

FINAL REPORT

Biodiversity assessment, and strategic conservation planning, for the riparian forests of the Spiny Forest Ecoregion of Madagascar.

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Introduction

Madagascar has been called the highest biodiversity priority in the world but biodiversity conservation priorities *within* Madagascar are only now being identified. Recent research, biodiversity planning and conservation action have focused on east coast rainforest areas, while other areas of potentially very high biological interest have largely been ignored. The WWF Spiny Forests Ecoregion action plan indicates that West coast dry forests and riparian forests are under-represented in Madagascar's reserve system, and are being degraded and fragmented at very high rates. This project is therefore addressing deficiencies in biodiversity data for this region in collaboration with The University of Tulear, WWF, and Frontier.

Project Aims and Objectives

- To provide an opportunity for transfer of entomological survey skills from Alison Cameron (PhD student) to a Malagasy DEA student (Maminarina Dutel Ravoninjatovo).
- To provide the DEA student with experience of project decision making processes and meeting project by providing opportunities to integrate with project teams from WWF (World Wide Fund For Nature) and Frontier Madagascar.
- The production of a DEA thesis, co-supervised by the University of Tulear and WWF staff in Tulear.
- To make field survey data publically available through the national biodiversity data base, known as the "Platforme D'Analyse" (PDA)*.

Training



Initial training was conducted in Beza Mahafaly Special Reserve, between the 29th - 31st Oct 2002. Alison spent 3 days in the field training Dutel (Photo 1 right) and also Edidy (Photo 1, left) who runs the small natural history museum at Beza Mahafaly.

Skills covered included; equipment specifications, bait types, transect site selection, habitat recording, sweep netting, blendon trapping with fruit bait, collecting caterpillars, field data recording, data entry into laptop, and specimen curation.

During this training stage the methods exactly matched the standardized survey protocols which Alison uses in her PhD research with California Academy of Sciences.

Photo 1. Sweep net training for Lepidoptera in Beza Mahafaly Special Reserve 2002.

Sites and methods

Dutel Ravoninjatovo joined WWF and Frontier field teams (Figure 1) to survey a total of 5 sites within the South Western Spiny Forests.

<u>Site Name</u>	<u>Survey dates</u>	<u>Latitude and Longitude</u>
Ankindranoke	12 th March 2003	Lat -22.2167, Lon 43.3189
Ankotapiky	13 th - 19 th March 2003	Lat -21.8750, Lon 43.3760
Mahariny	22 nd - 25 th March 2003	Lat -21.8672, Lon 43.6617
Ranobe	12 th April - 4 th May 2003	Lat -23.0396, Lon 43.6103
Beza Mahafaly	28 th Nov - 14 th Dec 2003	Lat -23.6555, Lon 44.6338

Ankindranoke, Ankotapiky, Mahariny are all located north of Tulear, within the Mikea region which is currently unprotected and poorly surveyed. Ranobe is closer to Tulear and is thought to be particularly valuable because it contains a diversity of habitats within a small area. Ranobe contains a considerable area of spiny forest, a small area of riparian forest and has permanent wetland and lakes. Although this forest is reputed for its high biodiversity, few baseline biodiversity studies of the area have been conducted and are a priority. Beza Mahafaly lies South East of Tulear and currently has the status of a special reserve.

