Project Ifotaka 1999 Final Report

University of Durham Expedition to Madagascar

15th July – 1st October 1999

A Collaboration between : The Libanona Ecology Centre, Durham University and Parc Botanique et Zoologique de Tsimbazaza.

University of Durham

RESUME DES TRAVAUX

Le projet Ifotaka 1999 était une expédition, pendant trois mois (Juillet-Octobre 1999) pour un programme de recherche pour la conservation, dans la forêt d'Ifotaka au Sud de Madagascar . C'était un projet anglo-malagasy dans la cadre de la collaboration entre l'Université de Durham (Royaume-Uni), Parc Botanique et Zoologique de Tsimbazaza (Madagascar) et le Centre Ecologique Libanona (Madagascar).
L'équipe, composée de vingt-deux membres a effectué ses observations dans une zone de forêt épineuse aux environs immédiats du village Ifotaka. Cette zone a été identifiée par le WWF dans le Sud de Madagascar.

Les études écologiques et anthropologiques ont été complétées par des activités d'education-conservation visant à mettre en contact des écoles primaires de Durham (Royaume Uni) et d'Ifotaka (Madagascar). Les études ont pu être effectuées grâce aux louables autorisations du Département des Eaux et Forêts malagasy et de Monsieur Tompotamy Remanintsy, Maire de la commune rurale d'Ifotaka. Les sujets de recherche:

1- **Ecologie des Lémuriens-** La densité de population de *Propithecus v. verreauxi* dans une forêt non perturbée est estimée à 37.25 individus par Km carré en utilisant des points de comptage. Les études de l'utilisation des habitats et des comportements des animaux ont montré l'importance des arbres adultes de l'espèce *Allaudia procera* pour les Sifakas.

2- **Ornithologie-** Un total des quarante deux espèces d'oiseaux ont été inventoriées dont trois non enregistrées auparavant dans la zone. Il s'agit du Cormoran à longue queue (*Phalocrocorax africanus*), du Gobe mouche de paradis (*Terpsiphone mutata*) et du Héron crabier blanc (*Ardeola idea*). Une étude de l'abondance relative de la communauté de l'avifaune a été aussi entreprise.

3- **Etude de la végétation-** Pour l'étude de la densité et de l'abondance de la couverture des arbres, on a pu enregistrer, dans un quadrat, 162 espèces pour 52 familles parmi lesquelles les plus communes sont les Euphorbiaceae, les Fabaceae, les Mimosaceae et les Rubiaceae.

4-**Investigation ethnobotanique-** Les travaux effectués principalement avec deux "*Ombiasy*" (guérisseurs locaux -Manahira et Fanahisoa), 169 espèces (nom locale - 100 ont été identifiées de nom scientific) de plantes médicinales ont été identifiées et qui entrent dans 312 utilisations. Les spécimens en herbier de ces plantes ont été déposés au Parc Botanique et Zoologique de Tsimbazaza.

5-**Investigation anthropologique-** En utilisant les "techniques PRA"(question-réponse) , une investigation sur l'attitude des paysans envers les ressources forestières et leurs utilisations locales ont été effectuées. A partir de la transcription de 32 interviews informelles, le thème majeur qui apparaissait était que les sols pauvres pour l'agriculture associés à l'accroissement des demandes conduisent les populations locales Antandroy à des utilisations inconscientes des ressources.

6- **Projet d'éducation-** Un projet d'éducation en quatre étapes a été entrepris au cours duquel ont été effectuées des visites d'écoles primaires à Ifotaka et Durham. En même temps l'équipe a fait des jeux avec tous les enfants d'Ifotaka.

Management Themes

The consideration of the themes outlined below should contribute to the development of a Management Plan for the Ifotaka Forest. Any management plan would be most effective if it is incorporated into National and Regional Environmental Action Plans (Hannah *et al.*, 1998) and should be implemented by means of collaborations between government agencies and conservation and development NGO's. It should consider not only biological data but also the economic and socio-cultural factors, which are central to tropical forest conservation (Brown and Brown, 1992). This is not intended to be an exhaustive list of the management issues, but simply lists some of the issues that became apparent during the expedition.

1. **Vegetation Status surveys** - these should be conducted to determine the extent of primary and secondary forest, scrub vegetation and cleared areas in the Ifotaka area. Aerial photographs complemented with ground-truthing surveys would allow this to be assessed.

2. **Allocation of areas for restricted use** – One approach to the management of the forest could be by allocating some areas within the forest as conservation zones or restricted use areas. This must be done with full consideration of all the stakeholders and decisions should be made by the local hierarchy to ensure it is effective with the local people. This approach would require further surveys of the vegetation status (see 1. above).

3. **Promotion and development of sustainable uses of the forest** - Potential activities include ecotourism and the use of non-timber forest products eg for medicinal uses. The potential for forest regeneration should be investigated. In addition the possibility of using the planting of exotic species for firewood and timber should be considered.

4. **Conservation of Ethnobotanical Knowledge** – The people of the Ifotaka area, in particular the *Ombiasy's*, have a huge amount of knowledge of uses of the plants of the area. This is at grave risk of being lost so it should be recorded and people encouraged to record and continue using it. Schemes such as that outlined in Swerdlow (2000) have potential, i.e. where *Ombiasy's* work as clinic herbalists, alongside practitioners of western medicine.

   Further investigations of the medicinal properties of the plants of the area should be carried out, as this is potentially of great importance (Prance, 2000). The intellectual property rights of the ethnobotanical knowledge of the Antandroy people must be respected (Dobson, 1985).

5. **Sustainable Agriculture** - With current agricultural practices being a major threats to the forest, developing sustainable agricultural techniques should be a priority.

6. **Population Growth** – This is a further threat to the forest as the quickly growing population in the forest is putting extra demands on timber and firewood trees. It also necessitates the creation and extension of areas for cultivation and grazing to produce food for the population.

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1.2 Background to Project Ifotaka

During a reconnaissance visit to southern Madagascar in September 1998 Barry Ferguson and Chris Perceval approached Mark Fenn, (Technical Co-ordinator to WWF Madagascar) requesting a topic of study for a conservation expedition the following summer. He suggested a study on the lemurs and vegetation of the Ifotaka Forest, one of the areas identified by the WWF Eco-region Programme/Dry Forest[1] as holding significant conservation potential. The subsequent visit to the village of Ifotaka and its adjacent forest led to the creation of Project Ifotaka 1999. The Ifotaka area has also been identified as a priority area on the map in Hannah *et al.* (1998) which was produced during the development of Madagascar's National Environmental Action Plan. Ifotaka was highlighted because of the lack of knowledge of its biodiversity.

A protocol of Collaboration was established between Durham University and Parc Botanique et Zoologique de Tsimbazaza (PBZT) with the project providing field experience for two technicians from the park and fieldwork equipment in exchange for the permission for the research being arranged by PBZT. A collaboration was also established between Durham University and the Libanona Ecology Centre (LEC) in Fort Dauphin, this involved LEC making the arrangements for student collaborators from the University of Tulear and providing accommodation for R&R periods in exchange for fieldwork equipment.

Initially, the aims of the project were to estimate the population densities of the four lemur species known to inhabit the Ifotaka Forest (*Lemur catta, Propithecus verreauxi verreauxi, Lepilemur leucopus, Microcebus murinus*) and to make an inventory of locally used medicinal plants. The scope of the project, while keeping conservation as its central theme, was developed over the 9 months in the UK before returning to Madagascar to allow a more holistic view of the issues of the area. These are outlined in section 1.4.

The research of the project covered five main areas (Lemur Ecology, Vegetation, Ornithological, Ethnobotany, and Anthropology) and was supported by an environmental education project. This allowed a more complete view of conservation issues in the area than if the research had been restricted to fewer topics.

Plate 1.1 : The Project Ifotaka Team at Mahavelo (The Basecamp).

[1] See Chapter Two for further information on the WWF Eco-region Programme/Dry Forest.

1.4 Aims of Project Ifotaka 1999

The expedition had 11 aims, which were tied together with a central objective.

Central Objective:
To contribute towards the conservation of the Ifotaka forest by increasing the academic understanding of the whole forest system and by facilitation of future conservation and development activities in the area.

Aims:

1. To compile a species inventory of the plants present in the Ifotaka forest and to collect data on their relative abundance.
2. To estimate the population density of Verreuax's Sifaka, *Propithecus verreauxi verreauxi.*
3. To investigate the characteristics of the habitat used by *Propithecus verreauxi verreauxi.*
4. To investigate the partitioning of time by *Propithecus verreauxi verreauxi.*
5. To confirm the presence of other lemur species in the area.
6. To compile a species inventory of the birds present in the Ifotaka forest along with data on their relative abundance.
7. To compile an ethnobotanical database for the area noting plants used for medicines and other cultural uses and to leave specimen samples of the plants in the Herbarium in Parc Tsimbazaza.
8. To conduct a preliminary investigation into the use of forest resources by the people of Ifotaka.
9. To establish a link between primary schools in Durham and Ifotaka by means of a conservation education project.
10. To train team members in ecological and anthropological fieldwork techniques.
11. To develop the collaboration between Durham University, The Libanona Ecology Centre and Parc Tsimbazaza and to set in place the necessary arrangements for a longer-term project in Ifotaka to be implemented.

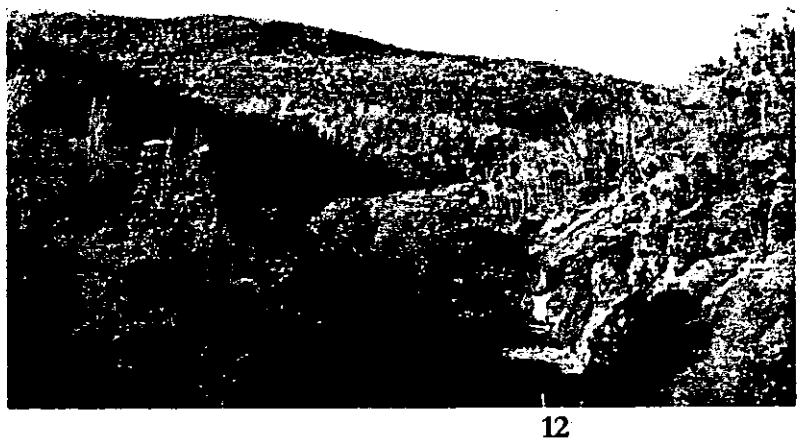
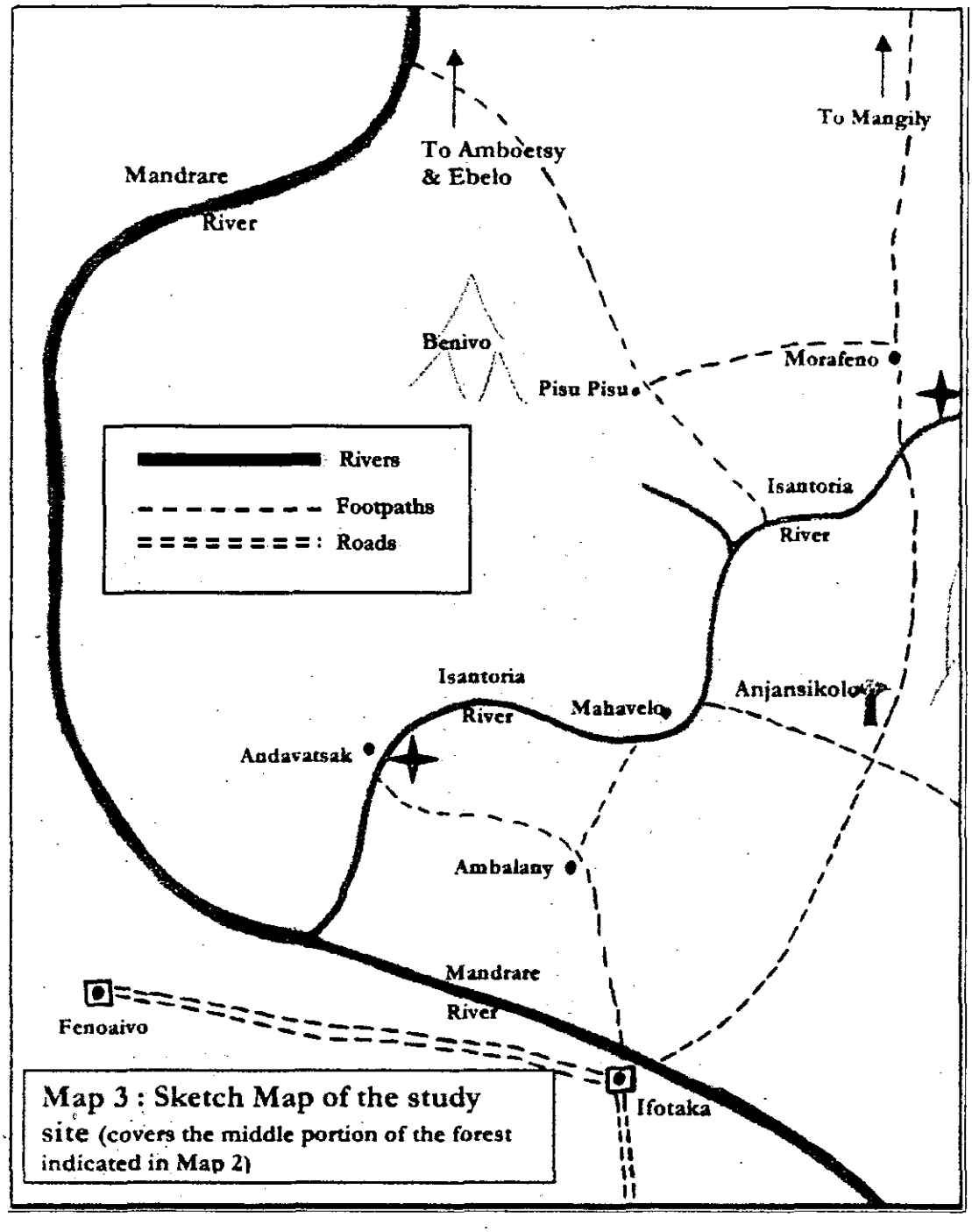


