LEMUR NEWS

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

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SPECIES SURVIVAL COMMISSION

UHH Universität Hamburg

Cover photo: *Prolemur simus* from Torotorofotsy; identification number FOTSY7.2, July 29, 2007. Photo taken by Richard Randriamampionona.

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EDITORIAL

Once again we have to mourn over the untimely death of one of our colleagues, Madame Gisèle Randria. She has been a stronghold of primatology at the University of Antananarivo and a vivid advocate for her students in the very dynamic phase while many organizations and people were struggling to delineate possible areas for protection under the Durban Vision. Her students will continue the long tradition of expert lemur work.

The time of defining possible areas for protection and assigning preliminary protected areas will come to an end and we now have to make sure that protected areas and conservation actions will be implemented and firmly rooted in the Malagasy law and also in local agreements, culture and thinking. Energy, mining and other industrial and agricultural initiatives are on their way, concessions cover Madagascar, and the companies are scraping their hooves to get going as soon as the protected areas will be defined. In the wake of these developments Madagascar will experience changes of unseen and unexpected magnitudes in the very near future. We have to work hard to set uniform standards for sustainable development and to make them an obligation by default for all activities with environmental impacts. In many cases we do not have to reinvent the wheel. The stranding of dolphins in June 2008 may or may not be linked to offshore oil and gaz exploration. The doubt remains. Admittedly there are huge gaps in our knowledge about effects of offshore exploration and mining. But there is also a wealth of data, experiences and rigid regulations applied in offshore activities in North America and Europe. The same applies to the mitigation of terrestrial environmental impacts. Madagascar is a rich country, not only with respect to people, culture, and biodiversity, but also with respect to ore and other resources which simply can not be exploited in a sustainable way. Once ore is extracted from the ground it is gone and there will be a hole where there used to be something else before (including what used to be on top of the hole). The world requests these resources. It is ready to pay for them and it would be naïve to believe that exploitation would not happen sooner or later. Given the world's requirements, Madagascar has to make sure that it replaces these limited resources by sustainable sources for income which will last once the ore will have gone. We might have to accept partial destruction of something to come to something better in the future. But we must be honest to ourselves and to others that these impacts are happening. If so, we must combine forces to find joint solutions for these problems beyond the beaten paths. During the 9th conference of the Convention on Biological Diversity in Bonn in May 2008, the idea of generating revenue through shares for "Biodiversity Funds" (similar to the Carbon Fund activities) has received public attention. Madagascar has another fortune in this respect and can make a financial fortune by managing these biotic resources. It might be wise also from a purely economic point of view to keep as much biodiversity in the "savings account" as possible. Madagascar has been the shining star when His Excellency, Monsieur le Président Marc Ravalomanana presented his "Durban Vision". Madagascar once again could become a world model for the integration of economic development and nature conservation under the roof of national law and uniform standards applied to all activities alike.

Nécrologie Gisèle Randria-Ravololonarivo (1954-2008)

Professeur RANDRIA-RAVOLOLONARIVO Gisèle fut née à Antananarivo le 17 Août 1954. Elle a obtenu son Doctorat de 3eme cycle en Anthropologie Biologique, option Primatologie à l'Université d'Antananarivo, Faculté des Sciences en 1990, et sa thèse de Doctorat d'Etat intitulée "Evidences sur la morphologie, analyses phénétique et cladistique des Lemuridae (Gray, 1821)" dans la même option en 1998.

Dès l'obtention de son DEA en 1983, elle a travaillé à la Faculté des Sciences de l'Université d'Antananarivo, en tant qu'enseignant-chercheur du Département de Paléontologie et d'Anthropologie Biologique, occupant le poste d'Assistant en 1983, de Maitre-assistant en 1990 et de Professeur d'Enseignement Supérieur et de Recherche depuis l'an 2000. Elle était le Directeur du Laboratoire de Primatologie et Biologie Evolutive depuis 1998, et le Responsable de la Formation en Troisième cycle dans le Département de Paléontologie et d'Anthropologie Biologique depuis 2000.

Elle a encadré plusieurs étudiants de 3ème cycle dans l'élaboration de mémoires de DEA et de thèses de doctorat de 3ème cycle, particulièrement dans l'option Primatologie. Elle fut aussi parmi les membres fondateurs du GERP (Groupe d'Etude et de Recherche sur les Primates) et a participé activement à l'organisation et à la tenue du 17ème Congrès de l'IPS qui a eu lieu à Antananarivo en 1998. Professeur Randria Gisèle était aussi membre du REPC (Réseau des Educateurs Professionnels de la Conservation à Madagascar) et du GDRI (Groupement de Recherche International).

Gisèle Francine Noro Randria

Ceux qui l'ont connue ont apprécié en elle son franc-parler et sa générosité. Nous regrettons tous son décès, et nous pouvons dire que nous avons perdu, non seulement une grande amie, mais aussi une personnalité de la nation malgache.

August 17, 1954 – February 11, 2008

Dr. Gisèle Francine Noro Randria (born Ravololonarivo), Chevalier de l'Ordre National de Madagascar, and Professor of Biological Anthropology at the Département de Paléontologie et d'Anthropologie Biologique, Faculté des Sciences, Université d'Antananarivo, Madagascar, died tragically on February 11, 2008. She was 54 years old. Dr. Randria was in charge of doctoral training for students in Earth Sciences and Evolution, Director of the Laboratoire de Primatologie.

After receiving her D.E.A. in Biological Anthropology in 1983, Ms. Randria pursued her "Thése de Doctorat de Troisième Cycle" in Primatology at the University of Antananarivo. She had received prior field training in

geology in the regions of Antsirabe (1978) on the road to Morondava (1979) and in the regions of Antsirabe, Tuléar, Fort Dauphin, Diégo, and Tamatave (1980). In 1980 she conducted primatological field research as a member of Dr. Alison Jolly's team at Berenty, and then in 1984 and 1985, she conducted paleontological excavations at Antsirabe and then Ankarana Diégo. She settled on a research project on the vertebral anatomy of a genus of extinct lemur, *Pachylemur*, for her Thèse de Troisième Cycle. She began compiling data on the vertebrae in the collections in Antananarivo, and then, in 1986, she spent one month collecting comparative data at the Laboratoire d'Anatomie Comparée du Muséum National d'Histoire Naturelle (Paris, France), and five months in the USA (in part at the Museum of Comparative Zoology, Harvard University, Cambridge, MA, in part at the American Museum of Natural History in New York, and in part at the University of Massachusetts, Amherst). During the latter, she lived with me, and we became life-long friends. Her first child, Myria, was very young at the time. Gisèle missed her terribly, and was glad to have my daughter, Mollie (then 7 years old) as a household companion. Mollie delighted in showing Gisèle how, in the cold winter of Massachusetts, one could walk on lakes. And when Gisèle was not hard at work, Mollie would take every opportunity to teach her the correct pronunciation of difficult English words, such as "the". Over and over again! Every evening after Mollie went to bed, Gisèle and I would settle down to work, sometimes well into the night. It was then that she learned certain analytical tools – the tools of cladistic and phenetic analysis – that she applied in her study of the vertebral column of *Pachylemur* (Randria 1990). Her work on the vertebral column of *Pachylemur* laid the foundation for her broader cladistic analysis of the cranial and postcranial morphology of extinct and extant Lemuridae, a study published both as her doctoral dissertation (Randria 1998), and in the book, *New Directions in Lemur Studies* (Randria 1999). It also provided an impetus for a collaborative analysis of the lumbar vertebrae of all subfossil lemurs (Shapiro *et al*. 2005). For her doctoral research, Gisèle collected an enormous amount of comparative skeletal data (in 1996 and 1997) at the Laboratoire d'Anatomie Comparée du Muséum National d'Histoire Naturelle de Paris, France, and, in the USA: the Field Museum of Natural History in Chicago, IL, the Museum of Comparative Zoology, Cambridge, MA, the American Museum of Natural History, New York, NY, and once again, the University of Massachusetts, Amherst. Once again she applied a variety of techniques, using cladistic software as well as SPSS to apply multivariate techniques such as principal components analysis to her morphometric data. These techniques were to become her trademark as a professor at the University of Antananarivo. Later (2005), she received training in the Laboratory of Genetics at Omaha's Henry Doorly Zoo, in Nebraska, USA. Her publications span a wide range of topics, from the behavioral ecology, genetics and conservation of living lemurs to the morphology and evolution of extinct and extant lemurs.

Beginning well before she completed her doctorate, Gisèle Randria became an educator *par excellence*. She taught students at every level in her university program (primatology, vertebrate paleontology, cladistics, and so on). She always encouraged her students to work hard and excel, and sought new research opportunities for them. Sometimes she teased them if their skills at anatomical illustration were not up to par (in good fun, she told Emilienne Rasoazanabary that her drawing of a skull of a lemur looked more like a car than a skull). In 1983, she became an Assistant at the Université d'Antananarivo; in 1990, Maître-Assistant; in 2000, Professeur d'Enseignement Supérieur et Recherche. Her administrative responsibilities were varied, and included, since 1994, member of the Bureau du G.E.R.P. (Groupe d'Etudes et de Recherche sur les Primates); since 1995, member of the Conseil Scientifique de la Faculté des Sciences; since 1998, Director of the Laboratoire de Primatologie et Biologie Evolutive; since 2000, member of the Conseil de discipline (CODIS) de l'Université d'Antananarivo (Faculté des Sciences); since 2004, member of the Réseau des Educateurs et Professionnels de la Conservation à Madagascar (REPC); and since 2006, member of the Groupement de Recherche International (GDRI). She has been responsible for students completing their doctorates "en troisième cycle" in the Département de Paléontologie et d'Anthropologie Biologique since 2000, and in 2007, she assumed responsibility for the doctoral education of students in the Sciences de la Terre et Evolution.

At a personal level, Gisèle was ambitious and warm; she opened her house to visitors from abroad, and took seriously her responsibility as educator of a generation of Malagasy students in biological anthropology and primatology. She was also a facilitator of research, not merely for her students but for foreign researchers, such as myself. I became, effectively, a member of her family, attending family weddings and other functions, visiting relatives, watching her daughter Myria, and then her son José and second daughter Tsianiva, grow into marvelous young people. Her loving husband Narcisse has been a joy to know; his wit, warmth and complete devotion to his wife and children have been a constant inspiration.

It is tragic that Dr. Randria's career, which was gaining so much momentum during the past decade, was eclipsed by her premature death. I will always be grateful for how she and her family have enriched my life, how she facilitated my own research in Madagascar, and how she, through her dedicated, tireless work, has contributed to the field not merely through her own research, but through that of her many students.

Shapiro, L.J.; Seiffert, C.V.M.; Godfrey, L.R.; Jungers, W.L.; Simons, E.L.; Randria, G.F.N. 2005: Morphometric analysis of lumbar vertebrae in extinct Malagasy strepsirrhines. Am. J. Phys. Anthropol. 128: 823-839.

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

Randria, G.F.N. 1998. Morphologie, analyses phénetique et cladistique des Lemuridae (Gray, 1921). Thèse de Doctorat d'Etat.

Randria, G.F.N. 1990. Contribution à l'étude de la colonne vertébrale du genre *Pachylemur* (Lamberton, 1946) – Anatomie et Analyse cladistique. Thèse de Doctorat de 3^{é} cycle.

Laurie Godfrey, April 15, 2008

NEWS and ANNOUNCEMENTS

Directives de la Direction Inter régionale de Toamasina d'ANGAP pour les recherches dans les Aires Protégées sous sa juridiction

Après consultation de tous les Chefs d'Unités de gestion rattachés à la Direction Inter Régionale de Toamasina, il a été arrêté que le nombre de chercheur pour chaque autorisation est limité comme suit dans les sept aires protégées: PN Andasibe Mantadia, RS Mangerivola, RNI Betampona, PN Zahamena, RS Ambatovaky, PN Mananara, PN Masoala.
Dont 1 chercheur principal, 3 assistants dont 1 étranger et 2 malagasy, 2 encadreurs dont 1 malagasy et 1 étranger pour que les sites puissent suivre les activités respectives des chercheurs.

Chantal Andrianarivo

Sir Peter Scott Award Presented to Dr. Russ Mittermeier

Holly Dublin, Chair of the SSC, presented Dr. Russell Mittermeier with the Sir Peter Scott Award for Conservation Merit at the recent meeting of the SSC Specialist Group Chairs in Al Ain, UAE. This award is presented to individuals in recognition of significant and long term service to conservation through their work with the SSC or associated institutions. Achievements are recognizable as particularly significant and noteworthy contributions to the conservation of wild fauna and flora, especially threatened species.

New Editor for Madagascar Conservation & Development

The current Editor-in-Chief of the Madagascar Conservation & Development Journal, Stephanie Zuellig, handed over this task and duty with immediate effect to Lucienne Wilmé. Stephanie wants to continue focusing on the layout process of the journal. We would like to thank her for all her efforts and time invested so far for the Editor-in-Chief job. Lucienne Wilmé is a biologist, and associated researcher at the Missouri Botanical Garden, Madagascar. She brings with her more than two decades of Madagascar experience. The whole MCD team would like to award a very warm welcome to Lucienne.

The Founder Editors: **Patrick Waeber (MWC) and Daniel Haenni (JGI Switzerland)**

New Editor for The American Journal of Primatology

Paul A. Garber, University of Illinois is the new Editor in Chief for the American Journal of Primatology.

New editors for IUCN/SSC/PSG regional journals

AFRICAN PRIMATES, the Journal of the Africa Section of the IUCN/SSC Primate Specialist Group, has a new senior editor in Carolyn Ehardt. Caroline invites you to submit manuscripts, short communications, and news items to: **Carolyn.Ehardt@utsa.edu**

ASIAN PRIMATES: Jatna Supriatna (Conservation International Indonesia) and Ramesh Boonratana (Mahidol University, Thailand) have launched Asian Primates – Journal of the Asian Section of the IUCN/SSC Primate Specialist Group, supported by Conservation International, the IUCN Species Survival Commission, and the South East Asian Primatological Association (SEAPA). Ardith Eudey will be continuing with the news section off Asian Primates, which she will be maintaining electronically in the future. Please send her appropriate news items for the PSG network of Asian primatologists. **eudey@aol.com**

Gestionnaire de la forêt de Maromizaha

Le GERP est officiellement le Gestionnaire de la forêt de Maromizaha. Une cérémonie de présentation organisée par la CIREEFT Moramanga et la DGEEF était survenue le vendredi 07 mars 2008 à Maromiza. Des autorités locales et des organismes environnementaux ainsi que les communautés locales y ont assistés.

Primate Info Net

A new "Rainforest Sifaka Fact Sheet" on taxonomy, morphology, ecology, behavior, conservation, with references and links can be found online at Primate Info **http://pin.primate.wisc.edu/factsheets/entry/diademed_sifaka**

IPS Grants and Awards for 2007 and 2008

Congratulations to all the winners and many thanks to the applicants and review committees.
For more information on these programs please see: **www.internationalprimatologicalsociety.org/funding.cfm**

Grants and Awards for 2007

IPS Research Grants
Alison Behie: The roles of nutrition, stress and parasites in determining population density in black howlers
Sarah Carnegie: Reproductive strategies and hormonal patterns in wild female white-faced capuchins
Marietta Dindo: Investigating primate social learning and culture
Kathelijne Koops: Elementary technology of foraging and shelter in the chimpanzees of Nimba Mountains, Guinea
Marie Pele: What is the influence of psychological traits in the ability of macaques to delay gratification?
Fiona Stewart: The evolution of shelter: Modeling human origins through field study of chimpanzee nest building

Michael Wasserman: The role of phytoestrogens in the feeding ecology of red colobus monkeys

Charles Southwick Conservation Education Commitment Award
Jerry Akparawa, CERCOPAN

Lawrence Jacobsen Education Development Award
Christos Astaras: Raising Awareness About Drill Conservation Status Among Youth at Korup Region, Southwest Cameroon
Marina Cords: Kakamega Environmental Education Program: Building a Conservation Education Center at Kibiri
Damodar Gaire: Creation of Community Awareness on Primate Conservation among the School Students and Indigenous People in the Buffer Zone of Bardia National Park, Nepal

IPS Captive Care Grants
Sagan Friant: An Investigation of the Gastrointestinal Parasites in Wild and Captive Cercopithecine Primates of Southern Nigeria
Natalia Ceballos-Mago: Survey of Margarita capuchin monkey, *Cebus apella margaritae* and other monkey species in captivity on Margarita Island, Venezuela
Doug Cress: Pan African Sanctuary Alliance (PASA) Population Project/Chimfunshi, Zambia

IPS Conservation Grants
Abby Baird: RAPID - Development of playback for rapid population assessment of the critically endangered brown-headed spider monkey (*Ateles fusciceps*) in Ecuador
Catherine Cooke: An assessment of primate species abundance and habitat use in Sette Cama and south Loango Park, Gabon
Antje Engelhart: Reproductive biology of wild Sulawesi-crested black macaques (*Macaca nigra*) in the Tangkoko-Batuangus Nature Reserve
Nguyen Man Ha: Primate Survey, with special focus on Hatinh langur (*Trachipithecus laotum hatinhensis*), red-shanked douc (*Pygathrix nemaeus*) and white cheeked gibbon (*Nomascus leucogenys*) in Huong Hoa district, Quang Tri province, Vietnam
Stacy Lindshield: Bridging Conservation and Development: Applied Primate Conservation in the Talamanca Region, Costa Rica
Alexandre Nascimento: Black-faced lion tamarin (*Leontopithecus caissara*) Conservation Program: Implementing Action Plan through filling data gaps
Felicia Ruperti: Population density and habitat preferences of the Sahamalaza sportive lemur (*Lepilemur sahamalazensis*)

Martha J. Galante Award
Martin Kowalewski

Grants and Awards for 2008

IPS Conservation Grants
Juliet Wright: The Lebialem Hunters' Beekeeping Initiative in Southwest Cameroon
Cuozzo Frank: An Ethnoprimatological Approach to Assessing Feral Animal Predation of Endangered Wild Lemurs and Domestic Livestock at Beza Mahafaly, Madagascar
Hsio Sara: Evaluation and monitoring of crop raiding mitigation strategies in villages around Budongo Forest Reserve, Uganda
Riccardo Pansini: Stress behavior and personalities of wild vervet monkeys (*Chlorocaebus aethiops*)
James Robins: Assessing the impact of anthropogenic activities on the distribution of proboscis monkeys (*Nasalis larvatus*) in Danau Sentarum National Park, West Kalimantan, Indonesia
Suzanne Hagell: Assessing Landscape Connectivity for Spider Monkeys (*Ateles geoffroyi*) in Southwestern Nicaragua
Tumukunde Alex: Expectations of Local Communities towards Ecotourism and its Potential for Conservation of Mountain Gorillas and Forest Habitats of Bwindi Impenetrable National Park

Martha J. Galante Award
Ndeloh Etiendem

IPS Research Grants
Mary Blair: Habitat modification and gene flow in *Saimiri oerstedii*
Kimberly Dingess: Social monogamy in the Bolivian gray titi monkey, *Callicebus donacophilus*: Conflict or cooperation?
Michelle Brown: Predicting intergroup relationships
Mackenzie Bergstrom: Dominance among female white-faced Capuchins
Robin Bernstein: Hormonal correlates of divergent growth trajectories in male anubis and hamadryas baboons
Cynthia Thompson: Why fight? Adressing the ultimate causes of aggressive intertroop encounters in white faced saki monkeys (*Pithecia pithecia*)
Lauren Brent: Sociability, coalitionary support and stress in female rhesus monkeys

IPS Captive Care Grants
Doug Cress/Claire Coulson (PASA): Enclosure Project for Endangered Guenons at the CERCOPAN Primate Sanctuary in Nigeria
Noruki Morimura: Reducing Aggression in Multi-male and Multi-female Chimpanzee Group Formation at the Chimpanzee Sanctuary UTO, Japan
Suzanne Turnock: The effect of environmental enrichment on the locomotive, feeding and social behavior of spider monkeys (*Ateles geoffroyi*) in the Zoologico Nacional, Honduras

The Charles Southwick Conservation Education Commitment Award
Pierrot Mbonzo, PASA
Mugabe Rbert and Byamukama Lawrence, Jane Goodall Institute

The Lawrence Jacobsen Education Development Award
Sian Sara Waters: Barbary Macaque Conservation in the Rif (BMCRif) - Education and Awareness Raising Among School Age Children
Allai Orimba: Grass root Empowerment for the Conservation of *Papio anubis* (Olive Baboon) in Kajulu Hills-Kenya
Tricia Parish: Identifying the CITES Appendix I listed Asian slow loris (*Nyctibcebus*): a training program for enforcement officials and rescue centers in Southeast Asia
Corrin La Combe: Completing the Conservation: Modifcation and Evaluation of Hooklock Gibbon (*Hoolock hoolock*) Conservation Education Program in Bangladesh.

Funds awarded by the Primate Action Fund

Christoph Schwitzer: Population density and habitat preferences of the Sahamalaza sportive lemur (*Lepilemur sahamalazensis*)

Elise Queslin: A pilot study on the diet, feeding behavior and ecology of the silky sifaka, *Propithecus candidus* in the humid rain forest of Marojejy National Park, Madagascar

Natalie Vasey: Alloparenting in red ruffed lemurs (*Varecia rubra*) in the Masoala Peninsula, Madagascar

Annemarie C. Rued, Steig Johnson, Jonah Ratsimbazafy: Social structure and female foraging strategies in white-collared lemurs (*Eulemur albocollaris*) of southeastern Madagascar

Christina Ingraldi, Steig Johnnson: Edge Effects on the White-Collared Lemur, *Eulemur albocollaris*, and seven sympatric lemur species in southeast Madagascar

Rachel Jacobs, Patricia Wright: The crisis of the greater bamboo lemur: resurveying *Prolemur simus* sites in Madagascar to determine population numbers of a critically endangered primate

Marina Blanco, Laurie Godfrey: Reproductive biology of cheirogaleids in the eastern rain forest of Madagascar

Peter M. Kappeler: Reasssessment of the distribution and abundance of *Cheirogaleus medius* in Kirindy Forest/CFPF, Western Madgascar

Matthias Markolf: Assessment of the geographical distribution and the conservation status of *Mirza zaza*

Ed Louis: Monitoring and home-range analysis of *Prolemur simus* in the Torotorofotsy wetlands

Cristina Giacoma: *Indri* population biology

Madagascar Fauna Group marks its 20th anniversary of conservation, education and training in Madagascar

The Madagascar Fauna Group (MFG) was founded as a consortium in 1988 on the basic principle that uniting zoos, aquariums, botanical gardens, universities and related conservation organizations under one umbrella significantly increases the contribution any one institution can make on its own in Madagascar. Indeed, the strength of the MFG consortium is derived from collaboratively pooling limited resources to enact a long term and continuous conservation program that is managed by our in-country staff within the framework of local needs, policies and politics.

For 20 continuous years, the MFG has worked in partnership with the Government of Madagascar to contribute to the country's efforts to overcome the environmental crisis which so negatively affects its wildlife, natural habitats and the future of its people. The MFG bases its activities at two linked sites, Parc Ivoloina and Betampona Nature Reserve, both located within 40 kilometers of the coastal town of Toamasina in eastern Madagascar. The MFG's work has always been based on the broad environmental objectives identified at the national level and refined at the local level.

Parc Ivoloina is located in a Forest Station, a unique facility for conservation education and training. Facilities includes a small zoo that holds important stock of endangered Malagasy species as a reservoir for several global breeding programs, with a current collection of lemurs, tortoises and a few other reptiles and amphibians. In collaboration with Missouri Botanical Garden, an *ex-situ* plant conservation unit has also been created. A matrix of forest and lake habitats with a community of endemic species provides sites for practical training and student field projects. The Ivoloina Environmental Education Center is a nationally recognized facility for teacher training and a regional base for public awareness about conservation and current environmental issues. Special annual programs help prepare local primary school children to advance to secondary school, and the Education Center receives national visitors from all over the island.

The new Ivoloina Conservation Training Center and associated Agroforestry Model Station have been developed with the primary objective of building local capacity in conservation biology and natural resource management. The ICTC now serves different local stakeholders for numerous trainings and events, with a meeting hall, laboratory, computer room/library and dormitory. MFG, Appalachian State University (North Carolina) and the University of Toamasina's Department of Natural Resources (GRENE) have a collaboration to promote education, training and research activities in ecoagriculture, agroforestry, soil conservation and fertility, tree nursery practices, seed management and restoration ecology. MFG also offers ecoagriculture workshops for local farmers with reforestation programs both at MFG project sites and in neighboring villages.

The Nature Reserve of Betampona consists of 2,228 ha of lowland rainforest. MFG's initial surveys focused on the reserve's lemur populations and the restocking of black and white ruffed lemurs from captive stock. This release project became the springboard for the MFG's broader conservation program that includes a research strategy which provides ANGAP with data for conservation management planning and prioritizes applied conservation research. The MFG has established a Research Station at the edge of the forest, with an active ecological research program involving both Malagasy and foreign university students and faculty. MFG conservation agents conduct systematic surveys and monitoring of plant and animal taxa, and a geo-referenced map of species distribution is being developed. Related activities at Betampona include creation of nurseries for endemic trees to supply local reforestation efforts and collaboration with neighboring villages to restore the Reserve's buffer zone. Environmental outreach and capacity building activities involve ANGAP personnel, regional mayors, farmers, school teachers and children.

Dr. An Bollen recently became the new in-country Program Manager for MFG, following the dedicated work of Dr. Karen Freeman and Gareth Kett (2004-2008) and Andrea Katz and Charlie Welch (1987-2004). Dr. Freeman continues as the MFG's Research Director; Ms. Katz and Mr. Welch continue as MFG Advisors. The scope of work of MFG has increased and diversified significantly from its early days. MFG's work today is based on four main pillars: research, conservation (both *in-* & *ex-situ*), environmental education and capacity building with a specific focus on sustainable natural resource management to promote conservation of biodiversity. By offering an integrated and complementary program, MFG strives to ensure the sustainability of its activities and sustainable conservation management in the long term.

Madagascar Fauna Group
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Et le massacre continue.... Nouvelle découverte d'une dépouille d'Aye-aye (*Daubentonia madagascariensis*) dans le nord de Madagascar

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Il est des jours où il vaudrait mieux ne pas se lever. Surtout lorsque ce jour là on découvre à nouveau une dépouille de Aye-aye (*Daubentonia madagascariensis*). De plus il s'agit de la 4ème dépouille trouvée en un peu moins de 2 ans. Et toutes ces dépouilles sont dues à des légendes d'un autre âge perpétuées par les populations locales qui veulent que la rencontre avec cette espèce porte malheur (Koenig 2005). Ce dernier animal a été trouvé à Djangoa, une commune située à 15 km au sud-ouest de la ville d'Ambanja dans la province d'Antsiranana (Diego-Suarez) en pleine région du Sambirano. Le cadavre était suspendu au bout d'un bâton au bord de la RN 6 à 13°15S et 48°20 E. Aussi malheureuse soit-elle cette découverte nous permet pourtant de confirmer la présence de l'espèce dans le nord-ouest de Madagascar. La région de Djangoa se trouve à 120 km au nord de la réserve spéciale de Bora (province de Mahajanga) dans laquelle deux dépouilles ont été trouvées (Koenig et Zavasoa 2006) et à environ 140 km au sud de la réserve des Tsingy de l'Ankarana (Rahajanirina et Dollar 2004). Le milieu où l'animal a été trouvé est assez dégradé et principalement peuplé d'arbres du voyageur (*Ravenala madagascariensis*). Même si nous aurions préféré trouver des animaux vivants, cette dernière découverte montre que la présence de l'espèce est géographiquement relativement continue.