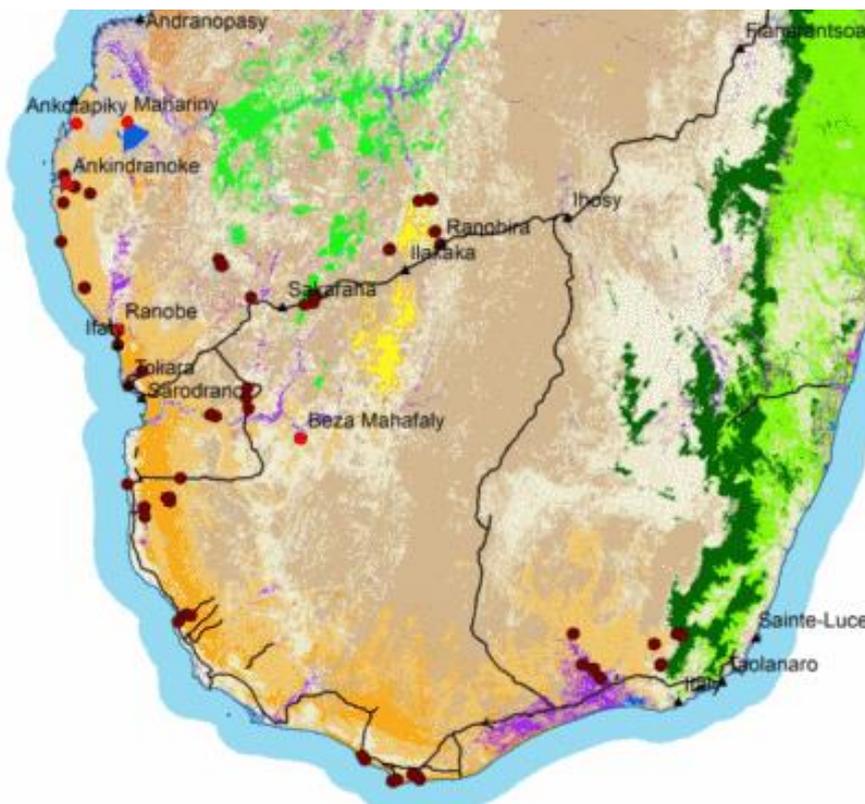


Figure 1. Map of survey sites.

- Sites surveyed by Dutel Ravoninjatovo using funding from RSG are shown with red dots and the site names are labelled.
- Sites surveyed by Alison Cameron with California Academy of Sciences are shown with brown dots.
- Sites are laid over the 2007 Kew Atlas of the Vegetation of Madagascar.
- Major roads are shown with black lines.
- Major towns are indicated with black triangles.

Twenty Blendon fruit traps, baited with rotten fruit, were deployed at each field site. Traps were checked and emptied three times a day (shortly after dawn, midday, and shortly before dusk). Between trap checks sweep netting and opportunistic collecting was conducted. Captured Lepidoptera were identified to species and representative collections of specimens were taken. Specimens were preserved in envelopes with silica indicator gel.

Dutel joined a highly skilled field survey team from WWF for three weeks to survey three sites (Raselimanana, Ankindroanoke, Ankotapiky). This team was headed by Dr Achile Raselimanana. Due to logistical limitations the number of sampling days at each site varied.



To survey the Ranobe area Dutel Ravoninjatovo then joined the Frontier Madagascar field team (Photo 2), benefiting from transport, canteen and camping facilities, as well as from logistical field support from volunteers and scientific supervision by Frontier staff. Additional funding of \$210 was granted by the African Butterfly Research Institute (ABRI) in Nairobi for this survey.

Photo 2. Frontier scientific staff at Ranobe. Dr Edward Bodsworth (right) and Hannah Thomas (left).

Finally, in November 2003 Dutel Ravoninjatovo returned to Beza Mahafaly (the training site) with the WWF team to conduct a two week survey. This was more productive than the training session had been as the rains had not yet started during October 2002 but in November 2003 it was raining so Lepidoptera were more abundant and active.

All specimen identifications were first checked by Alison Cameron at the California Academy of Sciences laboratory in Anatananarivo, then problematic specimens were then double-checked by Dr David Lees at the Natural History Museum London, and finally specimens were deposited at California Academy of Sciences and the University of Tulear.

Analysis and results

A total of 85 Lepidoptera species were recorded in the 5 survey sites (Appendix 1). Ranobe had the highest species richness with 72 species. The high species richness of Ranobe is due to the unusually high diversity of habitats and micro-habitats within the survey site. Following Ranobe was Mahariny with 38 species, Ankotapiky with 33, and Beza Mahafaly with 29. Although the results do reflect variations in sampling effort (number of days) only Ankindranoke could be considered to have been under-surveyed, with only one day of survey effort and only 8 species recorded (Appendix 1).

A hierarchical cluster analysis (Figure 2) using Wards method and Euclidean Distance was performed on all South Western sites surveyed by Alison Cameron and Dutel Ravoninjatovo (Figure 1). The level of branching of the cluster analysis tree from left to right (Figure 2) indicates how similar sites are to each other. At the similarity level (eight) indicated by the red line eight major clusters of similar sites are identified.

