | **Setting** | **Reference** |
|---|---|---|---|---|
| *Cheirogaleus medius* | Play, Sleep, 'Baby Sit' | Adult: M | *In-situ* | Fietz and Dausmann (2003) |
| *Eulemur mongoz* | Carry | Adult: M | *Ex-situ* | Wright (1990) |
| *Hapalemur griseus* | Carry | Adult: M<br>Older Sibling | *In-Situ* | Wright (1990) |
| *Lemur catta* | Groom, Nurse | Adult: F,M<br>Subadult: F,M<br>Juvenile: F,M | *In-situ* | Gould (1992) |
| *Lemur catta* | Groom, Nurse | Adult: F<br>Juvenile: F | *Ex-situ* | Pereira and Izard (1989) |
| *Lemur catta* | Contact, Groom | Adult: F<br>Juvenile: F | *In-situ* | Jolly (1966) |
| *Loris l. lydekkerianus* | Groom, Play | Adult: M | *In-situ* | Nekaris (2003) |
| *Loris l. lydekkerianus* | Groom, Play | Adult: M | *Ex-situ* | Rasmussen (1986) |
| *Loris l. nordicus* | Groom, Play | Adult: M | *In-situ* | Nekaris (2003) |
| *Microcebus murinus* | Groom, Nurse | Adult: F | *In-situ* | Eberle and Kappeler (2006) |
| *Perodicticus potto* | Groom, Play | Adult: M | *Ex-situ* | Frederick (1998) |
| *Propithecus candidus* | Groom, Play, Nurse, Carry | Adult: F,M<br>Juvenile: M | *In-situ* | This Manuscript; Patel *et al.* (2003) |
| *Propithecus verreauxi* | Contact, Groom | Adult: F,M<br>Juvenile: F,M | *In-situ* | Jolly (1966) |
| *Tarsius spectrum* | Carry, Food Share, Play, 'Baby Sit | Adult: F,M<br>Subadult: F,M | *In-situ* | Gursky (2000) |
| *Varecia variegata* | Contact, Groom, Play | Adult: F,M | *In-situ* | Morland (1990) |
| *Varecia variegata* | Nurse | Adult: F | *Ex-situ* | Pereira et al. (1987) |

Almost immediately once the male had stopped traveling, the infant scampered off the male and approached the oldest adult female in group (AF). The infant climbed on to this multiparous female who was already carrying her own infant on her ventrum (Fig. 2). For the next 50 minutes, this female engaged in continuous allocare of the other mother's infant while simultaneously caring for her own infant. Her allocare included all types demonstrated by the adult male, although she engaged in more carrying, but less play and grooming than the male. At 09:53 AM, the young mother of the allocare-receiving infant (BP), approached the older mother who was now carrying both infants. Just a few moments after the young mother was side-by-side in contact with the older mother, her infant jumped off the older allomother and directly on her own mother's ventrum. The infant began nursing immediately upon return to her mother.

Fig. 1: Adult male Silky Sifaka, PF, during 108 minutes of continuous allocare with a 6 week old infant. Photo Credit = Jeff Gibbs and Erik Patel

## Discussion

These results are similar to Jolly's (1966) observations of allocare in *P. verreauxi*. However, Jolly (1966) observed infants as young as 2 weeks of age in contact with other group members. Thus far, non-maternal infant care in silky sifakas has not been observed before 3 weeks of age (Patel *et al.*, 2003). Amongst the nine species of *Propithecus*, only *P. candidus* and *P. edwardsi* (Wright, pers. comm.) have been reported to engage in allonursing. Allo-carrying has been documented in *P. candidus* as well as *P. diadema*, where a sub-adult male carried and traveled with a 1 month old infant for 70 minutes (Irwin, pers. comm.).

The widespread occurrence of allocare across diverse prosimian taxa provides an excellent opportunity for future studies to test hypotheses regarding the evolution of allocare. The extent of allocare exhibited by a species may depend on patterns of post-natal growth, life history, or social factors. Rainforest sifakas, like *Propithecus candidus*, exhibit rapid infant growth rates exceeding that of dry forest sifakas (Ravosa *et al.*, 1993). Wright (1990) compared infant growth and paternal care in several prosimian and New World monkeys, and found that species exhibiting rapid post-natal growth and high infant/maternal weight ratios tended to show the most paternal care. At that time, tarsiers appeared to be an outlier since they possess huge infant/maternal weight ratios but little paternal care had been known to occur. This paradox has been somewhat resolved since it is now known that tarsiers do exhibit some allocare, although most allocare is performed by subadult females. Recently, Ross and MacLarnon (2000) conducted a large regression analysis across 49 anthropoids and similarly found that high allocare species wean infants at a younger age and grow more rapidly post-natally than lower allocare species of the same body size. Early allocare is most prevalent amongst cercopithecines with relaxed dominance hierarchies among females and seasonal breeding, e.g. *Cercopithecus* and *Erythrocebus* (Chism, 2000). Sifakas are not known to possess strict dominance hierarchies among females (Richard, 2003), although seasonal hierarchies do occur (Wright, 1999). *Propithecus* exhibits strict reproductive seasonality as

Fig. 2: Adult female Silky Sifaka, AF, carrying both her own and another mother's young infant during 50 min. of continuous allocare. Both infants are approximately 6 weeks of age. Photo J. Gibbs and E. Patel

in all Malagasy strepsirrhines. Asian and African prosimians do exhibit some reproductive seasonality but far less strict than amongst Malagasy prosimians (Sussman, 2000). Since these social and life history characteristics associated with anthropoid allocare are generally found in prosimians (Wright, 1999; Sussman, 2000), they may also help explain the widespread occurrence of prosimian allocare.

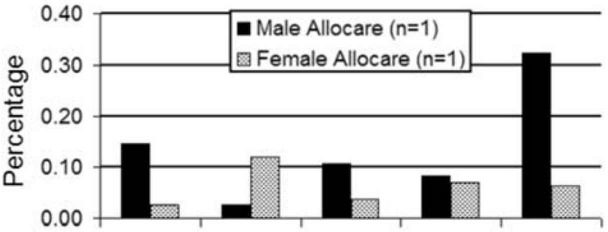

Fig. 3: Percentage of time across 5 types of allocare during 158 continuous minutes.

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## Research experience in Vohibasia Forest, southwestern Madagascar

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Vohibasia Forest is the northern parcel of Parc Nationale Zombitse-Vohibasia. The protected area of the Zombitse parcel consists of 17,240 hectares of dry deciduous forest, while the Vohibasia parcel is comprised of 19,612 ha (ANGAP 2003). Gazetted as classified forest in 1962, Zombitse-Vohibasia gained park status in 2001 under the management of the World Wildlife Fund (WWF). Management of the park has since been handed over to ANGAP.

During the month of June 2005, our team attempted to collect hair samples for analysis of genetic distances between sympatric sub-populations of red-fronted brown lemurs (*Eulemur fulvus rufus*) and ring-tailed lemurs (*Lemur catta*) in the Vohibasia Forest and surrounding forest fragments (Betsako, Berenty-Ankazoabo, Analavelona). Samples were to be collected via an experimental non-capture hair trapping method devised for this study. Hair traps consisted of a scent- or food-baited plastic cone with a spring mechanism for trapping hairs. While the hair traps were effective on captive lemurs and urban wildlife in St. Louis, Missouri, the method proved completely unsuccessful in the field. After placing 87 traps along ten-plus kilometers of trap-line, and nearly 20,000 trap hours, we were unable to obtain a single lemur hair sample. While there may certainly be a number of problems with this unproven method (foreign shape, color, and smell of traps, etc.), we believe that the exploited nature of the forest played some role in our inability to collect samples.

During three weeks at our initial field site, and while traversing nearly 150 kilometers, there was only one sighting of *Lemur catta* and no sightings of *Eulemur fulvus rufus*. Vocalizations of *Lemur catta* were heard on four occasions, and lemur tracks were seen on roads. The only other lemur signs were two sightings of Verreauxi's sifaka (*Propithecus v. verreauxi*) from distances of 300+ meters, one sighting of fork-marked lemur (*Phaner furcifer*), and regular nocturnal vocalizations of sportive lemur (*Lepilemur* sp.). While sightings of lemur are known to be less frequent during the dry season, we felt confident that human activities played some role in reduced lemur densities and/or increased vigilance and avoidance of all humans and human activities.

It was well-agreed upon between my guides that local human populations regularly hunt the lemurs for food. Hunting parties equipped with a shotgun, spears and hatchets were occasionally encountered within the region. In one village, the mandible of a lemur was observed in the sand of the courtyard. Throughout our field work in the northern Vohibasia Forest (and preliminary visits to two other sites in middle and northern Vohibasia Forest) regular signs of other types of forest exploitation were also apparent, including small-scale logging and gem mining. Several guides, local citizens, and the regional development officer attested to the fact that the situation could be expected to be similar in all of the outlying forest fragments as well.

While these activities are not permitted within the park and surrounding buffer zone, the director of the local ANGAP office stated that an agent had not visited that part of the forest in four years.

One cannot experience first-hand the poverty in Madagascar and begrudge the Malagasy for exploiting any available source of nutrition or income. Our experience in the Vohibasia Forest bolsters arguments that viable conservation programs must address the culture, education, and economic needs of local human populations while providing effective protection and management of classified areas.

The dry deciduous forests within and around Zombitse-Vohibasia present a very interesting opportunity for the study of forest conversion and fragmentation, with an archipelago of habitat fragments of various sizes and degrees of isolation, comprising only 2.5 % of what is thought to have been one large contiguous forest prior to the arrival of man (Smith, 1997). Likewise, this region may be of extreme interest to those studying the effects of human use on animal populations in modified and exploited landscapes. However, for the researcher of primate behavior and natural history (who may require frequent, prolonged, and/or close-range observations) or of primate population genetics (or other disciplines which may require significant samples of biological material), Zombitse-Vohibasia seems to have suffered significant loss of research potential.

The local ANGAP personnel regard Zombitse-Vohibasia as most remarkable for its avian fauna. While sightings of distinctive species were fairly common, the avifauna also seemed to be extremely wary of human presence and was much more often heard than seen. Not being an ornithologist, I am hesitant to pass judgment on whether or not the region may be suitable for ornithological inquiry; methods not requiring human proximity may prove productive.

The herpetologist, entomologist, botanist, or other scientist studying species not of consumption or exploitation interest may find Zombitse-Vohibasia to be an ideal site, as may anthropologists and researchers from other non-biological disciplines. Logistically, access was relatively easy (during the dry season), the mayors of local villages were receptive and cooperative, and the ANGAP personnel are to be commended for their dedication to facilitating our research.

While this missive may seem to be warning researchers against working in this area, those with questions which may be answered in the presence of human extractive activity (or may pertain to such activity) should be encouraged to work in this under-studied region; our permit fees, park entrance fees, guide fees, and contributions to the local economy may be key to cultivating a status of importance for these forests and the species therein.

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## A brief lemur survey of the Ranomafana Andringitra corridor region in Tolongoina, southeast Madagascar

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**Key words:** Primates, mammals, rain forest, transects, live trapping

### Introduction

Madagascar is one of the highest priorities for primate conservation due to a massive loss and increasing fragmentation of habitat, which directly affects biological diversity (Mittermeier *et al*., 2006). Landscape corridors between patches have been shown to reduce the negative effects of habitat fragmentation by allowing movement of organisms and facilitating gene flow (Damschen *et al*., 2006). Corridors can thus prevent local extinctions and increase diversity (Wilson and Willis, 1975). In particular, we were interested to investigate whether old coffee plantations which are being restored to provide cash crop for the local farmers might provide suitable habitat for animals and thus might serve as buffer zones or corridors between natural forest fragments. For this we conducted a brief assessment of the lemur diversity in the currently unprotected forest corridor that connects the Park National d'Andrigitra (AR) and the Parc National de Ranomafana (RNP) in southeastern Madagascar (Sterling and Ramaroson, 1996; Goodman *et al*., 2001; Wright and Andriamihaja, 2002; Rakotondravony and Razafindramahatra, 2004) (Fig. 1).

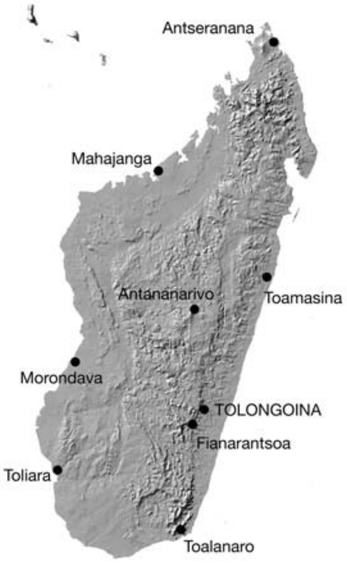

Fig. 1: Map of Madagascar showing the survey site of Tolongoina in the southeast.

### Study site

The study took place near the village of Mandriandy, ca. 3 km outside the town of Tolongoina in the province of Fianarantsoa. The village is very small and the area is dominated by farms consisting of one or two small houses surrounded by fields. The region is highly degraded and the only continuous forest that remains is the corridor at elevations between 800-1100 m (Fig. 2). The mountain rain forest is largely primary and characterized by mature trees with a canopy height of 20-25 meters. The lower elevations at 400-800 meters are characterized by deforested grass-covered slopes with the heliophilic traveler's palm, *Ravenala madagascariensis*, subsistence agriculture and cash crop such as bananas, lychees, and coffee. In addition to surveying the forest corridor, we were invited to survey private land that consisted of subsistence crop, a neglected coffee plantation, a patch of about 15 mature endemic trees and patches of shrub and trees consisting of both endemic and exotic plants, such as lychee and citrus.