Plate 1.3 : A typical landscape from the Ifotaka Forest

1.6 Maps and location of the study site

Map 1 : Madagascar showing Ifotaka and major places mentioned in the text



Map 3 : Sketch Map of the study site (covers the middle portion of the forest indicated in Map 2)

Map 3 above shows the geographical contest of the study area within the Ifotaka forest. The studies were conducted along a 11.5km stretch of the Isantoria River with the ends indicated by stars on the map - northern end indicated by a star near the village of Morafeno and the southern end indicated by a star near the village of Andavatsak.

VEGETATION SURVEY

2.1 Introduction

WWF-Living Planet Project have identified two hundred global 'eco-regions' that are in need of conservation initiatives and programmes. The dry tropical forests and spiny forests of Madagascar are particularly unique eco-regions of the African sub-continent. Detailed, participative research programmes are much needed, however, to address the current lack of knowledge regarding the biology and socio-economics of each eco-region and their potential for conservation.

To address this, WWF initiated the Eco-region Conservation Programme in the south and south-west of Madagascar. Of the twenty-three eco-region sites identified, the forest at the north of the Ifotaka commune was considered particularly valuable because of its size (30,000 hectares) and high biological diversity. However, traditional cultural and pastural practices currently represent a significant threat to the conservation of this unique habitat and its flora and fauna. Habitat loss is of particular concern since the arid climate and the severity of edaphic conditions (stony soils of low organic content) restrict secondary re-growth potential once primary forest has been degraded.

As a contribution to the WWF Eco-region Programme/Dry Forest, WWF co-ordinated a vegetation survey in collaboration with Project Ifotaka and the Etablissement Superieur de Science (ESS) of the University of Tulear. The field research programme also provided specialised training for research students from the University, as well as supporting the regional natural resource management programmes of the National Office of the Environment and complementing the research on Lemur populations undertaken by Project Ifotaka.

Although the Ifotaka Forest had been broadly described and characterised, a detailed survey of the vegetation had not been conducted. The aim of the present study was to;

- **Determine the identity, relative density and relative cover-abundance of tree species comprising the Ifotaka Forest (Plate 2.1 below).**

Plate 2.1 View over the Ifotaka Forest, including riverbed transect and study area (background) and characteristic vegetation (foreground).

2.3 Results

A total of 162 tree species were recorded during the vegetation survey, representing 52 families. *Enterospermum sp.* (Rubiaceae), *Alluaudia procera* (Didiereaceae), *Euphorbia leucodendron* (Euphorbiaceae), *Strychnos madagascarensis* (Loganiaceae), *Combretum sp.* (Combretaceae), *Croton bevilaniensis* (Euphorbiaceae) and *Grewia sp.* (Tiliaceae) had the greatest median density and cover-abundance scores (2 and 1, respectively) and were recorded in sixteen or more of the nineteen quadrats. The estimated density of these species, based on the median density score, would have been equivalent to 98-273 individuals per hectare. The abundance of *Alluaudia procera* was particularly significant since it was the species on which *Propithecus v. verreauxi* (Verreauxi's Sifaka) was most frequently encountered during investigations of habitat preference (Plate 2.2).

Plate 2.2 *Propithecus v. verreauxi* commonly sighted resting on an adult tree of *Alluaudia procera (Didiereaceae).*

Euphorbiaceae was the most common family with a total of sixteen species recorded and three species within the twelve most abundant trees. Fabaceae, Mimosaceae and Rubiaceae were the next most commonly represented families with six, seven and eight species recorded, respectively. A full species list including the identity (vernacular name and scientific name), relative density (median Index of Density coefficient and proportion occurrence) and relative cover-abundance (median Index of Cover-Abundance coefficient) of tree species recorded during the vegetation surveys is included in Section 2.3 below.

Vernacular name	*Scientific name*		*Median*	*Median*	*Proportion*
	Genus species	*Family*	*IDC*	*ICAC*	*occurrence*
Somoro	*Croton mongy*	Euphorbiaceae	1	x	0.53
Takisakisabato	*Kalanchoe sp.*	Crassulaceae	1	x	0.53
Tsiongake	*Rhopalocarpus lucidus*	Rhopalocarpaceae	1	x	0.53
Vahipindy	*Hypocratea loesnerea*	Hypocrateaceae	1	x	0.53
Darotandroke	*Commiphora orbiculata*	Burseraceae	0	0	0.47
Hily	*Stereospermum nematocarpon*	Bignoniaceae	0	0	0.47
Sofasofa	*Mundulea sp.*	Fabaceae	0	0	0.47
Jabihy	*Operculicarya decaryi*	Anacardiaceae	0	0	0.42
Magne	*Hibuscus macrogonus*	Malvaceae	0	0	0.42
Roipitike	*Mimosa sp.*	Mimosaceae	0	0	0.42
Taranta	*Rhus tarantana*	Anacardiaceae	0	0	0.42
Vontake	*Pachypodium sp.*	Apocynaceae	0	0	0.42
Kolohoto	*Albizzia sp.*	Mimosaceae	0	0	0.37
Laza	*Cyphostema laza*	Vitaceae	0	0	0.37
Mangiriboky	*Asparagus sp.*	Liliaceae	0	0	0.37
Rohondroho	*Alluaudia dimosa*	Didiereaceae	0	0	0.37
Vahiranga	*Cynanchum sp.*	Asclepiadaceae	0	0	0.37
Hazomby	*Croton sp.*	Euphorbiaceae	0	0	0.32
Hazontsanda	*Dialium sp.*	Euphorbiaceae	0	0	0.32
Mangerivoriky	*Strychnos sp.*	Loganiaceae	0	0	0.32
Sambonto			0	0	0.32
Tarena	*Canthium sp.*	Rubiaceae	0	0	0.32
Kotrigny			0	0	0.26
Mendoravy	*Albizzia greviana*	Mimosaceae	0	0	0.26
Somangipake	*Boscia longifolia*	Capparidaceae	0	0	0.26
Tainoro	*Tarrena sp.*	Rubiaceae	0	0	0.26
Talytivoke	*Terminalia divaricata*	Combretaceae	0	0	0.26
Vala	*Dombeya sp.*	Sterculiaceae	0	0	0.26
Vinoa	*Hildegardia sp.*	Sterculiaceae	0	0	0.26
Fangitse	*Dolichos fangitsy*	Papilionaceae	0	0	0.21
Forofoke	*Diaspyros cupulifera*	Ebenaceae	0	0	0.21
Hazomena	*Securinega sp.*	Euphorbiaceae	0	0	0.21
Hororoke	*Boscia madagascarensis*	Capparidaceae	0	0	0.21
Retsiotse	*Protorhus sp.*	Anacardiaceae	0	0	0.21
Takisakisaka	*Xerocyrius perrieri*	Cucurbitaceae	0	0	0.21
Tatavankibo	*Mollugo decandra*	Aizoaceae	0	0	0.21
Tsiboragnala	*Brachiaria sp.*	Poaceae	0	0	0.21
Tsiborankibo		Graminaceae	0	0	0.21
Voaovy	*Tetrapteroe sp.*	Fabaceae	0	0	0.21
Unknown sp.1			0	0	0.21
Aveotse	*Asparagus sp.*	Liliaceae	0	0	0.16
Boroa	*Tetradenia nervosa*	Labiaea	0	0	0.16
Famata	*Euphorbia sp.*	Euphorbiaceae	0	0	0.16
Hazolava	*Neobeguca mahefeli*	Meliaceae	0	0	0.16
Hola	*Adenia sp.*	Passifloraceae	0	0	0.16
Kope	*Mystroxylon aethopicum*	Celastraceae	0	0	0.16
Reringitsy			0	0	0.16
Sahondra 2	*Plumbago aphylla*	Plumbaginaceae	0	0	0.16
Sakoandalitse	*Operculicarya hyphenoides*	Anacardiaceae	0	0	0.16
Tontonga	*Aristolochia sp.*	Aristolochiaceae	0	0	0.16
Vahondrandra	*Aloe sp.*	Liliaceae	0	0	0.16
Vakoanala	*Pandanus xerophylus*	Pandanaceae	0	0	0.16
Voafogna		Erythroxylaceae	0	0	0.16

Vernacular name	*Scientific name*		*Median IDC*	*Median ICAC*	*Proportion occurrence*
	Genus species	*Family*			
Retsilaitse	*Noronhia myrtyoides*	Oleaceae	0	0	0.05
Roivontsy	*Acacia sp.*	Mimosaceae	0	0	0.05
Sahondra 1	*Henonia sp.*		0	0	0.05
Sainty		Rubiaceae	0	0	0.05
Sasavy	*Salvadora sp.*	Salvadoraceae	0	0	0.05
Seta	*Humbertiella henri*	Nalvaceae	0	0	0.05
Sida			0	0	0.05
Taintsande		Euphorbiaceae	0	0	0.05
Taritarike	*Leptadenia madagascarensis*	Asclepiadaceae	0	0	0.05
Tsilaitsy	*Nhoronia sp.*	Oleaceae	0	0	0.05
Tsirambeimbosy			0	0	0.05
Vahemalo			0	0	0.05
Vahimasy			0	0	0.05
Velomihanto			0	0	0.05
Velomihotoky		Liana	0	0	0.05
	Angraecum sp.		0	0	0.05
	Carina edulus		0	0	0.05
	Celastracus sp.	Celastraceae	0	0	0.05
	Ecbolium linea	Acanthaceae	0	0	0.05
	Enterospermum purinosum		0	0	0.05
	Eocodades sp.	Orchidaceae	0	0	0.05
	Euphorbia francoisi		0	0	0.05
	Kalanchoe grandidieu	Crassulaceae	0	0	0.05
	Kalanchoe tubiflora	Crassulaceae	0	0	0.05
	Maba microphylla		0	0	0.05
Unknown sp.2			0	0	0.05
Unknown sp.3			0	0	0.05

Lemur Ecology

3.0 Summary

- The presence of *Propithecus verreauxi verreauxi* (Verreaux's Sifaka), *Lemur catta* (The Ring-tailed Lemur), *Lepilemur leucopus* (The White Footed Sportive Lemur) *Microcebus murinus* (Grey Mouse Lemur) is confirmed at Ifotaka
- The population density of *Propithecus v. verreauxi* was estimated as 33.77 individuals per square kilometre from a transect walk survey.
- The population density of *Propithecus v. verreauxi* was estimated as 37.25 individuals per square kilometre from point count surveys.
- Populations of *Propithecus v. verreauxi* tend not to occur in sections of the transect with agricultural disturbance present.
- Point counts are a more reliable method of population survey for sifakas than transect walks with coefficients of variation of 10.79% and 37.78% respectively. For this reason the estimate of **37.2 individuals per square kilometre** is recommended by this study.
- In the study of habitat use, 12 species of trees were found to be used for support by the sifakas, 50% of the trees recorded as being used by *Propithecus v. verreauxi* in this survey were of the species Fantiolotse (*Allaudia procera*). This tree species is at great threat from human use because it is the main tree species used for house construction timber.
- The proportion of trees used by sifakas that were food species was not different to the proportion of randomly selected trees in the forest, which were food species. This result does not account for actual presence of food items.
- The basal area and height of the four nearest neighbours of trees used by sifakas is greater than that of randomly selected trees in the forest suggesting that Sifakas depend on mature stands of trees or stands of larger tree species.
- Allocation of time by sifakas shows 46% of time was spent Feeding, 36% of time Resting and 11% of time Moving.
- Peaks in moving and feeding occur in mid morning and mid afternoon. Peaks in resting and grooming occur at the start of the day the end of the day with a further peak in resting in the middle of the day.