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Killed aye-aye (*Daubentonia madagascariensis*) exposed on the gallows in northeastern Madagascar

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The aye-aye (*Daubentonia madagascariensis*) was considered as almost extinct some decades ago, but was recently recorded at many localities in eastern and even western forests though at rather low densities. Because of their nocturnal, cryptic habits and the inability to assess density from secondary signs such as feeding remains or nests, there is a paucity of accurate records on the abundance and distribution of *Daubentonia* in the wild (Sterling 2003). Due to its grotesque appearance the aye-aye is strongly affected by local taboos (fady) of native people in Madagascar. These "fady" vary from village to village, even within the same geographic region, and range from having to kill an aye-aye, burn down the village, and move when one is sighted, to believing that aye-ayes are embodiments of ancestral spirits accorded all the rites of a grand chieftain at death (Sterling 2003). Other authors describe the situation as follows: If it appears in a village, it is killed, exposed, but never eaten (Paulian 1981). Garbutt (1999) noted that in some areas they are thought to embody ancestral spirits and bring good luck. However, elsewhere they are considered as ill omens and may be killed, villagers sometimes then erect the tails of slaughtered aye-ayes on poles outside their dwellings (Koenig 2005; Koenig and Zavasoa this volume). According to Mittermeier *et al*. (2006) *Daubentonia* is still killed on sight in some areas as a harbinger of evil and also killed as a crop pest in coconut and lychee plantations, but, fortunately, is rarely hunted for food because of its evil reputation (Albignac 1987; Simons 1993; Simons and Meyers 2001). Habitat destruction and killing by humans are the primary threats to *Daubentonia* populations.

On Sunday, 20 February 2005, 15:45 pm, returning from an expedition to Marojejy National Park, we saw a killed adult male aye-aye exposed on the right border of the street Route Nationale west of Sambava. The lemur was hanging on the gallows with a rope around the neck that was fixed with a pole. The face was "looking" to the direction of Andapa, so that the animal was hardly to be overlooked by cars driving to Sambava. A part of the posterior skull was lacking which might indicate that the animal was killed by using a "coup-coup", a Malagasy bush knife. The injury of the skull was apparently rather fresh, indicating that the specimen was dead only since several hours (and clearly no longer than one day). We therefore assume that the aye-aye was killed in the region where it was exposed. The wider surroundings of the dead lemur were a mosaic of secondary forest, remains of primary forests, bush areas, agricultural fields and human settlements. About 100-200 m apart a soccer match with many spectators was just running. When we stopped our cars to photograph the dead lemur several people (the region is apparently dominated by the Betsimisaraka tribe) gathered around the location but none of them was able or willing to tell us the meaning or the reasons for killing the aye-aye. It is not clear if there was any relation with the soccer match (e. g. that the animal was used to bring bad luck to one of the teams). Our driver returned to Andapa in the morning of the 21. February and informed us later that the dead lemur had disappeared by then.

Our observations provide a new locality record for this species and the associated ritual killing of aye-ayes by Malagasy people. More efforts to sensitize the natives for the protection of the aye-aye would be desirable to reduce the threatening of this exceptional primate species.

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Transfert de gestion: Benana, Tsinjoarivo

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Background
The rural commune of Tsinjoarivo, 45 km southeast of Ambatolampy, contains the most intact and continuous eastern rainforest remaining in Antananarivo province (Fig. 1). Very few biological surveys have been conducted in the Tsinjoarivo region, but considerable biological biodiversity has already been documented with at least: 9-10 primates, 17 insectivores (including 16 endemic lipotyphlans), 7 rodents (including 5 endemic nesomyines), 5 carnivores (4 of which are endemic), 92 birds, 24 reptiles and 30 amphibians, and more than 200 species of flowering plants (Angiospermae). In 1999, a previously unknown local variant of *Propithecus diadema* (known as "sadabe") was discovered by K. Glander and colleagues (Fig. 2). Although morphologically distinct from other *P. diadema* populations, it is unclear whether this population is separated from *P. d. diadema* at the subspecific and possibly the species level. At the 2001 IUCN CAMP meeting in Madagascar, the Tsinjoarivo sifaka was recognized as a distinct taxon, and classified as critically endangered. Subsequently, the broader species *Propithecus diadema* (including the Tsinjoarivo variant) was also classified as critically endangered by the IUCN Redlist.

Fig. 2: Normal (left) and melanistic (right) forms of the critically endangered lemur species *Propithecus diadema* (diademed sifaka). Photos from Tsinjoarivo Forest.

Management Transfer ("Transfert de Gestion")
On August 28 2006, an association based in Beanana (Fokontany Ankazomena, Commune Rurale de Tsinjoarivo) was awarded a management transfer agreement by the Ministry of the Environment, Water and Forests (Antananarivo). In early 2007, the agreement was amended to include four associations – the one original association (based locally at Beanana) and three others (including one association based in Antananarivo). The decision to grant the transfer came from the Ministry in Antananarivo rather than the local water and forest offices in Antsirabe and Ambatolampy. The local government of Tsinjoarivo Commune had been working with biological researchers since 2000 and advocated the continuing protection of the Commune's forests, but lacked the authority to block the management transfer. The original agreement covered 800 hectares within Tsinjoarivo Commune, 20 km southeast of the town of Tsinjoarivo. The agreement was later amended to include 900 hectares. The eastern boundary of the area coincides with the administrative limit between Antananarivo and Toamasina provinces, and the area enclosed includes the most intact and undisturbed forest remaining in both Tsinjoarivo Commune and Antananarivo Province. The area was divided into three approximately equal-sized zones: a conservation area, an area of exploitation, and previously-cleared areas (cultivated or secondary forest). The agreement for the management of the three areas is as follows:

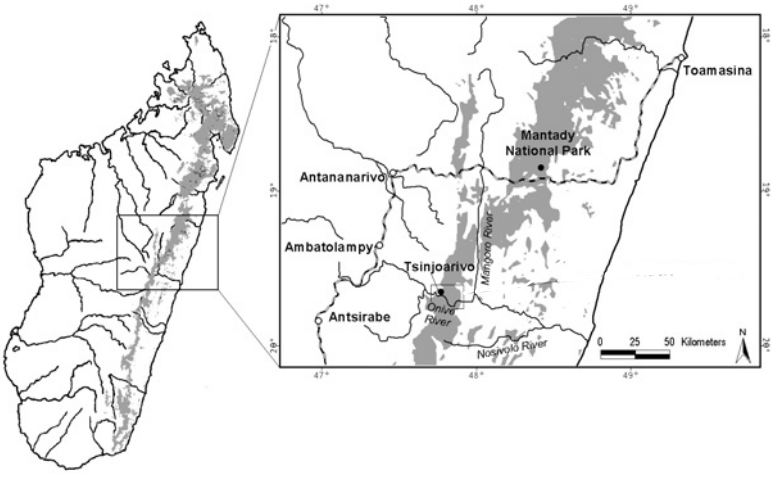

Fig. 1: Location of Tsinjoarivo forest within Madagascar. Forest cover after Green and Sussman (1990).

1. *Area conservation*: Within the conservation area, no exploitation is allowed.
2. *Exploitation area*: Within the exploitation area, the four participating associations are permitted to cut trees for sale, within specified limits. Specifically, harvesting is limited by: tree species, tree size and number of trees per hectare. Only trees marked by the Chef de Cantonnement Forestier (Ambatolampy) may be harvested.
3. *Previously-cleared areas*: Within the previously-cleared areas, the association is obliged to plant trees within all areas of >15 degrees slope, in order to return these areas to forest cover. Additionally, the association agrees to stop all tavy activities (slash-and-burn clearing of primary *and* secondary forest) but local people may continue to cultivate already-cleared areas of <15 degrees slope.

In general, the logic of the transfer dictates that local people:
1. Stop the clearing and burning of primary and secondary forest.
2. Return to forest cover all areas of slope >15 degrees.
3. Receive a share of the profits from exploitation as a compensation for the loss of previously-cultivated areas.

Assuming that the rules of the convention are followed, and that selectively-logged forest may effectively regenerate and continue to support its resident biodiversity, this logic seems to be an appropriate framework for managing the landscape. The water and forest team who delimited the transferred area in the field expressed the philosophy that it is better to control the use of the forest, than to leave it vulnerable to illegal slash-and-burn clearing.

However, the reality of the situation on the ground is inconsistent with the original logic of the transfer, for the following reasons:
1. Research in Madagascar and elsewhere has shown that selectively-logged forest (even with low harvest levels) supports only a fraction of the biodiversity it once contained. The transferred forests are therefore likely to lose a significant proportion of their biodiversity. The most vulnerable species tend to be large-bodied and frugivorous – therefore the three largest lemur species found at Tsinjoarivo are at risk of local extinction within the transferred area – the brown lemur (*Eulemur fulvus*), the red-bellied lemur (*Eulemur* rubriventer) and the critically-endangered diademed sifaka (*Propithecus diadema*). The time required for selectively-logged tropical forests to return to their natural state is on the order of several decades, and many forests never return to their natural state.
2. Research teams at Tsinjoarivo have already observed several breaches of the original agreement on the part of the local people. First, they continue to cultivate areas >15 degrees slope. Second, they still burn secondary forest to prepare land for cultivation. Third, areas of primary forest continue to be cleared by slash-and-burn activity. Fourth, local people have exceeded the harvesting limits by cutting trees not previously marked by the Ambatolampy Water and Forests Personnel.
3. Observing the ongoing exploitation has a significant and negative impact on the motivation of the local people to conserve the remaining forest areas. Previously, local farmers did not completely follow the national laws regarding land use (e.g. they cultivated high-lying areas), but much of the remaining forest area remained relatively intact. Now, seeing that many of the larger trees are being cut and taken to Antananarivo by truck, the motivation for local people to cut illegally has increased. First, because of the ongoing legal cutting, illegal cutting is less likely to be noticed by authorities. Second, the land transfer has lead to an "if the government can exploit the forest, so can I" attitude – and many local people seem to be cutting trees either for sale or for local construction. As a result, the impact on the exploited areas will be much greater than predicted by the original harvesting limits.
   This negative impact is not limited to the transferred area. People from all surrounding regions have been observing the exploitation at Beanana and are already starting to: (1) increase illegal exploitation of the forest, and (2) seek to form associations and negotiate management transfers of other areas. Thus, even people who previously were in favor of conserving remaining forests seem to be reconsidering their position and seeking to profit from their local forests. Therefore, all forest within Tsinjoarivo commune (as well as the adjoining forest in Toamasina province to the east) is threatened by the complex social effects of the management transfer.
4. Financial benefits of exploitation are not being evenly distributed among the local community. Specifically, members of the original association receive financial compensation for the trees sold and pay workers (most of whom have arrived from other regions) to cut the trees. This has caused discontentment among people living within the transferred area who are not within the association. This has in turn contributed to many of the breaches of the original agreement (e.g. burning of secondary and primary forest, continued cultivation of areas >15 degrees slope).
   Additionally, many of the tree-cutters were originally local people but they have gradually been replaced by workers from other areas, often far away. This contributed financially to the local community in a very small way – for example, one team of workers might receive 3,000 Ariary (USD 1.50) for each large tole (18 x 18 x 200 cm) that they cut and deliver to the staging area where it can be picked up by the truck. However, these workers generally have more experience cutting trees and can work faster than the local people, further reducing the local financial benefit.
5. The acquisition of the legal papers to transport cut trees by truck to Antananarivo may contribute to illegal exploitation of the conservation zone and areas around the transferred forest. Because police on the road cannot determine where trees were cut, it is relatively easy to transport illegally-cut trees using the legal papers from the Management Transfer.
6. The construction of the road in order to allow access by rented trucks to collect the cut trees required the clearing of a substantial forest area and caused associated disturbance of the forest edge near the road.
7. Very little terrain has been subject to planting of trees, and those planted have been the exotic *Eucalyptus* species but not native forest trees. Such reforestation will provide timber for local communities in the future but will not support populations of endemic plant and animal species. Additionally, most of the areas >15 degree slope have not been reforested as per the original agreement, but actually remain under cultivation as of July 2007.

Fig. 3: Forest exploitation at Beanana, Tsinjoarivo Commune.

An Alternative: Tsinjoarivo as a Tourist Destination

Because it is located near Antananarivo (about 140 kilometers south/southeast), Tsinjoarivo is a natural destination point for Malagasy and foreign tourists to visit and experience the vast diversity of animal and plant life for which Madagascar is known. The behavioral research of TFFP has already led to the habituation of four groups of *Propithecus diadema* which can be observed at close range (to 2 m). The topography of the region has also resulted in steep escarpments, mountain peaks and well-known waterfalls both at Tsinjoarivo and farther east in the continuous forest, adding a scenic component to the potential tourist experience. Finally, Tsinjoarivo also contains the historically important Rova (Queen's summer palace), which is currently being rehabilitated by the partnership for development between Vakinankaratra Region and Auvergne Region (in France). This unique combination of biodiversity and history provides a unique opportunity for a combined and integrated tourist attraction unmatched in other protected areas in Madagascar.

The protected area system at Analamazaotra/Mantadia could be used as a model for designing the Tsinjoarivo protected area, with one or more smaller, more accessible parcels dedicated to tourism and a larger, more remote parcel dedicated to biodiversity conservation. The administrative and financial linkage of two such parcels would allow the income generated by the tourist-accessible forest to fund the continued protection of the larger, more remote parcel.

The exploitation activities constitute a direct threat to the potential for ecotourism. The most accessible *Propithecus diadema* population is found at Mahatsinjo, 15 km southeast of Tsinjoarivo (currently the only population accessible by car). However, this population is extremely small, numbering approximately 5 groups and 20 animals - not sustainable in the long-term without gene flow from other areas. The only nearby forests containing *P. diadema* are to the south and southeast: the regions currently being exploited under the management transfer. If the populations in these areas are driven to extinction by the exploitation, the Mahatsinjo population will become isolated and will almost certainly go extinct.

Tsinjoarivo Forest, a Unique and Irreplaceable Part of Madagascar's Natural Heritage

There are 4 reasons that Tsinjoarivo Forest makes a rich and unique contribution to the natural heritage of Madgascar's remaining forests:

1. Under-representation of Antananarivo Province in protected area system: Presently, only one of Madagascar's protected areas is found in Antananarivo province: RS d'Ambohitantely, a fragmented, high-altitude central plateau forest ecosystem. Addition of Tsinjoarivo forest to Antananarivo province's protected areas would ensure the protection of more of this province's forest, and add a new forest type (rainforest) to its collection of protected areas.
2. Under-representation of high-altitude eastern rainforest in protected area system: High-altitude eastern rainforests are under-represented in Madagascar's protected area system. Because of its unusually high altitude (1400-1650 m), Tsinjoarivo forest is likely to contain many plant and animal species not found in pre-existing protected areas.
3. River barriers: Presently, no protected area exists north of the Onive river and west of the Mangoro river. These barriers to species dispersal have likely led to a unique animal and plant community in the Tsinjoarivo region, containing species not represented in other protected areas.
4. High potential for development of rich and successful integrated tourism programs: The combination of scenery, rich biodiversity, rich cultural history (Queen's summer palace) and proximity to Antananarivo are all contributing factors which could make Tsinjoarivo an attractive destination for Malagasy and foreign tourists.

Therefore, we hold the position that:

1. The reality of the management transfer on the ground is inconsistent with: (1) the original motivation of the transfer for better management of land use at Tsinjoarivo, (2) a long-term vision of improving life for local people over the long term, and (3) conservation of the rich and unique biodiversity found in Tsinjoarivo Forest.
2. The biodiversity of Tsinjoarivo Forest (including the critically endangered lemur *Propithecus diadema*) represents both a unique part of Madagascar's natural heritage and the world's natural heritage. As such the national government and international stakeholders should strive to assure its continued existence.
3. There are viable alternatives to the short-term strategy of forest exploitation which may provide a more sustainable benefit for local people while conserving biodiversity - such as the ecotourism initiative alrea-

dy initiated by the Tsinjoarivo Forest Fragments Project in collaboration with the partnership for development between Vakinankaratra Region and Auvergne Region (in France).

Inventaire biologique des lémuriens diurnes et nocturnes dans la forêt classée de Matsandre, Fokontany de Fenaivo, Commune rurale d'Ifotaka, District d'Amboasary Sud, Région d'Androy

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Mots Clés: Lémuriens, Densité de population, Forêt dense sèche, Plateaux calcaires, Matsandre

La biogéographie de certaines populations de la faune des lémuriens présente encore des incertitudes. Ainsi, la limite de la distribution de quelques espèces de ces lémuriens est encore floue. Le but de la présente mission était d'effectuer un inventaire biologique des lémuriens dans la forêt classée de Matsandre, du Village de Fenaivo, Commune rurale d'Ifotaka, District d'Amboasary Sud, Région d'Androy.
L'objectif principal de cet inventaire est de collecter des informations sur la communauté des lémuriens de la région en vue d'établir une base scientifique pour un programme de protection, de conservation et de gestion environnementale de cette zone en utilisant la technique d'évaluation rapide.

Méthodes

Site d'étude: Forêt classée de Matsandre
Cette forêt se trouve dans la rive Est de la rivière de Matsandre, dans le Fokontany de Fenaivo, Commune rurale d'Ifotaka. Les villageois de Fenaivo utilisent beaucoup cette forêt. Ils s'adonnent à une exploitation illicite et sélective du bois de forêt pour la construction et l'ébénisterie en quantité relativement importante (fabrication de planches sur place et leur transport en charrettes). La collecte d'ignames sauvages et l'élevage bovin, caprin dans la forêt qui détruit les composantes biologiques de la forêt s'observent dans cette forêt. On a pu noter tout cela lors du comptage des lémuriens le long du transect effectué. Malgré cela, cette forêt est remarquable: Elle est dominée par l'abondance des espèces des *Alluaudia procera* de 12 à 15 m de haut, dont le substrat est constitué de roches sédimentaires. L'inventaire intensif des lémuriens a été effectué dans une partie de cette forêt xérophile.

Observations: Les méthodes directes
Elles comprennent les observations éventuellement, voir l'animal ou écouter les cris ou autres sons. Pour la plupart des comportements, les animaux communiquent de trois manières (1) Visuel – démonstration, signes (vue), (2) Auditif – production de sons (écouté), et (3) Olfactif – traces d'odeurs (sentir). Au cours de la présente étude, nous avons compté et identifié les groupes d'animaux en suivant des itinéraires – échantillons définis selon les différents types d'habitats et de niches écologique existants, de l'altitude, bordures de cours d'eau et de différentes pistes dans la forêt.
Nous avons utilisé un transect de 3500 m dans lequel, on a mis en place des flags tous les 25 m. Nous avons appliqué la méthode de transect pour compter les lémuriens rencontrés ici, le long de ce trajet préalablement choisi. Les heures d'observations sont effectués entre 7 heures 34 et 11 heures 02, le 1er jour et entre 7 heures 05 et 9 heures 35, le 2ème jour au mois de mars. 2008. Pour chaque animal rencontré, on mesure la distance perpendiculaire au chemin. La moyenne de ces distances est prise comme la distance qu'on a surveillée ou observée est calculée à gauche et à droite comme suit: Soit S, la surface surveillée (S) = longueur du transect (L) x 2 x distance moyenne (W). Le nombre des animaux trouvés ou observés (N) divisé par la surface (S) donne une estimation de la densité (D) de la population d'où la formule:

$$D = \frac{N}{L \times 2 \times W}$$

Parfois, le son et les cris des animaux permettent de les connaître à distance. On n'a pas effectué des observations nocturnes dans cette forêt.

Observations: Les méthodes indirectes
Cela implique la recherche de traces indiquant la présence dans une zone et éventuellement les types d'activité (comportement). Les principaux types de traces sont: les traces de nourriture, restes de nourritures, farces (crottes ou autres), et les habitations, abris, nids et trous d'arbres. En effet, le recensement devrait se faire par la détection de ces indices de présence.
Un autre aspect de l'étude indirecte est d'interviewer la population locale sur l'apparition de l'espèce qui vous intéresse. Dans ce cas, on mène des enquêtes sur: la présence des autres espèces de primates, la fréquence

Fig. 1: *Propithecus verreauxi* (Sifa-bilany) sur *Alluaudia procera.*

du ou des groupes en question, l'abondance, la relation du groupe avec les activités humaines, la pression ou la raison de la régression du groupe.

Résultats et Interprétation

Méthode directe: Observations directes
Dans la forêt classée de Matsandre, une espèce de lémurien diurne a été inventoriée telle que le *Propithecus verreauxi*. Lors de nos observations dans le transect, on n'y a pas rencontré l'espèce *Lemur catta* mais 8 groupes de *P. verreauxi* constitués de 24 individus. Cette situation pourrait être due à l'abondance de la fréquentation du chien. Nous avons effectivement vu un chien qui aboie en apercevant un groupe de *P. verreauxi.*

Méthodes indirectes
On a trouvé un *Lepilemur leucopus* dans cette forêt en cherchant les trous d'arbres. Le lepimeur est sortie de son trou et se cache entre les branches fourchues de *Didiera trolli*, à une hauteur de 5 m environ, vers 9 heures du matin (Fig. 2).

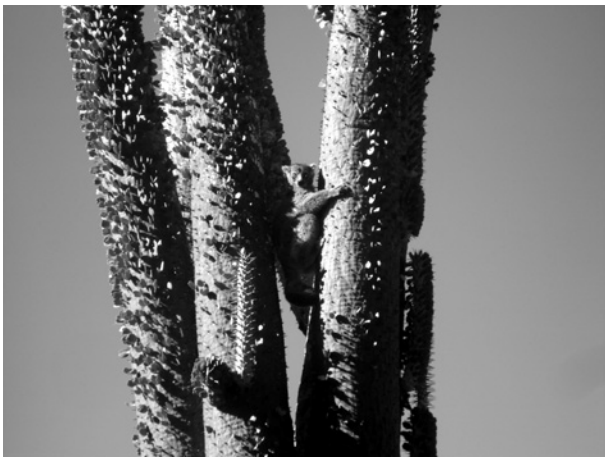

Fig. 2: *Lepilemur leucopus* sur le *Didiera trolli.*

Aucune *Lemur catta* n'est rencontré dans cette forêt. Suivant les enquêtes menées, cette espèce diurne a été présente mais á cause de l'existence des zébus, des chèvres et chiens qui circulent chaque jour dans cette forêt, elle est partie. En ce qui concerne les espèces nocturnes, ce sont seulement les *Microcebus* sp. qui existent dans cette forêt.

Discussion
On a obtenu les données issues du transect. Au total, on a rencontré 8 groupes de *Propithecus verreauxi*, renfermant 24 individus. Dans ce site, nous avons observé une seule espèce représentée par les *P. verreauxi* dont la densité est de 2,2 individus par hectare. Ce qui nous a surpris dans cette population de *P. verreauxi* de la forêt de Matsandre, est l'existence de deux groupes composés de 4 et 5 individus respectivement ayant les membres antérieurs et postérieurs, colorés en roux foncés comme les *P. verreauxi* du Parc d'Isalo ou en Malagasy Sifa-bilany (Mittermeier *et al.* 2006), qui cohabitent avec les *P. verreauxi*, de couleur normale. Mais nous avons remarqué aussi dans un groupe de *P. verreauxi*, de couleur normale, la présence d'un individu de type Isalo. Par conséquent, la forêt de Matsandre, est une nouvelle localité observée pour le type de *P. verreauxi* d'Isalo.

La forêt de Matsandre, dans laquelle, nous avons fait des inventaires biologiques des primates, est une forêt dense sèche des plateaux calcaires, dominée par les plantes épineuses entre autres les *Alluaudia procera*. Cette forêt constitue l'habitat naturel de l'espèce diurne *Propithecus verreaux.* C'est une forêt du type Bush xérophytique qui se trouve dans la Région d'Androy, District d'Amboasary Sud, Commune rurale d'Ifotaka, Fokontany Fenaivo. Les *Propithèques* qui habitent cette forêt sont calmes et ne sont pas fugitives. On n'a pas rencontré les *Lemur catta* pendant les observations diurnes. Pour les formes nocturnes, il existe des *Microcebus* sp., dans cette forêt. Ces *Microcebus* nécessitent une étude génétique moléculaire pour bien déterminer leur systématique car elles ressemblent à l'espèce *Microcebus griseorufus.* On a essayé de chercher les autres espèces entre autres les *Cheirogalius* sp., *Mirza* sp., mais on n'en a pas trouvé. Dans la famille des Lepilemuridae, on a rencontré l'espèce *Lepilemur leucopus.* En outre, on a découvert une nouvelle localité de *P. verreauxi*, de coloration variante de l'Isalo, dans la commune rurale d'Ifotaka, district d'Amboasary Sud, Région d'Androy.

Remerciements
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Occurrence of Bamboo lemurs, *Hapalemur griseus occidentalis**, in an agricultural landscape on the Masoala Peninsula

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*The taxonomic classification for *Hapalemur* in Masoala is still being revised. This is the best designation at this time (Edward Louis, personal communication).

Keywords: *Hapalemur griseus occidentalis*, Gentle lemur, agriculture, forest fragments, Masoala Peninsula, *Cathariostachys madagascariensis*

An important question for lemur conservation is which species can persist and adapt outside of protected areas amidst the inevitable advance of humans into lemur habitat. A number of primates on other continents are reported in the literature as tolerant to human-disturbed forests, for example, tolerance to forest fragmentation: Guatemalan black howler monkey, *Alouatta pigra*, in Mexico (Estrada *et al.* 2002), black and white colobus, *Colobus guereza*, and redtail monkey, *Cercopithecus ascanius*, in Uganda (Onderdonk and Chapman 2000). Some lemurs exhibit tolerance to forest edges: brown mouse lemur, *Microcebus rufus*, and Milne-Edward's sifaka, *Propithecus diadema edwardsi* (Lehman *et al.* 2006). There is also evidence that some folivorous lemurs use and feed on tree species within plantations (Ganzhorn and Abraham 1991). While studying lemurs in forest fragments in an unprotected region of Masoala Peninsula, I observed *H. g. occidentalis* in six locations within an agricultural matrix (Fig. 1; Table 1). This is a brief report of those observations.

H. g. occidentalis is classified as "Vulnerable" (IUCN/SSC 2005). The best studied *Hapalemur g.* spp. populations in the eastern rain forest are those found near and within Ranomafana National Park in southeastern Madagascar (Tan 1999; Arrigo-Nelson and Wright 2004; Grassi 2006). Arrigo-Nelson and Wright (2004) found *H. griseus* (Rabarivola *et al.* 2007 suggests this is *H. g. ranomafanensis*) in six surveyed sites within Ranomafana National Park that varied in levels of human-induced disturbance, altitude (725-1350 m), and distance to villages (1-5 km). The majority of the diet of *H. griseus* in Ranomafana is comprised of various parts of bamboo, including young leaf bases, young pseudo-petioles, young branch shoots, and ground shoots (Tan 1999; Grassi 2006). In another site of SE Madagascar, Vohibola III Classified Forest, *H. griseus* was shown to be edge-tolerant in a forest bordering cultivated fields (Lehman *et al.* 2006).

Table 1: Sites where *H. griseus* were observed in the Fampotobe region with a brief description of the site.