### Methods

#### *Censusing*

In the primary forest, nocturnal and diurnal mammal surveys took place for four days and nights in December 2005 at elevations between 1000-1100 m. A 1-km line transect (NW 320° start: S21°34'59.9" E 047°29'34.3", altitude: 1005 m) was walked by two people twice each day, once between 08:00-11:00 hrs and once between 19:00-22:00 hrs (Irwin *et al*., 2005; Johnsson and Overdorff, 1999; Whitesides *et al*., 1988). In addition, 1-hour walks were conducted along existing trails each evening at 20:00 hrs. In the plantation, diurnal and nocturnal non-random censuses were conducted in December 2005 for one day/night and for four days/nights in early November 2006 at an elevation of 508 meters (S21°35'03.0", E047°30'41.5"). Due to the highly fragmented nature of the area, census walks took place along trails and in areas where lemurs would most likely occur (dense shrubs and tress). Animals were detected by sight, sound or movement.

Fig. 2: The corridor in the survey area by the village of Mandriandy/Tolongoina. Note that only the top of the mountain corridor is covered with forest.

*Nocturnal micro-mammal trapping*

To survey small nocturnal lemurs and other mammals in the primary forest, 60 Sherman live traps (30 x 8 x 10 cm) were placed in pairs along trails approximately 25 m apart, 1-2 m above ground for four nights in 2005 at elevations between 1000-1100 m. In the plantation, up to 50 traps were placed in vegetation fragments, and amongst coffee and lychee trees. Trapping took place for one night in December 2005 and for six nights in early November 2006. Traps were baited with banana at 16:00 hrs and checked each morning at 06:00 hrs. All captured mammals were identified as accurately as possible and released. All nocturnal lemurs were weighed, marked, and measured (Atsalis *et al*., 1996) and tissue, hair and fecal samples were collected for analyses.

*Interviews*

To determine past and present lemur diversity, interviews were conducted with three local villagers that had been living in the area for a minimum of 30 years and ranged in age from 35 to 70 years.

## Results

*Primary Forest (Corridor)*

Four species of lemur, *Propithecus edwardsi*, *Eulemur fulvus rufus*, *Eulemur rubriventer* and *Varecia v. variegata*, and one species of mongoose (*Galidia elegans*) were encountered during the day (Table 1). No animals were seen or heard during nocturnal census walks, but we saw a deserted tenrec burrow with a remnant trap which was used by locals to capture tenrecs for food. Three species of endemic rodent, but no invasive rodents, were captured in the Sherman traps. No lemurs were trapped.

Table 1: Mammal species observed, captured or reported in the primary forest of the corridor (F) and in the low elevation plantation (P). "Sightings" refers to the number of times a species was observed on different occasions and "individuals" refers to the number of individuals observed at each sighting.

| **Species** | **Location** | **# of sightings** | **# of individuals** | **Height (m)** |
|---|---|---|---|---|
| *Varecia v. variegata* | F | 5 | 1-2 | 0-25 |
| *Propithecus edwardsi* | F | 2 | 2 | 15-20 |
| *Eulemur fulvus rufus* | F | 1 | 2 | 20 |
| *Eulemur rubriventer* | F | 1 | 2 | 15 |
| *Avahi* sp. | F | | | |
| *Microcebus* sp. | P | 5 | 1 | 1 |
| *Galidia elegans* | F | 1 | 1 | 0 |
| *Eliurus webbi* | F | 3 | 2 | 1 |
| *Eliurus tanala* | F | 4 | 1-2 | 1 |
| *Eliurus* sp. | F | 3 | 1-2 | 1 |
| *Echinops telfairi* | P | 2 | 1 | 0 |
| *Rattus rattus* | P | 6 | 1-3 | 1 |

*Plantation*

No mammals were seen during the day, but at night, two lesser hedgehog tenrecs, possibly *Echinops telfairi* were observed in the grass near coffee trees (Table 1). Nocturnal surveys during consecutive five nights resulted in a single sighting of a mouse lemur in a fragment consisting of trees and shrubs. Live trapping in both years resulted in invasive rats, and in 2006, five mouse lemurs (*Microcebus* sp.), two females and three males, were captured. Mouse lemurs were captured in small forest fragments consisting of endemic and exotic trees but not in areas without endemic trees, such as the coffee plantation. The mouse lemurs were of the *rufus* type with reddish fur, orange-colored forehead and a dark stripe down the back (Fig. 3). At an average weight of 75 g, individuals were nearly 50 % heavier than brown mouse lemurs (*M. rufus*) captured during the same time period in RNP and at an average weight of 94.5 g, females were more than twice as heavy as *M. rufus* females (unpublished data). Although the mouse lemurs were similar in appearance to *M. rufus*, their

Fig. 3: A mouse lemur female captured in the low elevation plantation outside the corridor near Tolongoina. Left a facial and ventral view and right the dorsal view. Note the large size (90 g) of this pregnant female and the rufus coloration of the forehead. The ears were relatively small and the dorsal stripe not pronounced.

large size suggests the possibility that these mouse lemurs are of a as yet unknown species (genetic analysis is pending). This survey suggests that mouse lemurs occur at low densities in this highly degraded area and are dependent on the presence of endemic trees but utilize exotic trees such as citrus, lychee and possibly coffee.

*Interviews*

Independent interviews with local villagers confirmed the presence of the four species of diurnal lemur we observed but no presence of other species. None of the villagers reported to have ever seen a nocturnal lemur in the primary forest, but all confirmed the presence of mouse lemurs in the lychee and coffee trees. Villagers further reported that hunting of diurnal lemurs takes place, although it has become rare because the lemurs are "difficult to kill". Mouse lemurs are regarded by many as a crop pest, and are as a consequence occasionally killed and even eaten.

In 2005 the team of the "Corridor Coffee Project" had reported a sighting of *Avahi* sp. in the natural forest (Chris Dunston, pers. comm. to J. Ganzhorn).

## Discussion

This brief survey shows that the corridor provides habitat for at least four species of diurnal lemur and several species of endemic rodent and may thus be very important with respect to gene flow between populations of RNP and AR and species conservation. Findings further show that the nocturnal mouse lemurs can exist in highly degraded, agricultural environments, even though densities may be low. However, the lack of endemic rodents and other lemur species in the low elevation suggests that most endemic mammals do not cope well with highly altered habitats. This may be due to the competition with invasive rats, the lack of food or habitat.

Presently, the primary forest corridor appears relatively intact and only a few narrow trails are used by locals to access the forest. According to our interviews, the forest edge has remained stable for the past decade due to self-regulatory measures supervised by the local community-based management authority (Communauté de Base: COBA). However, we found that large trees had been removed in the 11-months that lay between our visits, suggesting that the need for fire wood and building materials is putting pressure on the forest. We also encountered an abandoned shelter by the river near our camp that may have been used by hunters or crayfish collectors and a tenrec trap, indicating that locals remove animals from the forest. Hunting for lemurs still takes place but has supposedly become rare. On the up-side, Zebus are rare in the area and we never encountered or saw any traces of them in the forest.

Lemur encounters in the forest were rare, and the unhabituated animals moved out of sight very quickly. This also made density estimates difficult (see also Sterling and Ramaroson, 1995). *Propithecus edwardsi* were encountered twice, but we assume it was the same group of two individuals. This conforms with the minimum group size for this species observed in RNP. We were unable to determine the sex but this couple was probably not reproducing, since no infants or sub-adults were observed. *Varecia v. variegata* was encountered on several occasions usually high up in the canopy but on one sighting two individuals were observed on the ground. We never encountered more than two individuals at any encounter but a concert of vocalizations could be heard repeatedly each day and night, suggesting that there are numerous individuals and possibly several groups. The presence of *Varecia* is very positive because this genus is very sensitive to forest disturbance and prefers high canopy trees generally only found in primary forest (Balko and Underwood, 1995; White *et al*., 1995). Surprising was the low abundance of nocturnal lemurs in the forest, a finding that was supported by the interviews, especially since we found mouse lemurs outside of the forest.

The mouse lemurs showed great adaptability because they seem to be able to utilize exotic shrubs and trees, including lychee and citrus. Although some tiny forest patches were scattered throughout the area, they were completely disconnected, providing no suitable habitat for larger lemurs.

This brief survey was sufficient to determine approximate lemur species richness but the study was too short to determine abundance and densities. All lemur species detected are also found in RNP and AR, supporting the notion that the corridor is important in enabling gene flow and possibly animal movement between these protected areas. In the Tolongoina, the corridor is not more than a narrow strip of forest and increasing pressure by humans is making its long-term survival unlikely if the forest remains unprotected. Standing on the slopes of the corridor all one can see is endless kilometers of clear-cut land. Villagers stated that only 30 years ago, all one could see was forest.

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## Cytogenetics and taxonomy of the genus *Hapalemur*

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The gentle lemurs (genus *Hapalemur*) traditionally comprised three species, *Hapalemur aureus*, *H. griseus* and *H. simus* (IUCN, 1990). Cytogenetic and molecular data clearly confirmed the specific status of *H. aureus* and *H. simus*. But the taxonomic status of the different forms of *H. griseus* remains controversial.

Cytogenetic studies distinguished different karyotypes suggesting the classification of *H. griseus* into five subspecies: *H. g. griseus, H. g. meridionalis*, *H. g. occidentalis*, *H. g.* ssp1 *and H. g.* ssp2, *H. g.* ssp1 being characterized by a chromosomal polymorphism (2N= 54, 55, 56) (Rumpler *et al*., 2002). On the basis of previous field studies and data in the literature, the distribution of these subspecies appeared not only incomplete but questionable as no cytogenetic information was available from all regions of their supposed ranges (Fig. 1). Molecular data (sequences of a 357 bp fragment of the cytochrome b gene and a 438 bp fragment of the 12S ribosomal DNA sequence) provided evidence for specific rank for *H. meridionalis*, but also showed that *H. g.* ssp1 from the area of Ranomafana clustered either with *H. g. griseus* or with *H. meridionalis*, suggesting the existence of an ancestral polymorphism or an exchange of mitochondrial DNA (Fausser *et al*., 2002). In the latest classification reported by Mittermeier *et al*. (2006) *H. simus* was restored to its own genus as *Prolemur simus* and the genus *Hapalemur* contains five species: *H. alaotrensis*, *H. aureus*, *H. griseus*, *H. meridionalis and H. occidentalis.*

Here we present the results of our cytogenetic analyses of additional samples from formerly unsampled regions within the range of *Hapalemur* in the eastern and western forests of Madagascar, and propose two new subspecies.

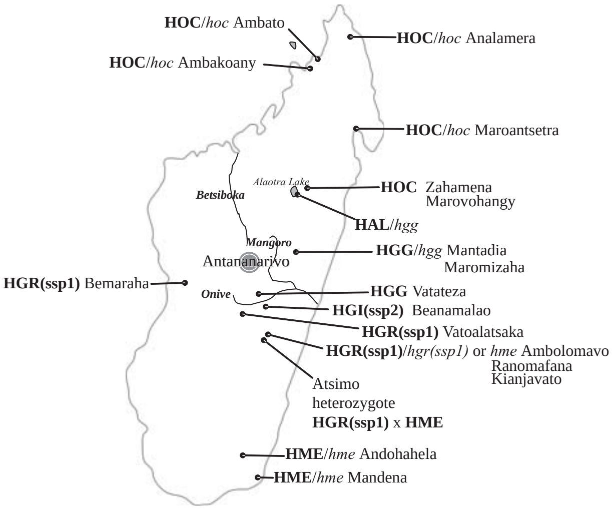

Fig. 1: Assumed distribution areas of the species and the subspecies of *Hapalemur* and sites of capture of the animals studied. Capital letters = karyotype; Tiny and italic letters = assignment to taxa according to molecular biology; HGG = *H. g. griseus,* HGI (ssp2) = *H. g. gilberti*, HGR (ssp1) = *H. g. ranomafanensis,* HME = *H. meridionalis*, HOC = *H. occidentalis,* HAL = *H. alaotrensis*.

**Materials and methods**

During surveys conducted between 2001 and 2006, samples of 13 individuals were obtained. Animals were captured using a blowpipe projector with an injection of 2mg/kg of ketamine solution (Ketalar® Parke-Davis). Small skin biopsies were taken under general anesthesia immediately after capture, and morphometric data were taken. The animals were released at the place of capture. Sampling sites and the number of animals sampled are indicated in Table 1 and Figure 1. Three additional samples of *H. alaotrensis* hosted in the Parc Zoologique of Mulhouse were also used to confirm the cytogenetic data established in earlier studies (Rumpler and Dutrillaux, 1985). Cytogenetic analyses were performed on fibroblast cultures, and RHG and CBG banding techniques (ISCN, 1978) were applied on the chromosomes.