Sussman, 1974), Beza Mahafaly (Richard 1977, 1985, 1992; Richard and Dewar, 1991), Kirindy (Ralisoamalala, 1996; Ganzhorn and Kappeler 1996; Carrai and Lunardini, 1996, Scharfe and Schlund, 1996) and Andohahela/Hazafotsy (Richard, 1974, 1977a). One published study has been conducted in unprotected forest at Antseranomby (Sussman, 1974) and one unpublished study by Boggess and Smith (1963) is reported from Lambomakandro (Harcourt and Thornback, 1990).

Population density estimates of *Propithecus verreauxi verreauxi* range from a small population of 40 to 50 individuals at Antseranomby (equivalent to 400 and 500 individuals per sq. km) (Sussman, 1974) to the most recent estimate in the gallery forest of Berenty of 211 individuals per sq. km (O'Connor, 1987). O'Connor (1987) found that disturbed spiny forest at Bealoka beside Berenty held a population at a density of 47 individuals per sq. km. It has an IUCN conservation status of Vulnerable

A behavioural study by Howarth *et al.* (1986) found troops at Berenty to spend 46% of their time feeding, 19% resting and 15% moving. When studying feeding behaviour in the spiny forest at Hazafotsy, Richard (1977) found that individuals spent more time feeding in the wet season (32.8%) than in the dry season (24.2%). Dietary studies of *Propithecus v. verreauxxi* indicate that it is both folivorous and frugivorous (Richard, 1985). This diet is supplemented by flowers and bark (Jolly, 1966; Richard, 1977). It is widely agreed that this sub-species exhibits great seasonal variation in its diet (Harcourt and Thornback, 1990, Richard, 1977, Jolly, 1966) and is an opportunistic feeder, taking a wide range of food items as they become available (O'Connor, 1987 reported in Harcourt and Thornback, 1990). Its diet in the wild consists of more than 79 species, although only a small proportion make a significant component during any season. Richard found this to be between 5 and 8 species, varying with season, year and food availability (1977). O'Connor (1987) found troops in Bealoka to feed on 35 species, but less than half of these were eaten for more than 1% of the time and less than a quarter were eaten in all seasons. The diet of populations in the spiny forest areas is almost entirely different, in terms of species composition, from that of populations in the dry deciduous forest in the west of Madagascar (Richard, 1977). Jolly, 1966 found *Propithecus verreauxi verreauxi* to feed on 18 plant species and reported Boggess and Smith as observing it feeding on 12 species. As with *Lemur catta* Jolly (1966) observed *Tamarindus indica* to be the staple food at Berenty in a diet consisting 65% of fruit, 25% leaves and 10% flowers. Richard (1977) saw much greater variation in dietary composition at Hazafotsy with fruit contributing from 20 to 80% and adult leaves from 10 to 70%, young leaves never exceeded 20% and flowers 30%. The variation was correlated with the seasons, with a higher proportion of fruit being consumed during the wet season, when it is more available. The proportion of adult leaves consumed increased at the start of the dry season when less fruit was available. Richard also found that the proportion of flowers in the diet was most significant during the onset of the wet season in January before the time of maximum fruit availability, she showed that proportion of each food item consumed is strongly linked to the phenological state of the plants, supporting the idea that sifaka are opportunistic feeders and their apparent seasonal preferences for food types are dictated by availability. This idea is supported by O'Connor (1987) and Jolly (1966). This wide ranging diet in the wild has been suggested as one of the reasons for difficulty in keeping the species alive in captivity (Jolly, 1966; Ranorosoa pers. comm.) perhaps because switching feeding from species to species is necessary to minimise the accumulation of any toxins. Their lack of need to drink water directly (Harcourt, 1990) and their broad diet are likely reasons for the species survival in a wide range of habitat types (Jenkins, 1987) despite less efficient habitat utilisation than *Lemur catta.*

3.3 Population Estimation of *Propithecus v. verreaxi*

3.31 Methods

Population densities of Malagasy lemurs outside protected or managed areas have not previously been estimated (Simons, 1997). For this reason a central objective of this study was to provide such estimates for the diurnal species inhabiting the forest. Two methods were employed.

a) Transect Walks:

The transect, based on the Isantoria River bed which is illustrated on Maps 2 and 3. It extended from the hamlet of Morafeno to the village of Andavatsak. The transect was 11.5Km in length and was dry during the survey period in July and August 1999. The transect was split into 500m sections and within each, the field of view along each side of the river was estimated visually, aided by FTM Map K-61 (FTM, 1956), so giving estimates of the survey area (See Figure 3.1 for schematic diagram). The 500m sections were then placed in four groups (Up Near, Up Far, Down Near and Down Far) and each of these four groups was surveyed by a pair of students four times, twice shortly after dawn (0700-0900)(once in each direction) and twice shortly before dusk (1530-1730) (again once in each direction). The pair accompanied by a local guide walked at a constant speed of ≈1.5Km/hr (Bibby *et al.*, 1992) scanning the area with the naked eye and 10X50 Binoculars. One person was responsible for each side of the river valley. Upon sighting a group of lemurs the team would stop for 10 minutes to determine the size of the lemur group, data recorded included species, group size, location (on sketch map) and time of sighting. The survey then continued. The mean of the results of the four surveys for each section was calculated to produce the density estimates in individuals per sq. km.

This method provided sufficient data to estimate population densities of *Propithecus v. verreauxi* and recorded the presence/absence of *Lemur catta.* A census of the human disturbance along the transect was also carried out by estimating the relative abundance of agricultural cultivation in each of the 500m sections (either adjacent to the riverbed or in the forest). Values on a scale from zero to five (with fractions) were allocated to each section, with zero indicating no cultivation and five indicating the maximum amount of cultivation (consisting of manioc, bageda, and maize as well as grazing by goats and zebu (cattle)).

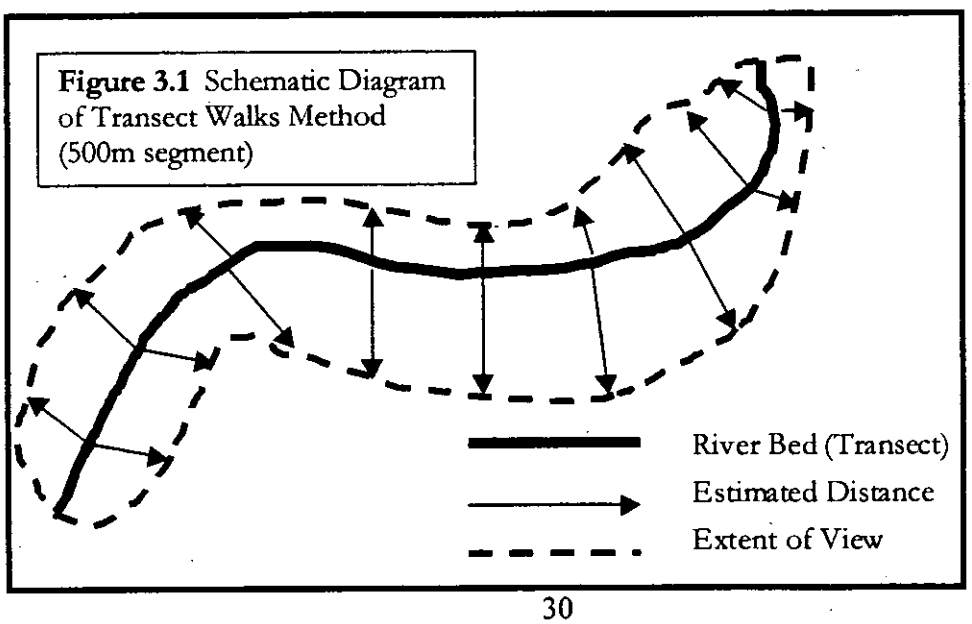


Figure 3.1 Schematic Diagram of Transect Walks Method (500m segment)

3.32 Results

a) Transect Walks

Figure 3.3 below illustrates the *Propithecus v. verreauxi* population density estimates obtained along the Isantoria Riverbed from the transect walks method. They ranged from zero to 219.65 individuals per square kilometre with a mean of 33.77 (SE 11.37). There is an unequal distribution of population densities (chi-square[1]=1937, df=22; P<0.01), the pattern shows a general increase with distance from either end of the transect. The village of Morafeno is located at the start of the 0-0.5Km section and the village of Andavatsak is located at the end of section 11-11.5Km, the centre section (5-5.5Km) was the field camp for the research team.

The survey of human agricultural disturbance along the transect is illustrated in Figure 3.4, it has an unequal distribution along the transect (chi-square = 60.49, df=22, p<0.05). The pattern exhibited the highest values at either end of the transect and the smallest values at the centre of the transect.

A modest correlation between population density and agricultural disturbance was observed (Spearman Rank = 0.517, p>0.02) suggesting a dissociation between the presence of lemurs and agriculture.

Figure 3.3 Population density estimates of Propithecus v. verreauxi with SE along the Isantoria Riverbed (from Transect Walks)

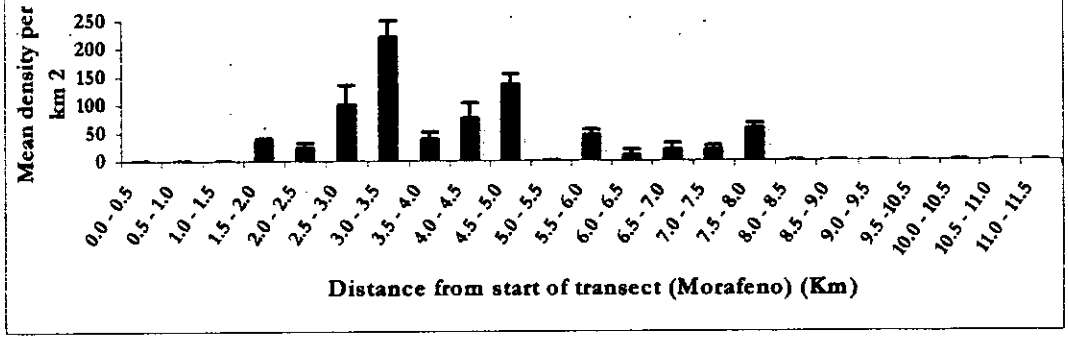
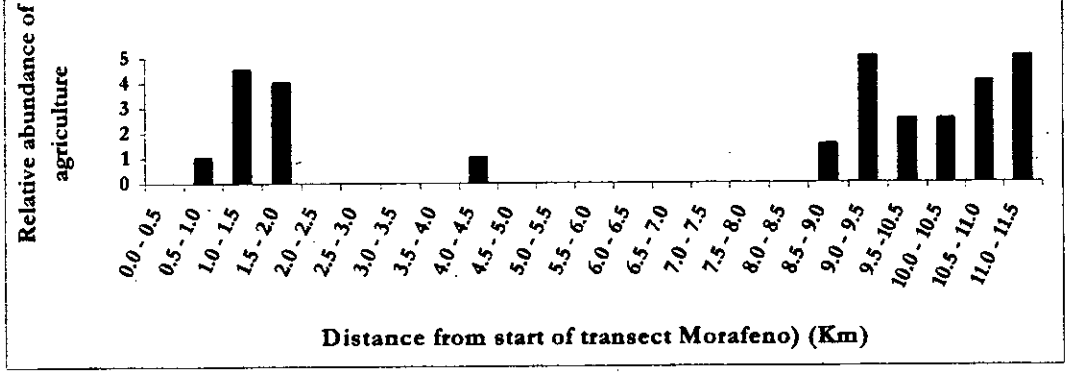


Figure 3.4 Agricultural Disturbance along the Isantoria Riverbed



[1] Using total counts over the four repetitions.

b) Point Counts

The point count surveys (illustrated in table 3.2) produced mean estimates from 7.34 to 95.07 individuals per square kilometre with a mean of 37.25 (SE 14.51) over the six sites surveyed.