Site	*H. griseus* minimum group size	Description of site and coordinates
Tsarasoa	3	0.8 ha fragment containing bamboo, adjacent (50 m) to family compound. Focus of this brief report. S15.86937 E50.12693
Potto	4	< 0.5 ha patch of riparian bamboo surrounded by shrubs, adjacent (10 m) to seasonal camp of 3 farmers. Two adults and two suspected infants or juveniles in June 2006. S15.87725 E50.13119
Camp 3	4	< 0.5 ha patch of riparian bamboo surrounded by shrubs and dry rice plantation, adjacent (20 m) to major footpath and field Camp 3. S15.88673 E50.14692
Camp 4	1	< 0.5 ha patch of riparian bamboo surrounded by shrubs and sugarcane, adjacent (5 m) to our field Camp 4; the individual could be part of Potto's group (about 200 m away). S15.87743 E50.13133.
Across River	2	< 1 ha patch of riparian bamboo within agricultural matrix. Saw *H. griseus* foraging in bamboo from a distance. About 100 m from a settlement. S15.88544 E50.15022
Trap	1	< 0.5 ha smallest patch of riparian bamboo within a patch of secondary-forest trees in area surrounded by rice paddies. A lemur trap was destroyed at this site. About 200 m from a settlement. S15.87478 E50.12751

Study Site and Methods

I habituated a group of three *H. g. occidentalis*, referred to here as the Tsarasoa group, with the help of three Malagasy assistants during June 2006. Lemurs in this group were already semi-habituated when I first encountered them; they would emit alarm calls but they would not flee. After following the group for three weeks in June, they no longer emitted alarm calls. The Tsarasoa group was then observed intermittently for 11 days between July 2 -August 4, 2006 in a 0.8 ha fragment of remnant humid-evergreen forest. The vegetation of the fragment was dominated by pioneer species (including *Harongana madagascariensis* and *Aframomum angustifolium*), and a patch of native, but planted, bamoo, *Cathariostachys madagascariensis*, (Poaceae). The study site (S15.86937, E50.12693) is located within an agricultural matrix of rice paddies, sugar cane plots, and cassava plots about 3 km east of the southern border of Masoala National Park, Madagascar, located within Toamasina Province. The altitude of the site is 21 m. The 0.8 ha fragment is over 250 m from a continuous but unprotected forest parcel that contains primary forest tree species. There is another 5 ha unprotected forest fragment approximately 200 m from the study site that contains a diversity of forest species approaching that of the continuous forest (Martinez unpublished data).

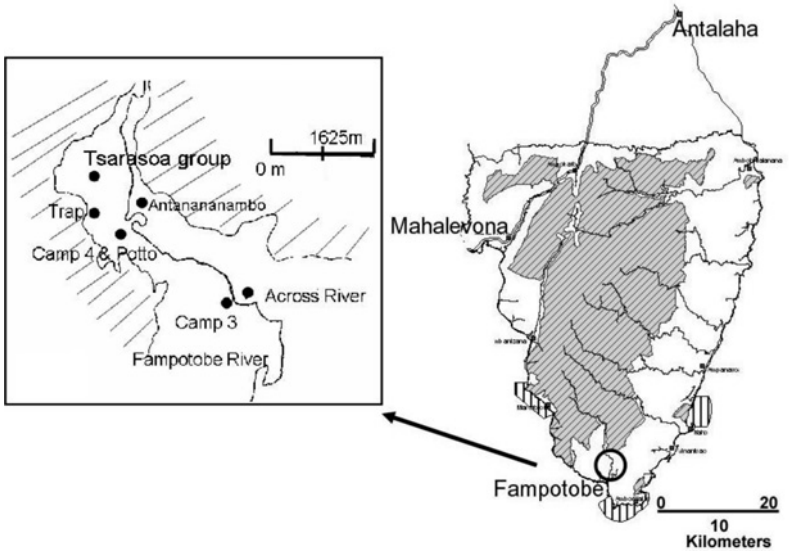

Fig. 1: On the right, a map of the Masoala Peninsula showing the boundary of Masoala National Park (hatched lines). On the left, Fampotobe River region showing approximate location of sites mentioned in paper. The hatched lines represent contiguous secondary or primary forest cover.

The study site is 50 m from a seasonal family housing compound with five adults and six children. The family planted the bamboo and they extract culms from the site for construction when necessary.

I collected behavioral data on *H. g. occidentalis* through a combination of ad-libitum and scan sampling at 10-minute intervals (Altmann 1974). Specimens of food items other than bamboo were collected for identification by botanical experts at the Tsimbazaza Herbarium, Antananarivo, Madagascar. I also spot-checked other patches of bamboo for the presence of *H. g. occidentalis* in April, late May, June and mid-July 2006, but devoted observational time towards the habituated Tsarasoa group due to its proximity to the family compound. I questioned the family of farmers living near the Tsarasoa group about the lemurs in their bamboo patch. Trained local guides working on my project, who were also farmers in the region, offered information on the hunting of bamboo lemurs.

Results

The Tsarasoa group was located on eight dates and observed for a total of 45.9 hours (mean = 5.7 hours/day ± 4.6 hours/day). On three additional dates I could not locate the lemurs and believe they were not in the fragment, since lemurs are easily detected by their eyeshine responding to flashlights at dusk. On these three days I searched for them at dawn and dusk throughout the fragment.

One or more members of the Tsarasoa group were feeding 37 % of the observation time; 89 % of these feeding observations included the young pseudo-petioles of the planted bamboo species. The remaining 11 % of the observations included the ripe fruits of three species typically associated with secondary or disturbed forests: *Ficus lutea* Vahl (Moraceae), *Eugenia jambos* L. (Myrtaceae), and the non-native shrub *Clidemia hirta* (Melastomataceae). I observed one instance of an adult feeding on soil for less than 1 minute. Feeding generally took place in the early morning (5AM-8AM) and evening (5PM-9PM).

I documented *H. g. occidentalis* at five other sites where bamboo was planted (Table 1). All of these bamboo patches were between 50-200 m from family settlements. I observed H. g. occidentalis traveling by ground through a rice field and a patch of the pioneer shrub, *A. angustifolium*, at the Camp 3 site. Local guides claimed that *H. g. occidentalis* groups were common near their homes, especially where bamboo was planted. At the "Trap" site two young boys were setting up a trap to catch *H. g. occidentalis*. A Malagasy guide destroyed the trap and told the boys not to do it again; they said they were trying to catch *H. g. occidentalis* for food.

Discussion

The feeding and behavioral observations were collected over a short period of time thus I am not attempting to draw substantial conclusions from these data. However, this brief study can provide some support to the previous suggestion that *Hapalemur g.* spp. are tolerant of human-altered landscapes, as reported in Arrigo-Nelson and Wright (2004). Based on the limited feeding observations, *H. g. occidentalis* appears to rely on a native, but planted, species of bamboo, *C. madagascariensis*. This species was planted by subsistence farmers in the past as a land claim. This activity potentially could be encouraged to support more habitats for *H. g. occidentalis*, but the farmers I spoke to are not interested in planting more bamboo in areas where rice could instead be planted.

Other preliminary observations are worth noting in hopes that researchers will be encouraged to study lemurs outside of protected areas, and in particular the *H. g. occidentalis* groups in the agricultural matrix outside of Masoala National Park. Although this species is not considered endangered, there is a great potential for conservation biology research projects at this site. For example:

1. A comparative study of the diet, including chemical composition of food, and activity budget of *H. g. occidentalis* in the continuous forest and the agricultural matrix. *H. g. occidentalis* was observed feeding on *Clidemia hirta*, a non-native shrub that commonly grows in disturbed areas. The seeds are small (0.5-0.75 mm long) (Wagner *et al.* 1999) and likely also dispersed by birds. Ratsimbazafy (2002) reported *V. variegata* feeding on *C. hirta* after a hurricane destroyed a majority of its regular food base in Manombo. The other two fruit species *H. g. occidentalis* fed on, *Ficus lutea* and *Eugenia jambos*, were not common along transects through neighboring fragments or in the continuous forest 250 m away (Martinez, unpublished data). Also, the agricultural groups appear be crepuscular.
2. An examination of the local hunting pressure. The ease of locating and observing *H. g. occidentalis* within the study area suggests a low hunting pressure. One local farmer admitted to trapping *H. g. occidentalis* because he saw the lemurs eating his rice. Possibly *H. g. occidentalis* is perceived as a pest species during the rice harvesting seasons and therefore hunted seasonally; they do not eat the bamboo culms and therefore are probably not considered pests of bamboo.
3. Travel by ground between habitat patches. There are only a couple of published incidents of typically arboreal lemurs traveling by ground between forest fragments through non-forest habitats: *Propithecus perrieri* and *P. edwardsi* (Lehman *et al.* 2005); *Eulemur rufus* (Dehgan 2003); and *P. diadema* (Irwin 2006). This behavior of terrestrial travel is one that warrants further study for all arboreal lemurs threatened by the expansion of agricultural land.

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ARTICLES

Confirmation of the greater bamboo lemur, *Prolemur simus*, north of the Torotorofotsy wetlands, eastern Madagascar

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Keywords: Greater bamboo lemur, *Hapalemur simus*, *Prolemur simus*, Torotorofotsy, Madagascar

After our initial report on the occurrence of the Greater Bamboo lemurs (*Prolemur simus*) within the Torotorofotsy ecosystem (Dolch *et al*. 2004), we herewith confirm the existence of a population of this critically endangered primate. Although *P. simus* is relatively common in the subfossil record, and Torotorofotsy being within the taxon's historical range (Godfrey and Jungers 2003; Godfrey *et al*. 2004), this discovery represents the only known extant population of the Greater Bamboo lemur north of the Mangoro River. This finding significantly increases the extant range of this species and highlights the urgent need for conservation and further surveys throughout all remaining habitat.

Compared to the bamboo lemurs of the genus *Hapalemur*, the greater bamboo lemur (*Prolemur simus*) is considered distinct based on dental, chromosomal, and genetic evidence, and thus has been placed in its own genus (Mittermeier *et al.* 2006). As with all bamboo lemurs, the diet of *P. simus* consists primarily of bamboo, specifically the giant bamboo (*Cathariostachys madagascariensis*), consuming its shoots, young and mature leaves, and pith according to the season. The largest of the bamboo lemurs, weighing up to 2.5 kg (Kappeler 1991; Tan 1999, 2000), *P. simus* is especially adapted to this diet, with powerful jaws that allow the animal to strip the outside of the live bamboo stalk and consume the pith, leaving evidence of this destructive behavior behind. In addition, *P. simus* forages for the flowers of the traveler's palm (*Ravenala madagascariensis*), the fruits of *Artocarpus integrifolia*, *Canarium* spp., *Dypsis* spp., and *Ficus* spp., and the leaves of *Pennisetum clandestinum* (Meier and Rumpler 1987). With home ranges of 60 ha or more (Sterling and Ramaroson 1996; Tan 1999, 2000), these polygynous groups of seven to 11 individuals actively utilize only a small portion of this range, moving after consuming the bamboo resources in their immediate area (Tan 1999).

Like many lemurs, the greater bamboo lemur's viability in the wild is threatened by several anthropogenic pressures including *tavy* (slash-and-burn agriculture), mining, illegal logging, and poaching (Meier 1987; Meier

and Rumpler 1987). These factors have contributed to its critically endangered status and ranking as one of the world's most endangered primates (Mittermeier *et al.* 2005, 2006). In fact, the greater bamboo lemur is considered the most critically endangered lemur species in Madagascar with the highest extinction probability (IUCN 2006; Mittermeier *et al.* 2006). The greater bamboo lemur is known during the last decade from only a few extant populations in southeast Madagascar (Wright *et al*. 2008) with the exception of Karianga where possibly the last three known individuals were removed on November 9, 2000, and placed in Parc Ivoliona (pers. comm. E. E. Louis). Current knowledge of the species' ecology and behavior in the wild is derived from fieldwork done in Ranomafana National Park (Tan 1999).

In 2004, community members brought to Association Mitsinjo's attention a lemur species fitting the description of *Prolemur simus* in the area adjacent to the Torotorofotsy wetlands in central eastern Madagascar (Dolch *et al.* 2004; Fig. 1). In 2005, the Torotorofotsy region was declared a Ramsar site of international importance due to its exceedingly high levels of biodiversity and status as the most intact natural wetlands within the eastern rainforest corridor (Dynatec 2006), while assigning Association Mitsinjo as its local management entity. Situated over 400 km to the north of all other known *P. simus* populations, the Torotorofotsy wetlands are located within the Andasibe commune and had not been formally surveyed for presence of this species.

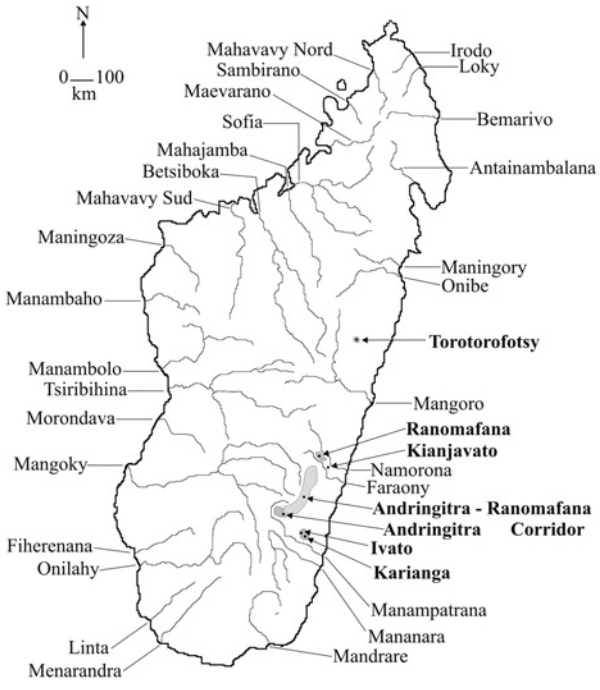

Fig. 1: Distribution map of the greater bamboo lemur, *Prolemur simus*, in Madagascar. The greater bamboo lemur is known during the last decade from only a few extant populations in southeast Madagascar, specifically Andringitra, Ranomafana, Andringitra-Ranomafana corridor, Kianjavato, Evendra (village of Ivato), and Karianga. In June 2007, a population of *Prolemur simus* was verified at Torotorofotsy, the only extant population found north of the Mangoro River.

The discovery of remains of giant bamboo with characteristic bite marks (Fig. 2), as well as calls and reported sightings of a large bodied animal (distinguishable from the smaller *Hapalemur griseus griseus*) by villagers were strong indications of the presence of a *P. simus* like lemur in Torotorofotsy. Subsequent surveys of the region where the animal was rumored to occur were jointly conducted by Omaha's Henry Doorly Zoo Madagascar Biodiversity and Biogeography Project (MBP-HDZ) and Association Mitsinjo during multiple expeditions in 2006 and 2007; however, these expeditions failed to confirm the presence of the species.

Fig. 2: Giant bamboo remains left behind by *Prolemur simus* feeding activities at Torotorofotsy, October 2007.

Methods and Results

A new survey was started in June 2007 further to the northeast of the original survey sites, which focused on areas where stands of giant bamboo were located. Daily searches in areas where characteristic feeding remains have been detected were carried out. Average search time was 150 man-hours per day with an average 20 people searching at a time. On July 23, after more than a month of intense survey, an adult female *Prolemur simus* was sighted (figure see cover) and immobilized with a Dan-Inject CO_2 projection rifle with 10ml/kg of Telazol® (Fort Dodge). On July 29, one subadult female and an adult male from the same group were captured using the same techniques. Four 2.0 mm biopsies and 1.0 cc per kg of whole blood were collected from each animal and stored in room temperature storage buffer (Longmire *et al.* 1992). A HomeAgain® microchip was placed subcutaneously between the scapulas of each lemur. In addition, all animals were radio-collared and morphometric measurements were recorded (Table 1). The radio-collared animals are part of a family group consisting of 12 individuals that our team followed and monitored over a period of 11 months. Monitoring is carried out by 4-6 people following the individual animals on a daily basis, recording GPS coordinates for each individual in the morning and in the afternoon to assess home ranges and habitat requirements. The maximum area of occurrence for this particular family group is approximately 97.2 ha, which appears to be larger than estimated territory of the southeast populations (Mutschler and Tan 2003). This discovery represents the only extant *Prolemur simus* population found north of the Mangoro River extending the known distribution of the species (Simons *et al*. 1990) within the subfossil range and validating the evidence found by Dolch *et al*. (2004).

Table 1: Summary morphometrics of *Prolemur simus* individuals captured during the present study.

Identification Number	Sex	Age	Weight (kg)	Body Length (cm)	Head Crown (cm)	Tail Length (cm)	Date of Collection
FOTSY7.1	F	Ad	2.43	29.5	10.2	45.4	23/07/2007
FOTSY7.2	F	Ad	1.65	28.7	12.0	42.5	29/07/2007
FOTSY7.3	M	Ad	2.15	32.5	13.0	42.3	29/07/2007
FOTSY7.4	M	Ad	2.70	34.7	11.3	52.6	24/11/2007
TORO8.22	F	Ad	2.60	33.2	10.9	49.4	14/02/2008
TORO8.23	F	Ad	2.60	32.1	11.2	47.7	15/02/2008
TORO8.24	M	Juv*	0.62	19.2	8.3	31.1	15/02/2008
Mean ± SD			2.36±0.40	31.8±2.3	11.4±1.0	46.7±4.0	

Juv* indicates that this is a juvenile and was excluded in the mean and standard deviation calculations.

Discussion

Ongoing survey work in and around Torotorofotsy has so far produced evidence indicating at least four distinct localities where traces of *Prolemur simus* have been found in the form of giant bamboo feeding sites. To date, we have documented three different groups in the area. Within Torotorofotsy, there are an estimated four to 11 *Prolemur* groups, comprising an estimated total population of less than 100 individuals.

The characteristic patchy distribution of the giant bamboo supports the thought that the size of greater bamboo lemur territory is larger than that of other lemur species (Tan 1999, Mutschler and Tan 2003, Wright *et al.* 2007). Living in discreet populations, this species' future is a concern to conservationists, especially given its reliance on a specialized food source. For instance, of the family groups identified, only two lie entirely within the Torotorofotsy Ramsar site. One group resides along the northern border of Torotorofotsy and lies within the newly protected area of Ankeniheny-Zahamena. However, the most vulnerable group extends eastwards into a graphite mining concession and currently lies outside any protected area. This group is the most closely monitored population to date. Since the Torotorofotsy population is surrounded by mining concessions (nickel and cobalt) to the west and to the east (graphite), mineral exploitation appears to be the most prominent threat to the population and requires immediate conservation action.

In order to assess active threats and develop an appropriate management plan for this species, continual surveillance and monitoring of the populations in this region are vital. Currently, the one family group is monitored daily by a team comprised of local community members and the MBP-HDZ and Association Mitsinjo collaboration in order to mitigate direct threats and provide valuable preliminary data for future research and conservation. This information will be utilized to determine territorial size, seasonal movement, population genetics, individual relationships, and social dynamics as a comparison to other *Prolemur* populations found in southeast Madagascar. It is imperative that this information be provided to government officials and conservation organizations so that informed decisions can be made to ensure the protection of this endangered animal and Torotorofotsy.

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Predation on the brown mouse lemur (*Microcebus rufus*) by a diurnal carnivore, the ring-tailed mongoose (*Galidia elegans*)

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Keywords: nocturnal lemur, radio telemetry, communal sleeping, solitary primate, predator-prey, Madagascar

Abstract

The brown mouse lemur (*Microcebus rufus*) is nocturnal arboreal primate endemic to southeastern Madagascar. Mouse lemurs are solitary foragers at night and sleep in tree holes or nests during the day. Due to their small size mouse lemurs are subjected to heavy predation pressure both during the night and the day. We observed a predation event by a diurnal terrestrial mammalian carnivore, the ring-tailed mongoose. In the morning, we observed an adult mongoose climbing up a tree toward a mouse lemur leaf-nest. The nest was subsequently destroyed and a mouse lemur fell to the ground where a second mongoose was waiting. The mongoose pair was scared off and the recovered mouse lemur died soon after. Its injuries indicated that it had been bitten in the head by the mongoose. Our observations suggest that the mongoose may have been hunting cooperatively and may have been systematically searching for mouse lemurs. Sleeping mouse lemurs may be easy prey for diurnal predators and the ring-tailed mongoose may be an important predator on the brown mouse lemur.

Brown mouse lemurs (*Microcebus rufus)* are small nocturnal primates endemic to the eastern rain forests of Madagascar (Mittermeier *et al*. 2006). Individuals of both sexes weigh on average 45 g and feed on fruits, flowers and insects (Harcourt 1987; Atsalis 1999). Brown mouse lemurs are generally solitary foragers that are active from dusk until dawn (Atsalis 2002), but on occasion individuals have been observed as early as 16:00 h when it is still light (personal observation). In Ranomafana National Park (RNP) (21 17.4'S, 47 26.0'E), southeastern Madagascar, brown mouse lemurs sleep singly or in small groups in tree holes, on branches, or in nests constructed of leaves (Deppe *et al.* unpubl.). Being small, mouse lemurs suffer high predation pressure from various predators including nocturnal and diurnal birds, snakes and mammals (Goodman 2003a). Even though predation rates for the brown mouse lemur specifically are unknown, Goodman *et al.* (1993) found that the closely related grey mouse lemur (*M. murinus*), typically found in the dry deciduous forests in Madagascar's west coast, suffered a predation rate of at least 30 % per year.

A relatively common small (700 g) mammalian omnivore in RNP is the ring-tailed mongoose (*Galidia elegans*). With densities of approximately 37 individuals/km^2 this viverrid is a diurnal predator that lives in ground burrows (Garbutt 1999). Even though they are largely terrestrial, they are also adept tree climbers (Goodman 2003b) and are known to prey on the arboreal mouse lemurs (Wright and Martin 1995). In the course of an ongoing behavioral study of the brown mouse lemur in RNP a predation event was observed. While locating a radio-collared mouse lemur individual in a tree hole around 9:00 h on October 31, 2006, two ring-tailed mongooses were spotted moving single file on the ground toward a mouse lemur leaf nest that we had located the previous morning and which had contained two male mouse lemurs. The nest was 10 m high in a large tree and one mongoose was climbing up the tree towards the nests, while the second was waiting near the base of the tree. Upon spotting the nest, the mongoose destroyed it and both the nest and one mouse lemur fell down to the ground. Our approach scared off the mongooses and we were able to recover the mouse

lemur that was still lying on the ground. The mouse lemur had suffered a bleeding, semi-circular head injury and an eye injury. The mouse lemur, which was a known male, was convulsing and died within one minute. As we walked away, five adult mongooses were observed climbing up and down various trees in the vicinity.

It appears that the ring-tailed mongooses were systematically searching for food high up in the trees and possibly targeting mouse lemur sleeping sites. Sleeping mouse lemurs may be easy prey for arboreal hunters. Within our study population we had previously identified a female, who upon her second capture in our live-traps, appeared to have had suffered a recent, rather severe head injury with half of one ear freshly torn off. On the top of her head she had a semi-circle shaped wound very similar to the one suffered by the dead male, and her scull cap appeared to have been injured as indicated by numerous bumps. The characteristics of her injuries suggest that she may have recently been bitten in the head by a mongoose. When we trapped her again one month later, she was in good health and her external wounds had healed, however, her skull remained bumpy suggesting bone damage. These findings hint that *G. elegans* attacks on the brown mouse lemur may not be a rare occurrence in RNP. Our observations of the mongoose pair involved in the attack on the mouse lemur nest further suggests that they may have been cooperating because one individual was up in the tree while the other was at the base of the tree possibly waiting for prey to fall to the ground. We suggest that even though mouse lemur sleeping nests are usually well camouflaged and may provide some protection from diurnal raptors as suggested by Karpanty (2003, 2006), they may provide less protection from viverrids.

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Low elevation silky sifakas (*Propithecus candidus*) in the Makira Conservation Site at Andaparaty-Rabeson: Ranging, demography, and possible sympatry with red ruffed lemurs (*Varecia rubra*)

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Keywords: Silky sifaka, *Propithecus candidus*, Makira, ranging, elevation, home range

"It is not acceptable to joke about the silky sifaka because there is much mystery surrounding them. We do not see them very often…we don't know how many there are." English Translation of Mr. Rabeson, Andaparaty, Madagascar. October 22, 2007.

Introduction

Determining the home range size, altitudinal range, and habitat preferences of critically endangered lemurs is crucial for conservation management and understanding lemur behavioral ecology (Ganzhorn *et al.* 1997; Cowlishaw and Dunbar 2000; Sussman 2000). Additionally, long-term observations of known individuals within focal groups can be an effective monitoring system for critically endangered wild primates and permit population viability analyses (Ross and Reeve 2003; Irwin 2007). In this report, we present the results of a two month study of silky sifaka (*Propithecus candidus*) ranging and demography within the Makira Conservation Site at the new Andaparaty-Rabeson field site (Fig. 1 and 2) where we plan to initiate a long-term monitoring program. Silky sifakas are one of the four most critically endangered lemurs in Madagascar (Patel *et al.* 2007), and are the most critically endangered lemur

within the Makira Conservation Site which arguably contains 20 species of lemurs, the highest lemur diversity of any protected area in Madagascar (Rasolofoson *et al.* 2007).

Silky sifakas have been rumored to exist near Maroantsetra for many years (Tattersall 1982; Dr. Christopher Holmes, WCS Technical Advisor, pers. comm.). Recent rapid surveys by ONG Antongil Conservation, Wildlife Conservation Society-Projet Makira (WCS) and the Groupe d'Etude et de Recherche sur les Primates de Madagascar (GERP) noted that some silky sifakasi inhabited the low altitude hilly rainforests adjacent to the land of Mr. Rabeson by the Antsahabe River 3 km north of the village of Andaparaty (population 1028), which lies along the large Antainambalana River approximately 30 km northwest from Maroantsetra (Rasolofoson *et al.* 2007; Ratelolahy and Raivoarisoa 2007; Rakotondratsima *et al.* this volume). A more detailed history of this field site can be found in Patel *et al.* (2008).

This location is remarkable for several reasons. It is the southern-most geographic range limit of *P. candidus*, which are not found west or south of the Antainambalana River. These silky sifakas are approximately 44 km southeast from the nearest known *P. candidus* at Manandriana (Rasolofoson *et al.* 2007). They are so far south that their habitat is actually just a few kilometers southwest from red ruffed lemurs (*Varecia rubra*) that have been observed at Anjiafotsy within the same block of continuous forest (Ratelolahy and Raivoarisoa 2007). Although prior reports have never suggested sympatry between *P. candidus* and *V. rubra*, we discuss new evidence suggesting some shared habitat.

Our general goals were to update the status of the silky sifakas at Andaparaty-Rabeson and develop this field site for longer term monitoring, research, and possibly eco-tourism. We began long-term data collection on silky sifaka ranging and demography and conducted numerous structured interviews using a questionnaire with local residents in order to assess local knowledge of the silky sifaka and the extent of bushmeat hunting. Our six specific goals included:

1) Determination of the number *P. candidus* groups and individuals.
2) Comparison of the elevational range of *P. candidus* at Andaparaty-Rabeson and Marojejy.
3) Comparison of the home range size of *P. candidus* at Andaparaty-Rabeson and Marojejy.
4) Development of a flagged trail system.
5) Assessment of *P. candidus* conservation threats at Andaparaty-Rabeson.
6) Assessment of sympatry with *V. rubra*.

Methods

Two expeditions were made to Andaparaty-Rabeson in the Makira Conservation Site: October 20 2007 to December 15 2007 and March 15 2008 to March 21 2008. We searched for silky sifakas and their traces (i.e. gouge marks made by males on tree trunks) daily with several research guides. When *P. candidus* were encountered, we followed them as long as possible, never approaching closer than 10 m since the sifakas were not habituated. During these encounters, GPS coordinates and altitude were recorded every 30 minutes using powerful Garmin 60csx GPS units. Physical descriptions were recorded for all individuals, and photos taken whenever possible. GPS points were also collected for all gouged trees encountered. A flagged (every 25 m) trail system was created along existing foot paths and travel routes used by *P. candidus*. A GPS point was also recorded for every trail marker. Whenever anthropogenic habitat disturbance was encountered, a GPS point was recorded, photos were taken, and the intensity of the disturbance was classified using Lehman *et al.*'s (2006) 4-point scale.