Table 1: Species with site of capture, number of animals studied (n), umber of animal karyotyped (nk), diploid number of chromosomes (2N), and cytogenetic data. HOC = *H. occidentalis,* HAL=*H. alaotrensis*, HGG=*H. g. griseus,* HGR (ssp1)=*H. g. ranomafanensis,* HGI (ssp2) =*H. g. gilberti*, HME = *H. meridionalis*. New animals for which data are presented here are marked with *.

| | n | nk | 2N | meta-centric | acroc-entric |
|---|---|---|---|---|---|
| *Hapalemur occidentalis* | | | 58 | 6 | 52 |
| Ambakoany | 1 | 1 | | | |
| Ambato | 2 | 2 | | | |
| Analamera | 4 | 2 | | | |
| Maroantsetra | 1 | 1 | | | |
| Zahamena | 2* | 1 | | | |
| Marovoahangy | 1* | 1 | | | |
| *H. alaotrensis* | 3 | 3 | 54 | 10 | 44 |
| *H. griseus griseus* | | | 54 | 10 | 44 |
| Maromizaha | 3 | 3 | 54 | 10 | 44 |
| Andasibe | 3 | 3 | 54 | 10 | 44 |
| Vatateza | 1* | 1 | - | - | - |
| Mantadia | 1* | 1 | 54 | 10 | 44 |
| *H. g. ranomafanensis* (ssp1) | | | | | |
| Ambolomavo | 2 | 1 | 56 | 8 | 48 |
| Ranomafana | 12 | 12 | 54 | 10 | 44 |
| | | | 55 | 9 | 46 |
| | | | 56 | 8 | 48 |
| Ambongo | 3 | 3 | 54 | 10 | 44 |
| | | | 55 | 9 | 46 |
| | | | 56 | 8 | 48 |
| Vatoalatsaka | 2* | 1 | | | |
| Bemaraha | 1* | 1 | 56 | 8 | 48 |
| *H. g. gilberti* (ssp2) | | | | | |
| Tsimbazaza Park | 1 | 1 | 52 | 12 | 10 |
| Beanamalao | 2* | 1 | 52 | 12 | 10 |
| *H. meridionalis* | | | | | |
| Andohahela | 3 | 1 | 54 | 10 | 44 |
| Mandena | 3 | 1 | 54 | 10 | 44 |
| *H. meridionalis* x *H. g.* ssp1 | | | | | |
| Atsimo | 1* | 1 | 54 | 10 | 44 |

**Results**

The cytogenetic data are reported in Table 1. The animals from Zahamena showed a chromosomal complement of 2N=58. This is identical to the situation described in *H. occidentalis* previously, comprising three pairs of submetacentric and 26 pairs of acrocentric chromosomes.

A chromosomal complement of 2N=56, identical to the karyotype 2N=56 of *H. g.* ssp1, was found in the animals from Bemaraha and Vatoalatsaka. It comprised four pairs of submetacentric and 24 pairs of acrocentric chromosomes.

A chromosomal complement of 2N=54, identical to that previously described in *H. g. griseus*, was found in the animals from Vatateza and Mantadia. It comprised five pairs of submetacentric and 24 pairs of acrocentric chromosomes.

The same karyotype was found in the three animals from the lake Alaotra without increase of heterochromatin, as earlier reported could be detected.

A chromosomal complement of 2N=52, identical to that of *H. g.* ssp2, was found in the animals from Beanamalao. It comprised six pairs of meta- and submetacentric and 22 pairs of acrocentric chromosomes.

A heterozygotic pattern of *H. meridionalis* and *H. g.* ssp1 (2N=54) was found in the animal caught in Atsimo. The chromosomal complement was 2N=54 and showed a heterozygotic chromosome pair number 6: one chromosome presented a large gain of heterochromatin as in *H. meridionalis*; the other one was shorter as in *H. g.* ssp1 (Fig. 2). Morphological data are reported in Table 2.

Fig. 2: Chromosome pair 6 of the heterozygote *Hapalemur* from Atsimo after RHG technique. HME left; HGR right; h indicates the important heterochromatic region characteristic of HME.

**Discussion**

*Cytogenetics and inferences on distribution*

As there are only few morphological differences between the subspecies of *H. griseus* the cytogenetic data are an important tool for determining the ranges of the different *Hapalemur* taxa. Our results suggest a distribution of *H. occidentalis* that is larger than previously assumed, with an extension as far as the reserve of Zahamena, east of Lake Alaotra. Similarly, the distribution area of *H. meridionalis* seems to extend northward to the region close to Atsimo, since a heterozygote between *H. meridionalis* and *H. g.* ssp1 has been found in this area. Conversely, the distribution area of *H. griseus* is more restricted than previously assumed, and the Onive River seems to constitute its southern limit. However, the most surprising result is the extension of the range of *H. g.* ssp1 to the western coast, at least as far as the forest of Bemaraha.

The distribution of *H. g.* ssp2 appears to be restricted to a small area between the Nosivolo and the Mangoro/ Onive Rivers.

*Taxonomic inferences*

Specific status of *H. meridionalis* is supported by both the cytogenetic and the molecular data (Fausser *et al*., 2002). Despite the small interspecific distances which separate *H. occidentalis* from the *H. griseus* subspecies (Fausser *et al*., 2002) the former has been considered as a distinct species (Mittermeier *et al*., 2006).

Neither cytogenetic nor molecular data differentiate *H. alaotrensis* from *H. g. griseus* (Fausser *et al*., 2002;

Table 2: Morphometric data of the *Hapalemur* sampled in the eastern and the western forests of Madagascar. HGG = *H. g. griseus*, HGR (ssp1) = *H. g. ranomafanensis*, HGI (ssp2) =*H. g. gilberti*, HME = *H. meridionalis*, HOC = *H. occidentalis*, HAL = *H. alaotrensis.*

| **Species/ Subspecies** | **sex** | **n** | **body mass (g)** | **ear length (cm)** | **tail length (cm)** | **total length (cm)** |
|---|---|---|---|---|---|---|
| HGG | F | 8 | 837.5±114.17 | 2.72±0.45 | 36.71±1.85 | 66.94±4.41 |
| | M | 8 | 846.25±130.27 | 2.63±0.58 | 37.71±2.35 | 67.69±3.41 |
| HGR (ssp1) | F | 8 | 846.25±149.25 | 2.63±0.38 | 37.71±1.19 | 67.69±1.97 |
| | M | 5 | 875±169.56 | 3.06±0.44 | 37.20±2.08 | 65±0.93 |
| HGI (ssp2) | M | 3 | 966.66±28.87 | 2.10±0.36 | 35.33±1.15 | 63±0 |
| HME | F | 6 | 870±140.43 | 3.23±0.15 | 36.37±2.53 | 66.78±3.43 |
| | M | 6 | 839.37±202.6 | 3.15±0.20 | 37.02±3.57 | 67.80±6.29 |
| HOC | F | 2 | 1187.5±335.87 | 2.65±0.14 | 36.75±1.76 | 66.50±1.41 |
| | M | 4 | 846.75±78.16 | 2.90±0.73 | 36.60±0.92 | 67.45±1.75 |
| HAL | F | 1 | 1550 | 2,8 | 38.0-41.0 | 77.0-81.0 |
| | M | 2 | 1350 | | | |

Pastorini *et al*., 2002) although the former is distinguished by its large size (Fig. 3).

*H. g. griseus*, *H. g.* ssp1 and *H. g.* ssp2 are characterized by their own karyotypes but with the available molecular data differentiating among them was not possible (Fausser *et al*., 2002). Thus we retain subspecies status for these three cytotypes, *H. g. griseus*, *H. g.* ssp1 and *H. g.* ssp2.

Despite the fact that there are no good type localities for any of the available names for varieties of *Hapalemur* (I. Tattersall, pers. comm.) we retain the type locality of Mantadia for *H. g. griseus*, so that two other subspecies have to be named. Below we describe the gentle lemurs from the regions of Ranomafana and Beanamalao, respectively, as two new subspecies of *H. griseus*.

Fig. 3: *Hapalemur alaotrensis* hosted in the zoo of Mulhouse. Photo P. Moisson

Fig. 4: *Hapalemur griseus ranomafanensis* from the Reserve of Ranomafana. Photo Ph. Barazer

Fig. 5: *Hapalemur griseus gilberti*. Photo B. Meier & Y. Rumpler

## Description of subspecies

*H. g. ranomafanensis*

**Type locality.** Reserve of Ranomafana (approx. 21°20'-21°21' S, 47°47'E).

**Holotype.** Tissues and DNA from 12 specimens stored at the University Louis Pasteur Strasbourg, France.

**Description.** The upper parts are grey to olive grey while the face and underparts are lighter. The fur around the eyes is a paler grey. The ears are small and rounded. The dorsum sometimes appears browner, and the ventrum a paler grey. The tail is grey (Fig. 4). The mean weight is 846 g for the females and 875 g for males. Mean total length is 65-68 cm (Table 2; Fig. 4).

**Diagnosis**. Chromosome diploid numbers of *H. g. ranomafanensis are* 2N=54, 55, 56, and the karyotypes differ from the other *H. g. griseus* and the *H. meridionalis*.

**Distribution.** *H. g. ranomafanensis* is distributed in the area of Ranomafana, in the eastern forests, and occurs in the western forests from the reserve of Bemaraha probably as far as the Betsiboka River. It is known to the south of the Mangoro/Onive rivers in the forests of Ranomafana and Kianjavato.

**Etymology.** The name *ranomafanensis* reflects it's the species' localisation in the protected area of Ranomafana, where its karyotype was first established.

*Hapalemur griseus gilberti*

**Holotype.** DNA from three specimens stored at the University Louis Pasteur Strasbourg, France.

**Type locality.** Beanamalao (approx. 47°48'S, 19°50'E), Province Fianarantsoa, Madagascar.

**Description.** Dorsal fur is grey-brown, while the ventrum is grey in its anterior part and reddish in its posterior part. The face is characterized by a grey dark ring encircling the eyes, above it is grey. The tail is grey dark (Fig. 5). The mean weight is 967g for the males. The total length is about 63 cm for the males.

**Diagnosis.** *H. g. gilberti* is characterized by a diploid number 2N=52 and, its karyotype differs from all the other members of its genus by at least one chromosomal rearrangement (Rumpler *et al*., 2002).

**Etymology.** *H. g. gilberti* is named in honor of Gilbert Rakotoarisoa who morphologically differentiated the first specimen of this subspecies among the *H. griseus* of unknown origin living in the Tsimbazaza Park.

**Distribution.** *H. g. gilberti* is known in a small area in the forest of Beanamalao, between Onive and Nosivolo Rivers. Further field studies are required to determine the exact distribution range, and especially its limits with its two related subspecies, *H. g. ranomafanensis* and *H. g. griseus.*

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# Le bloc forestier de Makira charnière de Lémuriens

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**Mots clés**: Makira, bloc forestier, diversité spécifique de Lémuriens, répartition biogéographique, Nord Est Madagascar

Parmi les domaines forestiers existant à Madagascar, les forêts sur le plateau de Makira constituent l'un des plus grand bloc forestier continu sans fragmentation, ce bloc regroupe neuf forêts classées, dont la superficie totale est de 376 156 ha avec les celles des forêts domaniales (Wildlife Conservation Society, 2004). Avant les années 2000, les activités exploratoires de recherche biologique y étaient peu connues; concernant les études des Lémuriens, elles ont surtout commencé par Bayliss et Hayes (1999), puis par Meyers (2001) et ensuite par Raharivololona *et al*. (2003). Ainsi, pour apporter des données supplémentaires sur les lémuriens, nous avons effectué des inventaires sur cette région (Fig. 1).

## Méthodologie

Les forêts dans le bloc forestier de Makira présentent les critères de forêt dense humide sempervirente, où la température moyenne annuelle varie entre 24 et 28° C, avec une oscillation variant entre 10 et 35° C. La précipitation varie entre 2500 et 4500 mm/an. Ces caractéristiques catégorisent cette zone Nord – Est à la zone climatique chaude et humide à perhumide du domaine de l'est (Humbert et Cours Darne, 1965; Du Puy et Moat, 1996).

La ligne-inventaire a été utilisée pour le recensement des espèces de Lémuriens diurnes, cathémérales et nocturnes rencontrées le long d'un trajet de 2 km préalablement choisi. L'observateur se déplace a une vitesse de 1 km par heure et à chaque fois où il rencontre un groupe d'animal, il s'arrête et note: l'heure de rencontre, la position géographique de l'endroit, le nombre d'individus rencontrés, ainsi que leurs âges relatifs et sexes respectifs, la distance entre l'animal et l'observateur, perpendiculaire au trajet puis il reprend le déplacement à la même vitesse. Les observations pendant la nuit utilisent des lumières artificielles atténuées (lampe frontales), puisque les "tapetum lucidium" sur la rétine des animaux nocturnes reflètent ces lumières et facilitent ainsi leurs repérages, ensuite l'observateur utilise des lumières plus puissantes pendant quelques minutes pour déterminer l'espèce. Les heures d'observations s'effectuent entre 07h00 et 11h00, le matin, puis entre 13h00 et 17h00 l'après-midi et entre 18h00 et 22h00 la nuit. Les densités relatives de la population des Lémuriens recensées pendant ces périodes sont estimées à l'aide de la formule: d = N/2 x W x l (avec d: densité estimée de la population, N: nombre d'animaux rencontrés, W: distance moyenne des animaux observés par rapport à la ligne-inventaire (transect), l: longueur de la ligne-inventaire).