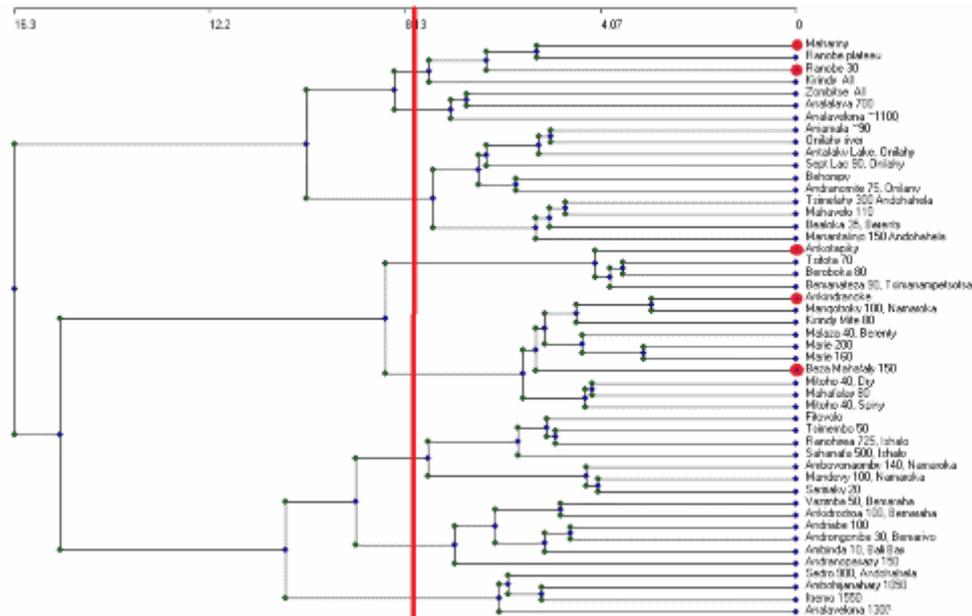


Figure 2. Hierarchical cluster analysis using Wards method and Euclidean Distance performed on presence/absence data for Lepidoptera from all south western survey sites. Red dots indicate the 5 sites surveyed by Dutel. The red vertical line indicates the similarity level 8, identifying 8 groupings of sites based on the similarity of their Lepidoptera communities.

It is very interesting that:

- I. some of the Mikea sites (particularly Mahariny and Ranobe surveyed by Dutel) cluster with Kirindy which is north of Morondava,
- II. Ankotapiky which is in the North of the Mikea clusters with Tsimampetsotsa which is south of Tulear
- III. Beza Mahafaly clusters with sites from Berenty and Cap Saint Marie.

This indicates that a lot of heterogeneity exists in the Lepidoptera communities in the South West and that biogeographical location, latitude, or WWF ecoregion are not simple predictors of the Lepidoptera community that will be found in a site.

We recommend that to conserve biodiversity at the community level priority sites from within each of the eight clusters should be identified for conservation management, and ideally for inclusion in the national protected areas network.

Project Outcomes

- Maminarina Dutel Ravoninjatovo, a DEA student from the University of Tulear, was trained in field survey methods, data management, and analysis.
- Copies of Dutel's thesis (which is written in French) on butterfly community composition and conservation in riparian forests of the spiny forest has been submitted and a copy has

been provided to WWF who are producing conservation action plans for the riparian forests of the South Western Spiney Forest.

- All butterfly records have been submitted to the national biodiversity data base project "Plateforme D'Analyse" (co-ordinated by the Wildlife Conservation Society). This national data archive means that the data is available for long term re-analysis and other scientists and conservationists to use.
- The specimens deposited in California Academy of Sciences are available for scientists to work on. Many of the specimens are being photographed using digital montage software, so that the images can be made available online.