Home range size was determined using the Ranges VI software package (Anatrack, Ltd.). 100 % minimum convex polygon (MCP), 95 % kernel, and 50 % kernel values were calculated using all of the GPS points recorded during silky sifaka encounters at Andaparaty-Rabeson (2007-2008) and at Marojejy Camp 2 (2001 to 2007) for comparison. Currently, 100 % MCP is not considered the best estimate of mammalian home range size since it is overly sensitive to outliers. It is the simplest and oldest way to calculate home range size by fitting the smallest convex polygon that fits all points (Sterling *et al.* 2000). Kernal methods provide more realistic estimates of home range size by using a probabilistic model that weights highly used areas. 95 % kernel is generally considered home range size while 50 % kernel is considered the core area (Worton 1989; Irwin 2007).

In order to learn more about local knowledge of the silky sifaka, bushmeat hunting, and socio-economics, adult local residents were interviewed in Andaparaty (n=35) and nearby Ankarongana (n=22) using a questionnaire of 27 open and closed ended questions that we created with Rachel Kramer (United States Peace Corps/WCS Project Makira). All interviews were conducted in the Betsimisaraka dialect of the Malagasy language by a native speaker, Anjaranirina Evelin Jean Gasta. Before starting, we first requested permission from the President of COBA and Fokontany, Mr. Bakalariat. Each subject was told before the interview began, that participation was completely voluntary, anonymous, and no salary would be given. In this report, we present results from the few questions directly pertinent to silky sifaka conservation.

Results

Silky Sifaka Encounters

Two groups of silky sifakas were encountered and followed on 10 days: Oct. 25 2007, Nov. 1, 6, 10, 21 2007, Dec. 1, 3, 5 2007, and March 20 2008. These encounters lasted from 15 minutes to 7 hours (when the sifakas were successfully followed all day). Group 1 contained four individuals (1 adult male, 1 adult female, 1 subadult male, and a young infant). Group 2 contained two individuals (1 adult female and 1 adult male). During these encounters the animals fled from us while emitting "Zzuss!" alarm calls on only a few occasions. They did appear quite vigilant however and engaged in extensive staring towards the observers. Overall, the sifakas did not behave as if there was hunting pressure on them at this particular site. They behaved as one would expect a wild unhabituated group to behave that was not yet fully accustomed to continual human observation (but not utterly unfamiliar with human presence).

Silky Sifaka Home Range Size and Elevational Range

167 GPS points were collected during silky sifaka encounters at Andaparaty-Rabeson (Fig. 1) and 134 previously at Marojejy (error range: 4 to 7 m). Table 1 displays 100 % MCP, 95 % kernel, and 50% kernel home range sizes for *P. candidus* at these two sites in compari-

son to other eastern sifakas. At Andaparaty-Rabseon, *P. candidus* was observed at altitudes between 289 m and 558 m above sea level (a.s.l.; n=167). *Propithecus candidus* at this Makira field site inhabit a much lower elevational range than at Marojejy Camp 2 where they range between 670 and 1030 m a.s.l. which is actually the lowest elevation that silky sifakas are found within Marojejy. Patel *et al.* (2008) contains all of the GPS points used in the analyses for Table 1.

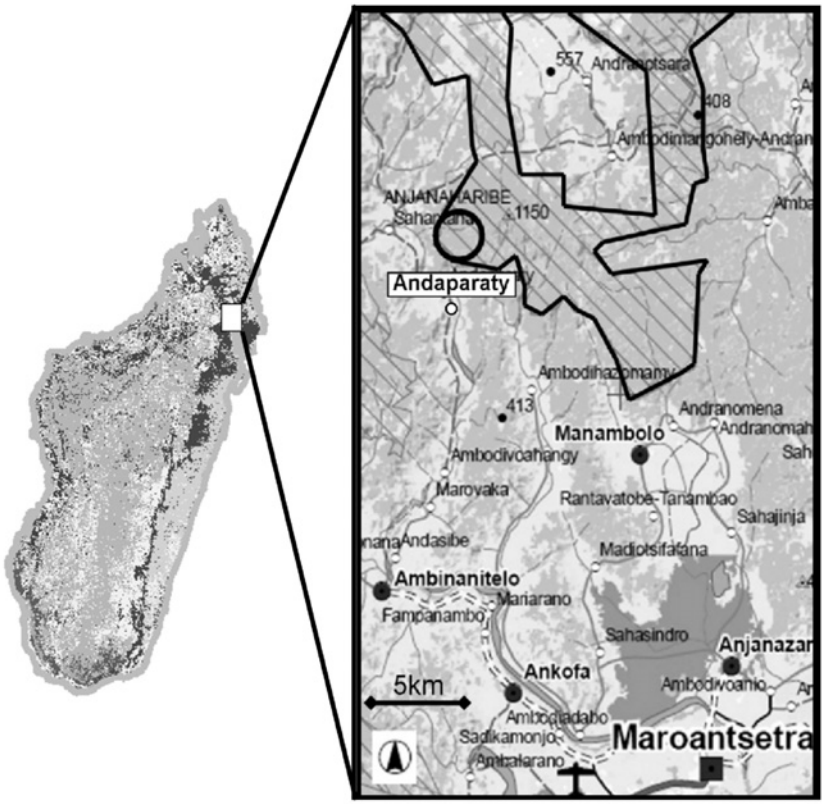

Fig. 1: Map of the region surrounding the Andaparaty-Rabeson fieldsite. Black circle represents *Propithecus candidus* sightings within the Makira Conservation Site (black polygon with stripes).

Table 1: Home range sizes in eastern sifakas.

Species (Field Site)	**100 % MCP (ha)**	**95 % Kernal (ha)**	**50 % Kernal (ha)**	**Reference**
P. tattersalli (Daraina)	12.2[b], 6.2[a], 9.2[b]			Meyers (1993)
P. diadema (Tsinjoarivo)	83.2[a], 76.0[a], 21.2[b], 40.1[b]	72.2[a], 79.3[a], 19.6[b], 36.8[b]	8.6[a], 13.4[a], 3.5[b], 5.9[b]	Irwin (2007)
P. diadema (Mantadia)	42[a], 33[a]			Powzyk (1997)
P. candidus (Marojejy: Camp 2)	37.5[a]	33.7[a]	12.3[c]	This Manuscript
P. candidus (Makira: Andaparaty-Rabeson)	40.2[c]	47.3[c]	11.1[c]	This Manuscript
P. edwardsi (Ranomafana: Talatakely)	38[c]			Wright (1995)
P. perrieri (Analamera: Antobiratsy)	1.0[b], 1.1[b]			Lehman and Mayor (2004)

[a]Continuous forest; [b]Fragmented forest; [c]Continuous forest with selective logging

Interviews of Local Residents

When shown a picture of a silky sifaka, only 19 % (11/57) of respondents said they had seen this animal before. When asked where they had last seen this animal, most of these people said at this Andaparaty-Rabeson field site (55 %; 6/11), but several people claimed to have seen silky sifakas in the Ambalangira forest near Antsahabe (27 %; 3/11). One respondent said at the Antselipoagna forest near the big lake. Similarly, another respondent said at Antselipoagna on the way to Andapa. No one reported that *P. candidus* was hunted, but 53 % (30/57) answered "yes" when asked "Are there people in this town who hunt other lemurs?" Most respondents reported that the most commonly hunted wild animals were bush pig (44 %) and white-fronted brown lemurs (38 %). Tenrec (10 %), civet (4 %), and fossa (4 %) were also reported to be hunted locally.

Red Ruffed Lemur Sightings

The unmistakable loud "roar-shriek" vocalizations of red ruffed lemurs were heard three times within the habitat of the silky sifakas at this field site. Based upon the high volume and direction of these roar-shrieks, we estimate that the red ruffed lemurs were apporoximately 1 km from us, within the habitat of the silky sifakas. Moreover, one of our research guides saw several red ruffed lemurs within known silky sifaka habitat, near trail marker MIT 650, on November 29 2007 (Sassidy, pers. comm.). Finally, the landowner, Mr. Rabeson said he knew of a ruffed lemur nest around this same location, and that he had recently seen red ruffed lemurs in that region.

New Trail System

When we arrived there was a single long trail (approx. 2 km) flagged as AJB. We replaced all old AJB flags with fresh flags and created 11 new trails totaling approximately 5.5 km. Further details of the new trail system can be found in Patel *et al.* (2008).

Anthropogenic Disturbance

The habitat of the silky sifakas at this field site should not be considered undisturbed primary forest. As seen in Figure 1 and 2, the southern and western border of their habitat is an abrupt forest edge adjacent to land cleared and occasionally farmed by the Rabeson family. Aside from the pre-existing AJB trail, five locations of slight habitat disturbance (Level 1: Lehman *et al.* 2006) were found. These included a few old zebu corrals, remains of *Pandanus* harvest, and several small (< 0.3 ha) patches of tall

wild ginger (lingoza). Importantly, one major disturbance site was discovered (Level 3: Lehman *et al.* 2006) that has not been reported in prior surveys at this site. A large region (approx. 1 hectare) of about 100 five to ten meter tall *Harungana madagascariensis* (Clusiaceae), a common colonizing species of slashed-and-burned rainforest, was found hidden away from the main AJB tail within silky sifaka habitat adjacent to a branch of the Antsahabe river (S 15° 11.912; E 49° 37.236). We estimate that the land was cleared five to ten years ago, but has not been much disturbed since that time.

Fig. 2: *Propithecus candidus* habitat in hills of rainforest adjacent to anthropogenic clearings. Note the pronounced habitat edge. Photo credit: Rachel Kramer

Conclusions

Andaparaty-Rabseon is important for four major reasons. Primarily, it offers two groups of wild silky sifakas in a relatively accessible location. Once habituation is achieved, the silkies at Andaparaty-Rabeson will be as accessible as the *P. candidus* at Camp 2 (Marojejy) of Marojejy National Park for example. Secondly, the elevational range of the silky sifakas at Andaparaty-Rabeson is the lowest ever reported. Within Marojejy National Park and Anjanaharibe-Sud Special Reserve where the majority of *P. candidus* are found, they have never been observed below 700 meters a.s.l. (Patel *et al.* 2007). Thus, the results of this report extend the altitudinal range of the silky sifaka and confirm that this sifaka species, despite their extreme rarity, exhibits the greatest altitudinal range of any sifaka species (*Propithecus* spp.) in Madagascar.

This field site is also remarkable in that it is the southern-most geographic range limit of *P. candidus*. The results of this report suggest that these silky sifakas are so far south they may actually share some habitat with red ruffed lemurs (*Varecia rubra*). If true, the Andaparaty-Rabeson field site would be the only known habitat in the world where these two high profile lemur species are sympatric. Finally, this field site offers a unique opportunity to examine how silky sifakas cope with habitat disturbance and edge effects. *P. diadema* and *P. edwardsi* groups inhabiting forest fragments exhibit reduced frugivory and body mass compared to groups inhabiting continuous forest. Compared to western sifakas, these rainforest sifaka species will seldom cross nonforested regions between fragments (Mayor and Lehman 1999; Irwin 2006; Arrigo-Nelson 2006; Dehgan 2003). *P. diadema* is edge-tolerant and prefers to feed in moderately disturbed regions of their home range (Irwin 2007). It is unknown whether *P. candidus* reacts similarly to disturbance and edge effects. The Andaparaty-Rabeson field site presents an opportunity to find out.

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Initiation and leading of travel in - *Lemur catta*

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Ring-tailed lemurs (*Lemur catta)* travel in groups through the forest foraging for food, searching for suitable resting sites, and guarding the perimeters of their territory. As with all group-living animals, ring-tailed lemurs must coordinate their activities to maintain spatial cohesion (Boinski and Garber 2000; Conradt and Roper 2003). Individual group members have different optimal foraging strategies and schedules resulting in conflicting interests over where to travel to and when (Kappeler 2000). Thus, coordination of group movement requires that individuals communicate their desired trajectories while also making compromises in their optimal activity budgets (Conradt and Roper 2003). Research on group travel can provide insight into the social dynamics of lemur troops and the mechanisms that govern their travel decisions (Trillmich *et al.* 2004).

In this study we consider the roles of group members – male and female, adult and juvenile, dominant and subordinate – in the initiation and leading of group movements in a troop of ring-tailed lemurs. *Lemur catta* live in female-dominant (Kappeler 1990; Pereira *et al.* 1990) groups that are female-resident, with males migrating at adolescence (Jones 1983; Sussman 1991, 1992). Since females are dominant and philopatric, do they lead more often than males? Similarly, do dominant members initiate and lead more than subordinates? Finally, are males and females, with their differing optimal activity budgets, leading to different activities?

The null-hypothesis of this study was that propensity to initiate and lead is independent of sex and dominance. The study took place at the Berenty Reserve in Madagascar. *Lemur catta* troop D1A was observed on 21 days for a total of over 200 hours during the months of October and November, 2002. Troop D1A had four females, two males, one sub-adult male, two juveniles, and four infants. Prior to beginning the study, both authors were able to reliably recognize all adult and juvenile members. For the study, the authors documented when they saw the acts of "initiation", "leading", and troop "progression". Initiation was defined as the act of a lemur separating itself from the edge of the troop by at least 10 m and indicating its desire to travel by facing away from the troop while continuously looking back and calling with quiet to medium meowing. Leading referred to a lemur being the first in line during a progression. Progressions were defined as the troop following a leader in a formation resembling a line over a distance of at least 10 m from one activity or feeding site to another. Co-initiation was the display of initiation behavior by two or more individuals. In a co-led progression there was an interchange between two lemurs for the lead position in line. Co-initiations and co-leads were excluded when analyzing the role of individual adult lemurs but included when comparing the difference between sexes in travel destinations and initiation success. An initiation was considered to be successful when the act of initiation resulted in a troop progression led or co-led by the initiator. Chi-square tests were used for statistical analyses.

One hundred eight documentations of travel behavior were made. These included 28 unsuccessful initiations, 49 successful initiations resulting in travel, and 31 progressions with no prior initiation detected by the observers. Every adult lemur initiated and independently led the troop in travel (Table 1). However, the dominant female and dominant male were the most frequent initiators and leaders.

Table 1: Initiations and leads of troop travel by individual adult troop members; *dominant individuals.

Lemur	Sex	Initiations	Leads
TR*	F	18	35
BT	F	5	7
FT	F	2	6
SA	F	3	3
PM*	M	31	13
BE	M	6	4

The number of initiations displayed by troop members varied significantly (χ^2 = 60.4, df = 5, p < 0.001). The dominant male displayed 47.7 % of the initiation behaviors, the dominant female came in second with 27.7 %, and the rest of the adults each displayed between 3.1 % and 9.2 % of the initiations. Leading of troop travel differed significantly between individuals (χ^2 = 64.7, df = 5, p < 0.0001). There was a strong propensity for the dominant female to lead the troop in travel. She led 51.5 % of the progressions, the dominant male led 19.1 %, and the remaining adults led between 5.9 and 10.3 %. The results align with Jolly's 1966 description of the leading of troop travel in *L. catta*: "No one animal consistently leads the others or initiates progressions. At any time the leader is likely to be a female or dominant male, since they are usually in the front of the group."

Initiation behaviors, as defined by the protocol of this study, preceded 61 % of the progressions. The remaining progressions were initiated by more subtle behaviors, as simple as a female standing up and walking away. The number of failed initiations for the two males was significantly higher than for the four females, while the number of leads with no prior initiation behavior (as defined by the study's protocol) was considerably lower for males than for females (χ^2 = 20.6, df = 2, p < .001). The findings shown in Table 2 suggest that males must exert more energy and time to initiate the troop in travel than females.

Table 2: Initiation success of adult male and female troop members.

	Failed Initiation	Successful Initiation	No Initiation Prior to Travel
Males (2)	17	24	4
Females (4)	6	23	26

A troop member playing a particularly unique role in the initiation of group travel was the sub-adult male. He initiated or co-initiated the troop 10 times. Four of his initiations were followed by troop progressions led by his father, the dominant male. The sub-adult male co-led with his father three times.

One of the primary research questions of this study was whether the activities that males and females led to differed. The findings showed that for this troop, progressions led by males versus females to the activities of feeding, resting, and encounters with foreign *L. catta* varied significantly (χ^2 = 15.91, df = 2, p < 0.001). Progressions to feeding, resting, and encounters by the troop's males and females are shown in Table 3. The majority of both female (88.2 %) and male (52.9 %) leads were to feeding patches. The higher percentage of female-led progressions to feeding may well have been because all four females were nursing infants (less than 3 months old) and were in the "season of greatest female need" (Sauther 1991). By reaching the feeding patches first, females may have been able to establish feeding priority over males (Erhart and Overdorff 1999).

Table 3: Progressions led by males and females to the activities of feeding, resting, and encounters with foreign *L. catta*.

	Feed	Rest	Foreign *Lemur catta*
Male (2)	9	2	6
Female (4)	45	6	1

The high proportion of male-led progressions to encounters versus female-led might be explained by who the encounters were with. Of the six male-led progressions to encounters, four were to migrating males within the troop's territory. A likely reason for the variation between males versus females leading to encounters and food is that the females were improving their reproductive success through food acquisition while the males were increasing the likelihood of their reproductive success by retaining access to mates (Wrangham 1980). Migrating males pose a threat to the reproductive success of resident males. Foreign troops, on the other hand, threaten females and infants by encroaching on their territory and competing for food sources. During October and November of 2002, the food resources at Berenty Reserve were plentiful and the average aggression of troop encounters was low (Mertl-Millhollen and Miles, unpublished data). However, high levels of aggression by females in troop encounters during times of environmental stress have been documented (Mertl-Millhollen *et al.* 2003). According to Jolly, *et al.* (1993), adult females take the most active role in confrontations between troops. Of the three encounters with foreign troops, two were led to by the dominant male and one was led to by the dominant female. Further research may reveal that females initiate travel to more inter-troop encounters than males, or that the role of each sex varies based on the abundance of food and the level of male-male competition for mates.

Previous studies of lemur travel behavior have suggested that females are generally more active than males in initiating and leading troop travel (Erhart and Overdorff 1999; Kappeler 2000; Trillmich *et al.* 2004). In a study on group movements of *Propithecus verreauxi*, Trillmich *et al.'s* (2004) findings showed that females led the troop in travel more often and for greater distances than males. Erhart and Overdorff's study on the coordination of travel in *Propithecus diadema edwardsi* and *Eulemur fulvus rufus* revealed a greater inequality in the number of female versus male leads for both species than this study did for *L. catta* (Erhart and Overdorff 1999). Erhart and Overdorff (1999) predicted that females of *P. d. edwardsi* and *E. f. rufus* might "implement alternative behavioral strategies such as group leadership in conjunction with, or in the absence of, dominance interactions to improve access to food." Perhaps the benefits for females arriving at a food patch first are of more importance to other species of lemurs than for *L. catta*, whose adult females have extreme dominance over males for food (Sauther 1993). The

number of leads between troop members is, of course, also dependent on the dynamics within the group. In Overdorff, Erhart, and Mutschler's study on patch entry (2003), the strong discrepancy between *Eulemur fulvus rufus* males and females witnessed in the 1999 study did not exist. Instead, *E. f. rufus* males and females entered the food patches equally (Overdorff *et al.* 2003). The 2003 study showed clear female dominance for entrance into feeding patches by *Varecia variegata* and again by *Propithecus diadema edwardsi* (Overdorff *et al.* 2003).

The results of this study provide a glimpse into the social dynamics of group movements in ring-tailed lemurs. In the focal troop, subordinate members did not always follow the initiations of dominant members, and every adult lemur initiated and led the troop in travel. However, the dominant female and male clearly had the largest roles in the initiation and leading of travel. Further research on the group movements of ring-tailed lemurs is needed to better understand the influence of a troop's social hierarchy on initiation and leading behaviors and troop travel decisions.

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Group size and group composition in Milne-Edwards' sifakas (*Propithecus edwardsi*) at Ialatsara Forest Station

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Keywords: Milne-Edwards' sifaka, demography, group composition, group distribution

Abstract

A long-term study of a Milne-Edwards' sifakas (*Propithecus edwardsi*) was initiated in 2005 at the Ialatsara Forest Station in south east Madagascar, 50 km north of Fianarantsoa. This forest station is divided in 6 fragments of natural forest, some of which shelter one or more groups of Milne-Edwards' sifaka. The main goal of this project is to evaluate the ecology of sifaka groups confined to forest fragments. To achieve this goal, a long-term project has been set up at the genetic, demographic and behavioral levels. At the start of the study, all individuals were captured to carry out biopsies for genetic analyses and collared to permit individual recognition in behavioral observations. Eight groups totalizing 44 individuals were distributed among the 6 fragments of natural forest. Preliminary observations revealed that group size (ranging from 3 to 8 individuals) and group composition corresponded to those recorded at Ranomafana National Park located about 30 km to the east of the station). Different types of association were recorded: pairs, multi-male/multi-female, harem, polyandrous). The number of groups per fragment seemed to be correlated with fragment size. In the only fragment containing several groups, the sex-ratio of

young individuals (infants, juveniles, subadults) was strongly male biased.

Data providing from IRD (Institut de Recherche pour le Développement) and CNRE (Centre National de Recherche sur l'Environnement de Madagascar) indicate that the natural forest which once covered most of Madagascar is disappearing very quickly at the rate of 200000 to 300000 ha per year (see also Green and Sussman 1990; Sussman *et al*. 1996). It is estimated that only 16 % of the surface of Madagascar is still covered with natural forest. However, this forest is home to many animal species, some of which depend entirely on the forest environment. This is the case for Milne-Edwards' sifaka (*Propithecus edwardsi*), which lives in the rainforests of the Malagasy east coast (Mangoro and Onive rivers delimit the northern part of their actual range and the Rienana river in Andringitra National Park the southern one).
A previously unstudied sifaka population inhabits the Ialatsara tropical rainforest. This site was originally contiguous with the western part of the Ranomafana National Park (RNP), but is now separated from it due to widespread agricultural activity (including clearing, burning, and farming). Today, thanks to the financial support of Conservation International Madagascar and the collaboration of the Valbio Center (RNP), a conservation project has been established on this site. The purpose of this project is to evaluate the effect of forest fragmentation on sifakas in order to maintain, and even increase, the number of individuals on the site.
According to recent IUCN evaluation, Milne Edwards' sifaka is threatened with extinction (EN(A2cd)), and was selected as the target of conservation because it is the least adaptable (in both its dietary and environmental needs) of the 6 species present on the site (see below). Of course, it is important to note that the targeted protection of sifakas will also allow the conservation of the all fauna and flora of the site. In the present paper, we report preliminary data obtained on group size and group composition at the start of our study.

Fig. 1: Study site location in Madagascar.

Methods

Study area
The study area (Fig. 1: 21°04'S, 47°14'E, elevation: 1300-1600 m) is a limited liability company in the name of Mr. and Mrs. Rajaona, tenants of an old forest station in the north of Ambohimasoa, 50 km from Fianarantsoa. In October 2001, a 50 year management convention was signed with le Ministère des Eaux et Forêts. This is an alternative established by the ministry for the transfer of forest stock management to Madagascar (transfert de gestion). The total surface of the site is approximately 2500 ha, of which about 1500 ha are covered with pines (1000 ha) and eucalyptus (500 ha). The remaining 1000 ha are covered with natural forest, less than half of which is intact, and is divided into 6 distinct fragments. This forest shelters a great variety of residual fauna. To date, six species of lemurs have been identified on the site: *Propithecus edwardsi*, *Eulemur rubriventer*, *Hapalemur griseus*, *Lepilemur microdon*, *Cheirogaleus major*, and *Microcebus rufus.*

Census of sifaka population
A preliminary census of the sifakas carried out from December 2004 to May 2005 counted 44 individuals divided into 8 groups on the site. The existence of such a sifaka "population" in such a small fragmented forest is quite unexpected, both from a genetic standpoint and an ecological one (e.g. availability of food resources). Both genetic health and the sifaka's adaptive strategies for survival in a closed environment will have to be evaluated to try to maintain and even increase the number of sifakas living in this area. For this purpose, all the individuals were captured between October 2005 and June 2006. These captures made it possible to identify each individual, to carry out skin biopsies for later genetic analyses, and to collar the animals to facilitate the collection of the demographic data and behavioral observations which follow.

Habituation of sifakas for capture
Since sifakas fled when faced with a predator or unknown situation, all individuals had to be habituated to our presence. After daily contact with the animals for a 15 day period we were able to approach (at a distance of 4 m) without eliciting a fear response, allowing us to conduct the captures under the best conditions possible. Initially, a fragment was traversed using marks on trees to detect the presence of sifakas: when they are

moving from one place to another sifakas mark the bark of some trees with their upper incisors before rubbing their marking glands there. In addition to indicating the presence of sifakas, these marks make it possible to date it roughly. When such marks were observed, linear transects were made. The forest fragment was thus traversed in parallel transects spaced approximately 50 meters apart. Once transects were complete for a given fragment, each one was explored by a researcher moving at a speed of approximately 1 km/h. All transects of a given fragment were traversed simultaneously.

We used a flute made of reed to imitate the cry emitted by a lost individual. Upon hearing this sound, group members indicated their position by responding with their own vocalisation. As such, sifakas could be easily located and followed for as long as possible. If the group was not accustomed to human presence, it fled quickly. After a few days, however, the time we were able to follow a group increased until we could follow them for one entire day and, as a result, establish their daily routine.

Captures

The anaesthetic used was Zoletil (20 mg/ml). Since 10 mg/kg is necessary and the weight of an adult sifaka is approximately 5 kg, each dart contained 2.5 ml of Zoletil. The dominant female was captured first. Since she leads the group, if she goes missing, the group tends to remain close to the place where she was last seen rather than to move away. Thus the capture of the other individuals was facilitated. Each individual was followed by the darter until it was in an ideal position to be captured: the darter must be situated as near as possible to be able to reach the animal at the level of the thigh easily. As soon as it was darted it was followed and caught with a net, since Zoletil's activation time varies from one minute to five minutes depending on the individual. Once captured, the individual was examined in order to evaluate its general state and to ensure that it was not wounded during its fall. Its temperature was measured before carrying out a biopsy on the ear, which was preserved in alcohol for later genetic analyses. A transponder was then implanted into subcutaneous tissue between the two scapulas. Morphometric data were collected (weight, sex, dimensions of cranium, body, tail, upper and lower limbs, canines and ears). Any distinguishing marks were noted (e.g. wounds, scars...) and its age was estimated from its teeth and its general health examination. Other observations, such as the possible presence of parasites or the presence of milk for females, were recorded. Finally, the adult animals (>4 years) were identified by a collar and a colour tag. The dominant female of each group was equipped with a radio-collar for future group location. Animals were kept in a bag until they had awoken completely (this generally took 5 hours from the time anaesthesia was administrated), and were then released. Each individual was released at the place where it was captured, and was followed for at least 20 min in order to monitor its general state.

Results

Morphometric data

No sexual dimorphism seems to exist in any age category (Table 1). Due to small sample size, statistical analyses were only possible for adults. Body size and weight did not differ between males and females (Mann-Whitney: n_1=13, n_2=17, respectively: U=102, p=.73; U=94.5, p=.53). We found a significant difference between males and females in upper canines length (U=68, p<0.01).

Table 1: Mean (and standard deviation) of body sizes and weights of males and females according to age classes (N = 44).