## Résultats et interprétations

Pendant les deux années d'étude sur le plateau de Makira douze sites ont été explorés, du nord au sud: Manandriana, Amparihibe, Bezavona, Ambatoharanana-Anjiabe, Anjanaharibe, Mangabe, Antsahabe, Andranomenahely, Anantaka, Ambongabe-Amparihimolengy, Maroankolany-Bevitsika et Lokaitra (Fig. 1). Chaque site a ses spécificités, mais en fait, la forêt constitue la végétation naturelle dominante sur le plateau de Makira. Les différents versants du plateau de Makira sont recouverts par des forêts primaires denses humides, sempervirentes de basse à moyenne altitude, à sous bois variable qui peut être épais avec des végétations très serrées inextricables, des lianes et, ou des bambous lianescents ou bien clairs où les fougères herbacées dominent. Les végétations sur les sommets du plateau varient en fonction de l'affleurement géologique

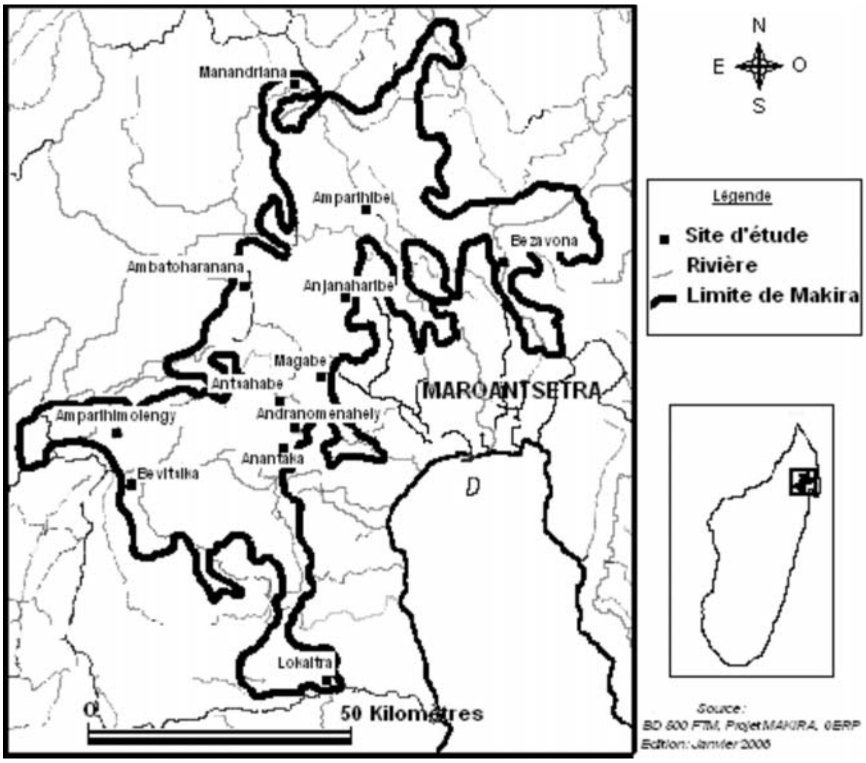

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Fig. 1: Carte des sites d'études.

et pédologique, et nous avons remarqué également une diminution de taille de la végétation, en fonction de l'hauteur. Une surface non négligeable de cette forêt est détruite soit par les actions anthropiques (utilisation des feux par les pratiques de tavy, les acquisitions des propriétés foncières et des espaces pour les bétails), soit par les actions des intempéries en particuliers les cyclones. Ces surfaces détruites sont substituées par des formations secondaires appelées: savoka ou par des savanes herbeuses peu boisées. En fait, le bloc forestier contient une grande diversité spécifique floristique et faunistique et concernant les Lémuriens. L'équipe de GERP (Groupe d'Etude et de Recherche sur les Primates de Madagascar) a recensé 960 individus en 2005 et 2114 individus en 2006. Le tableau 1 résume les espèces de Lémuriens observées dans le bloc forestier de Makira, dans leur site respectif.

Pendant les missions effectuées sur l'ensemble du bloc forestier de Makira, nous avons recensé au total 18 espèces de Lémuriens. Néanmoins avec l'espèce de *Cheirogaleus*, douteuse, que nous avons observé dans le site d'Anantaka, d'après ses caractéristiques (Groves, 2000; Mittermeier *et al*., 2006), nous l'avons considérée à l'espèce *sibreei*, dont sa densité est de 3,3 individus/km$^2$, et avec la deuxième espèce de *Lepilemur* que nous avons inventorié à Maroankoalany-Bevitsika à pelage gris brunâtre et d'après la description de Mittermeier *et al*. (2006) nous l'avons considéré à *L. microdon*, dont la densité est de 91 individus / km$^2$, la totalité de l'espèce de Lémuriens recensés dans le bloc forestier de la Makira revient à 20. Nous avons recensé également une espèce de *Microcebus* un peu différent de l'espèce *M. rufus* par ses caractéristiques morphologique et comportement, elle est en cours de détermination. Toutes ces espèces inventoriées sont rassemblées en 12 genres (*Indri*, *Propithecus*, *Varecia*, *Hapalemur*, *Eulemur*, *Avahi, Lepilemur, Cheirogaleus, Microcebus, Allocebus, Phaner* et *Daubentonia*) et regroupées en 5 familles (Indriidae, Lemuridae, Lepilemuridae, Cheirogaleidae et Daubentoniidae). En fait, les cinq familles de Lémuriens existantes à Madagascar sont rencontrées dans la forêt du plateau de Makira. Et 12 genres sur les 15 genres de lémuriens connus a Madagascar y sont observés; c'est-à-dire que la forêt de Makira présente un taux élevé de genre de Lémuriens, soit 80 %. Pendant nos observations, quelques sites contiennent deux sous espèces d'*Eulemur fulvus: E. f. albifrons* et *E. f. fulvus* B Ambongabe Amparihimolengy et Lokaitra. L'espèce de *Cheirogaleus* semble très abondante dans le bloc forestier de Makira. Parmi les 71 espèces répertoriées à Madagascar (Mittermeier *et al*., 2006), 20 espèces vivent dans la forêt de Makira, soit 28 % des espèces recensées jusqu'à présent. Notons que sur ces 20 espèces dénombrées, les espèces suivantes sont nouvellement répertoriées dans cette immense forêt du plateau de la Makira, il s'agit de *Propithecus diadema candidus,* dans le site de Manandriana, *Eulemur fulvus fulvus*, *Lepilemur mustelinus*, *Allocebus trichotis*, *Cheirogaleus ravus*, *C. crossleyi* et de *Daubentonia madagascariensis*.

La dominance des espèces nocturnes est impressionnante, 12 espèces, par rapport à celles des diurnes qui sont représentés par cinq espèces et a celles des cathémérales qui sont chiffrées à trois espèces.

La comparaison des 12 sites répertoriés permet d'apprécier que le site d'Anantaka est le plus riche en espèces de Lémuriens, on y dénombre au total 13 espèces; ensuite Antsahabe, Andranomenahely et Ambongabe Amparihimolengy et Lokaitra avec 12 espèces, puis Mangabe avec 11 espèces, après Anjanaharibe avec 10 espèces; suivi de Ambatoharanana Anjiabe et Maroankolany-Bevitsika avec 9 espèces, ensuite Bezavona et Manandriana présentent respectivement 8 et 7 espèces et en dernier Amparihibe présente seulement 3 espèces. Donc, le dernier site semble ètre la plus pauvre en nombre d'espèce par rapport aux autres sites cités auparavant.

## Comparaison avec les autres sites d'aires protégées

En 2001, D. Meyers a déjà estimé 15 espèces de Lémuriens à Makira, alors que la présente étude a dénombré 20 espèces, le chiffre estimé par Meyers est donc vérifié et même dépassé. Pour dire que le bloc de Makira présente une diversité lémurienne très élevée par rapport aux autres aires protégées de Madagascar, comme ceux du parc national d'Andringitra (Goodman et Rasolonandrasana, 2001) et du parc national de Ranomafana (Goodman *et al*., 2001), qui abritent tous les deux 12 espèces de primates. La réserve de Maromiza renferme 15 espèces de Lémuriens dont 2 espèces en cours de détermination (Rapport annuel Fondation NAT, 2004). Par rapport aux autres aires protégées environnantes,

Tableau 1: Tableau résumant les espèces de Lémuriens observées avec leur densité relative au estimé en individu par km² dans le bloc forestier de Makira et leur statut respectif (IUCN 2005).

| | **Espèces** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **MND** | **APB** | **BZV** | **ABT** | **AJB** | **MGB** | **ATB** | **ADM** | **ATK** | **APG** | **BVT** | **LKT** | |
| | **Coordonnées géographiques** | | | | | | | | | | | | |
| | **S14° 49'53.3" EO49° 27'37.3"** | **S15° 02'06.7" EO49° 35'02.0"** | **S15° 06'56.6" EO49° 48'18.8"** | **S15° 08'16.0" EO49° 21'02.3"** | **S15° 11'17.1" EO49° 36'50.8"** | **S15° 18'40.1" EO49° 30'12.1"** | **S15° 21'33.9" EO49° 30'12.1"** | **S15° 23'53.0" EO49° 27'05.2"** | **S15° 25'52.7" EO49° 27'16.0"** | **S15° 24'31.9" EO49° 08'05.1"** | **S15° 29'17.9" EO49° 09'33.5"** | **S15° 49'06.9" EO49° 30'37.8"** | **Statut IUCN** |
| **Formes diurnes** | | | | | | | | | | | | | |
| *Indri indri* | 1, 31 | 0 | 0 | 17, 5 | 0 | 1,63 | 2,1 | 6,7 | 7,45 | 15,5 | 1,47 | 5,62 | EN |
| *Propithecus diadema candidus* | 23,1 | 0 | 0 | 0 | 1,49 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | CR |
| *Varecia variegata rubra* | 0 | 0 | 11,6 | 0 | 0,9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | EN |
| *Varecia variegata subcincta* | 0 | 0 | 0 | 11,1 | 0 | 1,37 | 8,53 | 6,78 | 3,7 | 34 | 0,74 | 10,7 | CR |
| *Hapalemur griseus griseus* | 0 | 5,84 | 1,04 | 0 | 2,13 | 0,99 | 6,8 | 0,48 | 0,15 | 1,3 | 3 | 0,81 | VU |
| **Formes cathémérales** | | | | | | | | | | | | | |
| *Eulemur rubriventer* | 8,93 | 0 | 0 | 48,6 | 4,46 | 0 | 23,5 | 12,7 | 0 | 0,62 | 4,08 | 15,3 | VU |
| *Eulemur fulvus albifrons* | 82,2 | 38,2 | 48,3 | 4,1 | 50,3 | 29,1 | 5,74 | 4,62 | 31,8 | 9,45 | 38,8 | 0,4 | VU |
| *Eulemur fulvus fulvus* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 56,5 | 0 | 20,2 | VU |
| **Formes nocturnes** | | | | | | | | | | | | | |
| *Avahi laniger* | 0 | 17,85 | 37 | 89 | 83 | 74 | 31,36 | 18 | 92 | 20,7 | 55 | 43 | LC |
| *Lepilemur mustelinus* | 39,6 | 0 | 7,1 | 126 | 32 | 15 | 46 | 76,3 | 15 | 89 | 34 | 14 | DD |
| *Cheirogaleus major* | 104 | 0 | 4,6 | 104 | 9,5 | 28 | 49 | 27 | 42 | 38 | 0 | 8,4 | DD |
| *Cheirogaleus ravus* | 0 | 0 | 0 | 0 | 0 | 0 | 7,94 | 0 | 7,65 | 0 | 0 | 0 | DD |
| *Cheirogaleus crossleyi* | 0 | 0 | 0 | 30,7 | 0 | 0 | 0 | 0 | 0 | 15 | 0 | 0 | DD |
| *Microcebus rufus* | 30,6 | 0 | 32 | 30,6 | 12 | 6 | 39 | 60 | 12 | 106 | 48 | 21 | DD |
| *Microcebus* sp. | 0 | 0 | 5,3 | 0 | 0 | 38 | 65 | 0 | 12 | 17 | 12 | 42 | DD |
| *Allocebus trichotis* | 0 | 0 | 0 | 0 | 0 | 0 | 18,8 | 9,5 | 6,8 | 0 | 0 | 7,4 | DD |
| *Phaner furcifer* | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 12 | 5,6 | 0 | 0 | 0 | DD |
| *Daubentonia madagascariensis* | 0 | 0 | 0 | 0 | * | 3 | 0 | * | 1,5 | 0 | 0 | 0 | VU |
| **Nombre d'espèce** | **7** | **3** | **8** | **9** | **10** | **11** | **12** | **12** | **13** | **12** | **9** | **12** | |

Signification: MND: Manandriana, APB: Amparihibe, BZV: Bezavona, ABT: Ambatoharanana, AJB: Anjanaharibe, MGB : Mangabe, ATB: Antsahabe, ADM: Andranomenahely, ATK: Anantaka, APG: Amparihimolengy, BVT: Bevitsika, LKT: Lokaitra, / *: traces d'activités / CR : espèce en danger critique, EN: espèce en danger, VU: espèce vulnérable; LC : (Least Concern) espèce moins concernées, DD: (Data Deficient) données insuffisantes et non évaluées.

en tenant compte du nombre 20 espèces, le bloc de Makira tient un optimum en diversité spécifique lémurienne; parce qu'au Nord, la réserve spéciale d'Anjanaharibe Sud renferme 11 espèces (Schmid et Smolker, 1998, Goodman et Wilmé, 2003); au Nord Est le parc national de Marojejy, contient également 11 espèces (Sterling et McFadden, 2000) et à l'Est le parc national de Masoala possède 10 espèces (Sterling et Rakotoarison, 1998).

## Discussion sur la répartition biogéographique

De Manandriana au Nord, jusqu'à Lokaitra au Sud, l'espèce *Indri indri* présente une distribution continue sur la partie ouest de Makira. Les affluents de la rivière d'Antainambalana n'influent pas la répartition de cette espèce. Par contre, dans la partie Nord-Est du plateau de Makira, au nord de la rivière d'Antainambalana-Sahantaha, l'absence de cette espèce est très remarquable et cette lacune de distribution s'étend vers le nord dans le parc national de Marojejy (Sterling et Mc Faden, 2000) et vers l'est dans le péninsule de Masoala (Sterling et Rakotoarison, 1998). Par contre, la rivière d'Antainambalana joue un rôle de barrière écologique pour les espces *de Varecia variegata rubra* et *Varecia variegata subcincta*, la premire espèce se localise seulement au nord de cette rivière et dans le péninsule de Masoala, tandis que la deuxime espèce se trouve au sud de cette rivière (Vasey, 1997; Hekkala et Rakotondratsima, 1999: Vasey et Tattersall, 2002; Raharivololona *et al*., 2003; Mittermeier *et al*., 2006). La distribution de *Propithecus diadema candidus* semble être limité également par cette même rivière, cette espèce est seulement observée dans sa partie nord, pour s'étendre vers la Réserve spéciale d'Anjanaharibe Sud (Schmid et Smolker, 1998) jusqu'au parc national de Marojejy (Sterling et McFadden, 2000).