Table 3.2 Estimated Population density of *Propithecus v. verreauxi* from Point Counts in the Ifotaka Forest (individuals per sq. km)

Point	Location relative to Transect Walks	Day One	Day Two	Mean	SD	SE	Coefficient of Variation (%)
A	D1	15.35	18.77	17.06	2.42	1.71	14.18
B	D4	10.41	12.40	11.40	1.41	0.99	12.36
C	UP4	89.97	100.18	95.07	7.22	5.11	7.59
D	UP5	21.67	30.00	25.84	5.90	4.17	22.83
E	NW[3] (Benivo)	7.69	6.99	7.34	0.49	0.35	6.68
F	UP2	66.25	67.29	66.77	0.74	0.52	1.11
Mean		35.22	39.27	37.25			10.79
SD		34.39	36.78	35.54			7.48
SE		14.04	15.02	14.51			3.05

c) Review of census methods

One of the aims of this study was to make a comparison between the two different population census techniques. As shown in tables 2 and 3 the mean population density estimates for the two techniques are close despite surveying slightly different areas. The mean coefficient of variation for the point counts method is lower than that for the transect walks method (10.79 and 72.42 respectively) despite the point counts having only two repetitions compared to the four repetitions for the transect walks. This suggests that the point counts provide a more reliable estimate of population density with less survey effort.

[3] NW = Not within the transect walk area. Benivo is a hill north of the Asantoria River within the Ifotaka Forest.

3.4 Habitat Use by *Propithecus v. verreauxi*

3.41 Methods

An investigation into the habitat use by Verreaux's sifaka was conducted by examining the spatial association between the forest tree species and the lemur. Surveys were conducted by Barry Ferguson or Julian Mallinson accompanied by Claudine Ranorosoa from Parc Tsimbazaza and a local Ombiasa (Manahira or Fanahisoa). We searched for groups of lemurs between 0730h-0930h and 1500h-1730h between the 4th and 28th August 1999. On locating a lemur(s), the tree(s) on which the lemurs were resting at the time of first sighting was identified. The following variables were then recorded: Time of sighting, number of lemurs using tree, tree species (Identified by the Ombiasa), girth at breast height (gbh), phenology, status as a lemur food plant or not (data from Table 8 and Ombiasa knowledge). The Point Centred Quarter method was used to determine the tree density and canopy basal area of the trees surrounding the sample tree. Variables recorded for the nearest tree (gbh>10cm) were: species (food or not), gbh, distance from sample tree and phenology. This procedure was completed for 20 trees in the morning, 20 trees in the afternoon and 20 randomly selected trees.

3.42 Results

In this study sifakas were found to use 12 tree species for support in the morning and four of these in the afternoon. Randomly chosen trees were of 15 species, only 3 of which were found to be used by the lemurs. Half (20) of the trees used by lemurs in this survey (n=40) were Fantiolitse (*Allaudia procera*), 5 of the 40 trees surveyed were Siro Siro (*Gyrocarpus americanus*) and 4 were Kolohoto (*Albizzia sp.*). The other species found to be used were not recorded more than twice. 12 further species were recorded from the random sample, but were not in this instance found to be used by the sifakas (data illustrated in Figure 3.5).

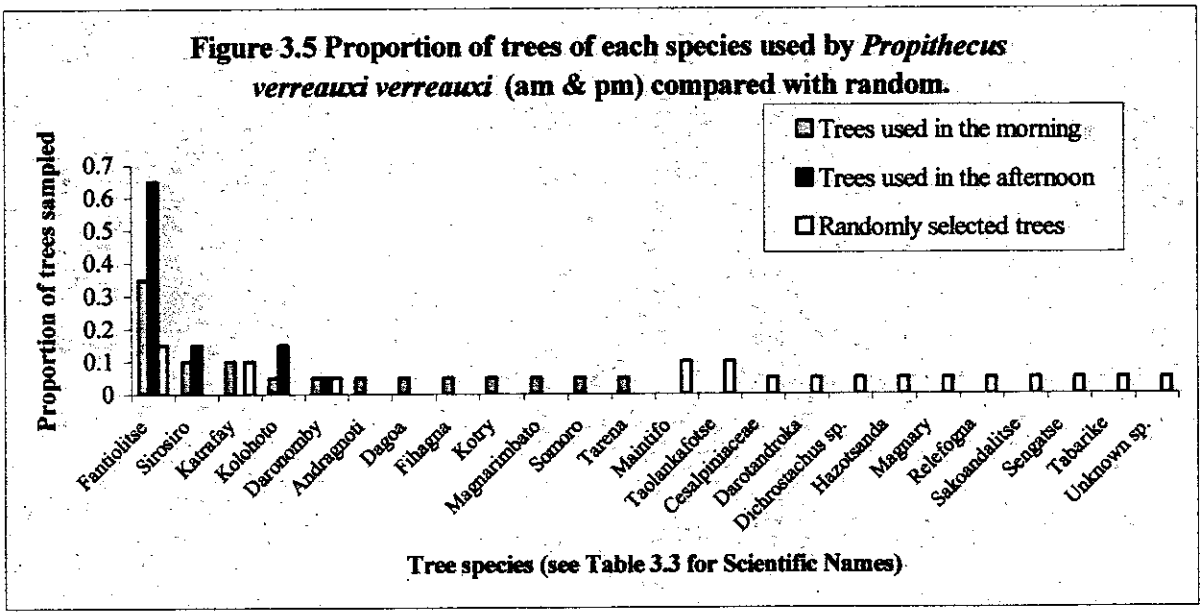


Figure 3.5 Proportion of trees of each species used by *Propithecus verreauxi verreauxi* (am & pm) compared with random.

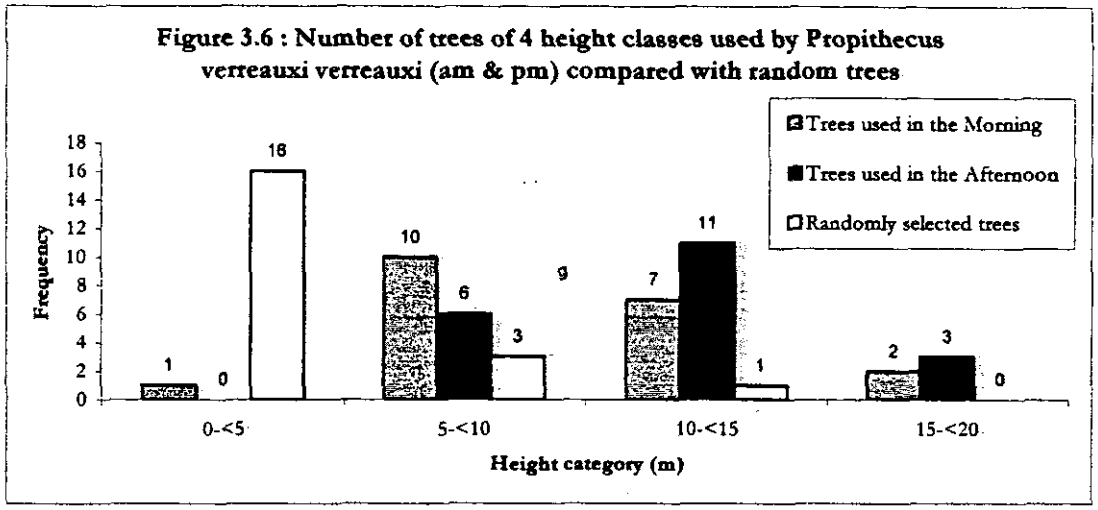


Figure 3.6 : Number of trees of 4 height classes used by Propithecus verreauxi verreauxi (am & pm) compared with random trees

Figure 3.6 (above) illustrates the proportion of the trees used by the sifakas in the morning and afternoon and the randomly selected trees which are food species. Comparisons between the randomly chosen trees and those used in the morning shows no significant difference (Chi square = 0.00023; df=1; NS). Similarly there is no significant difference between the random trees and those used in the afternoon (Chi square = 0.01738; df=1; NS).

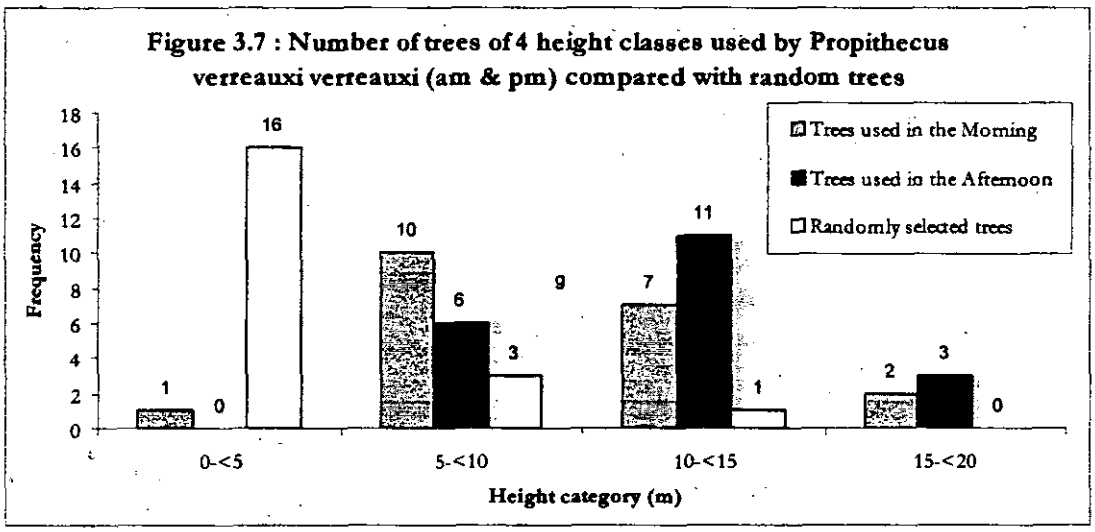


Figure 3.7 : Number of trees of 4 height classes used by Propithecus verreauxi verreauxi (am & pm) compared with random trees

Figure 3.7 illustrates the height categories of the trees used by sifakas in the morning and afternoon and the randomly chosen trees. A Fisher Exact test comparing trees used in the morning to random (combining the 0>5m/5>10m and 10>15m/15>20m categories) shows that the sifakas use significantly taller trees than the randomly selected trees in the forest (Fisher Exact $p < 0.01$). The comparison between the afternoon trees and the random trees also shows a significant difference with the trees used in the afternoon being significantly taller than the random trees (Fisher exact $p<0.001$). The comparison between the heights of the trees used in the morning and afternoon does not show a significant difference (Chi Square x=2.56, df=1, NS), although Fig 3.7 indicates that in this sample a greater proportion of tall trees are used in the afternoon than in the morning (70% of the trees used in the afternoon were greater than 10m tall compared with 45% of trees used in the morning).