	Body size (cm)	Tail (cm)	Weight (kg)	Cranium (cm)	Upper canines (mm)
Adults (> 4 Jahr)					
Females	52.1 (2.1)	39.7 (6.8)	5.5 (0.4)	1.7 (0.5)	8.7 (0.9)
Males	51.9 (2.1)	39.7 (6.8)	5.4 (0.38)	11.9 (0.6)	9.6 (0.7)
Subaduts/Juveniles (2-4 years)					
Females	47.9 (0.5)	43.4 (9.4)	3.7 (0.3)	11.6 (0.4)	7.5 (1.2
Males	47.1 (2.2)	40.9 (6.6)	3.6 (0.2)	11.1 (0.8)	7.0 (0.9)
Infants (<1 year)					
Females	41.6	38.6	2.3	10.7	4.7
Males	—	—	—	—	—

Body size:length from the head to the edge of the tail; Cranium: length from the nose to the neck

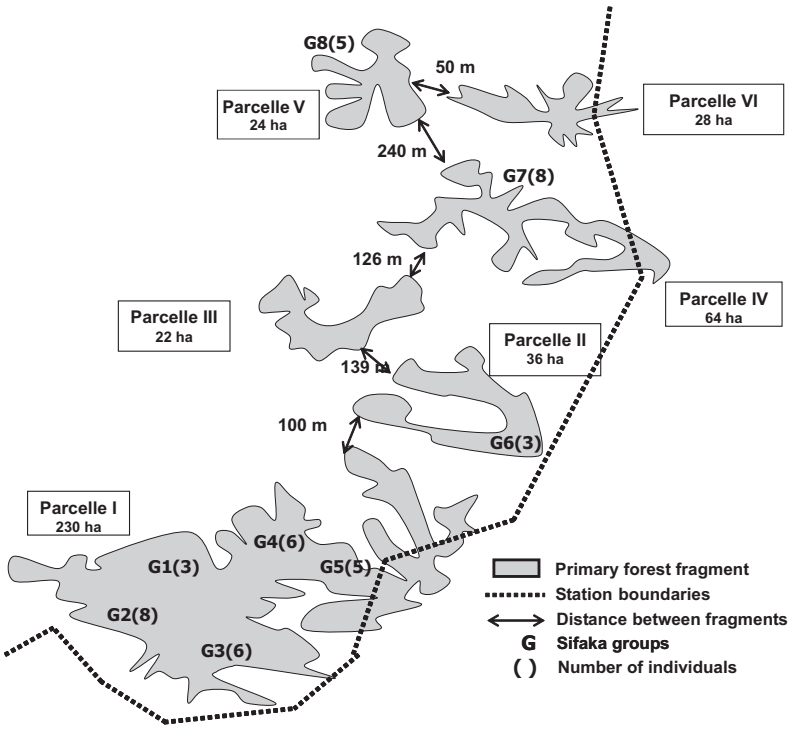

Fig. 2: Group distribution at Ialatsara forest station

Group distribution
The 8 groups of sifakas inhabit four fragments of natural forest. Fragment 1 (230 ha) was the only one to contain several (5) groups of sifakas, totaling 28 individuals. Fragment 2 (36 ha) sheltered a group of three individuals and fragment 4 (64 ha) contained a group of eight individuals. Finally a group of five sifakas established its territory on fragments 5 (24 ha) and 6 (28 ha), inhabiting 52 ha in total. Fragment 3 (22 ha) was the only not to contain sifakas.

Table 2: Surface per individual in each fragment.

	Fragment 1	Fragment 2	Fragment 4	Fragment 5/ Fragment 6
Surface (ha)	230	36	64	52
Number of individuals	28	3	8	5
Surface per individual (ha)	8.2	12	8	10.4

Group composition
Sex-ratio: Group composition varied from 3 to 8 individuals. On average a group contained 2.1 adult females and 1.6 adult males for an operational sex-ratio of 1.0: 0.7. With respect to adults, three groups (G1, G3, G6) contained as many females as males, four groups (G2, G4, G5, G7) contained more females than males and only one group (G8) contained more males than females. In the five groups of fragment 1, the subadults and juveniles were all males (n=8). By contrast, in the groups G6, G7 and G8, present in fragments 2, 4 and 5-6 respectively, the sex-ratio of the young individuals (infants, juveniles and subadults) was even (G8) or in favour of females (G6, G7) (Table 3).

Table 3: Group composition: F=females, M=males.

Fragment	Group	Adults > 4 years F / M	Subadults 2-4 years F / M	Infants < 1 year F / M
1	1	1 / 1	0 / 1	
	2	4 / 3	0 / 1	
	3	2 / 2	0 / 2	
	4	3 / 1	0 / 2	
	5	2 / 1	0 / 2	
2	6	1 / 1		1 /0
4	7	3 / 2	2 / 1	
5-6	8	1 / 2	1 / 1	

Mating system: We were able to determine the mating system of four groups. Groups G1 and G6 consisted of a reproductive couple and its offspring. In contrast, groups G4 and G5 could best be described as a harem breeding system. These 2 groups included 2 reproductive females, as indicated by two simultaneous births reported in each of these groups in June 2004 (G4) and June 2006 (G5). Only one reproductive male was present in each of these groups. We were unable to establish the mating system for the other four groups. Groups G2 and G7 each included two reproductive females, as two simultaneous births were reported in each of these groups in June 2002 and June 2006, respectively. The number of reproductive males could not be established for either group. Only one sexually mature female was present in group G8, but we do not know the number of reproductive males. Data for group G3 were insufficient to establish the number of reproductive males or females.

Discussion

Group distribution
Our results show that the presence of sifakas in a fragment depends on its surface area, and that the number of individuals is positively correlated with the size of the area and, consequently, with the quantity of food resources. If the surface area of a fragment is approximately 20 hectares or less, it does not seem to be sufficient to provide a habitat for a group of sifakas: fragment 3 (22 ha) does not contain any groups, and group G8 established its territory in fragments 5 (24 ha) and 6 (28 ha). This group was also observed moving on the ground in cultivated zones, which shows that sifakas are able to move out of the natural forest. A similar phenomenon has been described for *Propithecus perrieri* (Mayor and Lehman 1999).
According to these data, the average surface area necessary for 1 individual is 9.6 ha. However, it is important to note that, in order to check the relationship between the quantity of food resources and the presence of sifakas, a floristic inventory of each fragment must be carried out. It is possible that the presence of sifakas in a fragment depends mainly on food resource quality, and not only on the surface area of a fragment (Irwin 2008).

Group composition
Sex-ratio: The subadult and juvenile individuals of the fragment 1 (the only one containing several groups and therefore experiencing intergroup competition) were all males. By contrast, in the other fragments the sex-ratio among young individuals was equal or in favour of females. This result could be explained by a birth regulation phenomenon which occurs in an environment with limited resources. The local resource competition model for sex ratio adjustment may partially explain this bias (Perret 1990; Nunn and Pereira 2000). According to Bayart and Simmen (2005), who studied black lemur (*Eulemur macaco*) populations in various environments, the type of habitat may have an impact on sex-ratio. They found that, among black lemurs, in a degraded forest the sex-ratio is in favour of males, whereas it is in favour of females in an intact forest. This may be because food resource competition between females (dominant in this species) would be limited by a higher number of males. The same phenomenon may also occur in sifakas. From this point of view, it would be of interest to determine how dispersion is affected by forest fragmentation.

Social system
Studies of sifakas in the RNP indicated that the mating system of this species is difficult to categorize (Wright 1995; Hemingway 1999; Pochron *et al*. 2004). This is also the case for sifakas of the Ialatsara forest station. Our results show that, as for the sifakas of the RNP, the mating system varies widely between groups. The genetic and behavioral data that will follow will allow us to specify these results and to evaluate the stability of mating systems within a group.

Conclusion

Our preliminary observations reveal that group size and group composition of sifakas at the Ialatsara Forest Station correspond to those recorded at Ranomafana National Park (Pochron *et al.* 2004) and that. Milne-Edwards' sifakas exhibit different types of mating behavior (pair, multi-male/multi-female, harem, polyandrous). A long-term study of this population will enable us to evaluate the evolution of these systems and also the social bonds which ensure cohesion within a group. Behavioral observations will allow us to follow the social dynamics of group composition from September 2006 to October 2008. Four of the eight groups will be followed more extensively in order to evaluate possible behavioral differences between groups of the same fragment and groups isolated in a fragment. In the long term, the genetic, behavioral and demographic data will allow us to assess the evolution of this population and so to evaluate the effect of forest fragmentation on Milne-Edwards' sifakas. In the past, *Propithecus edwardsi*'s range was certainly larger than it is now, and included parts of the high plateau. Consequently, it appears important to conserve the Ialatsara population in terms of genetic diversity. We hope that the present project will help to a better understanding of sifakas' social organisation and ecology and participate to their conservation.

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Etude de la communauté de lémuriens de la forêt d'Ambodiriana, NE Madagascar

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Mots-clés: Madagascar, lémuriens, conservation, inventaire, densité, forêt tropicale humide de basse altitude, fragmentation.

La forêt d'Ambodiriana est gérée par l'Association de Défense de la Forêt d'Ambodiriana (ADEFA), qui souhaite classer la zone en Aire Protégée, les études déjà réalisées sur le site ayant montré une grande richesse floristique et faunistique endémique (ADEFA, non publié). Afin de définir les priorités de conservation de la communauté de lémuriens d'Ambodiriana, nous avons étudié la richesse spécifique et la densité des espèces de lémuriens, et réalisé une étude de leur habitat et de l'état de fragmentation de la zone.

Le site d'étude: la forêt d'Ambodiriana

La forLt d'Ambodiriana est située êsept kilomètres du village de Manompana (200 km au Nord de Toamasina). Le camp, établi en lisière de la forêt, se situe à une altitude de 100 mètres, au point géographique S16°40'34,7" et E49°42'16,3". La surface de la forêt est d'environ 1 km^2, et l'altitude maximum de 320 m. Ambodiriana est une forêt primaire dense humide de basse altitude. La température moyenne annuelle varie de 26°C à 29°C, et la pluviométrie moyenne est de 2400 mm (Goodman et Benstead 2003). Les données ont été récoltées entre le 16 décembre 2006 et le 8 janvier 2007 durant la saison chaude et humide. Deux collines se distinguent au Sud-Ouest et au Nord-Est de la réserve. Elles sont séparées par le fleuve Manompana, dont l'affluent Antsahamangarana constitue la limite Sud de la réserve. La réserve est traversée par deux chemins villageois menant à une forêt exploitée située au Nord de la réserve. A l'Est d'Ambodiriana s'étend une plaine rizicole. La physionomie de la forêt d'Ambodiriana se rapproche d'une formation à *Uapaca* sp. et *Anthostema madagascariensis* (Euphorbiaceae). La canopée de la forêt, qui s'élève à environ 15-20 m, est parsemée de grands géants comme *Canarium madagascariense* (Burseraceae) (Stamenoff

2005). A l'intérieur de la réserve on trouve quelques zones restreintes de forêt secondaire en régénération (savoka à *Harungana madagascariensis*) qui correspondent à d'anciens *tavy* (agriculture sur brûlis).

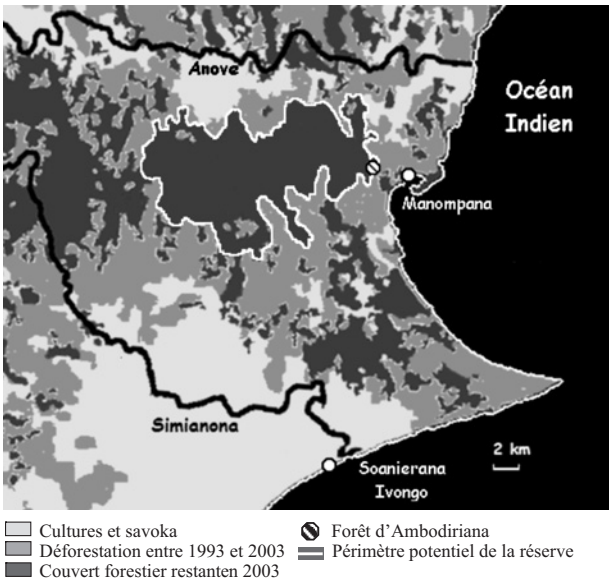

Fig. 1: Carte de l'évolution du couvert végétal.

Méthodologie

Recensement et densité des espèces
Les espèces de lémuriens ont été recensées avec la méthode des transects. Deux transects de 1000 m chacun (T1 et T2) ont été mis en place suivant les chemins villageois préexistants. Ce type de transect n'est pas une source de biais dans l'estimation de la densité d'*Eulemur fulvus fulvus* et d'*Avahi laniger* (Lehman 2006). Par contre ce biais existe pour les espèces très sensibles aux perturbations de leur habitat et au braconnage, telles que *Varecia variegata*. Nous avons donc mis en place un transect coupant à travers la forêt (T3) qui, en raison des contraintes du relief, ne mesure que 310 m. Nous avons effectué 14 passages sur T1, 10 passages sur T2, et 8 passages sur T3. Les transects ont été parcourus une seule fois par jour, à toute heure de la journée (entre 5h et 17h), en marchant lentement avec des petits arrêts. A chaque observation nous avons noté les données suivantes: espèce, nombre d'individus, hauteur, distance perpendiculaire au transect, position sur le transect, activité et heure. Nous avons effectué un repérage dans les forêts situées aux alentours d'Ambodiriana afin de vérifier la présence de lémuriens dans celles-ci.
Nous avons utilisé deux méthodes différentes pour réaliser une estimation de la densité des espèces de lémuriens: La première méthode est basée sur la limite de visibilité de chaque espèce. Le calcul de densité, qui s'exprime en nombre d'individus par kilomètre carré, s'effectue en fonction de cette limite (Whitesides *et al.* 1988).
Lorsque le nombre d'observations n'est pas suffisant pour calculer la limite de visibilité on utilise l'estimation de la densité par la méthode Léopold (Léopold 1933), qui est basée sur la distance perpendiculaire moyenne d'observation.

Etude de l'habitat
Etude de la végétation: A partir des connaissances relatives à l'alimentation des lémuriens (Birkinshaw et Colquhoun 2004), nous avons récapitulé les familles de plantes susceptibles d'être consommées par les espèces de lémuriens d'Ambodiriana, et calculé l'abondance relative de ces familles dans la forêt d'Ambodiriana. Pour cela nous avons utilisé les données récoltées lors de l'étude phytosociologique du site (Stamenoff 2005), la surface échantillonnée ayant été de 3100 m².

Evolution du couvert végétal et fragmentation
Au moyen de photos satellites ortho rectifiées (Landsat) prises à différentes dates (1993 et 2003) nous réalisons un bref constat de l'évolution du couvert végétal d'Ambodiriana et des zones environnantes. L'analyse de ces photos nous permet de déterminer l'état de fragmentation et les possibilités de connexion de la forêt avec d'autres zones favorables au maintien de la communauté de lémuriens. Nous réalisons une estimation des surfaces de la forêt d'Ambodiriana et des fragments pouvant être intégrés à l'intérieur des limites de la future Aire Protégée (logiciel eCognition).

Résultats et Discussion

Inventaire
La communauté de lémuriens d'Ambodiriana a été inventoriée en 2000 (Turner *et al.* 2000). Notre étude a permis d'actualiser cet inventaire (Tableau 1). Nous avons attesté de la présence de toutes les espèces recensées précédemment, à l'exception de *Microcebus rufus* et *Varecia variegata.*

Tableau 1: Domaine vital, fragment minimum, et statut IUCN des espèces de lémuriens d'Ambodiriana.

Espèce	Domaine vital (km²)	Fragment minimum* (km²)	Statut IUCN
A. laniger	0,01-0,02	0,4	Lower risk
D. madagascariensis	1,2-2,1	7	Endangered
E. fulvus fulvus	0,2	1	Lower risk
E. rubriventer	0,2	7	Vulnerable
H. griseus griseus	< 0,05	0,4	Lower risk
I. indri	-	8-10	Endangered
M. rufus	< 0,05	0,4	Lower risk
V. variegata variegata	0,2	7	Endangered
*taille minimale de fragment pour la survie de la population pendant 20 à 40 ans			

M. rufus est une espèce nocturne de très petite taille (Mittermeier *et al.* 1994), ce qui explique son absence de nos recensements diurnes. Cette espèce est présente en forte densité (110 à 260 individus par km²) dans les forêts de l'Est de Madagascar, y compris dans les formations forestières secondaires et les vieilles plantations (Mittermeier *et al.* 1994). Elle ne présente donc pas de vulnérabilité particulière et elle est certainement encore présente à Ambodiriana.
En 2000, au moins deux groupes de *V.variegata* ont été recensés à Ambodiriana (Turner *et al.* 2000), alors qu'en

2007 l'espèce est absente de la réserve. D'après les témoignages de la population locale, sa disparition d'Ambodiriana daterait de 2005. De par son écologie, *V. variegata* est une espèce très sensible a la perte et à la fragmentation de son habitat (Vasey 2003). Cette espèce est inféodée aux forêts humides de basse altitude de l'Est de Madagascar, où elle est distribuée en patchs (Mittermeier *et al.*1994). Elle est presque exclusivement frugivore, et ses populations sont très fluctuantes du fait des fortes variations de disponibilité des ressources dans les forêts de l'Est de Madagascar (Ratsimbazafy *et al.* 2002). Les taux de fécondité et de mortalité infantile varient considérablement et constituent une autre cause de fluctuation des populations de *V. variegata*. Ces traits d'histoire de vie peuvent conduire à une extinction locale des petites populations. La forte exigence écologique de cette espèce ne lui permet pas de se maintenir dans des fragments de forêt dégradée ou de petite taille (Vasey 2003). Ambodiriana semble répondre aux exigences alimentaires de *V. variegata* car 71 % des arbres appartiennent à des familles potentiellement consommées par cette espèce. La disparition de *V. variegata* à Ambodiriana n'est donc pas à imputer à un manque de ressources alimentaires, mais peut être due à la surface réduite de la réserve et/ou au braconnage.

Cet inventaire apporte de nouvelles données concernant les aires de répartition d'*E. f. fulvus* et d'*E. rubriventer*. La limite de répartition de la population Est d'*E. f. fulvus* se situerait plus au Nord que celle observée précédemment (Mittermeier *et al.* 1994). La zone de sympatrie d'*E. f. fulvus* et d'*E. f. albifrons* serait donc plus vaste (Goodman et Ganzhorn 2004). Nous observons ici *E. rubriventer* en basse altitude, alors qu'il apparaissait limité aux forêts humides de moyenne et haute altitude (Mittermeier *et al.* 1994).

Pour toutes les espèces recensées hormis *Hapalemur griseus* et *Daubentonia madagascariensis*, des juvéniles ont été observés, ce qui atteste d'une reproduction effective de ces espèces sur le site.

Un groupe d'*Indri indri* a été observé dans la forêt exploitée située au Nord de la réserve.

Densité

Concernant *E. f. fulvus* nous avons récolté un jeu de données suffisant pour pouvoir calculer une densité avec la méthode utilisant la limite de visibilité. Plus la distance perpendiculaire augmente moins on observe d'individus. Aucun individu n'est observé au-delà de 20 m. Cette distance correspond donc à la limite de détection de cette espèce pour la forêt d'Ambodiriana. A partir de cette distance limite de détection on obtient une densité de 121 individus par km². Or dans les forêts de l'Est de Madagascar, les densités observées pour *E. f. fulvus* varient entre 40 et 60 individus par km² (Mittermeier *et al.* 1994). La densité estimée à Ambodiriana est donc supérieure à celles mentionnées dans la littérature. Ceci peut s'expliquer par la faible surface de la forêt. En effet, dans les fragments de forêt de petite taille, la probabilité de détection augmente et peut amener à des surestimations de la densité. Cependant ce phénomène compense les sous-estimations de densité qui peuvent être faites dans les zones où les lémuriens, en réponse à une pression de braconnage élevée, adoptent des comportements cryptiques (Johnson et Overdorff 1999).

Pour les espèces *A. laniger* et *E. rubriventer*, la densité a été estimée à l'aide de la méthode Léopold. *A. laniger* est présent à Ambodiriana avec une densité de 86 individus par km² (distance perpendiculaire moyenne d'observation de 6 m), et *E. rubriventer* est présent avec une densité de 13 individus par km² (distance perpendiculaire moyenne d'observation de 14 m).

Les densités observées pour *A. laniger* varient entre 72 et 100 individus par km² (Mittermeier *et al.* 1994). La densité estimée à Ambodiriana correspond à une densité moyenne pour cette espéce. Cependant, *A. laniger* étant nocturne, nous avons probablement sous-estimé cette densité en réalisant nos transects uniquement de jour.

E. rubriventer présente généralement de faibles densités (Mittermeier *et al.* 1994). Dans l'Est de Madagascar, des densités comprises entre 19 et 22 individus par km² ont été observées pour cette espèce (Lehman *et al.* 2006; Lehman 2006). La densité estimée à Ambodiriana est inférieure à celle observée dans la littérature. Ceci peut s'expliquer par le fait que cette espèce n'est généralement présente qu'en moyenne et haute altitude (Mittermeier *et al.*1994). Ambodiriana est une forêt de basse altitude et ne correspond donc pas à son habitat optimal.

Pour les autres espèces, les données récoltées ne permettent pas de calculer une densité. La présence de *D. madagascariensis* a été attestée par des indices ponctuels de présence récents (traces de griffes et marques de dents sur des fruits consommés), et *H. griseus* a été observé une seule fois hors transect. Cette espèce se nourrit presque exclusivement de bambous et dépend fortement de leur abondance. Or, une étude récente a révélée une faible abondance de bambous à l'intérieur de la forêt d'Ambodiriana (ADEFA, non publié). L'insuffisance des ressources alimentaires peut expliquer le nombre restreint d'observations. De plus son rythme d'activité, considéré comme diurne, tend à être crépusculaire (Mittermeier *et al.* 1994), et aucun transect n'a été réalisé après 17h.

Habitat

L'étude phytosociologique du site a montré que la forêt présente une structure type de forêt sans perturbation majeure avec des caractéristiques structurales supérieures ou égales aux moyennes des forês tropicales (densité, diamètre) (Stamenoff 2005). La structure de la forêt d'Ambodiriana est relativement homogène et ne présente pas d'effet bordure marqué, malgré une surface réduite. Ces caractéristiques sont favorables aux espèces de lémuriens frugivores (Lehman 2006), tel que *V. variegata* ou *E. f. fulvus*, qui répondent généralement négativement à l'effet lisière.

Au niveau de la composition taxonomique, sur les 28 familles de végétaux recensées à Ambodiriana, 20 familles (72 %) sont potentiellement consommées par la communauté de lémuriens.

Au niveau de l'abondance, la proportion d'arbres potentiellement utilisés par les lémuriens pour leur alimentation, varie en fonction des espèces. La forêt semble répondre aux exigences des espèces de lémuriens à dominante frugivore telles que *V. variegata* (71 %), *E. f. fulvus* (70 %) et *E. rubriventer* (56 %). Une proportion moyenne d'arbres est utilisable par les espèces folivores telles qu'*A. laniger* (43 %). La faible proportion d'arbres utilisables pour *M. rufus* (31 %) peut être expliquée par son régime omnivore, les végétaux ne représentant

qu'une faible part de son alimentation. Il en est de même pour *D. madagascariensis* (23 %) qui est de plus très spécialisé pour les plantes qu'il consomme (*Ravenala* sp., *Canarium* sp.) (Mittermeier *et al.* 1994). Cette analyse se base sur le niveau taxonomique de la famille de végétaux. Or au sein d'une même famille il existe une grande variabilité quant à la palatabilité des espèces végétales pour les lémuriens. Ces résultats sont donc à interpréter avec parcimonie, et ne donnent qu'un ordre d'idée sur la qualité de la forêt d'Ambodiriana en terme d'exigences alimentaires des lémuriens présents.

Evolution du couvert végétal et fragmentation

La superposition du couvert végétal de 1993 et de 2003 révèle une nette diminution de la forêt durant cette décennie. On remarque que la fragmentation s'intensifie, avec une augmentation du nombre de fragments et l'isolation progressive de massifs forestiers réduits (Fig. 1). C'est un constat négatif pour le maintien de la communauté de lémuriens d'Ambodiriana car la diversité spécifique des lémuriens est corrélée positivement à la taille des fragments (Ganzhorn *et al.* 2003).

Une des conséquences majeures de la fragmentation est l'augmentation de l'effet bordure sur les fragments de forêt (Laurance et Yensen 1991). En lisière le diamètre et la hauteur des arbres sont inférieurs à ceux rencontrés en forêt non perturbée (Lehman 2007). Or dans les forêts de l'est de Madagascar l'abondance des fruits est directement corrélée à la taille des arbres (Ganzhorn 1995 ; Balko et Underwood 2005). De plus, les perturbations naturelles telles que les cyclones provoquent la chute des gros arbres fruitiers en lisière (Laurance et Yensen 1991). Ces caractéristiques des milieux de lisière ont pour effet la diminution des densités des espèces frugivores. Si ces espèces ont un rôle important dans la pollinisation et la dispersion des graines, comme c'est le cas pour *V. variegata*, *E. f. fulvus* et *E. rubriventer*, la diminution de leur densité induit un effet négatif sur la dynamique forestière (Restrepo *et al.* 1999). Les densités plus faibles de ces espèces peuvent aussi être un effet des pressions de braconnage plus importantes dans les milieux de lisière (Lehman 2007). L'effet bordure peut cependant avoir un effet positif sur les densités de lémuriens folivores. En effet la lumière pénétrant dans ces milieux augmente les quantités de protéines produites par les feuilles (Ganzhorn 1995) ce qui profite aux espèces telles que *I. indri* ou *A. laniger*. Ces augmentations de densité sont également modérées par le fait que les lémuriens folivores subissent aussi une pression de braconnage plus importante en milieu de lisière (Lehman 2007).

Enfin, l'isolement de plus en plus marqué des massifs forestiers a un effet négatif sur la dispersion des lémuriens. En effet la plupart des espèces ne traversent pas les prairies ou les exploitations agricoles entre les fragments (Lehman 2006), même si la capacité des lémuriens à traverser les milieux ouverts est controversée (Goodman et Benstead 2003).

Priorités de conservation

Malgré la faible surface de la forêt d'Ambodiriana (estimée à 1 km²), on y trouve une grande richesse spécifique. Six espèces de lémuriens (sans compter *I. indri*) y vivent en sympatrie. Mais, compte tenu de la petite taille de la réserve et des pressions anthropiques s'exerçant aux alentours de la forêt, la durabilité de cette richesse est précaire. Les différentes espèces de lémuriens de la forêt d'Ambodiriana présentent des sensibilités variables face aux pressions naturelles et anthropiques qui s'exercent dans la zone.

Les espèces telles que *M. rufus*, *H. griseus* et *A. laniger* ont des domaines vitaux relativement restreints (Tableau 1) (Mittermeier *et al.* 1994). Ils ne présentent pas de vulnérabilité par rapport à l'effet bordure (Lehman *et al.* 2006), et sont donc moins sensibles à la réduction de surface des fragments. Une étude a défini la taille minimale d'un fragment nécessaire à la survie d'une population de lémuriens, le temps de recréer des corridors de forêt (c'est-à-dire 20 à 40 ans), et de reconstituer un habitat suffisamment vaste pour assurer leur survie à long terme (Ganzhorn *et al.* 2000). Les trois espèces citées précédemment nécessitent un fragment d'au moins 0,4 km² (Tableau 1). Ambodiriana constitue donc un habitat de taille suffisante pour la conservation de ces espèces, qui sont classées dans la catégorie "Lower risk" de l'IUCN (IUCN 2006).

E. f. fulvus est lui aussi classé dans la catégorie Lower risk de l'IUCN. Cette espèce possède un domaine vital moyen de l'ordre de 0,2 km² (Tableau 1) (Mittermeier *et al.* 1994). *E. f. fulvus* est en grande partie frugivore, ce qui le rend sensible à un effet lisière (Lehman 2007). Il ne peut survivre entre 30 et 40 ans dans un fragment de forêt inférieur à 1 km² (Tableau 1). La forêt d'Ambodiriana constitue un minimum pour la survie à long terme de cette population. Cependant, s'il n'existe aucune connexion entre Ambodiriana et d'autres fragments de forêt, la population présente à Ambodiriana risque d' être isolée et serait exposée à un fort risque d'extinction.