Dans le bloc forestier de Makira, *Eulemur rubriventer* est absent dans les forêts de basses altitudes, cet espèce a un préférence d'habitat dont les altitudes sont plus élevées (Goodman et Rasolonandrasana, 2001), néanmoins cet espèce n'était pas observée dans le site d'Amparihibe, une cause qui peut être reliée à la perturbation de l'habitat suite aux passages cycloniques répétitifs (Hudah en 2000, Ihary en 2001 puis Elita et Gafilo en 2004). La distribution de l'espèce d'*Eulemur fulvus fulvus* dans le bloc forestier de Makira était douteuse (Mittermeier *et al*., 2006), mais nous confirmons la présence de cette espèce à partir de la zone sud de la rivière de Vohimaro, affluent d'Antainambalana, pour s'étendre vers Lokaitra au sud.

Quatre espèces de *Cheirogaleus* sont recensées dans le bloc forestier de Makira, elles peuvent être parfois sympatriques ou non, mais à part la distribution de *Cheirogaleus major* dans le domaine forestier de l'Est et

Sambirano (Mittermeier *et al*., 2006), les trois autres espèces *Cheirogaleus crossleyi, C. ravus* et *C. sibreei* ne se cantonnent pas seulement dans quelques forêts de l'Est (Groves, 2000), mais sa répartition peuvent s'étendre dans le bloc forestier de Makira.

La présence de l'*Allocebus trichotis* dans la partie Est de Makira, confirme la continuité de la distribution de cette espèce à partir de Marojejy au nord (Goodman et Raselimanana, 2002) jusqu'au Vohimanana dans le Sud (Rakotoarison *et al*., 1997; Mittermeier *et al*., 2006)

## Conclusion

Le bloc forestier de Makira constitue l'une des plus grandes étendues non fragmentées de la forêt dense humide sempervirente de l'Est de Madagascar. Chaque site exploré contient une richesse spécifique intéressante en matière floristique et faunistique et en particulier ceux de lémuriens. Concernant ces Lémuriens, nous avons recensé 20 espèces, dont 5 diurnes, 3 cathémérales et 12 nocturnes. La plupart de ces espèces étaient rencontrées dans la forêt d'Anantaka et les forêts qui présentent encore les caractéristiques des forêts denses humides sempervirentes intactes et peu perturbées. La chasse et la destruction de l'habitat seraient les principales menaces de disparition ou de migration de certaines espèces dans ce bloc forestier. Le bloc forestier de Makira peut être considéré comme une zone de croisement de distribution des espèces. La continuité du bloc forestier facilite le changement d'habitat pour chaque groupe de chaque espèce. Néanmoins, la rivière d'Antainambalana constitue une "barrière écologique" pour certaines espèces comme: *Varecia variegata rubra*, *Varecia variegata subcincta*, *Propithecus diadema candidus* et *Eulemur fulvus fulvus*. Nous suggérons que ce bloc forestier constitue une charnière pour la faune lémurienne, avec ses 20 espèces recensées jusqu'à présent. C'est le plus grand nombre par rapport aux autres sites de conservation connue, car il représente à lui seul au moins les 28 % des espèces de Lémuriens recensées à Madagascar.

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# Disputed taxonomy classification of sportive lemurs (*Lepilemur*) in NW Madagascar

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**Key words**: sportive lemurs, *Lepilemur*, new species, NW Madagascar

The years 2006 and 2007 have seen a massive rise in diversity on the species level of sportive lemurs (*Lepilemur*). The number of species has increased from eight to more than 20 species (Andriaholinirina *et al*., 2006; Louis et al., 2006; Rabarivola *et al*., 2006; Craul *et al*., 2007). Since many of the new forms have been described solely on mtDNA sequence variation, the validity of the proposed new species has been questioned by Tattersall (2007). Here we will not discuss the usefulness and pitfalls of species delimitation based solely on mtDNA markers. In this paper we will comment on what appears to be an artificially inflated number of species in the former range of *Lepilemur dorsalis* due to the lack of knowledge about the exact type locality of *L. dorsalis* and to the incomparability of DNA markers used by different authors.

The holotype of *Lepilemur dorsalis* Gray, 1871 is in the British Museum of Natural History and its type locality is specified as "NW Madagascar?" (Jenkins, 1987). Where exactly it comes from is apparently not known. The same is the case for the name *Lepilemur grandidieri* Forsyth Major, 1894, a name which is traditionally regarded as a synonym of *Lepilemur dorsalis* but which must also be taken into account when describing putative new species.

In what follows, when we refer to "the former range of *L. dorsalis*", we mean the area mapped for the taxon recognised under that name by Petter *et al*. (1977) and Tattersall (1982).

Recent molecular genetic and cytogenetic studies depict the situation of *Lepilemur* in the Sambirano region of NW Madagascar as follows (Fig. 1; Tab. 1).

1. Andriaholinirina *et al*. (2006) identified two *Lepilemur* taxa within the former range of *L. dorsalis* and one, actually, from just beyond it. *L. sahamalazensis* was a new species from Sahamalaza (just beyond the southern border of the former range of the *L. dorsalis*). Samples from the island of Nosy Be and the opposite region of Manehoka formed a separate, distinctive clade which they considered to be the true *L. dorsalis*. *L. dorsalis* is found only in Inter River System IV (IRS). We refer to this concept as *L. dorsalis* (1).
2. Louis *et al*. (2006) analyzed samples also from Nosy Be, but not from Manehoka. Their Nosy Be specimens were described as a new species, *L. tymerlachsoni*, because they considered specimens from south of the Sambirano (Antafondro and Manongarivo) as *L. dorsalis*. *L. dorsalis* is found only in IRS V. We refer to this concept as *L. dorsalis* (2).
3. Rabarivola *et al*. (2006) described a new species from the Ampasindava peninsula, *L. mittermeieri*. They adopt the concept of Andriaholinirina *et al*. (2006), i.e. *L. dorsalis* (1).
4. Craul *et al*. (2007) considered specimens within the former range of *L. dorsalis* as *L. dorsalis* but suggest that two subspecies exist north and south of the Sambirano river (IRS V and VI). We refer to this concept as *L. dorsalis* (3).

Additionally, Louis *et al*. (2006) described a new species from Anjiamangirana, in the former range of *L. edwardsi* as *L. grewcocki*, whereas Craul *et al*. (2007) described specimens from nearly the same locality as *L. manasamody*. Craul *et al*. (2007) added a second new species to the list from Ambodimahabibo, *L. otto*.

The ranges of the various taxa are partly congruent with the centres of endemism of the Watershed model (Wilmé *et al*., 2006) and the interfluvial regions of the Inter River System model (Olivieri *et al*., 2007). However, two taxa have been described in each of three interfluvial regions; *L. tymerlachsoni* and *L. dorsalis* (1) for Nosy Be and Manehoka (IRS VI), *L. mittermeieri* and *L. dorsalis* (2) from Ampasindava and Manongarivo

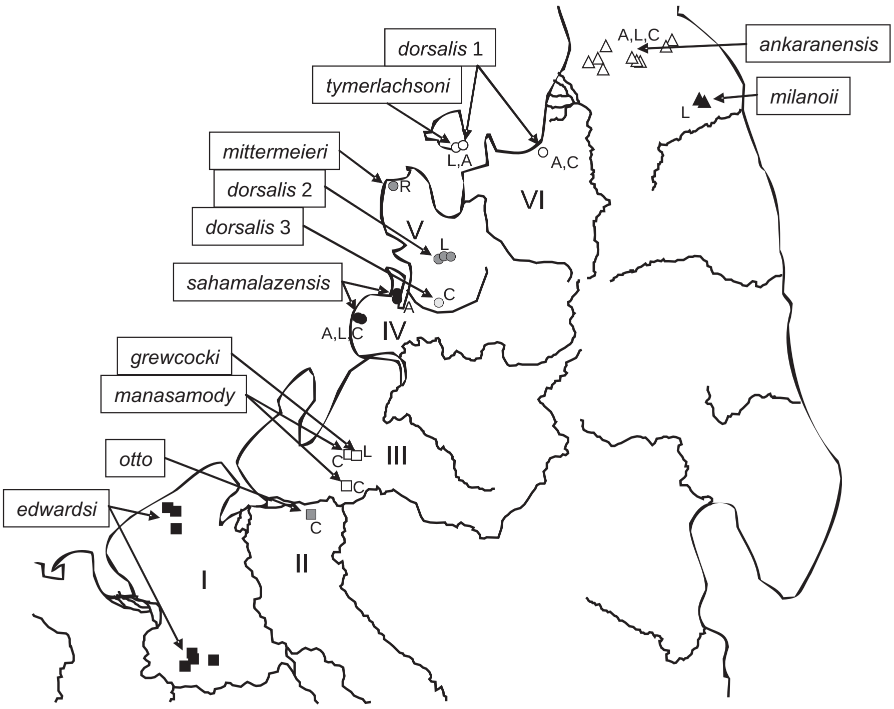

Fig. 1: *Lepilemur* sampling sites in NW Madagascar. Sampling sites of: A = Andriaholinirina *et al*., 2006; R = Rabarivola *et al*., 2006; L = Louis *et al*., 2006; C = Craul *et al*., 2007; I – VI Inter River Systems.

Table 1: Origins of *Lepilemur* specimens.

| **Site; IRS** | **Coordinates in decimal degrees** | **Andriaholinirina *et al.*, 2006** | **Rabarivola *et al.*, 2006** | **Louis *et al.*, 2006** | **Craul *et al.*, 2007** |
|---|---|---|---|---|---|
| Nosy Be; VI | 48.33° E, 13.39° S | *dorsalis* | | *tymerlachsoni* | *dorsalis* |
| Manehoka; IV | 48.80° E, 13.43° S | *dorsalis* | | | *dorsalis* |
| Ampasindava; V | 47.90° E, 13.60° S | | *mittermeieri* | | |
| Antafondro; V | 48.20° E, 14.04° S | | | *dorsalis* | |
| Manongarivo; V | 48.27° E, 14.02° S | | | *dorsalis* | |
| Mahilaka; V | 48.20° E, 14.29° S | | | | *dorsalis* |
| Sahamalaza; IV | 47.97° E, 14.23° S | *sahamalazensis* | | | |
| Ankarafa; IV | 47.75° E, 14.37° S | | | *sahamalazensis* | *sahamalazensis* |
| Anjiamangirana Class. Forest; III | 47.72° E, 15.15° S | | | *grewcocki* | *manasamody* |

(IRS V), and *L. grewcocki* and *L. manasamody* from Anjiamangirana and Ambongabe (IRS III). Two questions arise: (1) are the taxa from the same biogeographical region really different taxa or do they constitute synonyms, and (2), of more relevance to the present paper, which of the two *dorsalis* taxa are correctly named, and which might correspond to *L. grandidieri* Forsyth Major, 1894?

## Methods

Since sequence data from *L. manasamody* and *L. otto*, and from the specimens from Mahilaka (possibly also *L. dorsalis* (2)), are not available at the moment, these taxa are not included in the analysis but have been included provisionally (graphically) in a phylogenetic tree reconstruction. Data of the Louis *et al*. 2006 specimens are derived from NCBI GenBank.

We sequenced specimens from Ankaranana, Nosy Be, Manehoka, Ampasindava, Sahamalaza and Ampijoroa. Animals were captured using blowpipe projection. Skin samples were cut off under general anaesthesia with a 2 mg/kg injection of ketamine solution (Ketalar® Parke-Davis) and preserved in liquid nitrogen.

The extraction of DNA was performed with QIAamp DNA Minikit according to the manufacturer procedures. Amplification of a fragment about 550 bp long of the mitochondrial D-loop region was generated via PCR with primers as described (Wyner et al., 2000; Baker et al., 1993). Reactions were performed in a Perkin Elmer Cetus DNA thermocycler 480 as follows: predenaturation (10 min at 94° C) and 35 cycles each consisting of denaturation (1 min at 94° C), annealing (1 min at 54° C) and extension (1 min 30 s at 72° C), followed by a final extension step (10 min at 72° C). The results of the amplifications were checked on 1 % agarose gels and the PCR products cleaned with the Qiagen PCR Purification kit. PCR products were sequenced from both directions on an automated ABI PRISM sequencer with the BigDye Terminator Cycle Sequencing kit. Due to the low number of indels, sequences were easily aligned by eye. The final dataset included sequences from 22 sportive lemurs from NW Madagascar as well as from one specimen of *L. leucopus*, which was used for outgroup purposes. Pairwise genetic distances (d) were calculated with Mega 3.1 (Kumar *et al*., 2004). Before reconstructing phylogenetic relationships, poorly aligned positions and gaps were removed with the Gblocks software (Castresana, 2000), which reduced the final dataset to 505 bp. Phylogenies were generated with the maximum-likelihood (ML), neighbor-joining (NJ) and maximum-parsimony (MP) algorithms as implemented in PAUP 4.0b10 (Swofford, 2002) and TREEPUZZLE 5.0 (Strimmer and von Haeseler, 1996). For MP analyses, all characters were treated as unordered and equally weighted throughout. A heuristic search was performed with the maximum number of trees set to 100. NJ and ML trees were constructed with the HKY + I (= 0.6202) + $\Gamma$ (= 0.5774) model of sequence evolution as it was selected as best-fitting model with MODELTEST 3.06 (Posada and Crandall, 1998) as well as with standard models. Relative support of internal nodes was performed by bootstrap analyses with 1,000 replications (MP, NJ), or by the quartet puzzling support values on the basis of 1,000 puzzling steps (ML).