Additional Project Outcomes Since 2004

- The Plateforme D'Analyse* later became Réseau de la Biodiversité de Madagascar (www.rebioma.net) and the Lepidoptera data was transferred to this new system in 2010.
- Between 2006 and 2008 the Lepidoptera survey records contributed to the national level Système d'Aires Protégées de Madagascar (SAPM) conservation planning exercise to expand the protected areas network from 2 million hectares to 6 million hectares. Specifically the records contributed to:
 - a national GAP analysis run by the SAPM taxonomic working group, which was presented at an IUCN meeting in Cape Town in 2007.
 - the identification of the Mikea region as a national priority and the establishment of the 184,630 hectare Mikea National Park in 2008.
 - a systematic conservation planning analysis that was published in *Science* (Kremen *et al.*, 2008).

Appendix 1. List of species recorded per site.

Species Name / Site Name	Mahariny	Ankotapiky	Ankondranoke	Ranobe	Beza Mahafaly
Acraea dammii	1			1	
Acraea eponina	1			1	
Acraea igati					1
Acraea lia				1	
Acraea mahela				1	
Acraea obeira obeira	1				
Acraea ranavalona		1	1	1	
Acraea turna		1	1	1	
Aterica rabena				1	
Azanus morphosp3	1			1	1
Azanus sitalces sitalces	1			1	
Azanus soalalicus	1			1	1
Belenois creona prorsus				1	
Belenois grandidieri	1	1		1	1
Borbo gemella		1		1	
Byblia anvatara anvatara	1			1	1
Catopsilia thauruma		1		1	
Charaxes analava				1	
Charaxes andara				1	1
Charaxes antamboulou	1	1		1	
Charaxes cacuthis				1	
Charaxes zoolina betsimisaraka	1			1	
Chilades miniscula	1	1		1	
Chilades trochylus				1	
Coeliades ernesti	1	1		1	
Coeliades rama		1		1	
Coeliades ramanatek ramanatek	1		1	1	
Colotis amata crowleyi	1	1		1	1
Colotis evanthe	1	1	1	1	1
Colotis guenei					1
Colotis lucasi	1	1		1	1
Colotis mananhari		1		1	1
Colotis zoe		1	1	1	1
Cupidopsis jobates jobates				1	
Danaus chrysippus aegyptius	1	1		1	1
Deudorix dinochares				1	
Eagris nottoana smithii				1	
Eagris sabadius andracne				1	
Euchrysops malathana				1	
Euchrysops morphosp1				1	
Euchrysops osiris				1	
Eunica amazoula					1
Eunica howensis	1	1			
Eunica madagascariensis	1	1		1	

Species Name / Site Name	Mahariny	Ankotapiky	Ankondranoke	Ranobe	Beza Mahafaly
Eurema floricola floricola	1	1	1	1	1
Eurema hapale	1				
Eurytela dryope lineata				1	
Fulda australis	1	1		1	
Fulda bernieri					1
Fulda lucida					1
Fulda rhadama				1	
Hemolaus cobaltina		1		1	
Heteropsis ankaratra	1	1	1	1	1
Heteropsis narcissus fraterna	1			1	1
Hypolimnas misippus				1	
Hypolycaena philippus	1			1	1
Iolaus argentarius		1			
Iolaus trichiolaus mermeros				1	
Junonia hierta paris	1	1			1
Junonia oenone epiclelia					1
Junonia orithyia				1	
Junonia rhadama	1	1	1	1	1
Leptosia alcesta sylvicola				1	1
Leptotes pirithous	1	1		1	
Leptotes rabefaner	1	1	1	1	
Melanitis leda helena	1			1	
Mylothris phileris				1	
Nepheronia buquetii pauliani				1	
Neptidopsis fulgurata fulgurata	1	1		1	
Neptis kikedeli				1	
Neptis saclava saclava				1	
Papilio demodocus demodocus		1		1	
Papilio epiphorbas epiphorbas		1	1	1	1
Papilio erithonioides	1			1	
Papilio grosesmithi				1	
Pardopsis punctatissima	1	1		1	
Parnara naso poutieri				1	
Phalanta phalanta aethiopica	1			1	1
Pharmacophagus antenor	1			1	1
Pinacopteryx eriphia mabiliei	1	1		1	
Pseudacraea imerina imerina				1	
Tagiades insularis insularis	1				
Zizeeria knysna	1	1		1	
Zizula hylax		1		1	
Total number of species recorded	38	33	8	72	29