Les espèces *E. rubriventer*, *V. variegata*, et *D. madagascariensis* nécessitent un fragment au moins égal à 7 km² pour assurer leur survie jusqu'au reboisement d'un habitat plus grand, tandis que *I. indri* nécessite un fragment dont la surface est comprise entre 8 et 10 km² (Tableau 1). La surface de la forêt d'Ambodiriana est trop faible pour assurer la survie à long terme de ces espèces. *V.variegata* a déjà disparu, et il est étonnant d'observer *E. rubriventer* et *D. madagascariensis*. La présence de ces espèces témoigne d'un ancien rattachement d'Ambodiriana à un bloc de forêt beaucoup plus vaste, et d'une fragmentation relativement récente de la zone (< 5 ans). Ces espèces emblématiques sont classées dans la catégorie Endangered de l'IUCN (sauf *E. rubriventer* classé dans la catégorie Vulnérable), et constituent donc un enjeu majeur de conservation.

De plus, elles sont qualifiées d'espèces "parapluies". Leur conservation permet de protéger l'ensemble des espèces végétales et animales présentes dans leur habitat (Simberloff 1998). La présence de *I. indri* aux alentours immédiats d'Ambodiriana est particulièrement importante, car cette espèce n'a encore jamais survécu en captivité (Mittermeier *et al.* 2004), et sa conservation implique obligatoirement la conservation de son habitat naturel.

Ces analyses appuient donc le projet de création d'une Aire Protégée amorcé dans la zone d'Ambodiriana par l'ADEFA. L'agrandissement de la zone protégée apparaît nécessaire pour la conservation de la communauté de lémuriens. L'analyse cartographique a révélé la présence d'un bloc forestier de 150 km² situé à l'Ouest d'Ambodiriana (Fig. 1). Ce bloc forestier, qui est un avantage certain compte tenu du peu de forêt humide de basse altitude restante dans l'Est de Madagascar, pour-

rait être intégré dans la définition des limites de la future Aire Protégée.

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Les principaux facteurs menaçant les lémuriens de l'aire protégée de Makira

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La couverture forestière de Madagascar ne cesse pas de dégrader, les pratiques de tavy et les exploitations forestières abusives en sont les principales causes et elles sont souvent amplifiées par les effets du passage cyclonique provoquant ainsi des dégâts non négligeables dans les écosystèmes forestiers. Les forêts sur le plateau de Makira n'échappent pas à l'impact de ces phénomènes de dégradation, rendant ainsi à la vulnérabilité de ces forêts dans leurs états actuels. L'influence du phénomène "El Ninô" dans l'Océan Indien, a augmenté la formation des dépressions tropicales et qui se transforment parfois en cyclone, dans notre région. Ces perturbations climatiques deviennent répétitives ; ainsi depuis 1985 jusqu'à l'année 2007, au moins 13 cyclones ont frappé la partie Nord Est de Madagascar, comme Kamisy (avril 1985); Honorine (mars 1986); Géralda (février 1994), Bonita et Daisy (janvier-février 1996); Eline, Gloria et Hudah (février-avril 2000), Ihary et Kesiny (mars-mai 2002), Elita et Gafilo (février-mars 2004), Indlala et Jaya (janvier-février 2007) et tout récemment Ivan (février 2008), soit en moyenne un cyclone tous les deux ans. Les impacts de tous ces facteurs écologiques menacent la biodiversité sur différents points, entre autre, la diminution de biomasse végétale qui a des effets importants sur l'échange gazeuse dans le cycle des éléments naturels, dans la photosynthèse, l'accélération de la perte de la flore et de la faune. Pour le cas de l'aire protégée de Makira, les 20 espèces de Lémuriens existantes risquent de s'anéantir avec la dégradation de son habitat, car l'adaptation de ces espèces au rythme de changement brusque défavorise l'avenir de

leur génération, et par conséquent, elles vont périr, au niveau local, au niveau régional et au niveau mondial. Néanmoins, le cas suivant se présente dans l'aire protégée de Makira pendant les observations que nous avons effectuées entre les années 2005 et 2007, des espèces de lémuriens semblent être sensibles et vulnérables au changement brusque de leurs niches écologiques, alors que d'autres semblent s'adapter et résister à cette variation. La présente étude essaye d'analyser l'influence des menaces anthropiques et les impacts de passages cycloniques qui s'exercent sur ces lémuriens.

Méthodologie

Sites d'études
L'aire protégée de Makira est localisée entre: latitude S 14°34'67,3" et S 15°51'76,0" et longitude E 050°00'34,1" et E 048°56'96,7". En fait, le site est àcheval entre trois régions de Nord Est de Madagascar: la Sava, dans la partie Nord, l'Analanjirofo dans la partie Est et Sud et la Sofia dans la partie Ouest. Le tableau 1 résume la position géographique des localités prospectées.

Tableau 1: Position géographique des sites explorés dans l'aire protégée de Makira.

Sites d'études	**Position géographique**	
Manandriana	S 14°49'53,3"	E 49°27'37,3"
Amparihibe	S 15°02'06,7"	E 49°35'02,0"
Bezavona	S 15°06'56,6"	E 49°48'18,8"
Ambatoharanana Anjiabe	S 15°08'16,0"	E 49°21'02,3"
Anjanaharibe	S 15°11'17,1"	E 49°36'50,8"
Mangabe	S 15°18'40,1"	E 49°30'12,1"
Antsahabe	S 15°21'33,9"	E 49°30'12,1"
Andranomenahely	S 15°23'53,0"	E 49°27'05,2"
Anantaka	S 15°25'52,7"	E 49°27'16,0"
Ambongabe Amparihimolengy	S 15°24'31,9"	E 49°08'05,1"
Maroankolany Manonga Bevitsika	S15°29'17,9"	E 49°09'33,5"
Lokaitra	S 15°49'06,9"	E 49°30'37,8"

Pendant trois années 12 sites ont été explorés dont huit sont suivis périodiquement pendant les différentes saisons. La figure suivante indique la localisation des différents sites (Fig. 1).

Méthodes
La méthode consiste à estimer les surfaces d'incidences des catastrophes naturelles (cyclone) et à identifier les menaces susceptibles d'avoir un impact négatif à chaque espèce de lémuriens. Nous avons procédé également à des comptages directs et indirects des activités anthropiques menaçant sur les habitats des lémuriens et qui ont des influences sur leur comportement et leur vie, en se basant sur des lignes-inventaires. Ainsi, nous avons essayé de mesurer l'intensité des facteurs, en particulier les pressions humaines, par évaluation des surfaces d'incidence des activités humaines comme l'exploitation forestière, le tavy, la cueillette, la chasse, les différentes activités que l'homme exercé dans la forêt, le nombre des villages environnants et la distance moyenne des villages par rapport à la forêt. Pour connaître l'influence des différentes pressions, nous avons calculé

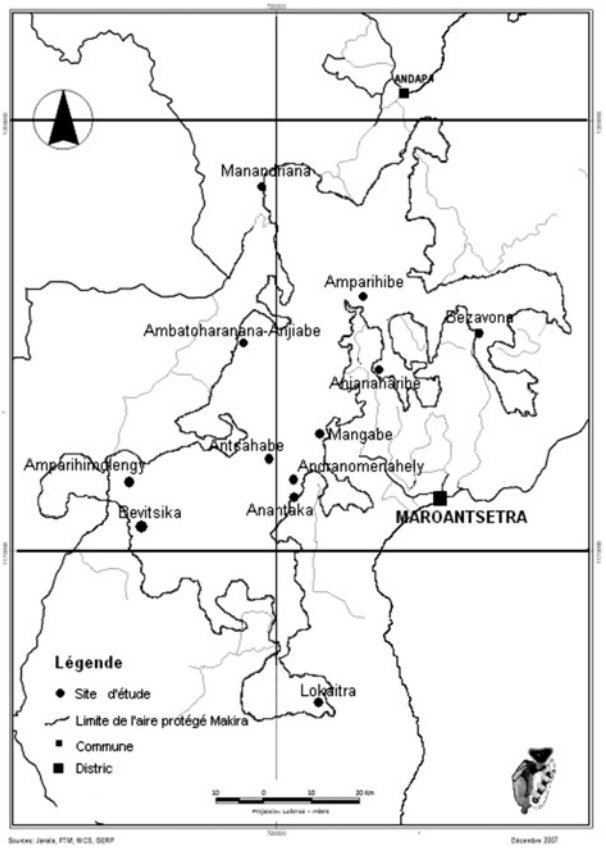

Fig. 1: Les douze sites d'études dans l'aire protégée de Makira.

le coefficient de corrélation 'r_s' représenté par l'indice de Spearman. Enfin, nous avons essayé de voir la relation entre les dégradations naturelles, anthropiques d'une niche écologique et les disparitions des animaux. Les dates et l'effort des inventaires durant les années d'observations dans l'aire protégée de Makira sont représentés par le tableau 2. Notons que, du 11 Janvier au 27 Février 2003 une évaluation biologique rapide des lémuriens a été menée par Raharivololona *et al.* (2003) dans la partie orientale de la forêt humide du plateau Makira, dans les sites d'Amparihibe et d'Anjanaharibe.

Résultats et Discussion
Les pressions anthropiques dans l'aire protégée de Makira.L'homme exploite la forêt en tant que ressource naturelle pour satisfaire ses besoins quotidiens.
Le tableau 4 résume les produits collectés et leurs utilisations par les paysans qui vivent en interface avec la région de Makira. L'accès de ces paysans dans la forêt pour collecter ces produits n'est pas réglementé. Les quantités des produits collectés varient en fonction de la zone, de la saison et des contextes de la vie, ainsi l'effet de ces collectes risque de déséquilibrer l'écosystème. A part ces collectes de produits forestiers, plusieurs facteurs socioculturels menacent énormément l'écosystème forestier dans le plateau du Makira. Nos résultats d'observations et d'enquêtes ont constaté que la distance du village par rapport à la forêt, les pièges à lémuriens, les défrichements de la forêt et les exploitations minières ont des influences directes sur les lémuriens.

Tableau 2 : Les dates des inventaires et les nombres des espèces des lémuriens trouvés durant les années d'observations.

Site	2003		2005		2006		2007	
	Date	Espèces	Date	Espèces	Date	Espèces	Date	Espèces
APB	11/01 au 27/02	9		3				
AJB	11/01 au 27/02	8	12 au 18/10	9	29 au 4/06	10	12 au 18/10	5
MGB			21 au 29/05	6	21 au 27/10	11		
ADH			24 au 30/10		20 au 26/06	12		
ATK			04 au 10/11		29 au 05/07	14	27/09 au 02/10	6
ATB					12 au 18/06	12	18 au 24/06	9
APG			17 au 23/06	8	06 au 12/10	12		
LKT			07 au 13/06	9	15 au 21/06 03 au 09/10	12		

Signification: APB: Amparihibe, AJB: Anjanaharibe, MGB: Mangabe, ATB: Antsahabe, ADM: Andranomenahely, ATK: Anantaka, APG: Amparihimolengy, LKT: Lokaitra

Tableau 3: Tableau des principaux produits forestiers collectés dans l'aire protégée de Makira et leurs utilisations.

Produits collectés	Utilisation
Feuille de Pandanus (*Pandanus madagascariensis*, *Pandanus* sp.)	Vannerie
Raphia (*Raphia ruffa*)	Vannerie, cordage, construction de maison, alimentation, clôture
Ravenala (*Ravenala madagascariensis*)	Vannerie, cordage, construction de maison, alimentation
Dracaena partie du cœur des grandes espèces	Alimentation
Palmier (*Dypsis nudifera*, *D. fibrosa*)	Construction de maison, sarbacane, balaie
Arbres ligneux, lianes	Construction de maison, cordage, pirogue, manches, matériels de travaux, ressource de revenus
Bois mort ou arbre spécifique (*Potamea antevaratra*, *Gaertnera…*)	Bois de chauffe
Ecorce de plantes (*Evodia madagascariense*, *Dilobeya thouarsii*, *Prunus africanum*, *Dombeya*)	Ferment d'alcool local, médecine traditionnelle ; vannerie, cordage
Plantes médicinales	Médecine traditionnelle
Gibiers (lémuriens, sangliers, vivéridés, oiseaux, poissons, anguilles, écrevisses, crabes)	Alimentation
Collecte de miel	Alimentation, ressource de revenus

Ces résultats montrent que dans l'aire protégée de Makira, huit espèces de lémuriens sont hautement menacés par la pression anthropique, il s'agit de deux espèces diurnes: *Propithecus candidus* et *Varecia rubra*, une espèce cathémérale: *Eulemur fulvus fulvus* et cinq espèces nocturnes: *Cheirogaleus crossleyi*, *C. ravus*, *C. sibreei*, *Allocebus trichotis* et *Daubentonia madagascariensis*. Le niveau de pressions qu'elles subissent est fortement corrélé avec l'effectif des villages périphériques, la distance du village par rapport à la forêt, le défrichement de la forêt et l'exploitation minière. *Eulemur albifrons* est hautement menacée par les pièges et moyennement menacé par le défrichement de la forêt et l'exploitation minière et faiblement menacée par la distance des villages par rapport à la forêt. *Cheirogaleus major* est hautement menacée par l'abondance de village, les pièges et le défrichement de la forêt, moyennement menacé par la distance de la forêt par rapport au village et par l'exploitation minière. *Phaner furcifer* est hautement menacée par le défrichement de la forêt et faiblement menacé par la l'abondance de village et la distance de la forêt par rapport au village. *Eulemur rubriventer* est hautement menacée par le défrichement de la forêt et les pièges et moyennement menacé par la l'abondance du village et la distance de la forêt par rapport au village, et faiblement menacé par l'exploitation minière. Les autres espèces, *Varecia variegata subcincta* sont hautement menacées par la distance de la forêt par rapport aux villages et par les pièges. Elles sont moyennement menacées par le défrichement de la forêt, et faiblement menacées par l'exploitation minière. *Hapalemur griseus* est hautement menacée par l'abondance du village et la distance de la forêt par rapport au village, cette espèce est moyennement menacée par les pièges et le défrichement de la forêt et elle est faiblement menacée par l'exploitation minière. *Microcebus mittermeieri* est hautement menacé par la distance de la forêt par rapport aux villages et moyennement menacée par les pièges, le défrichement de la forêt et l'exploitation minière. *Microcebus* sp. est hautement menacée par l'exploitation minière, moyennement menacée par la distance de la forêt par rapport aux villages et les pièges et elle est faiblement menacée par le nombre de villages et le défrichement de la forêt. *Lepilemur seali* est hautement menacé par la distance de la forêt par rapport au village et le défrichement de la forLt et moyennement menacée par le nombre du village, les pièges et l'exploitation minière. L'*Indri indri* est moyennement menacée par le nombre de village périphérique, la distance de villages par rapport à la forêt, les pièges, le défrichement de la forêt et l'exploitation minière. *Avahi laniger* est moyennement menacée par la distance des villages par rapport àla forêt, les pièges et le défrichement de la forêt, cette espèce est faiblement menacée par le nombre de village périphérique et l'exploitation minière.

Outre à ces pressions anthropiques, le cyclone semble être un des facteurs écologiques qui des influent sur les effectifs de lémuriens. Nous avons constaté qu'à chaque année de suivi écologique le nombre d'espèces et les effectifs des groupes inventoriés de lémuriens varient. Parmi les douze sites explorés dans l'aire protégée de Makira, huit sites sont suivis deux à trois fois depuis 2005 jusqu'à 2007, il s'agit d'Amparihibe, Anjanaharibe, Mangabe, Antsahabe, Andranomenahely, Anantaka, Amparihimolengy et Lokaitra. Suite aux passages des cyclones Ihary et Kesiny en 2002, puis les cyclones

Tableau 4: Corrélation entre la densité des lémuriens et l'abondance des facteurs anthropiques menaçants dans l'aire protégée de Makira.

Espèces lémuriens	**r_s nombre de village périphérique**	**r_s distance de village périphérique**	**r_s piège à lémuriens**	**r_s défrichement de la forêt**	**r_s exploitation minière**
Propithecus candidus	- 1	1	n.c.	1	1
Varecia rubra	- 1	1	n.c.	1	n.c.
Eulemur fulvus fulvus	- 1	1	- 1	- 1	-1
Cheirogaleus ravus	- 1	1	- 1	- 1	n.c.
Cheirogaleus crossleyi	- 1	-1	n.c.	n.c.	n.c.
Cheirogaleus sibreei	- 1	1	- 1	- 1	n.c.
Allocebus trichotis	- 1	0,98	- 1	1	1
Daubentonia madagascariensis	- 1	1	- 1	1	n.c.
Cheirogaleus major	- 0,77	0,49	- 0,98	0,77	0,45
Eulemur albifrons	- 0,25	- 0,25	1	0,41	0,52
Phaner furcifer	- 0,24	0,27	- 0,24	0,99	n.c.
Eulemur rubriventer	- 0,39	0,27	0,97	- 0,77	- 0,14
Varecia variegata subcincta	0,28	0,77	0,77	- 0,43	0,04
Hapalemur griseus	- 0,60	0,61	- 0,33	- 0,43	- 0,14
Microcebus mittermeieri	- 0,33	0,68	- 0,33	- 0,33	0,33
Microcebus sp.	0,03	0,33	- 0,30	0,14	0,56
Lepilemur seali	- 0,33	0,65	0,33	- 0,63	- 0,30
Indri indri	0,28	0,45	0,05	- 0,45	0,34
Avahi laniger	- 0,10	- 0,50	0,46	0,45	- 0,10
Lepilemur microdon	n.c.	n.c	n.c	n.c	n.c

L'intensité des pressions varie suivant la valeur de coefficient de corrélation "indice de Spearman" (r_s) entre un type de pression et la densité de l'espèce de Lémuriens. La pression est "très haute" si $r_s = \pm 1$, elle est "haute" si $-1 < r_s < -0{,}53$ ou $0{,}53 < r_s < 1$, "moyenne" si $-0{,}53 < r_s < -0{,}27$ ou $0{,}27 < r_s < 0{,}53$; "faible" si $-0{,}27 < r_s < 0$ ou $0 < r_s < 0{,}27$. Si $r_s = 0$, il n'y a pas de corrélation.

Elita et Gafilo (février-mars 2004), ainsi que Indlala et Jaya (janvier- février 2007) qui ont frappés cette région, nous avons constaté que l'espèce de lémuriens a diminué en général, alors qu'il semble augmenter en l'absence de cette perturbation climatique. Ces cyclones formés dans l'Océan Indien peuvent être très dévastateurs et frapper très fort dans la région. Avant 1960, les cyclones étaient rares, ces derniers temps, ils sont devenus nombreux, fréquents et avaient fait de gros dégâts.

Dans le site d'Amparihibe, en 2003, neuf espèces de lémuriens ont été recensées, et en 2005, trois espèces sur neuf seulement ont été observées, Pendant l'inventaire de 2005, nous avons remarqué qu'une grande surface forestière était détruite par le passage cyclonique (Elita et Gafilo février-mars 2004). Cette dégradation forestière est en relation avec la diminution d'effectif des espèces de lémuriens inventoriées et qui correspond soit à une migration, soit à une disparition des espèces non adaptées comme *Varecia rubra*, *Eulemur rubriventer*, *Lepilemur seali* suite au changement brusque de leur habitat. Les Cheirogaleidae recensées en 2003, par Raharivololona *et al.* (2003*) Microcebus mittermeieri*, *M.* sp., *Cheirogaleus major*, peuvent être en hibernation ou en torpeur (Martin 1973; Pollock 1979). Pendant nos observations, des espèces supportant et résistant au changement brusque de leurs niches écologiques comme *Hapalemur griseus* et *Eulemur fulvus albifrons* ont été inventoriées. Notons que les forêts d'Amparihibe et d'Anjanaharibe se fixent sur des résidus d'éruption volcanique et des fractures tectoniques. Alors, les arbres ne peuvent pas résister aux vents violents car les surfaces de fixation des racines sont peu profondes. De ce fait, plus les arbres grandissent, moins leurs racines n'arrivent plus à les soutenir normalement.

A Anjanaharibe huit espèces ont été recensées en 2003 (Raharivololona *et al.* 2003) neuf espèces en 2005, 10 espèces en 2006 et cinq espèces en 2007 (Rasolofoson *et al.* 2007). En 2005 et en 2007, nous avons remarqué une augmentation de la dégradation de la forêt dans la zone explorée et qui entraînait une variation du nombre d'espèces de lémuriens observées au cours de ces années. Pendant les suivis, *Propithecus candidus* n'est observée qu'en 2006 seulement et *Varecia rubra* n'est ni observée, ni entendue en 2005 et en 2007, et il en est de même pour *Daubentonia madagascariensis* qui n'est pas recensée en 2003 ni en 2007; pour dire que ces espèces sont très sensibles à la perturbation de leurs habitats. Néanmoins, les espèces comme *Eulemur fulvus albifrons*, *Eulemur rubriventer*, *Avahi laniger*, *Lepilemur seali*, *Microcebus mittermeieri* et *Hapalemur griseus* sont toujours observés pendant les suivis écologiques, c'est a dire que ces espèces auraient supporté et résisté en général au changement brusque de leurs habitats.

Dans le site de Mangabe, en 2005, six espèces de lémuriens ont été recensées: *Indri indri*, *Varecia variegata subcincta*, *Eulemur fulvus albifrons*, *Lepilemur seali*, *Phaner furcifer* et *Avahi laniger*; par contre l'année 2006, 11 espèces ont été inventoriées. Les deux passages cycloniques d'Elita et de Gafilo, en février et mars 2004, ont provoqué une perturbation de quelque partie de la couverture forestière dans ce site, entraînant ainsi soit la migration, soit la disparition des espèces de lémuriens non adaptées au changement brusque de leurs habitats, comme *Hapalemur griseus*, *Cheirogaleus major*, *Microcebus mittermeieri*, *M.* sp. et *Daubentonia madagascariensis* et les réadaptations des six autres espèces ci-dessus qui supportent et résistent à ce changement.

A Antsahabe, 12 espèces de lémuriens ont été observées en 2006 et neuf espèces en 2007. Les neuf espèces *Indri indri*, *Varecia variegata subcincta*, *Hapalemur griseus*, *Eulemur fulvus albifrons*, *Eulemur rubriventer*, *Avahi laniger*, *Lepilemur seali*, *Allocebus trichotis* et *Microcebus mittermeieri* s'adaptent et résistent aux changement de leurs habitats. Les espèces migrantes ou en hibernation sont *Cheirogaleus major*, *C. ravus*, *Microcebus* sp..

A Andranomenahely, le nombre d'espèces observées est stabilisé à 12, *Allocebus trichotis* seulement pourra être l'espèces sensible à l'influence du cyclone dans ce site. Le site n'est pas très influencé par le passage cyclonique car l'habitat y est peu perturbé que toutes les autres espèces inventoriées pendant l'année 2005 ont été tou-

Tableau 5: Effectifs des espèces recensées dans huit sites de l'aire protégée de Makira depuis 2005 et les études effectuées par Raharivololona *et al*. (2003).

	APB 2003*	**APB 2005**	**AJB 2003***	**AJB 2005**	**AJB 2006**	**AJB 2007**	**MGB 2005**	**MGB 2006**	**ATB 2006**	**ATB 2007**	**ADM 2005**	**ADM 2006**	**ATK 2005**	**ATK 2006**	**ATK 2007**	**APG 2005**	**APG 2006**	**LKT 2005**	**LKT 2006**
Indri indri	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1
Propithecus candidus	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Varecia rubra	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Varecia variegata subcincta	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1
Hapalemur griseus	1	1	1	1	1	0	0	1	1	1	1	1	1	1	0	1	1	0	1
Eulemur fulvus albifrons	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Eulemur fulvus fulvus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
Eulemur rubriventer	1	0	1	1	1	1	0	0	1	1	1	1	0	0	0	1	1	1	1
Avahi laniger	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Lepilemur seali	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Lepilemur microdon	1	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Cheirogaleus crossleyi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Cheirogaleus major	1	0	1	1	1	0	0	1	1	0	1	1	1	1	0	0	1	0	1
Cheirogaleus ravus	0	0	0	0	0	0	0	0	1	0	0	0	1	1	0	0	0	0	0
Cheirogaleus sibreei	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0
Allocebus trichotis	0	0	0	0	0	0	0	0	1	1	0	1	0	1	0	0	0	1	1
Microcebus mittermeieri	1	0	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1
Microcebus sp.	1	0	0	0	0	0	0	1	1	0	0	0	1	1	0	0	1	1	1
Phaner furcifer	1	0	0	0	0	0	1	1	0	0	1	1	1	1	0	0	0	0	0
Daubentonia madagascariensis	0	0	0	1	1	0	0	1	0	0	1	1	1	1	0	0	0	0	0
Nombre d'espèces	9	3	8	9	10	5	6	11	12	9	12	12	13	14	6	8	12	9	12

Signification: APB: Amparihibe, AJB: Anjanaharibe, MGB: Mangabe, ATB: Antsahabe, ADM: Andranomenahely, ATK: Anantaka, APG: Amparihimolengy, LKT: Lokaitra; *: Données de Raharivololona *et al.* (2003)

jours recensées pendant l'année 2006. Il s'agit de *Indri indri*, *Varecia variegata subcincta*, *Hapalemur griseus*, *Eulemur fulvus albifrons*, *Eulemur rubriventer*, *Avahi laniger*, *Lepilemur seali*, *Cheirogaleus major*, *Phaner furcifer*, *Microcebus mittermeieri* et *Daubentonia madagascariensis.*

A Anantaka, 13 espèces de lémuriens ont été recensées en 2005, 14 espèces en 2006 et six espèces en 2007. Huit espèces de lémuriens: *Hapalemur griseus*, *Cheirogaleus major*, *C. ravus*, *C. sibreei*, *Phaner furcifer*, *Allocebus trichotis*, *Microcebus* sp. et *Daubentonia madagascariensis* ne supportent pas le changement brusque de leurs habitats, alors que six espèces de lémuriens: *Indri indri*, *Varecia variegata subcincta*, *Eulemur fulvus albifrons*, *Avahi laniger*, *Lepilemur seali* et *Microcebus mittermeieri* peuvent résister et s'adapter à ce changement brusque d'habitat.

A Amparihimolengy, huit espèces de lémuriens ont été recensées en 2005, 12 espèces en 2006. Huit espèces de lémuriens (*Indri indri*, *Varecia variegata subcincta*, *Hapalemur griseus*, *Eulemur fulvus albifrons*, *Eulemur rubriventer*, *Avahi laniger*, *Lepilemur seali* et *Microcebus mittermeieri*) peuvent résister et s'adapter aux changements brusque de leurs habitats et quatre espèces de lémuriens (*Eulemur fulvus fulvus*, *Cheirogaleus crossleyi*, *C. major* et *Microcebus* sp.) n'en supportent pas. Elles migreront vers d'autres milieux plus propices a leurs viabilités et/ou disparaîtront du site.

A Lokaitra, neuf espèces de lémuriens ont été recensées en 2005 et 12 espèces en 2006. Trois espèces de lémuriens: *Hapalemur griseus*, *Eulemur fulvus fulvus*, et *Cheirogaleus major* ne supportent pas les changements brusques de leurs habitats et auraient migré vers d'autres milieux plus propices à leurs viabilités et, ou disparaissent du site. Par contre, neuf espèces de lémuriens *Indri indri*, *Varecia variegata subcincta*, *Eulemur fulvus albifrons*, *Eulemur rubriventer*, *Avahi laniger*, *Lepilemur seali*, *Allocebus trichotis*, *Microcebus mittermeieri* et *M.* sp. peuvent résister et s'adapter à ce changement d'habitat.

Les couvertures forestières dans les sites d'Antsahabe, Andranomenahely, Amparihimolengy et Lokaitra sont peu perturbées par les passages cycloniques, c'est la raison pour laquelle la diversité spécifique de lémuriens dans ces sites présente une stabilité.