## Results

Within the former *L. dorsalis* range, uncorrected pairwise differences between taxa range from 4.7 to 5.9 % (Tab. 2). Between *L. tymerlachsoni* and *L. dorsalis* (1) and between *L. mittermeieri* and *L. dorsalis* (2) the distance is only 0.5%, a magnitude of variance which is normally found within *Lepilemur* taxa of NW Madagascar.

In all phylogenetic tree reconstructions (Fig. 2) identical tree topologies were obtained that differ only in support values for different branches. Accordingly, *L. tymerlachsoni* and *L. dorsalis* (1) cluster together and form a sisterclade to the northern-most species *L. ankaranensis* and *L. milanoii*. *L. mittermeieri* and *L. dorsalis* (2) constitute a second distinct clade, while *L. sahamalazensis* constitutes a third. The relationships among these three clades are not resolved.

Table 2: Uncorrected pairwise differences (%) based on partial D-loop sequences. (grey shaded = taxa within the former *L. dorsalis* range; italic = intra taxon differences; bold = differences between taxa from the same region).

| | **edw** | **grw** | **sah** | **mit** | **dor (2)** | **tym** | **dor (1)** | **mil** | **ank** |
|---|---|---|---|---|---|---|---|---|---|
| edw | | | | | | | | | |
| grw | 6.2 | | | | | | | | |
| sah | 9.1 | 8.7 | *0.7* | | | | | | |
| mit | 9.7 | 9.6 | 4.7 | *0.9* | | | | | |
| dor (2) | 9.7 | 9.5 | 4.7 | **0.5** | *0.5* | | | | |
| tym | 10.3 | 11.1 | 5.3 | 5.9 | 5.6 | *0.4* | | | |
| dor (1) | 10.0 | 10.7 | 5.2 | 5.5 | 5.3 | **0.5** | | | |
| mil | 9.6 | 10.9 | 7.0 | 6.6 | 6.3 | 3.1 | 3.3 | *0.6* | |
| ank | 9.6 | 11.6 | 7.3 | 7.0 | 6.9 | 3.9 | 3.9 | 2.9 | *1.1* |

edw = *L. edwardsi*; grw = *L. grewcocki*; sah = *L. sahamalazensis*; mit = *L. mittermeieri*; dor = *L. dorsalis*; mil = *L. milanoii*; ank = *L. ankaranensis*

## Discussion

In a comparative analysis based on partial D-loop sequences, we found no evidence that *L. tymerlachsoni* and *L. dorsalis* (1) or *L. mittermeieri* and *L. dorsalis* (2) are taxonomically different. Genetic differences within the two taxon pairs resemble those found in intra-taxon comparisons and each of the two taxon pairs form one well supported monophyletic clade. We also think it is likely that *L. grewcocki* and *L. manasamody* are the same, because the sampling sites are less than 2 km apart and there is no obvious biogeographical barrier between the two sampling sites. Although further testing is necessary, at the moment the respective sequence data are not available. Furthermore, we have no data to test whether *L. dorsalis* (3) (from Mahilaka) will cluster with *L. dorsalis* (2)/*L. mittermeieri* or whether it is a distinct form. What is clear is that the number of species in NW Madagascar is rather less than it had seemed to be as of May, 2007.

Since the type localities of *L. dorsalis* and *L. grandidieri* were simply given as "NW Madagascar?" (Gray, 1871; Forsyth Major, 1894), it is difficult or even impossible to know, without testing samples from the type specimens themselves, which of the recently described new species might be synonyms of one or another of the type specimens (or both, if they turn out to be identical). Depending on their true identities any one of the three molecular concepts of *L. dorsalis* could be the "real" *L. dorsalis* or *L. grandidieri*, or one of these two names could turn out to be senior synonyms of *L. tymerlachsoni*, *L. mittermeieri* or even *L. sahamalazensis*. To tackle this interesting taxonomic problem it would be necessary to include the holotypes of *L. dorsalis* and *L. grandidieri* into a molecular genetical and thorough morphometrical analysis.

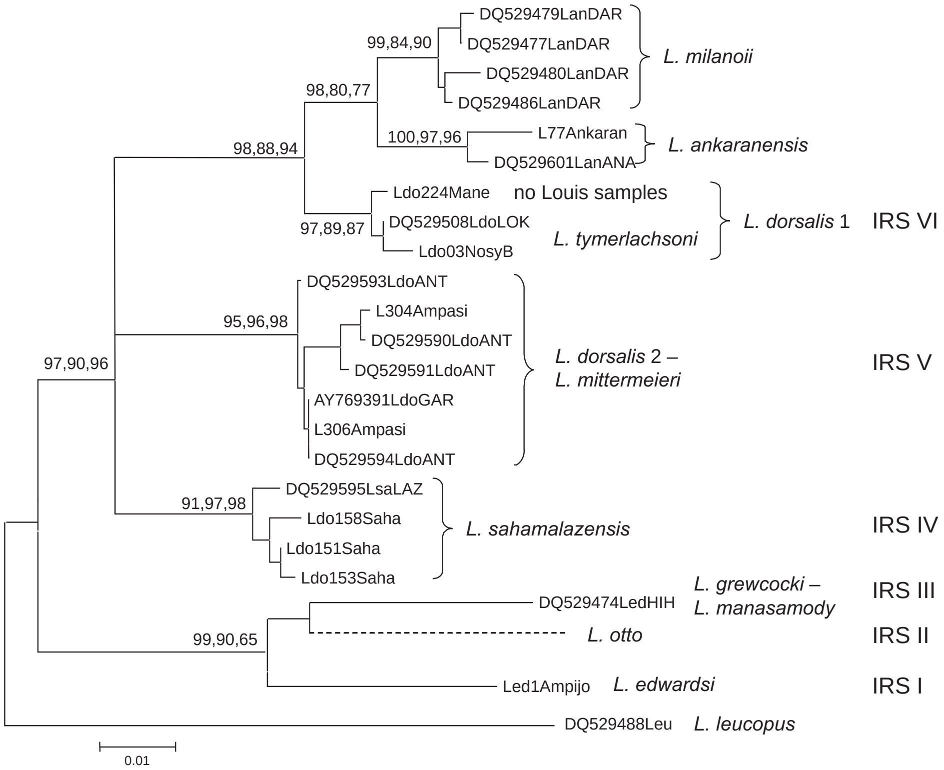

Fig. 2: Phylogenetic relationships as obtained from mitochondrial D-loop sequences (505 bp), with branch lengths drawn according to those estimated by the NJ algorithm and by applying the HKY + I + Γ model of sequence evolution. Numbers on internal branches indicate support values (first: ML, second: NJ, third: MP). IRS = inter river system; sequences with GenBank accession numbers were used by Louis *et al.*, 2006; dashed line = possible position of new taxon *L. otto* Craul et al., 2007 according to its phylogenetic position in Craul *et al.*, 2007.

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# FUNDING AND TRAINING

### The Pittsburgh Zoo & PPG Aquarium Conservation Fund

The Pittsburgh Zoo, as part of its continuing commitment to conservation, announces the continuation of the Pittsburgh Zoo Conservation Fund, dedicated to the preservation of wildlife and wild habitat. Annual awards of from $1,000 to $3,000 will be made. A wide variety of projects will be considered, but field studies and cross-disciplinary approaches to conservation are especially encouraged. Visitor surveys, travel and training (except to bring foreign researchers to meetings) and seed money for technique development are NOT appropriate for this fund.

The application deadline for this year is November 15. Email submissions are welcome. Award notification will be on or before January 1. Recipients must submit a progress report one year after the awarding of funds. For application forms or further information contact:

**Shelby Wyzykowski**
Administrative Assistant, Science & Conservation, Pittsburgh Zoo & PPG Aquarium, One Wild Place, Pittsburgh, PA 15206, USU

### Small Grants Programme run by the Conservation Working Party of the Primate Society for Great Britain

Grants can be made up to the value of GBP750/USD1400, to support projects involving:

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- conservation education relevant to primates

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**David Jay**
Senior Programmes Officer - Field Conservation, Born Free Foundation, 3 Grove House, Foundry Lane, Horsham, West Sussex RH13 5PL, United Kingdom,
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PCI will grant seed 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. All appropriate projects will be considered, but the regions of current interest are Asia and West Africa.
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### Lemurs of Madagascar Pocket Identification Guide

Book Title: *Lemurs of Madagscar Pocket Identification Guide* by Russell A. Mittermeier, William R. Konstant, Frank Hawkins, Edward E. Louis, Olivier Langrand, Jonah Ratsimbazafy, Rodin Rasoloarison, Jorg U. Ganzhorn, Serge Rajaobelina Ian Tattersall, and David M. Meyers. Illustrations and maps by Stephen D. Nash. ISBN: 978-1-881173-99-1. Soft cover. Third Edition. Price: US$7.95 (includes *UPS Ground* shipping within the continental United States)
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TROPICAL POCKET GUIDE SERIES
LEMURS
of Madagascar
Pocket Identification Guide

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Jörg U. Ganzhorn, Serge Rajaobelina,
Ian Tattersall & David M. Meyers

Illustrated by
Stephen D. Nash

### Theses completed

Andriaholinirina, V.N. 2006. Contribution B la révision systèmatique de deux genres d'Indriidae (*Avahi*, Jordan 1834 et *Propithecus*, Bennett 1832) de la côte est de Madagascar. Thèse de Doctorat en Anthropologie Biologique, Spécialité Primatologie, Département de Paléontologie et d'Antrhopologie Biologique, Faculté des Sciences, Université d'Antananarivo, Madagascar.
Une étude morphologique et génétique de différentes populations de deux genres d'Indriidae de l'île de Madagascar: *Avahi* et *Propithecus* a été réalisée. Des prélèvements ont été effectués sur des animaux répartis dans les forLts de l'Est de l'île. Les animaux capturés ont été photographiés, pesés et mesurés pour des comparaisons morphologiques. Pour chaque animal, le caryotype a été déterminé; et le cyt-b et D-loop- sur l'ADN mitochondrial, ont été séquencés. La comparaison des séquences a permis de calculer la distance génétique séparant différentes populations et d'établir une phylogénie. Pour *Avahi*, seuls les marqueurs moléculaires différencient nettement deux populations susceptibles d'être considérées comme des espèces différentes. A l'intérieur de chacune de ces deux populations les mêmes marqueurs ont encore permis d'isoler deux sous populations. Aucune différence chromosomique n'a été décelée au sein des *Avahi* de l'est et les différences morphologiques se sont révélées discrètes. Pour *Propithecus* seul *P. edwardsi* est défini à la fois par des caractères morphologiques distincts, une formule chromosomique spécifique et des caractéristiques moléculaires et doit être considéré comme une espèce. Au vu des résultats moléculaires obtenus à partir d'un faible échantillonage et des données cytogénétiques, le statut spécifique de *P. candidus, P. diadema et P. perrieri* a été considéré comme discutable. Le rôle des fleuves Mangoro et Onive qui marquent la frontière entre *P.diadema et P.edwardsi* ainsi qu'entre les deux taxons issus de *A.laniger* a été discuté. L'importance de révision taxonomique pour la définition de la répartition

et la mise en Éuvre d'une politique de protection a été discutée.

Mots clés: Lémurs, Madagascar, *Avahi, Propithecus*, Systèmatique, cytogénétique, Biologie moléculaire, Barrière géographique.

Lahann, P. 2006. Coexistence of three cheirogalid lemurs in a littoral rainforest of south-east Madagascar. Dissertation, Hamburg University, Hamburg, Germany.

The lemurs of Madagascar are known for their extraordinary species diversity. Often several species and congeneric species (genera *Microcebus*, *Cheirogaleus, Hapalemur, Eulemur*) occur sympatrically in the same habitat. Mechanisms that allow the coexistence of these species are still poorly known. Interspecific differences in feeding ecology, habitat utilization and activity patterns might contribute to species niche partitioning and coexistence. These factors were studied for three sympatric species of Cheirogaleidae (*Microcebus murinus* [body mass: 80 g], *Cheirogaleus medius* [body mass: 180 g] and *Cheirogaleus major* [body mass 360 g]) in a littoral rainforest in southeast Madagascar during three rainy seasons using vegetation analyses, radio telemetry, capture-recapture and observation techniques. All three species were mainly frugivorous and fed on 68 different plants species with small- and medium-sized fruits (median length/width 11.9/9.5 mm). 91 % of these forage plant species were visited by all three lemur species. Fruits larger than 25-30 mm were avoided. There were no differences in the morphological and the biochemical characteristics of fruits eaten between the species. All three species had the same activity patterns at night, they seem to go into hibernation and torpor during the dry season and the reproduction is synchronized for *C. medius* and *C. major*. The promiscuous *Microcebus murinus* showed small home ranges in females (0.6 ha) and large overlapping home ranges in males (4.1 ha). Home ranges of the monogamous *Cheirogaleus medius* (1.5 ha) and *C. major* (4.2 ha) showed extensive overlap of family group members. Home ranges of all three species did overlap completely in the study area but home-range size differed between species and was positively correlated with body masses. My analyses of sleeping behavior showed that males of *Microcebus murinus* slept in open vegetation (79 %) and alone (71 %), whereas females of *M. murinus* and family group members of *Cheirogaleus* spp. preferred communal sleeping in tree holes. I found significant interspecific differences in the choice of sleeping sites: smaller lemurs chose smaller trees and used more sleeping sites than larger lemurs. Species differed also significantly in the vertical dimension of forest utilisation. I found *Cheirogaleus major* using the upper part of the trees. *C. medius* used the middle parts and *Microcebus murinus* used the understorey during their nocturnal activity. In conclusion, the three species differed mainly in their vertical habitat utilisation and showed a vertical stratification.