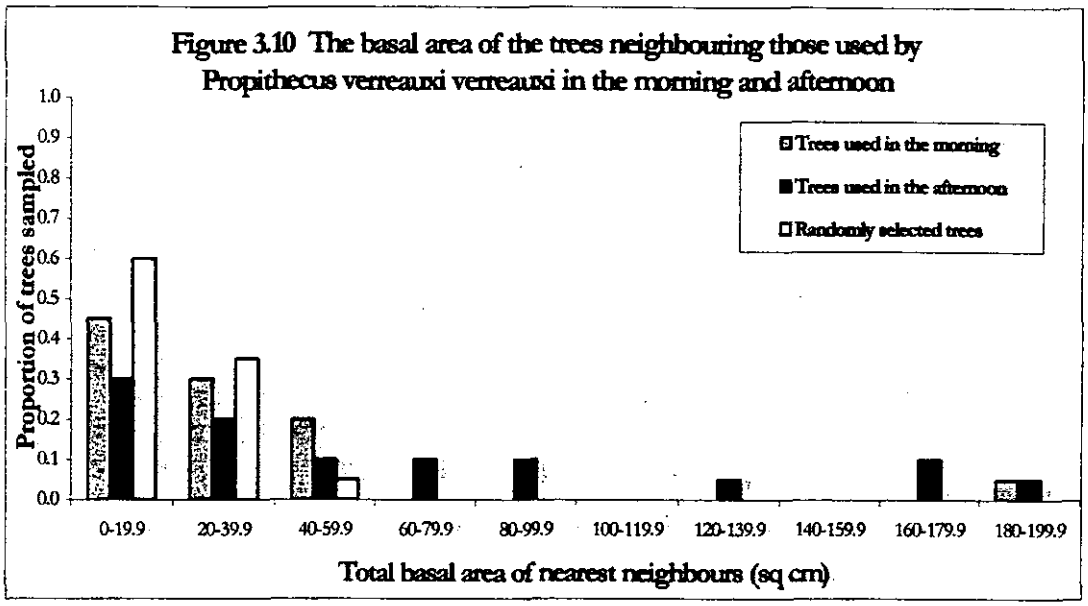


Figure 3.10 illustrates the distribution of total basal area of nearest neighbour trees to those trees used by sifakas in the morning, afternoon and random trees. Mann-Whitney *U*-tests were applied to comparisons between:

1) **Morning and afternoon** -showed no significant difference between the medians ($u=140; p>0.05$).
2) **Morning and random** - showed a significant difference with the median of morning being significantly greater than the median for the random trees ($u=112$; $p<0.05$). This shows that the communities around the trees used in the morning are composed of trees larger than the communities around the randomly selected trees.
3) **Afternoon and random** – showed a significant difference with the median of the afternoon trees being significantly larger than the median of the random trees ($u=71$; 0.05). This shows that the communities around the trees used in the afternoon are composed of trees larger than the communities around the randomly selected trees.

3.43 Discussion

The point quarter centre survey of Sifaka habitat use saw the sifakas using 12 tree species in the morning and 4 of these in the afternoon, the randomly selected trees were of 15 species, of which only 3 were found to be used by the lemurs. Fantiolitse, *Allaudia procera* proved to be the tree most used by the sifakas, with half of the records being on this species. This may be due to a range of benefits conferred by the features of the tree, including its great height relative to other species in the forest, the small proportion of non-vertical branches and the presence of food items. The first two will allow the sifakas a good view of the surrounding area and relatively easy movement, both of which are benefits in escape from predators. In addition, the sifaka is known to be primarily a vertical clinger and leaper (Jolly, 1966) so the vertical and near vertical branches will provide the most appropriate habitat.

As illustrated by figure 3.6 there was no significant difference in the proportion of food species used in the morning or afternoon compared to random, this may be due to the wide range of plant species consumed by the sifakas. However, as this study did not record the presence or absence of food items on individual trees any future study

3.5 Time Allocation by *Propithecus v. verreauxi*

3.51 Methods

An investigation was carried out to examine how Verreaux's Sifaka (*Propithecus v. verreauxi)* allocates its time. Observations were conducted by pairs of students from vantage points, from 0600 – 1800h, using the naked eye when possible supplemented by 10X50 Binoculars. After a trial period of two days, used to refine the method and to familiarise the team with the method the survey was started. The survey team would locate a group of Sifakas as early as possible after dawn, choose an appropriate observation point and then observe the behaviour of all visible members of the troop at five-minute intervals. Observed behaviours were classified into seven categories (resting, feeding, moving, and grooming, alert, vocalising, and aggressive). A total of 115.71 hours observations were obtained with a total of 4357 individual behaviour records.

3.52 Results

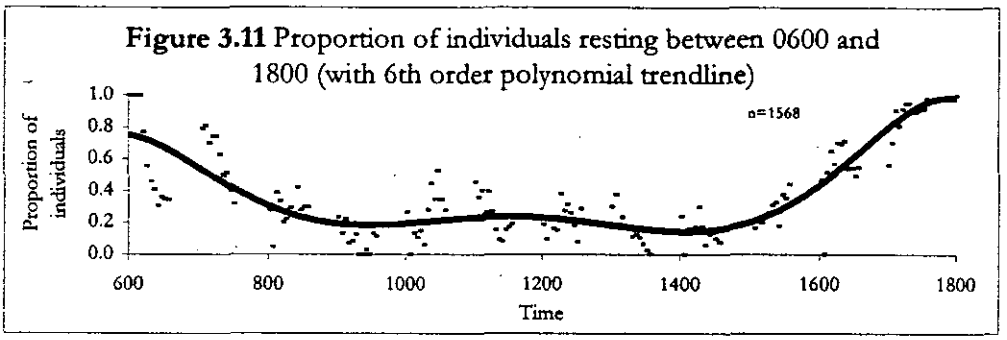


Figure 3.11 Proportion of individuals resting between 0600 and 1800 (with 6th order polynomial trendline)

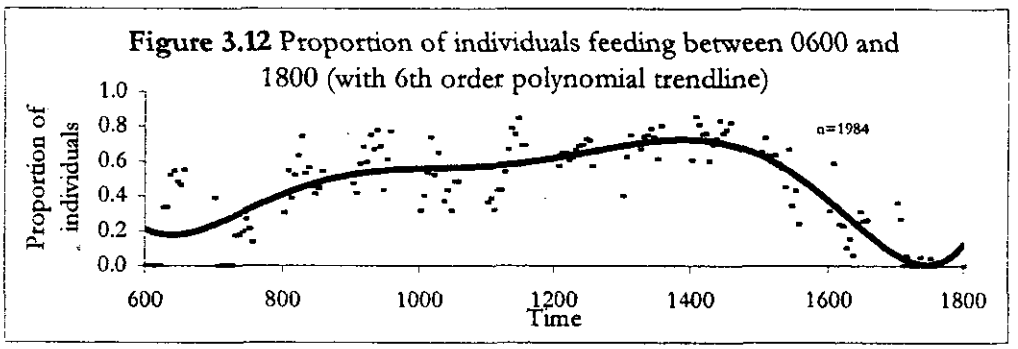


Figure 3.12 Proportion of individuals feeding between 0600 and 1800 (with 6th order polynomial trendline)

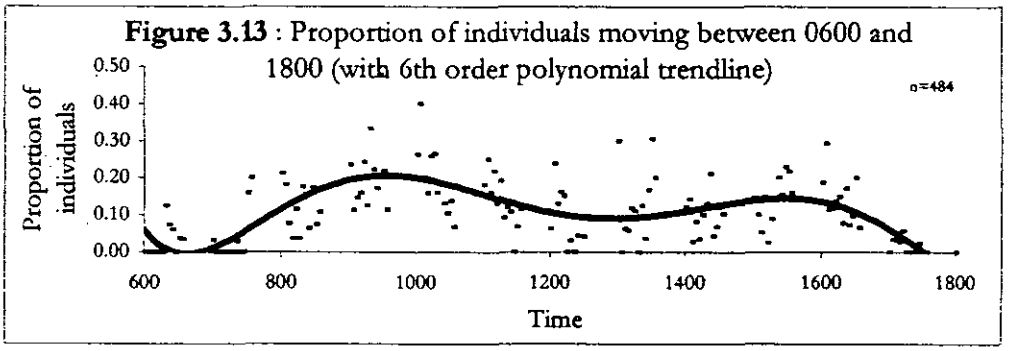


Figure 3.13 : Proportion of individuals moving between 0600 and 1800 (with 6th order polynomial trendline)

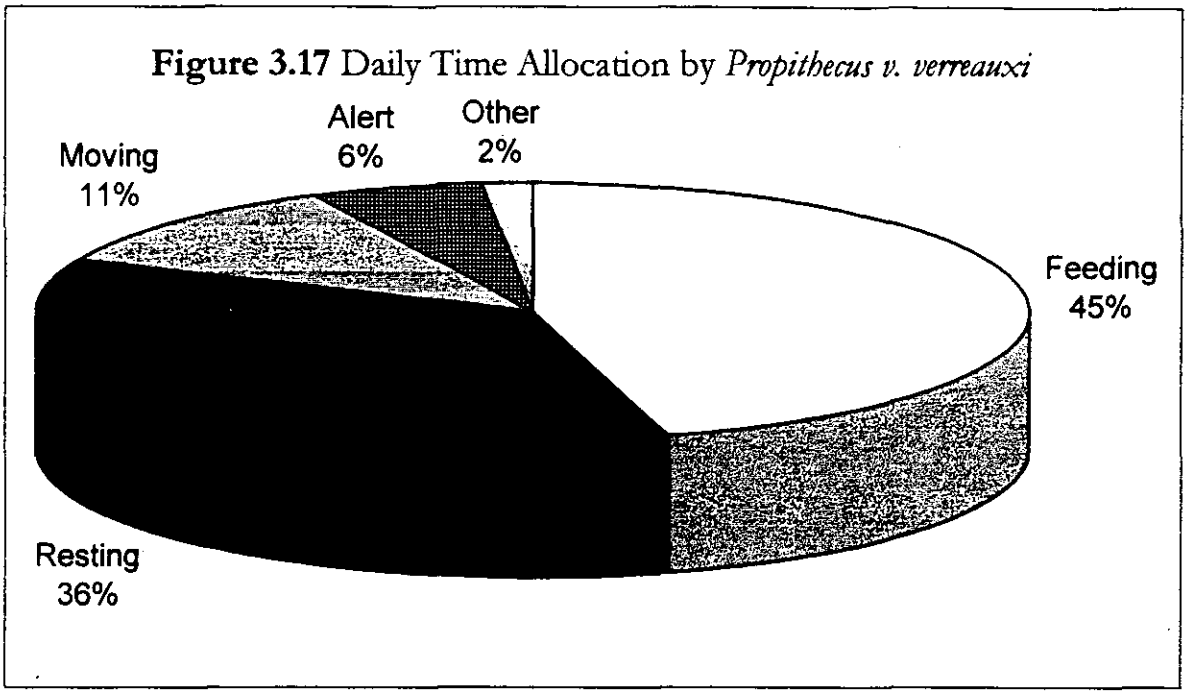


Figure 3.17 Daily Time Allocation by *Propithecus v. verreauxi*

Figure 3.17 illustrates the overall division of time between 0600 and 1800 with the three dominant behaviours being feeding (46%), resting (36%) and moving (11%) despite the patterns exhibited by other behaviours they remain minor activities.

In general, sifakas were observed to start the day by resting and less frequently grooming, they would generally be feeding and moving by the mid-morning (0830). Resting would show a peak during the hottest part of the day and feeding and moving would take over as the dominant behaviours by the mid afternoon, the day would generally end in the same way as it started with individuals resting and grooming.

The observations of vocalising behaviour and aggressive behaviour were very limited (n=16 & n=15 respectively). Vocalising was observed only when there were birds of prey such as the Madagascar Harrier –Hawk (*Pol radiatus*) and the Madagascar Kestrel (*Falco newtoni*) soaring above the sifakas. This is suspected to be an alarm and anti-predator call, however Goodman and Patterson (1997) call into question the theory that sifakas are preyed upon by raptors. Oda (1998) observed sifakas to react differently to tape recordings of anti-raptor and anti-carnivore calls by *Lemur catta* which showing that sifakas react to the threat of predation from both raptors and terrestrial carnivores. On one occasion during the fieldwork, I observed a troop of *Lemur catta* producing alarm calls, while a Harrier Hawk was circling overhead. This was soon followed by alarm calls from the nearby troop of Sifakas that I was observing, suggesting that the two diurnal lemur species in the forest may react to each other's alarm calls.