Dans l'aire protégée de Makira, les analyses des influences des pressions anthropiques et des passages cycloniques démontrent que les espèces *Propithecus candidus*, *Varecia rubra*, *Eulemur fulvus fulvus*, *Cheirogaleus crossleyi*, *C. major*, *C. ravus*, *C. sibreei*, *Allocebus trichotis* et *Daubentonia madagascariensis* semblent très sensibles aux perturbations provoquées par les deux types de facteurs écologiques, alors que *Indri indri*, *Varecia variegata subcincta*, *Hapalemur griseus*, *Eulemur albifrons*, *Eulemur rubriventer*, *Avahi laniger*, *Lepilemur seali* et *Microcebus mittermeieri* semblent résister et s'adapter aux influences de la perturbation de ces facteurs. En 2006, Ratsisetraina a déjà démontré que *Varecia rubra* est sensible au passage cyclonique, par contre *Eulemur fulvus albifrons* résiste à l'influence de ce facteur dans la presqu'île de Masoala. En 2002, Ratsimbazafy a souligné que *Varecia v. variegata* résiste et s'adapte au changement brusque de son habitat lors du passage cyclonique, dans la région de Manombo, Farafangana. Néanmoins, il faut tenir compte de la variation saisonnière qui provoque parfois des fluctuations d'effectifs pendant les inventaires, en particulier pour l'observation de *Cheirogaleus* qui s'hiberne pen-

dant l'hiver, ainsi que le cas de *Microcebus* et *Allocebus trichotis* qui ne s'hibernent pas, mais qui peuvent être en torpeur (Martin 1973; Pollock 1979) pendant cette période dans cette aire protégée.
Ces deux types de facteurs ont des impacts négatifs sur les espèces de lémuriens, mais nous avons constaté que la dégradation causée par le passage des cyclones est plus intense par rapport à celle des activités anthropiques, car les grands arbres de cette région n'arrivent pas à résister aux vents violents à cause de la nature du sol et de l'altitude, ils tombent facilement et vont créer par la suite une sorte de chablis ou clairière à l'intérieur de la forêt. Ces restrictions de surface forestière ne fait que diminuer les niches écologiques de ces animaux. Cette situation serait néfaste à la vie des animaux, comme *Varecia variegata rubra* qui choisit de préférence les grands arbres à hauteur élevée comme substrat.

Conclusion
Les facteurs anthropiques (défrichement de la forêt, pratique de tavy, pièges) et les passages cycloniques sont les deux principaux facteurs écologiques qui bouleversent la diversité spécifique de lémuriens dans les différents sites de l'aire protégée de Makira. Ces facteurs provoquent la destruction des habitats et perturbent les niches écologiques de ces animaux. Ces destructions pourront entraîner soit la migration, soit la disparition des espèces. En effet, parmi les espèces de lémuriens connues dans l'air protégée de Makira: *Propithecus candidus*, *Varecia rubra*, *Eulemur fulvus fulvus*, *Cheirogaleus crossleyi*, *C. major*, *C. ravus*, *C. sibreei*, *Allocebus trichotis* et *Daubentonia madagascariensis* sont les plus sensibles aux perturbations d'origine humaine et climatique tandis que *Indri indri*, *Varecia variegata subcincta*, *Hapalemur griseus*, *Eulemur albifrons*, *Eulemur rubriventer*, *Avahi laniger*, *Lepilemur seali* et *Microcebus mittermeieri* semblent résister et s'adapter aux changements brusques de leurs habitats.
Dans le cadre de la conservation des lémuriens de la forêt de Makira, l'atténuation de l'impact des facteurs anthropiques nécessite un développement d'une campagne de sensibilisation et d'éducation environnementale à l'intérieur et aux environs de cette de forêt et ceci en partenariat avec les autorités locales et les institutions techniques.

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Distribution and conservation status of *Mirza zaza*

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The recently described Northern giant mouse lemur, *Mirza zaza* is currently listed as data deficient in the IUCN Red List. We conducted nocturnal surveys to determine the distribution of this species along the northwest coast of Madagascar. Combining results of these surveys and recent reports in the literature, it appaers that *Mirza zaza* only occurs in isolated forest patches between the Mahavavy river in the north and the Maeverano in the south. Given this limited distribution and low densities in fragmented forests, the Northern giant mouse lemur should be classified as "threatened".

The island of Madagascar is a global hotspot for biodiversity and conservation (Myers *et al.* 2000), not the least because of its endemic primate radiation. To develop effective conservation action plans for the maintenance of Madagascar's lemurs, basic knowledge about abundance and geographical distribution is required, which is still lacking for many taxa. This is also true for the genus *Mirza*.

The distribution of the genus *Mirza* is restricted to western dry deciduous forest. *Mirza* shows a highly disjunctive distribution with a gap of up to several hundred kilometers between northern and southern populations. Until 2005, the genus *Mirza* GRAY, 1870 was only represented by a single species- Coquerel's dwarf lemur, *Mirza coquereli* (Grandidier, 1867). A comparison based on morphological, behavioral and genetic data of *Mirza* individuals from Kirindy forest with individuals from Ambato revealed that these populations are distinguishable at the species level. Therefore Kappeler *et al.* (2005) described the northern *Mirza* from Ambato as a new species, *Mirza zaza* KAPPELER and ROOS, 2005.
Mirza coquereli is known to occur between the Parc National de Bemaraha and the Parc Zombitse-Vohibasia. Additionally, single personal observations indicated its presence in the Andranomena Special Reserve, the Tsingy de Bemaraha National Park (Kappeler 2003) and also in the Tsingy de Namoroka National Park (Mittermeier *et al.* 2006). In the case of the newly described *M. zaza*, only little locality information is available. Type specimens come from the Sambirano region in northern Madagascar, specifically from "Pasindava" on the Ampasindava Peninsula and from Ambato. Moreover, C. Schwitzer reported (confirmed by genetics) that *M. zaza* is also present in the Ankarafa Forest of the Sahamalaza region (Mittermeier *et al.* 2006). Randrianambinina *et al.* (2003) described sightings from census walks of individuals of *M. coquereli* in the Mahalaka forest and Randriatahina (2004) reported individuals of *M. coquereli* in the Ankarafa forest and in Andranobe and Ambendrana.
Because these latter reports were made before the description of *M. zaza*, it is possible that these individuals also belong to this species and not to *M. coquereli*, or that sympatric distribution is likely at these sites. In fact, we know almost nothing about the distribution and abundance of *M. zaza*, except for one small population at Ambato. *Mirza zaza* is curently listed as "data deficient" in the IUCN Red List, but given the fact that *M. coquereli* is listed as vulnerable, *M. zaza* must be considered at least as "threatened" and could also be "endangered" (Mittermeier *et al.* 2006; Roos and Kappeler 2006). To obtain more information on the distribution and abundance of *M. zaza* we therefore conducted surveys in north-western Madagascar.

Methods
We visited five localities in north- western Madagascar. The first locality was the type specimen locality near Ambato to reassess densities in an already investigated area. Further to the south, we conducted surveys at Ankiabe and Andranobe near Befotaka and in the Sahamalaza region at Ambendrana and the Ankarafa forest. Locations are indicated in Figure 1.
Because we were not able to walk straight line transects, this reduces the statistical power for the calculation of population density to the measurement of encounter rates (individuals seen per km). All lemurs were discriminated to the species level, if possible. In the case of *M. zaza* this was almost always possible, because of its much greyer fur and the pronounced tip on the tail in comparison to *Mirza coquereli*. Transects were conducted by two observers in October and November 2007.

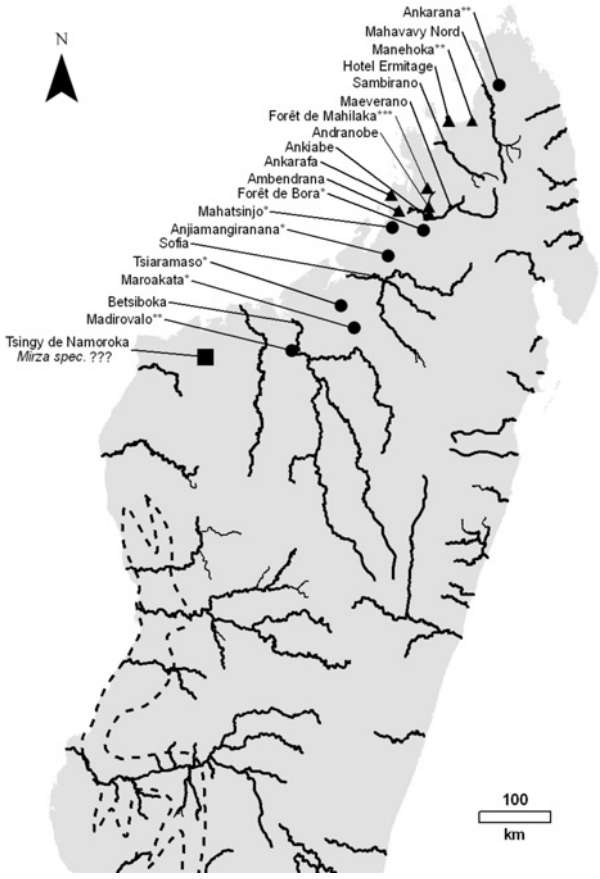

Fig. 1: *Mirza* distribution map. Note that *Mirza zaza* is known to occur only between the rivers Mahavavy nord and Maeverano.
Triangles= *Mirza zaza* present, circles= no *Mirza* present, squares= unknown species, black lines= rivers, dotted line= Range of *Mirza coquereli*, asterisks show surveys of other authors, *Olivieri *et al.* (2005), **Rasoloharijaona *et al.* (2005), ***Randrianambinina *et al.* (2003)

Results
In the following we give a short description of each site. Encounter rates are listed in Table 1.
Ambato Peninsula (*Hotel Ermitage Plage*): This is the site where Kappeler *et al.* (2005) found the type specimen for the description of *Mirza zaza*. It was already described as highly degraded forest of only about 4 ha in size with a lot of mango trees. Kappeler *et al.* (2005) estimated a density of 1086 ind/km^2. When we visited this site, we found almost no remaining forest, making transect walks impossible. Nevertheless, during a short night walk around the remaining trees (mostly mango-trees) we discovered four *Mirza zaza* individuals within 20 minutes. But due to the destruction of the habitat, the local extinction of *M. zaza* it is only a question of time.
Ankiabe: We spent two nights at Ankiabe. The remaining forest cover near Ankiabe runs approx. 4-5 km along one side of a hill that surrounds a feeder river of the Maeverano. It is already highly degraded, which was most obvious by great patches of small shrubs and grass. The ground here was impassable because the hill is very steep and the ground was mostly covered with loose rocks. We only saw a few individuals of *M. zaza* at this site.

Table 1: Encounter rates (ind./ km) for various lemur species at four sites in NW-Madagascar.

Location	Geographical coordinates	transect length (m)	*Mirza zaza*	*Microcebus* spec.	*Lepilemur sahamalensis*	*Cheirogaleus* spec.	*Microcebus sambiranensis*	*Cryptoprocta ferox*	*Eulemur macaco*	Not identified
Ankiabe	S14°37"24.7' E48°15"26.1'	1729	1.2	3.5	0.0	0.0	0.6	0.6	0.0	1x Mz, Ch ?
Adranobe	S14°31"37.2' E48°15"03.3'	1246	15.2	0.0	0.0	0.0	0.0	0.0	0.8	1x Lepi ?
Ambendrana	S14°35"20.4' E47°51"41.1'	2103	3.3	0.0	0.0	0.5	0.0	0.0	1.0	2x Mz, Ch ?
Ankarafa	S14°22"49.3' E47°45"27.6'	3876	0.3	0.0	4.1	1.0	0.0	0.0	*	1x Mz, Ch ?

If it was not possible to identify the species, we listed the genus. If it the genus was unclear, we listed this in the row "Not identified" and propose possibilities. Mz= *Mirza* spec., Ch= *Cheirogaleus* spec., Lepi= *Lepilemur* spec., * we did not count this species, because detailed information about density can be obtained from scientists of the AEECL field station.

Andranobe: The remaining forest at Andranobe was very similar to Ankiabe. As in Ankiabe, we could see the beginning and the end of the forest when approaching the site by foot. The forest is also highly degraded, but in contrast has a large number of mango trees. Here we counted most individuals and could also observe five animals that left together a nest, supporting similar observations by Kappeler *et al.* (2005) at Ambato.

Ambendrana: The forest near Ambendrana also runs along a small riverbed. Again the degree of forest degradation and the number of Mango trees was high. It was previously unknown, whether *Mirza zaza* is present at this site. We counted the second highest number of individuals here.

Ankarafa: Ankarafa forest was by far the most natural forest of the five sites, although it includes primary and secondary forest fragments. The primary and secondary forest fragments are separated by a small savannah-like area of less than one km^2 (Schwitzer *et al.* 2007). We stayed for five days at the AEECL (Association Européenne pour l'Etude et la Conservation des Lémuriens) field station, where C. Schwitzer already reported the presence of *Mirza zaza*. First, we surveyed the smaller primary forest area, which looked like a perfect habitat for Cheirogaleids, because of dense vegetation with many lianas. We saw only two *Cheirogaleus* during the first three nights and only heard one *Mirza* calling during the second night. After approaching this vocalization, we were also able to see the individual and identify it as *Mirza zaza*.
Because we heard *Mirza* vocalizations within the camp during the third night, we continued our survey in the camp area, which is a stronger degraded, secondary forest with many mango trees. While waiting for dusk at a nest, we could see three individuals of *Mirza zaza*. But again, walking transect afterwards did not reveal any detection of *Mirza*, neither visually nor acoustically. Another species seen frequently was *Lepilemur sahamalensis*.

Discussion
Mirza zaza was found in all localities visited. Highest encounter rates were obtained in Andranobe and Ambendrana, both of which showed a high degree of forest degradation together with a high denisty of mango trees. This observation indicates that mango trees may be an important resource for *Mirza zaza* or that this correlation is a secondary effect of forest degradation. These clumped resources may also influence their social behavior and detectability. Two independent observations from two different localities confirmed that *Mirza zaza* sleeps not solitarily and shows more social interactions than *Mirza coquereli*. As already argued in Kappeler *et al.* (2005), it seems not likely that this type of sociality is just the result of high population densities because in Ankarafa, where we had the lowest encounter rates of all sites, we could also observe three individuals visiting together a nest at the beginning of the night. Their social behavior had consequences for our surveys and the estimation of population densities. *Mirza zaza* was found to vocalize a lot, in particular at the beginning of the night, which alerts observers to the direction of the animal, and thus probably enhances encounter rates. Encounter rates for *Mirza coquereli* in Kirindy (Ganzhorn 1995) were at 0.2 individuals per km in 1990/1992, a value lower than our smallest value from Ankarafa. Thus, it seems that density of *M. zaza* is generally higher, maybe because of its more frequent social interactions.
At the time being, we know that *Mirza zaza* is still present at the Ambato Peninsula, Ankarafa, Ambendrana, Ankiabe and Andranobe (Fig. 1). Additionally *Mirza coquereli* (before the northern population was given the species status*)* was found in the Forêt de Mahilaka (Randrianambinina *et al.* 2003), which lies between our visited localities and between Ambanja and Ambilobe near Manehoko (Rasoloharijaona *et al.* 2005). These animals are most likely also *M. zaza* and not *M. coquereli*. Randrianambinina *et al.* (2003) and Olivieri *et al.* (2005) surveyed several localities in the "Province de Mahajanga" more to the south, for example in the Reserve Naturelle de Manongarivo, Reserve Naturelle de Bora, the Parc National d'Ankarafantsika, but found no *Mirza* individuals. Thus, according to the currently available information, the range of *Mirza zaza* is restricted from Manehoko in the north to Ankiabe in the south. If this is true, the Maeverano River probably serves as barrier for *M. zaza* in the south and the Mahavavy in the north.
The distribution of *Mirza coquereli* is much more widespread, ranging probably from the Parc Nationale des Tsingy de Namoroka in the north to the Onilahy river in the south (Mittermeier *et al.* 2006), even though its distribution is also best described as patchy, which again reflects the forest fragmentation throughout the western dry forests (Mittermeier *et al.* 2006). The northern limit is still uncertain, because we still lack information about *Mirza* individuals from the Parc Nationale des Tsingy de Namoroka, whereas we could confirm with genetic data that an individual from the Reserve Naturelle des Tsingy de Bemaraha was a *Mirza coquereli.*

Thus, the range of *Mirza coquereli* is extended to the north of the Tsiribihina river. Because there is no indication for the presence of *Mirza zaza* between the Betsiboka and the Maeverano rivers, it seems more plausible that *Mirza coquereli* is found up to the PN Tsingy de Namoroka (see Fig. 1). Additional survey work between the Betsiboka and the Menambolo rivers is needed to address this question.

Mirza coquereli, which is listed as vulnerable in the IUCN Red List, is still found in larger forest areas, such as the Kirindy-Ambadira forest in Menabe Central, where more than one population can exist simultaneously. In general, few fragments of western dry deciduous forest in Madagascar are greater than 800 ha (Smith 1997; Ganzhorn *et al.* 2001). A recent population genetic study of a *Mirza coquereli* population in Kirindy/CFPF (Markolf *et al.* subm.) indicates that a forest of this size (i.e., >10.000 ha) is the minimum size to maintain genetic diversity in this species. Because Ankarafa forest is the only protected area within the range of *M. zaza*, more scientific work on the degree of genetic divergence and the potential of inbreeding of their small fragmented populations is indicated.

Conclusions

The results of our field surveys indicate that the range of *Mirza zaza* is limited to only a few, mostly highly degraded forests in northwestern Madagascar. Even though individuals are regularly seen together, population densities are low at all of these sites. Because these sites also represent fragmented forests, *M. zaza* should be classified as "threatened" based on the available information about their distribution and abundance.

Acknowledgements

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Preliminary inventory of lemurs at ten Priority Sites for Plant Conservation

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In 2003, at the World Parks Congress in Durbin, the President Ravalomanana declared that Madagascar would triple the area managed primarily for conservation (Ravalomanana 2003). This represented a never-to-be-repeated opportunity to improve the conservation of Madagascar's rich, unique and highly threatened biodiversity. Missouri Botanical Garden (MBG) responded to this challenge by analyzing botanical information to identify 76 Priority Areas for Plant Conservation (PAPCs) and is currently facilitating the designation of four of these sites as New Protected Areas. In addition, in 2006, MBG obtained funding from the Goldman Fund to select and designate an additional five PAPCs as New Protected Areas. These five sites will be selected from ten PAPC that were chosen mainly on the criteria that they had not attracted the interest of other conservation organizations (i.e. "orphan sites") and that their environmental profile was poorly represented in the exist-

Table 1: Lemur inventory at 10 priority sites for plant conservation.

Site, Georeference, (Lat, S; Long E), (dates of survey)	**Vegetation types (MBG 2007)**	**Threats**	**Species**	**Comments**
Vohipaho 23°27'27"; 47°30'16" 23°30'28"; 47°30'57" (June and Aug. 2007)	Low elevation humid forest	Uncontrolled shifting cultivation and selective exploitation of timber	*Avahi* cf *laniger*	Local name is Fotsife. Colouration resembles *A. laniger*.
			Cheirogaleus sp.	Appear to be rare
			Daubentonia madagascariensis	Dead individual seen
			Eulemur albocollaris	This site includes individuals having morphological variation of color. Some males resemble to *Eulemur collaris*.
			Hapalemur griseus	Pelage of this species appears different from *Hapalemur griseus* seen elsewhere. Identificaton needs to be confirmed.
			Microcebus rufus	Apparently, this specie inhabit in the middle stratification of the forest.
Angodoka-Ambako 16°55'50"; 44°43'50" (June-July 2007)	Wet grassland Dry grassland Dry forest Wooded grassland	Fire and uncontrolled shifting cultivation	*Cheirogaleus* sp.	Its local name is Mataviram-bo. Based on investigation on local population.
			Daubentonia madagascariensis	Presence established on basis of feeding traces
			Eulemur rufus	Hunted. Density evaluated as 1.35 individuals/ ha
			Hapalemur occidentalis	Its local name is Kojy
			Microcebus murinus	This specie seems to be rare
			Propithecus deckeni	Density evaluated as individuals/ha
Fanambana 13°36'55"; 49°59'55" (June-July 2007)	Humid forest Rupicolous forest	Hunting	*Cheirogaleus* sp.	Based on investigation on local population
			Eulemur sanfordi	Hunted individuals are subjected to trade
			Daubentonia madagascariensis	Based on feeding traces.
			Hapalemur griseus	Individuals are more active during the night
			Microcebus rufus	One individual captured
Mahajamba Complex 15°01'44"; 47°16'20" (July 2007	Western dry forest Mangroves Marshland Grassland	Fire	*Cheirogaleus* sp.	Investigation on local population
			Daubentonia madagascariensis	Based on feeding traces
			Eulemur fulvus	Hunted. Apparently seeks refuge from hunting during the day in the Tsingy.
			Lepilemur sp.	Based on investigation on local population
			Microcebus murinus	One individual captured
			Propithecus coquereli	Not hunted because fady for local populations (Sakalava and Tsimihety)
Anjombalava Complex 14°11'04"; 49°56'15" 14°06'02"; 50°02'44" (Aug.-Sept.2007 and April 200)	Lowland humid forest	Slash and burn cultivation of *Vanilla* Several hunting	*Avahi laniger*	This specie is subjected to hunting.
			Daubentonia madagascariensis	Two individuals seen and a lot of feeding traces recorded in all parts of forests.
			Eulemur coronatus *Eulemur sanfordi*	The *Eulemur* species are frequently hunted. It would seem that they are less active during the day than the night – possibly as a behavioral adaptation to reduce hunting pressure.
			Hapalemur griseus	*Hapalemur griseus* inhabit savoka, and also bamboos neighboring Bemarivo river in where they are hunted
			Cheirogaleus major	Abundance evaluated as 2.53 individuals per km
			Cheirogaleus crossleyi	Abundance evaluated as 0.4 individuals per km
			Microcebus rufus	Hunted (villagers keeping two killed individuals seen)

Site, Georeference, (Lat, S; Long E), (dates of survey)	Vegetation types (MBG 2007)	Threats	Species	Comments
Antanifotsy 12º46'07"; 49º01'35" (Sept.-Oct.2007)	Dry forest on limestone Marshland Savannah	Uncontrolled fire Selective exploitation of some plant species	*Daubentonia madagascariensis*	Based on feeding traces.
			Eulemur coronatus *Eulemur sanfordi*	130 individuals of *E. coronatus* and 152 individuals of *E. sanfordi* were seen. During the day most of their time was spent resting in Sorindea or Cynometra trees. During the night most time spent feeding on Mango trees adjacent to river.
			Lepilemur septentrionalis	Density evaluated as less than 1 individual per hectare
			Microcebus murinus	Population densities evaluated as 12 individuals/km^2
Middle Mangoky 21º41'14"; 44º19'45" 21º48'52"; 44º08'24" (Sept. 2007)	Western Dry thicket	Uncontrolled fire	*Cheirogaleus medius*	Investigation on local population
			Eulemur rufus	Abundant nearest the Mangoky river
			Lemur catta	Rare
			Lepilemur sp.	Investigation on local population
			Microcebus murinus	One individuals captured
			Propithecus verreauxi	Appears to be abundant
Analavelona 22º40'40"; 44º11'30" (Nov. 2007)	Western humid evergreen forest Sub-caducifoliate forest Xerophytic forest	none	*Cheirogaleus medius*	Its local name Bodohy, recorded by SAGE (2005)
			Eulemur rufus	Group contains 7 to 9 individuals. Female carrying twice was observed
			Lemur catta	Groups contain between 2-5 individuals. Also recorded by SAGE (2005) and Griveaud and Peyrieras (1975)
			Lepilemur rufucaudatus	Appears to be abundant.
			Microcebus murinus	Rare
			Propithecus verreauxi	Seen eating fruits of Poupartia
Sorata 13º44'10"; 49º23'27" 13º41'08"; 49º26'30" 13º38'48"; 49º32'13" (Nov. 2007)	Evergreen middle altitude forest Evergreen high altitude forest	Hunting	*Cheirogaleus medius*	Investigation on local population
			Daubentonia madagascariensis	Dead individual seen
			Eulemur fulvus *Eulemur rubriventer*	Hunted. The *Eulemur* species seem to be mainly active at dusk and during the night. This activity pattern may be an adaptation to reduce hunting.
			Hapalemur griseus	Rare
			Microcebus rufus	Rare
Adabolava complex 24º12'38"; 46º18'02" 24º21'20"; 46º10'51" (Nov. 2007 and Feb.-March 2008)	Dry deciduous forest Dry forest Rupicolous forest	Fire Slash and burn cultivation	*Lemur catta*	Nocturnal studies are very difficult due to the Dahalo (cattle rustlers) who live in the forest.
			Lepilemur leucopus	Rare, abundance evaluated as 0.33 individuals/km
			Microcebus murinus	Rare, 0.33 individuals/ km
			Microcebus griseorufus	More individuals were seen in degraded forest. Its density 4.25 individuals/km
			Propithecus verreauxi	Density was evaluated as 2.2 to 2.8 individuals/km.

ing network of protected areas. In 2007 each of the ten candidate sites was subjected to a rapid evaluation by a multi-disciplinary survey team composed of a primatologist, an ornithologist, a small mammal expert, a herpetologist and a sociologist. The objective of the visit was to provide preliminary information on: the biological importance of the site; the nature and magnitude of threats to its biodiversity; and the conservation opportunities. This information is being used to select the five sites that will be designated as NAP. Here we provide a preliminary inventory of the lemurs recorded at the candidate sites.

The lemur inventory was conducted by direct observation during day and night for at least one week. Compli-

mentary information was collected by interviewing local people. When lemurs were seen we noted: the species, vernacular name, and time of observation. Where possible, information was also collected on group size, sex, age (infant, young, or adult), and behavior. Information on threats was also collected by direct observation and by interviewing local people. The preliminary inventory of lemurs at the ten sites is shown in Table 1. This table also includes information on threats.

All of the ten sites visited are important for primates. Perhaps the site of greatest importance is Vohipaho, where animals were seen with pelage resembling both *E. albocollaris* and *E. collaris*. Further studies are required here to determine the correct identity of these animals. Also of interest was the presence of *Eulemur sanfordi* and *Eulemur coronatus* in the Anjombalava and Fanambana forests. These sites are south of the Manambato River that was considered to the southern limit of these species by Mittermeier *et al*. (2006).

Fig. 1: *Eulemur coronatus* (left) from Antanifotsy *Microcebus* sp. (right) from Adabolava; photos by A. Ravoahangy.

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RECENT PUBLICATIONS

Biodiversity, Ecology and Conservation of Littoral Ecosystems in Southeastern Madagascar, Tolagnaro (Fort Dauphin)

By J.U. Ganzhorn, S.M. Goodman, and M. Vincelette, eds. 2007. Smithsonian Institution Press, Washington, D.C.

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It is our hope that the people of Tolagnaro and Madagascar will find the information provided in this book inspirational in their quest to achieve long term sustainable development goals. We thank all the researchers that contributed to this book, the government of Madagascar, and QMM for making the book possible.

The book is available as supplies last from QIT Madagascar Minerals, BP 225, Tolagnaro 614, Madagascar; RioTinto, 6 St. James Square, London, UK; SI/MAB Program PO Box 37012, Washington D.C. 20013-7012.

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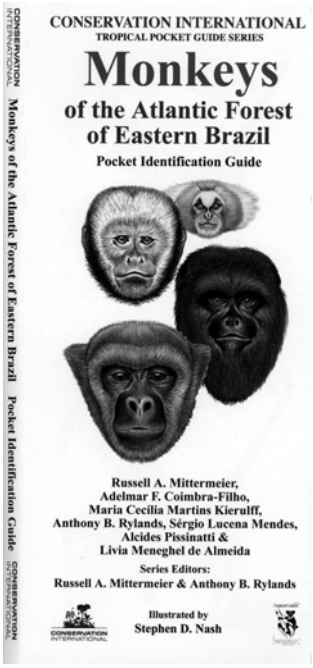

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Andrianome, V.N. 2007. Facteurs accentuant l'effet de la consommation de *Leucaena leucocephala sur les femelles* de *Lemur catta* dans la réserve privée de Berenty, Madagascar. Mémoire de DEA de Sciences Agronomiques, Département des Eaux et Forêts, Ecole Supérieure des Sciences Agronomiques, Université d'Antananarivo.