Rabesandratana, A.Z. 2006. Variations microgéographiques et Bioacoustiques de *Lepilemur edwardsi* (Geoffroy, 1858) dans le Parc National Ankaranfantsika (région nord-ouest de Madagascar). Thèse de Doctorat de Biologie, Ecologie et Conservations Animales, Département de Biologie Animale, Faculté des Sciences, Université d'Antananarivo, Madagascar.

Les lémuriens nocturnes sont parmi les Primates menacés par les dangers dus à la dégradation incessante de l'environnement et des écosystèmes. C'est le cas de Lepilemur de Milne-Edwards (*Lepilemur edwardsi*), objet de notre étude, un lémurien nocturne qui a la taille d'un chat. Le site d'études était la seule distribution continue de cette espèce qui subsiste au nord-ouest de Madagascar, Parc National Ankarafantsika (PNA) et alentours. Pour réaliser ces études, 9 sites, répartis dans le PNA ont été choisis plus un 10$^{\text{Pme}}$, Ampijoroa, comme site de référence, afin d'éclaircir les problèmes relatifs à sa distribution, son abondance, son éthologie, sa bioacoustique et surtout de promouvoir, en sa faveur, une conservation efficace. Les périodes d'études s'étendent de mai à octobre 2003 et de mai à octobre 2004. Pour la première fois une tentative d'explication sera entreprise dans ces études sur la distribution et l'abondance de *Lepilemur edwradsi* dans le PNA, par la méthode de transects et de recensements nocturnes. La densité relative de *Lepilemur edwardsi* dans le PNA est relativement faible (0-3 individus/km) par rapport à Ampijoroa. La radiotélémetrie a permis de récolter les données comportementales de 42 individus répartis dans 8 sites, d'enregistrer leur vocalisation et d'établir les contextes des cris. Les analyses morphomètriques et bioacoustiques ont montré qu'il n'y a pas de différence entre les mâles et les femelles dans chaque site; ce qui a permis de comparer les sites. Il y a beaucoup de similarités morphométriques et acoustiques de l'espèce étudiée dans 8 sites du PNA. Il peut en être déduit que *Lepilemur* y forme une seule métapopulation. Cependant, quelques variables morphomètriques et acoustiques semblent être significatives par l'effet des sites et elles sont dues probablement à des adaptations particulières des populations à des types d'habitat local. Les contextes des cris ont permis d'évaluer leur symétrie temporelle entre ceux du matin et ceux du soir. Un statut de conservation de rang plus élevé est alors proposé pour *Lepilemur edwardsi* du fait de sa faible densité dans le PNA, compte tenu de sa reproduction très limitée et des incessantes menaces de perte d'habitat et de braconnage.

Mots clés: Lémuriens nocturnes, *Lepilemur edwardsi*, morphométrie, bioacoustique, comportement, Parc National Ankarafantsika, Madagascar.

Rahalinarivo, V. 2007. Etude comparative des activités (années 2003 et 2005) de *Hapalemur griseus* (Link, 1795), *Hapalemur aureus* (Meier et al, 1987) et *Prolemur simus* (Gray, 1871) dans le Parc National de Ranomafana, Fianarantsoa-Madagascar. Mémoire de DEA de Biologie Evolutive, spécialité Primatologie, Département de Paléontologie et d'Anthropologie Biologique, Faculté des Sciences, Université d'Antananarivo, Madagascar.

Cette étude a été réalisée dans le site de Talatakely du Parc National de Ranomafana. Ella a pour but d'étudier les activités des trois espèces. *Hapalemur griseus*, *Hapalemur aureus* et *Prolemur simus* en 2005; et de les comparer avec celles de 2003 (RAMAROKOTO). Et enfin, de voir la relation de proximité au sein de chaque groupe. Les activités changent d'une espèce à l'autre et d'une année à l'autre. La totalité des fréquences des activités de ces trois espèces sont généralement indifférentes durant ces deux périodes étudiées. Le repos est la plus importante activité. Il varie de 51 (2003) à 62 % (2005), ensuite vient l'alimentation entre 38 et 29 %, le déplacement est compris entre 7 et 6 % et enfin, les activités sociales qui se chiffrent entre 4 et 3 %. Les strates les plus utilisées sont comprises entre 5 et 10 m pour *Hapalemur* *griseus* et *Hapalemur aureus* et de 1 à 5m chez *Prolemur simus*. Le bambou est la base de leur nourriture surtout l'espèce *Catharyostachys madagascariensis* dont les parties les plus consommées sont les bougeons et les jeunes feuilles chez les deux genres de *Hapalemur*; et les tiges et les pousses pour le *Prolemur*. Seul le *Hapalemur griseus* et l'*Hapalemur aureus* consomment des plantes non bambous. L'individu adulte de sexe opposé se trouve à côté du focal lors des activités sociales et pour les autres activités, l'animal proche du focal change suivant les activités.

Mots clés: *Hapalemur griseus*, *Hapalemur aureus*, *Prolemur simus*, activités, Parc National de Ranomafana, Madagascar.

Rakotobe, H.R. 2006. Stratégie d'adaptation de *Eulemur rubriventer* dans une forêt de basse altitude. Exemple de la forêt de Sahafina (Anivorano Est et Mahatsara, Brickaville). Mémoire de CAPEN.

Bien qu'on ait pensé que *Eulemur rubriventer* se produit à moyenne et haute altitudes, cette étude a essayé de montrer les stratégies d'adaptation de l'espèce indépendamment de l'altitude et la présence des essences à fruits favorise son adaptation, étant donné qu'elle est principalement frugivore. Par la méthode du "Scan sampling", par l'établissement des plots et par des enquêtes auprès des guides durant 2mois en octobre et novembre 2005 dans la forêt de Sahafina, forêt dense humide sempervirente de basse altitude dans communes rurales d'Anivorano-Est et de Mahatsara, District de Brickaville, nous avons pu déterminer le budget d'activité journalière de *Eulemur rubriventer*, son profil alimentaire et la variété floristique de sa niche écologique. Les résultats obtenus indiquent que 7 groupes environ ont été suivis parmi les quinze groupes possibles, répartis dans les quatre points cardinaux de la forêt et c'est dans les parties occidentales et méridiennes qu'on peut les rencontrer fréquemment. Un groupe se compose en moyenne de 3 individus, toujours un mâle et une femelle et un petit. Son alimentation est constituée en grande partie de fruits mfrs de *Uapaca thouarsii* et *Dypsis* sp. durant cette période. La niche écologique est riche en variétés floristiques à haut taux d'endémisme et comportant même des essences d'une forêt littorale. Comme la forêt de Sahafina est une forêt domaniale fragmentée récemment protégée, elle a une potentialité de régénération. Nous pouvons conclure que *Eulemur rubriventer* peut bien s'adapter dans la forêt de Sahafina laquelle est une forêt de basse altitude en bonne voie de conservation. Par ailleurs, elle constitue un milieu favorable pour des recherches scientifiques transversales et pédagogiques. Elle peut être utilisée dans le cadre de l'Education Relative à l'Environnement des populations riveraines et autres.

Mots clés: *Eulemur rubriventer*, lémuriens, stratégie d'adaptation, basse altitude, Scan sampling, éducation relative à l'environnement, conservation, forêt de Sahafina, Madagascar.

Ramanakoto, H.L. 2006. Stratégie alimentaire et analyse fécale de trois espèces sympatriques de Talatakely: *Hapalemur aureus* (Meier et col, 1987), *Hapalemur griseus griseus* (Link, 1795), *Prolemur simus* (Gray, 1871) dans le Parc National de Ranomafana, Ifanadiana, Fianarantsoa. (Madagascar). Mémoire de DEA de Biologie Evolutive, spécialité Primatologie, Département de Paléontologie et d'Anthropologie Biologique, Faculté des Sciences, Université d'Antananarivo, Madadgascar.

Cette étude se rapporte sur la stratégie alimentaire et analyse fécale de trois espèces sympatriques de Talatakely dans la Parc National de Ranomafana. Elle a été faite pendant la saison sèche et froide (Juin, Aoft 2003). Nous avons fait l'étude sur trois groupes: *Prolemur simus* (7 individus), *Hapalemur aureus* (5 individus) et *Hapalemur griseus gris*eus (6 individus). La méthode utilisée lors des suivis est la méthode de "focal animal sampling" et nous avons enregistré les différentes activités générales et alimentaires sans oublier la récolte des feces. Les résultats obtenus montrent qu'il y a une différence significative entre les activités de ces trois espèces. *Hapalemur aureus* semble passer plus de temps à être inactif, *Prolemur simus* dépensent beaucoup de temps à s'alimenter et *Hapalemur griseus griseus* se déplacent plus souvent. Pendant une journée, le taux de la fréquence d'alimentation s'élèvent progressivement pour les trois espèces l'après midi à partir de 14 heures. La différence est également significative pour ces trois espèces concernant l'orientation des supports utilisés lors de l'alimentation. *Hapalemur aureus* et *Hapalemur griseus griseus* préfèrent les supports horizontaux tandisque *Prolemur simus* opte pour les supports obliques. Pour les types de nourriture, *Prolemur simus* est le plus dépendant du bambou (Volohosy), ensuite *Hapalemur aureus* et enfin *Hapalemur griseus griseus* le plus indépendant car elle consomme plusieurs variétés de bamboo et même des plantes non bambou. De même pour les parties consommées, le test est significatif donc ces parties sont différentes pour les trois espèces. En tout cas le matin, le midi et l'après midi, les préférences alimentaires sont les mêmes pour chaque espèce. Pour l'analyse fécale, ces trois espPces se diffèrent en ce qui concerne le nombre de pelotes fécales, la dimension des crottes brutes, la dimension des particules fécales et le poids des déchets secs obtenus dans le filtre 2mm seulement. Des recherches approfondies sont à envisager ultérieurement concernant l'étude chimique de ces déchets.

Mots-clés: *Hapalemur aureus, Hapalemur griseus griseus, Prolemur simus*, alimentation, fécal, Parc National Ranomafana, Madagascar.

Ramanamahefa, R. 2007. Dynamique de la population des deux espèces des Lémuriens, *Eulemur coronatus* (Gray, 1842) et *Eulemur sanfordi* (Archbold, 1932) dans la partie nord de Madagascar. Mémoire de DEA de Biologie Evolutive, spécialité Primatologie, Département de Paléontologie et d'Anthropologie Biologique, Faculté des Sciences, Université d'Antananarivo, Madagascar.

Cette étude a été menée depuis l'année 2000, 2002 et 2005 dans la partie nord de Madagascar (Parc National de la Montagne d'Ambre, Réserve Spéciale d'Analamerana, et Réserve Spéciale d'Ankarana). Elle se porte sur deux espèces qui sont *Eulemur coronatus* et *Eulemur sanfordi*. Le nombre total d'individus capturés est égal à 136. En plus, les programmes de GENEPOP 3.1, FSTAT STRUCTURE 2.0, BOTTLENECK v.1.202, sont utilisés pour déterminer la diversité génétique et la structure des ces populations. Préalablement, l'application de PCR ou la Réaction en chaîne Polymérase détermine le génotypage. Ainsi 14 marqueurs sont utilisés pour *Eulemur sanfordi* et 13 marqueurs pour *Eulemur coronatus*. Il n'y a pas de structure observée au niveau de ces deux espèces, et les populations ne subissent pas de goulot démographique "Bottleneck". La migration entre la population d'Analabe et Ampasimaty est très remarquable pour l'espèce *E.sanfordi* (Nm=2,469), cette migration se présente aussi entre les populations d'Ankarana et d'Ankavanana pour l'espèce *Eulemur coronatus* (Nm=1,319). En outre, on n'observe pas plus de 2 ou 3 migrations par génération selon les deux espèces. Un certain degré de consanguinité a été constaté à Analabe pour *E. coronatus* (Fis=0,133) et dans le Montagne d'Ambre pour *E.sanfordi* (Fis=0,129). En général, les valeurs moyennes les plus élevées sur les diversités de gènes de ces deux espèces suggèrent que cette diversité de gène est plus ou moins importante. Exemple, pour *Eulemur coronatus*, la moyenne de diversité de gène la plus élevée est égale à 0,643; elle est égale à 0,639 pour *Eulemur sanfordi*. La population d'Ampasimaty et du Montagne d'Ambre de cette espèce *sanfordi* sont différentes selon leur diversification. Et les populations d'Antobiratsy et d'Ankavanana d'*Eulemur coronatus*, ainsi que les populations d'Ankavanana sont également différentes.

Mots clés: *Eulemur coronatus*, *Eulemur sanfordi*, Montagne d'Ambre, Ankarana, Analamerana, génétique, microsatellites, ADN, Madagascar.

Ranaivoarisoa, J.F. 2007. La dynamique de population des lémuriens B collier roux, *Eulemur collaris* (E. Geoffrey, 1812) dans les Parcs Nationaux d'Andohahela (Fort Dauphin) et du Midongy du Sud et de la Réserve Spéciale de Kalambatritra (Betroka-Iakora) - MADAGASCAR. Mémoire de DEA de Biologie Evolutive, spécialité Primatologie, Département de Paléontologie et d'Anthropologie Biologique, Faculté des Sciences, Université d'Antananarivo, Madagascar.