With the relatively small sample size of this survey and the fact that the nature of the data does not allow statistical analysis, it is suggested that for any future studies a larger dataset should be collected in the field. Animals should preferably be habituated and accurate data on their feeding behaviour and use of trees recorded. In addition, a differentiation between movement and travelling should be made (as was done in studies by Richard (1978) and Jolly (1966)). This is because movement around a small area in search of food, a resting spot or for interaction with other group members, is different to individuals or the group travelling greater distances to a new part of the forest.

3.7 Other Lemur Species in Ifotaka

The presence of four lemur species was recorded and is illustrated in Table 3.5 below. It may be possible that other species are present in the forest, most likely being *Cheirogaleus medius*, whose range is recorded by Tattersall (1982) as potentially extending to the area. Despite not being sighted during this expedition, *Daubentonia madagascarensis* and *Phaner furcifer* may potentially be present, both having been recorded in the spiny forest of Andohahela, the latter by O'Connor et al. (1986) and former by Russell and McGeorge (1977). Neither of these species have been recorded at Berenty Reserve the nearest studied site to the Ifotaka Forest.

Table 3.5 The lemur species observed in the Ifotaka Forest July-Sept 1999

English Name	Scientific Name	Local Name	Activity Period	Conservation Status (IUCN)
Ring-tailed Lemur	*Lemur catta*	Maki	Diurnal	Vulnerable
Verreaux's Sifaka	*Propithecus verreauxi verreauxi*	Sifaka	Diurnal	Vulnerable
White Footed Sportive Lemur	*Lepilemur leucopus*	Tsiongike	Nocturnal	Rare
Grey Mouse Lemur	*Microcebus murinus*	Hatak	Nocturnal	Abundant

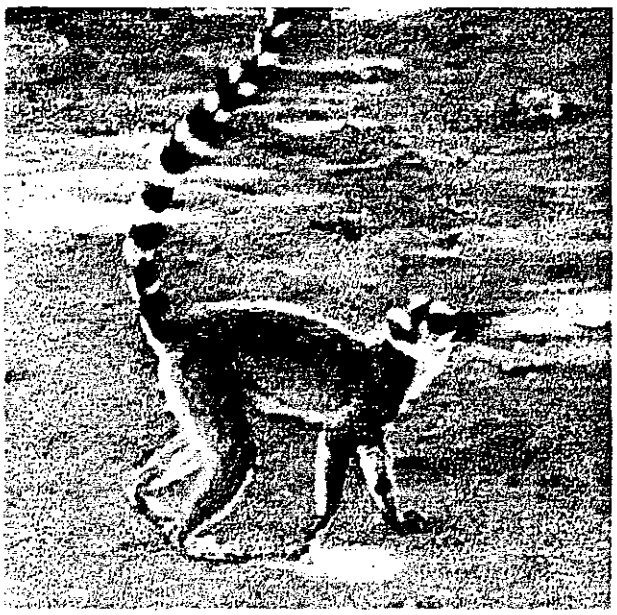


Plate 3.4 *Lemur catta*
The Ring-tailed Lemur

ORNITHOLOGY

4.1 Species Diversity

A species inventory of the birds in the forest was carried out by Julian Mallinson, Barry Ferguson and Claudine Ranorosoa, species were identified using Morris and Hawkins (1998) and the local guides Resitahaka, Masimbala, Manahira and Fanahisoa from the village of Ifotaka identified local names. The inventory was carried out from the 23rd July to 10th September 1999. One previous bird inventory had been carried out by a WWF rapid survey team (WWF, 1999). Project Ifotaka 1999 recorded the presence of 42 species, 3 of which had not previously been recorded at Ifotaka (Long-tailed Cormorant; Madagascar Paradise Flycatcher; Madagascar Pond Heron). Of the 42 species recorded, two have a conservation status of near threatened (Madagascar Pond Heron and Verreaux's Coua) all other species recorded in this survey are not globally threatened. 22 of the recorded species are endemic to Madagascar and a further 11 are endemic to the Indian Ocean region.

The WWF survey had recorded the presence of the Red-Shouldered Vanga (*Calicalicus rufocarpalis*) which was not known from this region (Hawkins pers. comm.) this expedition did not record its presence. A further 16 species recorded by the WWF survey were not recorded by this survey.

Table 4.1a Species inventory of birds recorded in the Ifotaka Forest (July – Sept 1999)

English name	Scientific Name	Local Name	PR	Status	Endemic
Barn Owl	*Tyto alba*	Vorondolo or Hekoheko	Y	NGT	Not Endemic
Chaberts Vanga	*Leptopterus chabert*	Voron'antake	Y	NGT	Endemic
Common Jery	*Neomixis tenella*	Tsimitse	Y	NGT	Endemic
Common Myna	*Acridotheres tristis*	Remaro	Y	NGT	Not Endemic
Common Newtonia	*Newtonia brunneicauda*	Andrebakia	Y	NGT	Endemic
Crested Coua	*Coua cristata*	Tivoke	Y	NGT	Endemic
Crested Drongo	*Dicrurus forficatus*	Relove	Y	NGT	Reg Endemic
Giant coua	*Coua gigas*	Eoke	Y	NGT	Endemic
Greater Vasa Parrot	*Coracopsis vasa*	Vazan-tsihotse	Y	NGT	Reg Endemic
Grey Headed Lovebird	*Agapornis canus*	Karyaka (or Farivaza)	Y	NGT	Endemic
Hamerkop	*Scopus umbretta*	Takatse	Y	NGT	Not Endemic
Helmeted Guinefowl	*Numida meleagris*	Akanga	Y	NGT	Not Endemic
Hook Billed Vanga	*Vanga curvirostris*	Tsilovanga	Y	NGT	Endemic
Lafresnayes Vanga	*Xenopirostris xenopirostris*	Fiok'ala	Y	NGT	Endemic
Lesser Vasa Parrot	*Coracopsis nigra*	Bolokikely (or Sihotse)	Y	NGT	Reg Endemic
Long-tailed Cormorant	*Phalacrocorax africanus*	unknown	N	NGT	Not Endemic
Madagascar Bulbul	*Hypsipetes madagascariensis*	Tsikonina	Y	NGT	Reg Endemic
Madagascar Buzzard	*Buteo brachypterus*	Hondria	Y	NGT	Endemic
Madagascar Coucal	*Centropus toulou*	Kotrohokha (or Toloho)	Y	NGT	Reg Endemic
Madagascar Harrier Hawk	Polyboroides radiatus	Bevortse (or Bobaka)	Y	NGT	Endemic
Madagascar Hoopoe	*Upupa marginata*	Tsikodara	Y	NGT	Endemic
Madagascar Kestrel	*Falco newtoni*	Hitikitike	Y	NGT	Reg Endemic
Madagascar Magpie-Robin	*Copsychus albospecularis*	Pitse	Y	NGT	Endemic
Madagascar Malachite Kingfisher	*Alcedo vintsioides*	Vintsy	Y	NGT	Reg Endemic
Madagascar Nightjar	*Caprimulgus madagascariensis*	Langopaka	Y	NGT	Reg Endemic
Madagascar Paradise Flycatcher	*Terpsiphone mutata*	unknown	N	NGT	Reg Endemic

Table 4.2a The relative abundance of the bird species along the Asantoria Riverbed 11th/12th August 1999.

	Common Name	*Scientific Name*	Total	Abundance Index
1.	**Crested Drongo**	*Dicrurus forficatus*	18	1
2.	**Namaqua Dove**	*Oena capensis*	16	0.88
3.	**Crested Coua**	*Coua crestata*	14	0.77
4.	**Madagascar Magpie-Robin**	*Copsychus albospecularis*	13	0.72
5.	**Grey headed lovebird**	*Agapornis canus*	12	0.66
6.	**Madagascar Red Fody**	*Foudia madagascariensis*	12	0.66
7.	**Vasa Parrot sp.**	*Coracopsis sp.*	11	0.60
8.	**Madagascar Turtle Dove**	*Streptopelia picturata*	10	0.55
9.	**Madagascar Malachite Kingfisher**	*Alcedo vintsioides*	9	0.5
10.	**Common Jery**	*Neomixis tenella*	7	0.38
11.	**Chaberts Vanga**	*Leptopterus chabert*	6	0.33
12.	**Madagascar Coucal**	*Centropus toulou*	6	0.33
13.	**Pied Crow**	*Corvus albus*	6	0.33
14.	**Common Newtonia**	*Newtonia brunneicauda*	5	0.27
15.	**Madagascar Buzzard**	*Buteo brachypterus*	5	0.27
16.	**Sunbird sp.**	*Nectarinia sp.*	5	0.27
17.	**Madagascar Kestrel**	*Falco newtoni*	4	0.22
18.	**Lafresnayes Vanga**	*Xenopirostris xenopirostris*	3	0.16
19.	**Common Myna**	*Acridotheres tristis*	2	0.11
20.	**Madagascar Bulbul**	*Hypsipetes madagascariensis*	2	0.11
21.	**Madagascar Harrier Hawk**	Polyboroides radiatus	2	0.11
22.	**Madagascar Hoopoe**	*Upupa marginata*	2	0.11
23.	**White Headed Vanga**	*Artamella viridis*	2	0.11
24.	**Green Backed Heron**	*Butorides striatus*	1	0.05
25.	**Madagascar Paradise Flycatcher**	*Terpsiphone mutata*	1	0.05
26.	**Madagascar Pond Heron**	*Ardeola idea*	1	0.05
27.	**Stripe Throated Jery**	*Neomixis striatigula*	1	0.05
28.	**Unidentified FODY**	*Foudia sp.*	1	0.05
29.	**Unidentified Species 2**	*Unid2*	1	0.05
30.	**Unidentified Species1**	*Unid1*	1	0.05
31.	**Yellow-billed Kite**	*Milvus aegyptius*	1	0.05

The right hand column (in bold) shows the relative abundance of each of the species recorded in the lists, this figure is obtained by dividing the number of lists in which the species appears by the total number of lists completed.

The Mackinnon List survey recorded 31 species, two of which remain unidentified. Of the 31 two could only be identified to genus (Vasa parrot sp. and Sunbird sp.). This meant that up to 11 of the species recorded in the inventory did not appear in the relative abundance survey and therefore either may be relatively less abundant or that they may selectively use alternative habitat to that adjacent to the riverbed.

ETHNOBOTANY

5.0 SUMMARY

The role of the *Ombiasy* is significant in the human use of forest resources, especially for treatment of common complaints. Their role is less central in a changing social setting, although people in forest dwelling hamlets rely upon their knowledge more than those living in the village because they do not have such easy access to the hospital. Knowledge accumulated from a series of excursions conducted with two *Ombiasy* indicated the range of medical treatments that are commonly used. Local villagers consider plant remedies to be effective but not as permanent as the more expensive hospital treatments. The value of the investigation was that it showed that forest resources have a wide range of uses in village life, and pointed to the fact that this information is in need of further investigation before the changes associated with modernisation supersede traditional knowledge. 149 plant species with a total of 312 human uses were recorded by this survey.

5.1 INTRODUCTION

The Antandroy depend on forest resources for food, medicines, tools and building materials. The dynamics of the natural resource management by the tribe has changed with respect to certain resources, having become more sedentary agriculturists since the time of colonisation and more dependent upon introduced crop species than on less productive forest resources. The dependence of the *Ombiasy* on the plants for their medicinal and spiritual properties is a changing theme, with their expertise being replaced by trained medical doctors. By documenting the reported medical properties of forest plants, a database of current knowledge has been built in order to conserve traditional knowledge that has become increasingly threatened by the changes occurring within the society.