Différents facteurs semblent accentuer l'effet de la consommation de *Leucaena leucocephala sur les femelles Lemur catta* dans la réserve privée de Berenty, Madagascar. Les comportements alimentaires et sociaux de quatorze (14) femelles issues de trois (03) groupes des différentes zones de la forêt d'Ankoba: River, Standing stone et C2A sont observés durant huit (08) mois (Avril au Novembre 2005) pour découvrir ces différents facteurs. "*Continuous focal animal sampling*" est appliqué pour l'observation de ces comportements des individus. L'état du pelage des femelles a été estimé tous les quinze (15) jours selon la méthode utilisée par Jolly. *La phénologie par transect* a été adoptée pour évaluer les ressources végétales disponibles et *la méthode de Hladik* a été choisie pour déterminer la quantité de chaque aliment consommé par chaque individu. Les données obtenues sont analysées statistiquement par le test de corrélation de Spearman et par le test de Chi-carré (χ^2) au moyen d'Excel stat. Les résultats obtenus ont démontré que la diversité des espèces végétales dans le régime alimentaire, la consommation de *Leucaena* combinée avec certaines espèces végétales introduites et le nombre d'agressions subies par chaque individu peuvent accentuer l'effet nocif de *Leucaena* sur l'état du pelage des Makis femelles. Cette étude a enrichi nos connaissances pour être disponible à Éuvrer dans le domaine de la recherche pour la conservation de la diversité biologique. Aussi, ce document est utile pour puiser des informations pouvant aider à formuler des recommandations pour l'aménagement et la gestion d'un écosystème fragmenter et pour la conservation de *Lemur catta.*

Mots-clés: *Leucaena leucocephala*, *Lemur catta*, Berenty, Etat du pelage, Comportements, Régime alimentaire.

Arrigo-Nelson, S.J. 2006 The Impact of Habitat Disturbance on the Feeding Ecology of the Milne-Edwards' Sifaka (*Propithecus edwardsi*) in Ranomafana National Park, Madagascar. Doctor of Philosophy, Anthropology, Stony Brook University.

The impact of habitat disturbance on non-human primates remains disputed within the scientific community. While some studies report that disturbance decreases food availability and abundance in some habitats and for some species, other studies have found the opposite effects for other species or habitats. By documenting habitat differences and comparing the feeding behavior of Milne-Edwards' sifakas (*Propithecus edwardsi*) simultaneously, within disturbed (four study groups) and undisturbed (three study groups) habitats, the present study has been able to provide evidence for the effects of habitat disturbance in a way not possible in many previous studies. From December 2002 to November 2003, over 3,375 hours of focal group observations were conducted on the sifaka study groups, the phenological patterns of 466 sifaka food trees were monitored bimonthly, and the plant composition of 2.1ha of sifaka rainforest habitat was inventoried. Results indicate that selective logging has altered the physical structure, species composition. and availability of sifaka foods within the disturbed forest site. Additionally, sifakas living in the disturbed forest were found to consume foods from tree taxa in disproportion to their dominance within the forest and to rely more heavily on non-tree plant foods than their pristine forest counterparts. As a consequence, disturbed forest sifakas take in fewer fats and sugars than sifakas living in the pristine forest. When taken together, these differences in food availability and nutrient intake are reflected in the divergent activity budgets recorded for the study sites. Sifakas in the disturbed forest spending significantly less time interacting socially and significantly more time feeding and self-grooming than animals in the pristine forest. Ultimately, such a decrease in social activity is likely to lead to a reduction in social group cohesion, the quality of infant care and/or predator detection, and individual health. That these differences are found to be most significant during the austral winter and lean season only makes their potential impact on the Ranomafana sifaka population of greater consequence. In the long-term, these differences will likely lead to differences in reproductive success within the pristine and disturbed forest sifaka populations.

Berg, W. 2008. The bald lemur syndrome and *Leucaena leucocephala* at Berenty Reserve, Madagascar. Diplom thesis, Hamburg University.

The bald lemur syndrome describes the seasonal appearance of severe alopecia in some troops of *Lemur catta* in Berenty since 1998. Common diseases, ectoparasites and malnutrition were ruled out as causes by a veterinary study but censuses of the entire Berenty population of *Lemur catta* indicated a connection between alopecic lemurs and the introduced plant *Leucaena leucocephala.* Leucaena is highly nutritious but contains mimosine, a toxic amino acid that

inhibits cell division. Effects of toxicity include alopecia, anorexia, cataract, goitre and even death. To investigate the possible connection between the bald lemur syndrome and *Leucaena leucocephala* a study on feeding ecology and fur condition was started in April 2005. I continued data collection between November 2005 and October 2006. The amount of *Leucaena leucocephala* in the diet varied greatly between troops, with one troop feeding significantly more of this leguminous tree than the other two troops. However, all troops fed on leucaena almost exclusively during the dry season. Fur condition generally decreased during the dry season (May to October) and increased during the wet season (November to April). Individuals from troops with little leucaena in their diet only alternated between good and medium coat condition though, while the troop that consumed greater amounts of leucaena had much worse fur at all times. Several of these animals were completely bald during the dry season 2006 but all except one recovered and regrew some fur until October of the same year. Correlation analyses of fur condition and percentage of leucaena in the diet provide evidence for a connection between the bald lemur syndrome and *Leucaena leucocephala* and reveal a lag time of three to four months between leucaena consumption and fur loss.

Irwin, M. T. 2006. Ecological Impacts of Forest Fragmentation on Diademed Sifakas (*Propithecus diadema*) at Tsinjoarivo, eastern Madagascar: Implications for Conservation in Fragmented Landscapes. Doctor of Philosophy. Anthropology. Stony Brook University.

Forest fragmentation is known to seriously threaten primate populations, yet the ways in which fragmentation causes local extinction remain relatively unknown. Primate species vary widely in their susceptibility to fragmentation, but the causes of this variation are poorly understood. Because of long generation times, some species may persist in fragments for many years despite ecological stress, yet their extinction over the longer term may be inevitable without intervention. An increased understanding of the ecological mechanisms affecting primate persistence in fragmented habitats will allow for more effective conservation, by targeting species that are most at risk. In this dissertation, I examine the effects of forest fragmentation and disturbance on the ecology, behavior and demography of the diademed sifaka (*Propithecus diadema*) at Tsinjoarivo, eastern central Madagascar. Data are presented on four study groups (two in continuous forest and two in forest fragments) over an annual cycle, with demographic surveys over a three-year period. Fragmentation has severely altered the forest's physical structure, species composition and phenology. Sifakas in continuous forest eat more fruit, specifically large fleshy fruits of canopy trees which are absent in fragments; the mistletoe *Bakerella clavata* is an important keystone resource during the dry season. Sifakas in fragments, in contrast, rely on *B. clavata* throughout the year, and spend more time feeding per day. Home range is severely reduced in fragments, but daily path length is relatively unchanged. Sifakas in continuous forest tend to forage near forest edges, suggesting that low-level disturbance may increase resource abundance; in contrast, sifakas in fragments avoid their heavily-disturbed forests' edges. Sifakas in fragments also exhibit reduced group cohesion, resulting from the small patch size of their staple resource, *B. clavata*. This has led to reduced levels of grooming and aggression, but group composition and dominance relationships are largely unchanged. Preliminary data indicate that birth rate and infant survival are not adversely affected but mortality of immatures is increased (largely due to predation), and some evidence suggests constrained dispersal. In summary, although diademed sifakas have survived in forest fragments over the short term, the considerable ecological trade-offs documented here place their long-term survival in jeopardy.

Kesch, K. 2008. Flexibility in behavior and ecology of the collared lemur (*Eulemur collaris*). Diploma thesis, Hamburg University.

The aim of the project was to study the behavioral flexibility of *Eulemur collaris* (collared lemur) in the littoral forest of Mandena. The study site is situated within a Conservation Zone set up by QIT Madagascar Minerals (QMM) near Tolagnaro in south-eastern Madagascar. For this I studied three different sized groups in three forest fragments with different states of degradation. The results show that the animals are able to cope with diverse living conditions by pursuing different strategies. Increased group size or a more degraded habitat are compensated fore by a larger home range, sequential home range use and a higher number of feeding tree species. The group in the more degraded habitat used smaller feeding trees and their main food consisted of a species that the other groups did not use at all. The groups did not differ in the biochemical components of their nutrition. In addition, the groups did not differ in their fur condition as an indicator for their state of health. Thus, collared lemurs show high flexibility between as well as within populations. This might facilitate the survival of the species in highly degraded forest fragments.

Rakotoarivony, R. 2007. Biogéographie régionale de - *Microcebus ravelobensis* et de *M. murinus* dans le Parc National Ankarafantsika, Madagascar. Thèse de Doctorat de Sciences de la vie, spécialité Biologie, Ecologie et Conservations Animales, Département de Biologie Animale, Faculté des Sciences, Université d'Antananarivo, Madagascar.

M. ravelobensis et M. murinus vivent partiellement en sympatrie dans la région d'Ankarafantsika malgré leur similarité en taille, en mode d'activité en général, en leur biologie dans l'ensemble. Néanmoins, aucune approche écologique de grande échelle géographique n'était disponible pour clarifier leurs besoins écologiques spécifiques qui régularisent leur présence et abondance, et pour comprendre ainsi la base écologique de leur coexistence. Le but de cette étude est d'étudier la biogéographie régionale de ces deux espèces dans le Parc National d'Ankarafantsika, de chercher des signes de différenciation écologique qui leur permet de cohabiter et qui pourrait expliquer leur mode de distribution et leur abondance. L'étude a été faite au cours des saisons sèches 2002-2004 dans 22 microhabitats de types différents (sec, intermédiaire, relativement humide) appartenant a 10 sites et couvrant un gradient d'altitude de 70 a 343 m. La distribution et l'abondance des deux espèces ont été étudiées en faisant des captures avec relâches, combinées avec des observations systématiques nocturnes. La structure de la végétation, la composition floristique ainsi que des effets anthropiques sur la forêt ont été examinés et ont été corrélés avec l'abondance et la distribution de ces deux espèces, *M. ravelobensis* et *M. murinus* n'était pas également distribuées à travers le parc. Ils ont cohabité dans 50 %

des habitats seulement et diffèrent systématiquement entre eux et entre les sites par leurs modes de distribution et leurs abondances. *M. murinus* a habité tous les habitats secs mais non pas tous les habitats humides. Le contraire a été constaté pour *M. ravelobensis*. Cette différence de distribution de ces espèces reflète les densités de leurs populations. De plus, les abondances ces deux espèces étaient en corrélation négative: *M. ravelobensis* était à faible densité dans les habitats oj *M. murinus* était abondant et vice versa. Comparé à *M. murinus*, *M. ravelobensis* a été largement distribué et a généralement eu des densités plus hautes. Les densités des populations étaient en correlation négative (pour *M. ravelobensis*) ou positive (pour *M. murinus*) avc végétation et de la diversité floristique. *M.murinus* est relié à des caractéristiques structurale et diversité floristique. *M. murinus* est relié à des caractéristiques structurale et diversité floristique. Au contraire, *M. ravelobensis* était présent dans une large variété de microhabitats dont beaucoup d'entre eux se chevauchaient avec les habitats de *M. murinus*. Ces résultats montrent une grande plasticité écologique de *M. ravelobensis* comparé à *M. murinus*. Finalement, aucune de ces deux espèces n'a montré une évidente réponse négative aux perturbations humaines. Elles ont été recensées dans la majorité des sites visités. Néanmoins, l'abondance de *M. ravelobensis* a été significativement réduite dans les habitats fortement détruits par les feux.
Mots-clés: Biogéographie régionale-écologie-*Microcebus ravelobensis-M.murinus*-Parc National Ankarafantsika-Madagascar.

Rambinintsoa, A.2007. Révision de la systématique et dynamique de la population du genre *Avahi* (Jourdan, 1834). Thèse de Doctorat en Sciences de la Terre et de l'Evolution, option Anthropologie Biologique, Département de Paléontologie et d'Anthropologie biologique, Faculté des Sciences, Université d'Antananarivo, Madagascar.
Avahi se rencontre sur la partie Est de Madagascar depuis Anjanaharibe-Sud au Nord jusqu'à Andohahela au Sud et sur la partie ouest depuis Antafondro au Nord jusqu'à Bemaraha au Sud. Des analyses du fragment D-loop et des fragments COIII, ND3, ND4L, ND4, ARN-t^{GLY}, ARN-t^{SER} et une partie d'ARN-t^{LEU} de l'ADN mitochondrial ont été faites pour l'Etude phylogénétique d'*Avahi* entre Mananara Nord et Andohahela en utilisant la méthode du plus proche voisin (neighbor-joing), la méthode de parcimonie maximum (maximum parsimony) et la méthode de vraisemblance maximum (maximum likelihood). Des études de l'ADN nucléaire ont été faites pour estimer les paramPtres de la génétique de population en utilisant vingt deux marqueurs génétiques polymorphiques, les données génotypiques ont été testées avec les logiciels MICROCHECKER, GENEPOP3.1, BOTTLENECK v. 1.2.02 et STRUCTURE 2.0. Au total, neuf espèces qui sont *Avahi betsileo* trouvée à Fandriana et *Avahi nova species* trouvée à Ranomafana. Toutes les populations des 22 sites étudiés présentent une tendance vers la consanguinité dont la population de Betampona possède un très haut degré de consanguinité (F_{ts}=0,95). Les populations de Midongy du Sud, Manombo, Anjozorobe, Mananara-Nord, Mantadia ont subi le phénomène de goulot démographique (bottleneck). La population de Mariarano présente une structure.
Mots-clés: *Avahi*, étude phylogénétique, nouvelles espèces, génétique de population, marqueurs génétiques, consanguinité, goulot démographique, structure.

Rabenahy, F.N. 2007. Etude de la forme et de la taille de la mandibule des 2 espèces de *Pachylemur* (Lamberton, 1946). Mémoire de recherche pour l'obtention du diplôme de D.E.A en Sciences de la Terre et de l'évolution, option Paléontologie et Evolution Biologique, spécialité Primatologie, Département de Paléontologie et d'Anthropologie Biologique, Faculté des Sciences, Université d'Antananarivo, Madagascar.
Cette étude a été faite dans le laboratoire de la Paléontologie de Primatologie. Le travail consiste à comparer les 2 espèces *Pachylemur*, avec le genre *Varecia* (*Varecia* étant leur groupe-frre). Les mesures ont été prises sur chaque individu. Cette étude nous a permis de reconstituer leurs différences et leurs ressemblances au niveau de la mandibule. Ainsi, *Pachylemur jullyi* et *Pachylemur insignis* se ressemblent beaucoup sauf pour la longueur de la molaire M_1 qui est supérieur chez *Pachylemur insignis*. La mandibule entre *Pachylemur jullyi* et *Varecia* ne se ressemblent pas pour tous les caractères étudiés sauf pour le rapport de la largeur de la surface articulaire de la symphyse mandibulaire oblique médiane et leur même largeur prise perpendiculairement. L'analyse Multivariée ne permet pas de distinguer les formes entre les deux espPces de *Pachylemur* et avec *Varecia.* Seulement le facteur 1 nous montre que la mandibule de *Pachylemur jullyi* est plus grande que celle de *Pachylemur insignis* et du genre *Varecia*.
Mots-clés: *Pachylemur insignis*, *Pachylemur jullyi*, mandibule, robustesse.

Razafindrakoto, M. 2007. Rareté d'eau saisonnière et sa signification écologique pour les lemurs à front rouge (*Eulemur rufus*: Audebert, 1799) dans la forêt de Kirindy (CFPF), dans la région de Morondava à l'ouest de Madagascar. Mémoire de recherche pour l'obtention du diplôme de D.E.A en Sciences de la vie, option Biologie, Ecologie et Conservation Animales, Département de Biologie Animale, Faculté des Sciences, Université d'Antananarivo, Madagascar.
La présente étude a pour but de connaître les stratégies utilisées par les lemurs à front rouge (*Eulemur rufus*) pour survivre pendant la période sèche. Cette étude a été faite dans la forêt sèche de Kirindy à l'ouest de Madagascar depuis la fin du mois de septembre 2003 jusqu'au début du mois de décembre 2004. Cet endroit est localisé à 60 km au nord de Morondava est estimé à 20 km à l'est du canal de Mozambique. Ce site a été choisi parce que, durant la saison sèche, la source d'eau est tellement rare et l'espèces étudiée ne peut pas vivre sans se procurer de l'eau. Huit groupes de lemurs èfront rouge ont été observés durant la période sèche et pluvieuse. Parmi ces groupes, deux sont classés comme résidants et les autres comme migrateurs. Chaque groupe a été observé pendant neuf jours durant la saison sèche et cinq jours durant la saison de pluie. Pendant l'observation, leur position géographique ont été prise grâce au GPS (Global Positioning System) afin d'établir leur territoire durant chaque saison. Le suivi révèle que les groupes marchent pour rejoindre le point d'eau afin de diminuer la dépense énergétique. Les migrateurs se déplacent entre 600 et 900 m jusqu'au point d'eau et ils utilisent, pendant la saison pluvieuse que durant la sècheresse. *E. rufus* passe la plus part de la journée à se reposer durant la période sèche. Manifestement, les groupes utilisent des stratégies différentes pour avoir accès au point d'eau même

s'ils habitent à la même distance par rapport à ce dernier.
Mots-clés: *Eulemur rufus*, Stratégie de survie, Point d'eau, Forêt sèche, Kirindy, Morondava, Madagascar.

Schneider, N. Population genetics of the gray mouse lemurs (*Microcebus murinus*) in northwestern Madagascar. Diploma thesis, Institute of Zoology, University of Veterinary Medicine Hannover.
Madagascar´s forests are extremely threatened by deforestation and fragmentation, whereas the effects of these influences on the genetic diversity and differentiation of lemur populations are hardly determined. The aim of this thesis was to examine the influence of geographic distance, a big river, fragmentation and a national road on the genetic structure of gray mouse lemurs. For this purpose the genetic diversity and differentiation of 15 geographical samples, containing 3-27 individuals (a total of 195 individuals) were analyzed, using mitochondrial DNA (455 bp of d-Loop) and population genetic analyses. The samples derived from two Inter-River-Systems in the Northwest of Madagascar (IRS 1: between the rivers Betsiboka and Mahajamba; IRS 2: between the rivers Mahajamba and Sofia). Ten sites were sampled in the Ankarafantsika National Park and the other sites were located in isolated forest fragments of the IRS 1 and IRS 2. In this study it was possible to demonstrate a strong effect of fragmentation on the genetic variability of samples. Big forests showed in general a higher genetic diversity than small and isolated forest fragments. Especially three fragments, Tsinjomitondraka, Maroakata and Mangatelo, had a low or even missing genetic variability. Isolation-by-distance was detected as a significantly positive correlation between genetic and geographic distance. A separating effect of a national road on gene-flow between samples within the National Park was observed, although the differentiation between eastern and western samples was not strict. Other factors probably contributed to the genetic structure in the park, for example the colonisation history and/or the river Karambao. The river Mahajamba had no larger isolating influence on gene-flow than the savannah. This could indicate that the migration of gray mouse lemurs into this area occurred more recently than that of the reddish sibling-species, the golden-brown mouse lemur, indicating that the river Mahajamba did not form a genetic barrier for a long time yet.

Tecot, S.R. Seasonality and Predictability: The hormonal and behavioral responses of the red-bellied lemur, *Eulemur rubriventer*, in Southeastern Madagascar. University of Texas at Austin.
This dissertation investigates the relationship between Madagascar's environment and the stress physiology of the red-bellied lemur, *Eulemur rubriventer*. Unique lemurid traits are proposed to have evolved in response to selection pressures unlike those in other primate habitats, and appear to be particularly suited to helping animals cope with harsh and unpredictable environments. Several hypotheses as to why lemurs evolved characteristics such as small group sizes, low basal metabolic rates, and cathemerality rest upon the untested assumption that these species are ecologically and/or reproductively stressed. This study simultaneously analyzes seasonal changes in climate, ecology, and the behavior and stress hormones (cortisol) of *Eulemur rubriventer*, as well as differences in these parameters across habitats with different ecological matrices. The goals of this dissertation are to: (1) evaluate the influences of seasonally varying food availability and climate upon lemur behavior and physiology, to determine whether such changes are sufficient to exert strong selective pressure; and (2) assess the additional influences of habitat composition and quality to evaluate the effects of unpredictability and habitat disturbance. *Eulemur rubriventer* are sensitive to seasonal environmental changes, as indicated by their activity budgets, diets, and fecal cortisol levels. Overall they adopt a time minimizing strategy whereby energy is conserved by resting a majority of the time. Ripe fruit scarcity periods elicit the launch of an energy maximizing strategy whereby fecal cortisol levels and time feeding increase, and time resting decreases. Sensitivity to these influences varies across habitats. The behavioral and stress responses of groups in the undisturbed habitat (UND) were more seasonal and pronounced than those from their disturbed habitat (DIST) counterparts. Lower cortisol levels in DIST may result from a less seasonally predictable environment requiring frequent short-term responses (with possible energy deficits during critical reproductive stages yielding 3 deaths out of 5 births and out-of-season reproduction). Alternatively, the attenuated behavioral and hormonal response to environmental change in DIST may indicate a severely stressed population with insufficient energy to launch an appropriate coping response. The hypothesis that animals in DIST have adapted to frequent unpredictability due to disturbance is rejected because all animals behaviorally and hormonally respond to fruit declines, indicating that this species undergoes ecological stress.

Treatman-Clark, K. 2006. The Evolution of the Reproductive System in Strepsirhine Primates Doctor of Philosophy in Anthropology at Stony Brook University.
The purpose of this dissertation was to test hypotheses concerning the evolution of the reproductive system in strepsirhine primates. There were three major components of this analysis. First, the genitalia and reproductive anatomy of thirty-four strepsirhine taxa were described, measured, and illustrated. Next, hypotheses about ancestral conditions and evolutionary changes in reproductive anatomy and behavior were tested. Finally, functional hypotheses to explain the variation in strepsirhine genitalia were evaluated. The description and analysis of strepsirhine genitalia included many taxa that had never been described, or had been described based only on single, preserved cadavers. It was determined that cadaver preservation alters genital morphology and significantly affects genital measurements. The genital descriptions were used to assemble the most comprehensive data set of reproductive characters to date. Of particular importance, this study was the first to give equal emphasis to variation in male and female reproductive anatomy. The purpose of the evolutionary analysis was to reconstruct the reproductive anatomy, physiology, and behavior of ancestral strepsirhines, lemurs, and lorises. Some very surprising results emerged, including the finding that most of the reconstructed character states for the genitalia of ancestral strepsirhines are more consistent with the low levels of sperm competition found in pair-bonded groups than with the high levels of sperm competition found in multi-male groups. To flesh out the picture of ancestral strepsirhine reproductive behavior, it was determined that

they gave birth to small litters after relatively long gestation periods, and that ancestral strepsirhine neonates straddle the fence between altricial and precocial offspring types. The functional hypotheses that were tested centered around the impact of social and mating systems on reproductive anatomy. Variation in male penis length, penile spinosity, and testis size were all linked to sperm competition, with males in multi-male social systems exhibiting larger values for these traits than would be expected for their body size. Variation in female genitalia was also linked to variation in social systems. Clitoris length was significantly correlated with female social dominance, and the loss of vaginal closure was associated with the shift to gregarious habits.
The dissertation can be accessed at
http://home.comcast.net/~kcssgt.

Wennert, N. 2007. Eude des marquages olfactifs effectués par *Propithecus verreauxi verreauxi* (A; Grandidier, 1967) dans la forêt dense sèche de Kirindy/ CFPF Morondava. Mémoire de recherche pour l'obtention du diplôme de D.E.A en Sciences de la vie, option Biologie, Ecologie et Conservation Animales, Département de Biologie Animale, Faculté des Sciences, Université d'Antananarivo, Madagascar.
L'étude des marquages a été faite au sein de la population sauvage de "Sifaka" (*Propithecus verreauxi verreauxi*) dans la forêt dense sèche de Kirindy. Cette étude a pour but de déterminer le sens exact des marquages. Différentes données sur l'organisation sociale et la morphologie ont été rassemblées sur 20 animaux de cette espèces (dont 8 femelles et 12 mâles) pendant 4 mois successifs (décembre 2001-mars 2002) suivant la méthode d'observation continue (Continuous recording). La majorité des marquages se passent au niveau des territoires non chevauchants. Les "Sifaka" marquent indépendamment des catégories d'arbre. Les marquages n'étaient donc pas faits pour délimiter les territoires. Trois différents types de marquages ont été observés chez les "Sifaka", à savoir le marquage buccal, le marquage anal et le marquage par la poitrine. Le marquage anal est le plus fréquemment utilisé. Cependant les "Sifaka" pratiquent aussi des marquages par la poitrine et par la bouche. L'utilisation de ces trois types de marquages varie selon la dominance entre les individus du groupe et la présence d'un groupe voisin. Les dominants (mâles ou femelles) pratiquent davantage des marquages. Les mâles pratiquent dix fois plus de marquages que les femelles de même âge. Les jeunes ne font pas de marquage. L'effectif des mâles adultes dans le groupe n'affecte pas la fréquence de marquage d'un mâle dominant. Les mâles à fréquences de marquages élevées présentent une coloration de poitrine plus importante. Il n'existe pas de rapport entre les fréquences de marquages et certaines différences morphologiques telles que la taille des testicules et le poids corporel. Les femelles pratiquent les marquages pour annoncer leur présence et défendre leurs ressources alimentaires, tandis que les mâles le font pour attirer les femelles. Une étude plus approfondie apporterait plus d'explication au rôle des marquages olfactifs chez les Propithèques.
Mots-clés: *Propithecus v. verreauxi*, Propithèques, Sifaka, marquage olfactif, comportement, hiérarchie, territoire, Kirindy, Madagascar.

Zaonarivelo, J .R. 2007. Révision de la systématique et dynamique de population du genre *Indri* (E. Geoffroy et G. Cuvier, 1796). Thèse de Doctorat en Sciences de la Terre et de l'Evolution, option Anthropologie Biologique, Département de Paléontologie et d'Anthropologie biologique, Faculté des Sciences, Université d'Antananarivo, Madagascar.
Indri indri se rencontre sur la partie Est de Madagascar depuis Anjanaharibe-Sud au Nord jusqu'à Anosibe an'ala au Sud. Des analyses du fragment D-loop et du fragment de Pastorini de l'ADN mitochondrial ont été faites pour l'étude phylogénétique d'*Indri indri* en utilisant la méthode du plus proche voisin (neighbor-joing), la parcimonie maximum (maximum parcimony) et la méthode de vraisemblance maximum (maximum likelihood). Des études de l'ADN nucléaire ont été faites pour estimer les paramètres de la génétique de population en utilisant vingt polymorphiques marqueurs génétiques. Les données génotypiques ont été testées avec les logiciels MICROCHECKER, GENEPOP3.1, STRUCTURE 2.0. *Indri Indri* forme une seule espèce en utilisant le concept des espèces phylogénétiques. Toutes les populations étudiées ont un nombre moyen d'allèles par loci et une richesse allPlique. La population de Zahamena, Anjanaharibe Sud à Anosibe an'ala ont chacune un haut coefficient de consanguinité peu élevée et présente de structure.
Mots-clés: *Indri indri,* systèmatique, ADN mitochondrial, marqueurs génétiques, microsatellites, diversité génétique, richesse allèlique, consanguinité, structure, migration.

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