Cette étude génétique a été réalisée à partir des échantillons des *Eulemur collaris* collectées dans la partie Sud-Est de Madagascar comprenant les deux Parcs Nationaux: le P.N. Midongy du Sud (Biarena Sagnira et Ampasy), ainsi que la Réserve Spéciale de Kalambatritra (Betanandro, Befarara, et Sahalava). Elle a pour but d'établir les bases directives en génétique et d'assumer la situation de conservation de la population *d'Eulemur collaris*. Quinze marqueurs polymorphiques ont été sélectionnés pour effectuer le Génotypage par l'application de la technologie moléculaire et de la Réaction en Chaîne Polymérase (P.C.R.). Des tests statistiques performants sont utilisés pour les analyses des données connaissant le GENEPOP 3.1, STRUCTURE 2.0, BOTTLENECK v.1.2.02. Ces tests annoncent bien les rôles négatifs des braconnages très intenses et la présence des barrières géographiques comme les rivières et l'éclairement de la zone forestière par la pratique de "Tavy" et la déforestation. Toutes ces différentes populations d'*Eulemur collaris* montrent un moindre flux génique entre elles, prouvé par les richesses allèliques faibles (entre 2,9 et 3,3), les nombres des migrants par générations petites; et l'état de santé moyen (diversité génétique modérée). Ces populations présentent des coefficients de consanguinité légèrement élevés mais à des degrés différents. Ce coefficient est plus élevé chez la population d'Andohalela (Fis = +0,1113) (test GENEPOP). Toutes les populations de ces aires protégées sont complètement isolées (test de STRUCTURE). Les deux populations venant de deux sites (Biarena et Ampasy) issues du P.N. Midongy du Sud sont aussi isolées, même ces deux milieux étaient récemment séparés par la déforestation. Enfin, elles présentent des taux d'excés en hétérozygotes faibles (test BOTTLENECK), principalement chez la population d'Andohahela (He = 0,02396).

Mots clés: *Eulemur collaris*, génétique, conservation, Réserve Spéciale, Parcs Nationaux, Midongy, Andohahela, Kalambatritra, Madagascar.

Randriamiarisoa, M. 2006. Morphologie, microhabitat, distribution spatiale de *Microcebus rufus* (Lesson, 1840) à Talatakely dans le Parc National de Ranomafana (Ifanadiana-Fianarantsoa). Mémoire de DEA de Biologie Evolutive, spécialité Primatologie, Département de Paléontologie et d'Anthropologie Biologique, Faculté des Sciences, Université d'Antananarivo, Madagascar.

Cette étude a été effectuée à Talatakely, dans le Parc National Ranomafana, en deux années 2004 (septembre-novembre) et 2005 (octobre-décembre). Elle a été réalisée pour estimer la distribution spatiale et aussi d'étudier le microhabitat de *Microcebus rufus*. Nous avons utilisé la méthode de capture-recapture et la méthode de plot. Les résultats ont montré que le mâle et la femelle ne présentent pas de dimorphisme sexuel. La densité estimée étant de 1,22 animaux par hectare. Le sexe ratio présente une variation au cours des mois mais, en général, il est en faveur des mâles. Le poids moyen des animaux varie hebdomadairement pour la première période que la deuxième période d'étude et varie aussi suivant leur distribution. Cette variation est due à deux phénomènes: la reproduction et la disponibilité alimentaire. Pour leur distribution, trois niveaux sont considérés: crête, mi versant, et vallée. La fréquentation des animaux dans ces trois niveaux diffère entre les mois. Les mâles fréquentent plus le niveau crête tandis que pour les femelles le niveau vallée est le plus fréquenté. L'étude sur leur microhabitat révèle que les arbres à petites dimensions ($2{,}5 \le \text{DHP} \le 5$ cm) et à hauteur moyenne ($5 \le \text{H} \le 10$ m) sont les plus nombreux dans ce site. Et la similarité en espèces d'arbres entre les trois niveaux étant moyenne. La distribution des plantes consommées par le *Micrcebus rufus* est inégalement repartie sur les trois niveaux. Mais une étude à long terme s'avère nécessaire pour avoir l'impact de la dégradation de la forèt sur les petits lémuriens tel que le *Microcebus*.

Mots clés: *Microcebus rufus*, morphologie, distribution spatiale, microhabitat Parc National Ranomafana, Madagascar.

Rasolofosona F.F. 2006. Etude écologique des îlots forestiers relictes dans la zone d'écodéveloppement de la station forestière d'Antrema (Inventaire-Typologie-Régénération naturelle, Cartographie). Département de Biologie et Ecologie végétales, Option Ecologie appliquée, Faculté des Sciences, Université d'Antananarivo, Madagascar.

La Conservation de l'espèce va toujours de paire avec celle de son habitat. Des recherches relatives à l'inventaire floristique, à la typologie, à la régénération forestière et de quelques espèces consommées par *Propithecus verreauxi coronatus*, et à l'étude diachronique des îlots forestiers de la zone d'écodéveloppement ont été effectuées dans la Station Forestière à Usage Multiple d'Antrema. L'objectif de cette étude est de contribuer à la prévision de l'évolution future des surfaces forestières et surtout à l'identification des menaces que subissent les îlots forestiers. Les principes méthologiques retenus pour cerner le sujet ont été le transect de Duvigneaud (inventaire), le place au de Braun Blanquet (Régénération naturelle), la structure de Gauthier et al., (Typologie) et le traitement Map Info Professional V6.5 pour la cartographie. Il ressort de nos recherches que 140 espèces reparties dans 95 genres et 54 familles correspondant à cinq groupements sur un sol à texture généralement sableuse ont été identifiées. Toutes les formations végétales présentent un taux de régénération foresti-

Pre élevée variant de 1902 à 2068 %. Les taux de régénérations des espPces consommées par *Propithecus verreauxi coronatus* sont promoteurs variant de 500 à 2866 %. Quoi qu'il en soit, il a été identifié aussi que l'évolution de la surface forestiPre est de type régressive (21,56 ha/an défriché soit 107,83 % ha pour cinq ans). La perte de l'habitat par le feu et ses conséquences constitue les principales menaces qui pèsent sur la vie de *Propithecus verreauxi coronatus.* La connaissance des caractéristiques de ces îlots forestiers et ses menaces ont permis en effet d'avancer quelques mesures pour la conservation de l'espèce *Propithecus verreauxi coronatus.*

Mots clés: Madagascar, Antrema, zone d'écodéveloppement, *Propithecus verreauxi coronatus*, Sifaka, conservation, habitat.

Ratsisetraina, I.R. 2006. Etude de recouvrement de population de *Varecia variegata rubra* (E. Geoffroy, 1812) et de *Eulemur fulvus albifrons* (E. Geoffroy, 1897) à la suite d'une perturbation cyclonique dans le Parc National de Masoala, Madagascar. Mémoire de DEA de Biologie, Ecologie et Conservation animales, Département de Biologie Animale, Faculté des Sciences, Université d'Antananarivo, Madagascar.

La forêt de Masoala a été dévastée par un cyclone très intense dénommé Hudah le mois d'Avril 2000. Une étude d'impact de cette catastrophe naturelle sur les populations de deux sous-espèces de lémuriens diurnes: *Varecia rubra* et *Eulemur albifrons* a été menée un an après (du janvier au mars 2001) dans deux sites situés sur la côte est de la presqu'île de Masoala, région la plus affectée par le cyclone. Les variations des paramètres démographiques de ces sous-espèces tels que l'abondance, la taille de groupe, la densité, le sex ratio, la structure d'âge et le taux de reproduction; ainsi que la structure de la forêt comme la couverture de la canopée et l'état des arbres ont été étudiées. La présente étude (du janvier au mars 2004) consiste alors à déterminer le recouvrement de population de ces lémuriens ainsi que la reprise de la forêt constituant leur habitat naturel quatre ans après le passage du cyclone. En général, une tendance au rétablissement des paramètres démographiques vers leur état avant la perturbation cyclonique est observée chez *Eulemur albifrons*. Il en est de mLme pour *Varecia rubra*, seulement, cette tendance dépend du degré de perturbation du site. Quant à la régénération de la forêt, elle se fait en deux façons. Dans les endroits plus perturbés, la régénération par le développement du sous-bois par la germination des semis est plus importante. Dans les parties moyennement dégradées, le processus de régénération est marqué surtout par la reprise des feuilles des arbres défoliés et à branches cassés et la repousse des rejets pour les arbres à troncs coupés. Les résultats sur le régime alimentaire de ces deux sous-espèces montrent une variation de leur nourriture surtout pour *Varecia rubra* qui est fortement lié à leur habitat forestier. Ces variations sont observées sur le type de feuilles et l'absence des fruits consommés par l'animal étant donné que cette espèce est principalement frugivore. De cette étude ressort une différence de réponses de ces espèces à la perturbation de leur habitat. *Eulemur albifrons* se montre plus résistant et plus résilient à une dégradation de la forêt que *Varecia rubra* qui en est plus vulnérable.

Mots clés: Lémuriens, *Eulemur albifrons*, *Varecia rubra*, Démographie, habitat, perturbation cyclonique, recouvrement, régénération, Masoala, Madagascar.

Razakamaharavo, R.V. 2006. Dynamique de la population de *Varecia rubra* dans deux sites du Parc National de Masoala-Antsiranana. Mémoire de DEA de Biologie évolutive, spécialité Primatologie, Département de Paléontologie et d'Anthropologie Biologique, Faculté des Sciences, Université d'Antananarivo, Madagascar.

*Varecia rubra* se rencontre seulement dans la forêt de la péninsule de Masoala. Une étude génétique est conduite dans deux sites de ce parc à savoir Masiaposa et Ambatoledama dans le but de fournir des directives de base en génétique et d'estimer la situation génétique de la population de *Varecia rubra*. Ainsi, vingt et quatre loci microsatellites sont utilisés pour examiner la diversité génétique et la différentiation de la population de *Varecia rubra* dans ce parc. En utilisant des tests statistiques performantes (GENEPOP 3.1, GENECLASS 2, STRUCTURE 2.0, WHICHRUN 2.0) et en investiguant les trois modPles de mutations alleliques existantes, des divergences génétiques sont perçus parmi les échantillons collectés. Les trois échantillons collectés dans le site de Masiaposa se répartissent en trois sous populations après un test d'optimisation de STRUCTURE 2.0, ceci après avoir pris connaissance lors du test GENEPOP 3.1 et du test préliminaire de STRUCTURE 2.0 qu'une structure cryptique existe au sein de la population de Masiaposa. La population d'Ambatoledama constitue presque une entité à part. Le test d'Assignement de GENECLASS 2 confirme ce résultat. Le test par Bottleneck 1.2.02, révèle que la sous-population d'Ambatoledama ainsi que la sous-population 1 de Masiaposa ont subi un goulot démographique, tandis que les sous-populations 2 et 3 ne le sont pas. Les distributions des fréquences allPliques confirment ce résultat. Il y a aussi consanguinité. Cette étude a une implication en conservation parce que la population en entière est assez robuste génétiquement mais du point de vue consanguinité, il y a un risque encouru.

Mots clés: Génétique de conservation, espèces en danger d'extinction, microsatellites, *Varecia rubra*, goulot démographique, différenciation génétique.

Steiner, J. 2006. Sleeping site choice in grey mouse lemurs (*Microcebus murinus*) of Kirindy forest. Diploma thesis, Department of Behavioral Ecology & Sociobiology, German Primate Center (DPZ), Göttingen, Germany.

Primates spend about half of their lives resting or sleeping. During these times of inactivity, small primates, in particular, are exposed to high predation risk and face high costs of thermoregulation. It is therefore expected that individuals choose sleeping sites according to their protective and isolating characteristics. The aim of this study was to explore sleeping site characteristics and usage patterns in grey mouse lemur (*Microcebus murinus*). These small lemurs inhabit the highly seasonal dry forests of western and southern Madagascar, where they face high predation risk and large temperature fluctuations during the austral winter. Between August and October 2005, 6 male and 6 female grey mouse lemurs were captured and equipped with radio-collars in Kirindy forest. Data on spatial movements and behaviour were recorded by radio-tracking and direct observations. Sleeping site usage patterns were monitored continuously over 60 days for all individuals. For each sleeping site (n=139) the following characteristics were recorded: type, height above ground, number and size of entrances, visibility of animal and characteristics of the tree such as live/dead and diameter. Males used absolutely more individual sleeping sites than females. Due to sex-differences in home range area, however, the number of sleeping sites per area did not differ between the sexes. In general, males and females preferred tree holes over leaf nests or open sites. Unexpectedly, highly frequented sleeping sites did not differ in any characteristic from less frequented ones, except in that they provided on average better visual protection. Females stayed longer at one particular site continuously, whereas males changed sleeping sites more often. Whereas females usually associated in sleeping groups of 2-3 members, males slept alone. Thus, grey mouse lemurs preferred tree holes as sleeping sites, which might provide protection against visually hunting predators. Also, isolating features of holes in trees might extend periods spent in torpor and thus lower the osts of thermoregulation. Communal resting of females might further enhance this energy saving strategy.

Wagner, K. 2005. Coordination of group movements in wild redfronted lemurs (*Eulemur fulvus rufus*). Diploma-Thesis, Department of Behavioral Ecology & Sociobiology, German Primate Center (DPZ), Göttingen, Germany.

An important aspect for group-living species is maintenance of group cohesion, for which individuals need to coordinate their different interests. I studied behavioural aspects and mechanisms of coordinated group movements in wild redfronted lemurs in Kirindy/CFPF forest, western Madagascar. In particular, I investigated the initiation and course of group movements, as well as vocalisations used to initiate group movements in 4 social groups. Results indicate that both sexes initiated group movement, but females did so more often, whereas particular females in each group initiated movements most often. Sex of the leader of group movements neither affected number of individuals that followed nor average travel distances. I also found that redfronted lemurs did not use specific vocalisations or signals to initiate or control group movements. The results of this study indicated that redfronted lemurs converge with many other group-living primates in several fundamental proximate aspects of group coordination and cohesion. In contrast to many other primates, however, lemurs as seen here, but also in sifakas, do not use particular signals to coordinate their group movements.

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