5.2 AIMS

The purpose of our investigation was to produce database of plants used by *Ombiasy* for treatment of illness and those used more widely by society in their everyday lives. The database is not intended to be exhaustive as time restricted the amount of data collected A local perception of the role that the *Ombiasy* play in a changing social environment is reported in the Anthropological section and indicates how significant ethnobotanical knowledge is within the community.

5.3 METHODS

Participatory Rural Appraisal (Kapila and Lyon, 1994) was used to grasp an empowered vision of forest use by locals in general. Almost all the data was collected with two local *Ombiasy's,* One of the two *Ombiasy,* Manihira, had lived in the village of Ifotaka all his life and was locally respected for his extensive knowledge of and application of the uses of forest plants. He was accompanied on a series of excursions into the forest between July and September 1999. He gave information on how each plant could be used, as and when he came across them. Helene Razomatsoa identified the plants (both in the field and back in Tana in the Herbarium. She also translated the explanation of their use, preparation and abundance which Manahira had told her. On Helene's departure Claudine Ranorosoa took over her job.

The second *Ombiasa,* Fanahisoa, had been brought up in Ifotaka, but had learnt his knowledge of plants during years spent trading zebu between regions. Semi-

Human Use	Part used	Preparation	Local name	Scientific name	Family	Class
1. PREGNANCY						
(M)Abortion	Leaves	Boil and drink	Andrapasy	*Dichapetulum sp.*	DICHAPETALACEAE	V(2m)
(M)Anti-hemmorrage, and to	Leaves	Boil and drink	Andrapasy	*Dichapetalum sp.*	DICHAPETALACEAE	V(2m)
cause an abortion						
(F)Avoid miscarriage.	Leaves	Grind and mix with Tsimarefe, apply to	Soazanabazy			H(3m)
		body after taking a shower in a waterfall				
(F)Female hemmorhage	Leaves	Boil and drink	Andranahake			B
(M)Induces birth	Leaves	Grind, with water, and apply to genitals	Sagnira	*Phyllanthus seyrigii*	EUPHORBIACEAE	H(3-4m)
(M)Induces lactation	Bark, stem and root	Boil and drink	Manongo	*Zanthoxylum sp.*	RUTACEAE	H(6-7m)
(F)Morning sickness *1	Leaves	Boil and drink	Sakoa	*Poupartia caffra*	ANARDIACEAE	H(5-7m)
(M)Noisy foetus in womb *2	Roots	Suck or chew	Katsakatsa	*Crotalaria retusa*	PAPILIONACEAE	B(0.6m)
(M)Pregnancy pain relief	Stem and leaves	Boil and drink	Tarazofoana			
(M)Pregnancy pain relief	Stem and leaves	Boil and drink	Tarazofoana			B
(F)Reduce likelihood of miscarriage	Leaves	Grinded with Soazanabany, poured on	Tsimarefe			H(3m)
		body after washing in a waterfall				
(M)Reduces disturbance of fetus	Roots	Suck and chew	Katsakatsa	*Crotalaria refusa*	PAPILIONACEAE	B(0.6m)
(and noises) in pregnant women*2						
(M)Reduces labour pains	Leaves	Boil and drink	Lambigna	*Bauoninia fluggeiformis*	CESALPINAE	H(2-3m)
(M)Back pains&aching stomachs	Leaves and stem	Boil and drink	Fantakakoho	*Capparis cf chrysomeia*	CAPPARIDACEAE	H(3-4m)
in pregnant women						
(M)Relieves 'sovake'- pain in the womb	Leaves	Boil and drink	Sofa sofa	*Munduka stenophylla*	FABACEAE	H(2-4m)
wind in womb						
(G)Relieves 'sovake'- a pain in the womb	Leaves	Consume	Sofa sofa	*Munduka stenophylla*	FABACEAE	H(2-4m)
(M)Removal of blood from	Bark	Boil and drink	Hily	*Commiphora sp.*	BURSERACEAE	H(4-7m)
uterus after birth						
(F)Strengthen pregnant women	Roots	Boil with milk and drink	Tsiongake	*Rhopalocarpus lucidus*	SHAEROSEPACEAE	H(3-4m)
(F)To aid lobour	Leaves	Boil and drink	Ahibe			B(1.5m)
(F)Wash after giving birth	All	Mix and wash	Boroa	*Tetradenia goudotii*	LAMIACEAE	H(1m)
(M)Washing female genitalia *1	Bark	Boil and bathe	Sakoa	*Poupartia caffra*	ANARDIACEAE	H(5-7m)
(F)Morning sickness *1	Leaves	Boil and drink	Sakoa	*Poupartia caffra*	ANARDIACEAE	H(5-7m)
2. DIARRHOEA						
(M)Anti diuretic	Stem fibre	Boil and drink	Alomborona	*Albizia polyphylla*	MIMOSACEAE	H(1-7m)
(M)Anti diuretic, stomach aches	Root	Boil and drink	Ahidambo	*Heteropogon contortus*	POACEAE	B(1m)
(M)Anti-diuretic**C	Roots	Remove bark, boil and drink	Tamenaka	*Combretum coccinea*	COMBRETACEAE	V
(M)Anti-diuretic	Roots	Boil and drink	Pisopiso	*Pemphis madagascariensis*	LYTHRACEAE	H(2m)
(M)Anti-diuretic for babies	Bark	Boil and drink	Sely	*Grewia lavanalensis*	TILIACEAE	H(2-3m)
(M)Anti-diuretic	Branches	Boil and drink	Hentinentina	*Calyptostylis humbertii*	MALPIGHIACEAE	V(3-4m)

(M)Stomach aches	Stem	Boil and drink	Rohondroho			H(3.5m)
(M)Stomach pains	Stem	Boil and drink	Fandotsara			B
4. WOUNDS						
(M)Anti-inflammatory	Branches	Crush, use as cream	Volifitomboke	*Kalanchoe grandidieri*	CRASSULACEAE	H(1-2m)
(F)Antiseptic	Leaf and stem	Chew with saliva and apply	Filo filo			
(F)Antiseptic	Leaves	Chew up and apply without binding	Ravikalombarogne			H(5m)
(M)Antiseptic	Unripe fruit	Peel	Roy	*Acasia farmesiana*	MIMOSACEAE	H(2-3m)
(M)Antiseptic(stops bleeding)	Latex	Apply directly	Taritarika	*Leptadenia reticulata*	ASCLEPADIACEAE	V(-10m)
(F)Antiseptic for wounds *4	All	Grind and apply	Angamay	*Tridax procumbens*	ASTERACEAE	B
(M)Antiseptic wound dressing*4	All	Grind and apply	Angamay	*Tridax procumbens*	ASTERACEAE	B
(M)Blister healing, reduces puss	Leaves	Crush and apply	Taintaramo			B
(M)Heals wounds	Leaves	Crush and apply	Anambe	*Solanum nigrum*	SOLANACEAE	B
(M)Removal of cactus spines	Leaves and stem	Grind and apply	Folotse		EUPHORBIACEAE	V
(M)Removes puss from blisters	Leaves	Grind, and apply with eggs	Taintaramo			B
(M)Removes puss from boils	Branches and leaves	Crush scrapings and use as cream.	Keleone	*Allophyllus bejerianus*	SAPINDACEAE	H(4-5m)
		Boil and drink				
(F)Stop bleeding	Bark	Grind with water and apply	Jabihy	*Operulicarya decaryi*	ANACARDIACEAE	H(4m)
(M)Stop bleeding after use	Bark	Boil, drink and apply	Jabihy	*Operulicarya decaryi*	ANACARDIACEAE	H(4m)
(F)Trconsumes thorn scratch	Leaves	Grind with water and apply	Hazomalangy	*Moringa drouhardi*	MORINGACEAE	H(4-5m)
(M)Wound dressing	Leaves	Grind, and apply juice	Anambe	*Solanum nigrum*	SOLANACEAE	B(2-4m)
5. IRRITATIONS						
(M)Aching eyes	Bark	Boil scrapings and bathe eye	Somotsoy	*Fernandoa madagascarensis*	BIGNONIACEAE	H(3m)
(M)Antiseptic for itches**G	White flowers	Crush flowers, bathe in it and drink	Kiraranamboa	*Solanum auriculatum*	SOLANACEAE	H(1-2m)
(M)Babies itches	Stem	Crush and apply	Tsimatavindrano	*Aristolochia acuminata*	ARISTOLOCHIACEAE	V
			Tamboroba			
			Boroa			
(F)Boils	Seeds	Grind, and apply around boil.	Vagnemba			Crop
		Press around head of boil.				
(F)Boils	Head	Cut head off and place on top of the boil	Fly			
(F)Eye trconsumement	Roots	Grilled and applied with water to bad eye	Banobo			
(F)Itches	Liquid from bark		Siro siro			H
(M)Itches, especially for children:	Leaves and stem	Bathe in water soaked with it, and drink	Boka with	*Pentopetia androsaemifolia*	ASCLEPIADACEAE	V
known as "Fandriandambo"		the water. Wrap in blanket	Fandriandambo	*Physena sessiflora*		
(M)Relieves itches	Leaves	Bathe in it, and drink	Fandriandambo	*Physena sessiflora*	PHYCENACEAE	H(3-4m)
(M)Relieves itches	Roots	Boil, drink and bathe	Tamboro			
6. CONSTRUCTION						
(M)Artisans	Trunk		Tanbazotsy			H

(F)Shampoo	Leaves	Grind and use				
(M)Soap	Leaves		Magna	*Hibiseus macrogonus*	MALVACEAE	H(5-6m)
(F)Wash after giving birth	All	Mix and wash	Boroa	*Tetradenia goudotii*	LAMIACEAE	H(1m)
(G)Wash newborn babies for protection	Leaves	Bathe in water without boiling	Takisakisake			
(M)Washing female genitalia	Bark	Boil and bathe	Sakoa	*Poupartia caffra*	ANARDIACEAE	H(5-7m)
8. PSYCHOLOGICAL						
(M)Epilepsy	Bark and marrow	Boil and drink	Halamboro	*Abizzia polyphylle*	FABACEAE	H(5-6m)
(M)Epilepsy	Bark and marrow	Boil and drink	Halamboro	*Abizzia polyphylle*	FABACEAE	H(5-6m)
(F)Exorcise demon possession		Place with excreted snake skin and with	Fandotsara	*Cynodon dactylon*	POACEAE	B
		Viky around neck				
(F)Exorcise demons from people		Place, with excreted snake skin and	Viky			
		Fandotsara around neck				
(M)Exorcise ghosts	Leaves and branches	Burn leaves, mash, mix with water, spray	Tsimalelamba	*Homelium albiforum*	FLABORTIACEAE	H(6-7m)
		inside house				
(F)Fails to recognise young		Hang her from a tree for a short period	Goat which rejects offspring			
(F)Fails to recognise young		Take vaginal juices and spread onto young	Zebu which rejects offspring			
(M)Forces a divorce	Branches and leaves	Put under the pillow- causes fanaboka	Mampisaraka	*Rinorea sp.*	VIOLACEAE	H(3-4m)
		(altered destiny)				
(F)Psychological problems	Any part	Boil and drink	Fomakamy			H
(M)Relieve bad astrological alignments	Leaves	Bathe in tub of it	Fihamy	*Ficus sp.*	MORACEAE	H(7-8m)
(F)Relieve bad astrological alignments	Leaves	Bathe in tub of it	Fihamy	*Ficus sp.*	MORACEAE	H(7-8m)
(F)Spiritual protection against lightening			Fario	*Erehtia diospyroides*	BORAGINACEAE	H
(M)Spiritual protection from lightening	Branch		Relefo	*Strychnos madagascarensis*	LOGANIACEAE	H(3-4m)
(M)Special illnesses **D	Roots	Boil and drink	Fatiboay	*Argemana mexicana*	PAPVERACEAE	B
(F)Undiagnosed illnesses**D	Roots	Boil and drink	Fatiboay	*Argemane mexicana*	PAPAVERACEAE	B(0.8m)
9. POISONS						
(F)Fatal poison	Stomach	Consume	Lizard's stomach			
(M)Poison	Latex especially	Just the smell of the roots may be fatal.	Fio Fio	*Pervillia sp.*	ASCLEPEACACEA	V
	from roots	Found esp. at the top of cliffs				
(F)Poison	Main part and roots	Boil and drink	Fio Fio	*Pervillia sp.*	ASCLEPEACACEA	V
(M)Poison **F	Latex	Consume	Lombiro	*Cryptostegia madagascarensis*	ASCLEPIADACEAE	V
(F)Poison	Roots	Boil and drink	Vary			
10. FOODS						
(M)Animal food	Fruit, leaves	consume	Sakoandolitse	*Operculicarya hyphenoides*		H(3-4m)
(M)Food	Fruit	consume	Kopaipote	*Grewia sp.*	TILIACEAE	H(2-3m)
(M)Food	Fruit	consume	Sasavy	*Salvadora augustifolia*	SALVADORACEAE	H(3-4m)

(G) Fire starters	Branch	Rub together	Sely			
(M)Glue	Unripe fruit	Peel	Roy	*Acasia farmesiana*	MIMOSACEAE	H(2-3m)
(M)Haircream	Fruit	Boil and apply oil to hair	Savoa	*Jatropa curcas*	EUPHORBIACEAE	H(2-3m)
(F)Harden the soft head of a baby	Branches	Cut branch into sections, boil and drink				
(M)Improve sound of voice	Fruit	Consume	Fihamy	*Ficus sp.*	MORACEAE	H(7-8m)
(M)Making alcohol illegally**B	Fruit	Ferment	Kily			
(G)Making alcohol illegally**B	Fruit	Rice, water and sugar cane mixed	Kily			
		in a process of 'Alambique'				
(M)Perfume	Bark	Crush and add coconut oil	Somoro			H(2-3m)
(G) String			Yohakalomboro			
(G) String			Vahamangetse			
(G) String			Kolohoho			
(M)Walking stick	Trunk and stem		Mavarimbato			H(3-4m)
12. SEXUAL						
(F)Aphrodisiac	Bark	Scrape bark into cold water, and drink	Hazolava and	*Neobeguea mahafalensis*	MELIACEAE	H(5-6m)
			Katrafay			
(M)Aphrodisiac **E	Branches	Boil and drink	Vahiamalo	*Vanilla madagascarensis*	ARCHIDACEAE	V
(M)Gonnorohea	Leaves and stem	Boil and drink	Kotoke	*Diospyos sp.*	EBANACEAE	H(2-3m)
(F)Gonnorohea	Leaves	Boil and drink, on its own	Manongo	*Zanthoxylum sp.*	RUTACEAE	H(6-7m)
(F)Sexually Transmitted Diseases	Roots	Grind and sprinkle on like a powder	Vahamombirindoho			H
13. MUSCULAR						
(F)Lower back ache		Hconsume up and lie on it	Sand			
(F)Muscle cramps**B	Seeds	consume	Kily			
(M)Muscle pains, antibiotic	Leaves	Boil and drink	Boroa	*Tetradenia goudotii*	LAMIACEAE	H(1m)
(M)Musclular development	Bark and marrow	Boil and drink	Hazolava	*Neobeguea mahafalensis*	MELIACEAE	H(5-6m)
(F)Muscular development	Leaves	Drink without boiling	Katrafay	*Cedrelopsis grevei*	MELEACEAE	H(3-4m)
(G)Muscular development	Bark	Boil and drink	Katrafay	*Cedrelopsis grevei*	MELEACEAE	H(3-4m)
14. DIETARY SUPPLEMENTS						
(M)Source of vitamins	Marrow	Consume	Songatse			H(3m)
(F)Vitamin rich	Leaves	Cook and consume, with Atikakoho	Ravibalihazo			
(F)Vitamins	Fruit	consume	Tsiongake	*Rhopalocarpus lucidus*	SHAEROSEPACEAE	H(3-4m)
(M)Vitamins and strength, particularly	Bark	Boil, add milk and drink	Tsiongake	*Rhopalocarpus lucidus*	SHAEROSEPACEAE	H(3-4m)
for pregnant women						
(M)Vitamins for babies *6	Stem and leaves	Boil and drink	Obognobo			B
(M)Vitamins for babies	All	Boil and drink	Sarehisatse			B
(M)Vitamins for babies	All	Boil and drink	Sarehisatse			B

(F)Ceaselessly crying baby	Leave	Boil and drink	Vontofosa			
(M)Crying babies *8	Leaves	Grind, and rub on skin	Romba	*Ocimum gratissimum*	LAMIACEAE	B
(M)Crying babies	Leaves	Boil and drink	Andriambolafotsy	*Coton sp.*	EUPHORBEACEAE	H
			with Marolahy			
(M)Digestive problems in babies	Stem	Boil and drink	Taivorotsiloza			B(0.75m)
(F)Ear aches	Young sapling	Hconsume in fire to extract liquid, and then	Voazavo			
		pour a few drops into ears each morning				
(F)Removes problems that may	All	Boil and drink	Angamay	*Tridax procumbens*	ASTERACEAE	B
block babies throat						
(M)Strengthening babies' skulls	Leaves	Crush and apply	Solety	*Marena filiformis*	CAPPARIDACEAE	H(4M)
(F)Tetanus		Grill, and destroy, mix with	Kalalao(insect)			
		water and drink straight away				

(M) - Manahira as informant (F) - Fanihisoa as informant (G) - Group of four male informants from Ifotaka village

Plant Classes (local description) - H Hatay (shrub); V Vahy (Tree); B-Bozaka (small plant)

Plants listed that occur in "Plantes medicinales malgaches", Ravi-Maitso:

*1: Boil leaves and inhale the fumes to reduce fever in babies.

*2: Delirious infants, with fever, should boil with Voatavo Giga, and inhale fumes and drink one cup a day.

*3: Rub leaves into itches

Boil, add sugar, and drink for coughs.

Boil a small amount and drink half a spoon each morning for babies with coughs.

*4: Boil and drink to relieve problems with urinating.

*5: Babies with coughs or whooping cough should inhale fumes when it has been boiled with Sabita.

*6: boil and drink with kifafalahy to reduce tiredness

peel budding leaves and apply to wounds, and apply the juice on top.

*7: Pour juice into eye to remove speck.

*8: Grind leaves and put into the hole of a bad tooth

Boil 4 g of leaves and drink

Take the grains for a headache

Plants listed that occur in "Plantes medicinales de Madagascar", Boiteau:

**A: The gum is used against coughs

**B: Used for stomach problems, as a laxative and anti-spasmodic. Also used for skin problems

**C: Used as a vermifuge

**D: Used to induce hypnosis, to reduce coughs, convulsions. Large doses are dangerous. Roots, leaves, seeds all used for different things.

**E: Aphrodisiac

**F: Good for the heart, but must be in very small dose

**G: General disinfectant

5.5 DISCUSSION

The data from the two main informants (Manahira and Fanahisoa) was given in two different ways. Manihira gave information on the plants without discussing the spiritual context, whilst Fanihisoa was keen to move open-ended interviews into discussions about his powers of harnessing the spirit world through the plants. Manahira divulged little of his knowledge of the spiritual world and how it influenced his prescription of plants. Although informants in the anthropological research suggested that Manahira was renowned in the region for his spiritual power, he did not admit these strengths. This suggests that an investigation into the variation of the importance of the spiritual side of the *Ombiasy's* role would be valuable.

Uses were assigned by the two *'Ombiasy'* for 169 different plants with a total of 312 human uses, however only 100 of these have had their scientific names identified. Only twenty of these were mentioned by both men, eighteen of which were considered to have the same function. This represents a proportion of agreement of 0.12. This measure of overlap might not be a fair assessment of reliability since information was collected from each *Ombiasy* in a different way. Also, a low proportion of agreement is explained by the fact that the two men did not share their knowledge with each other since this would devalue their own skills. Their remedies were perceived to be effective and reliable by local informants, although they did tend to mention a preference for longer lasting hospital treatment if it could be afforded. A shift towards a preference for non-traditional remedies was reflected by the difficulty Manahira had with remembering certain plant uses, saying that he had not used them for many years. Despite this, he was still considered to be "one of the big *Ombiasy*" whose abilities gave him a prominent position within society.

The majority of the plant uses mentioned by both were used within the community for construction purposes or as food, but medical properties were largely unshared. The exception to this was *Argemana mexicana* which is used by both *Ombiasy* for "undiagnosed illnesses". It seems fair to assume that the range of plants used for different problems reflects the ailments that are most often suffered by the community, and so stomach problems and common side effects from pregnancy seem common. Problems like acne have no assigned remedy because it does not pose a major problem to the community. Comparing the remedies told by the *Ombiasy* with those of published material, eight of the plants that had been assigned Scientific names were found to have uses reported in Ravi-Matsoa's "*Plantes medicinales Malgaches*". Only one of these had exactly the same use, *Combretum coccinea*, used to remove specks in the eye. Compared with Pierre Boiteau and Lucile Allorge-Boiteau's "Plantes medicinales de Madagascar", seven of the plants in the database that had been assigned Scientific names had been mentioned in the book. *Vanilla madagascarensis* is noted by both for its potency as an aphrodisiac. The importance of plant medication for treatment associated with childbirth was identified by both *Ombiasy*. It is likely that plants associated with these pregnancy treatments will remain important in a rapidly expanding population, where such knowledge is of universal and ongoing value, whilst the removal of other (less frequently used) plants will be likely if the system continues to rely more and more on forest destruction for growing food, grazing livestock, the sale of wood, and has an increasing faith in the efficacy of hospital treatment.

The village doctor said that there was a noticeable change that had occurred in the community over the years. Zebu herders, who remained more dependent upon the

5.6 Conclusion

The ethnobotanical data collected on this expedition was extensive, and the two *Ombiasy's* datasets differ providing a view of the common perception of the use and properties of the forest resources that are used. The ethnobotanical database identifies the value of conserving local knowledge as well as the forest itself, it shows the potential for an alternative use of the forest (exploitation of medicinal plants) which has implications for the future management of the area. This potential use must be carefully investigated in the future to assess the real potential of the knowledge plants, also, if exploited the intellectual property rights of the people from whom the knowledge is exploited must be respected. It complements the lemur research discussed in other chapters by identifying plant species used by humans and so the degree of threat posed by man to the forest.

Figure 5.2 - Manahira, a local Ombiasy in Ifotaka.

6.2 METHODS

The aim of the Anthropological investigation of the project was to gain an appreciation of how villagers perceive and manage the forest area and the flora and fauna contained within it and to observe the current threats facing their livelihood today. In relation to this, the team sought to understand the organization and functioning of the Antandroy tribe living within the community of Ifotaka. The Participatory Rural Appraisal (PRA)[2] method was conducted where community integration and participation acted as an interdisciplinary and multi-level approach -_this allowed for a balanced and unbiased collection of data, focusing particularly on the local people's knowledge and the way they organise and control their resources. This methodology has been described as rapid, holistic and interactive (Kapila & Lyon 1994); is designed for short duration and low cost research. It is particularly useful in investigating social issues and natural resource management.

The team concentrated on *the qualitative* side of PRA (i.e. non-statistical), which involves observation and questioning of the local community through semi-structured interviews – informal interviews with open-ended, interactive questions, which can be carried out with large groups, families and individuals. It was realised that *quantitative* information, such as the estimation of areas cultivated would be difficult to obtain, since the respondents may not accurately measure this; also it avoided controversial or difficult questioning. As a result, the survey was successful as there was good cooperation by the villagers.

There were six main areas of investigation which gave overall indications of human impact on the forest; social organisation, demography and the division of labour; traditional economic activities; the Antandroy's perception of the environment; the partitioning of the forest and the pressures on it, followed by descriptions and priorities for forest management. The Antandroy of the Ifotaka forest became full participants in the study, aided by Jimmy and Yves, our two Malagasy interpreters, who had origins in the Antandroy. Two members of the team went with an interpreter into the villages to interview the villagers. The semi-structured interviews lasted approximately one hour and were largely held in the respondents' households. The semi-structured method allowed the respondent to reply and talk freely about the various topics raised it was flexible enough to allow the question to be rephrased or simply left unanswered. An attempt was made to get an effective age and gender mix which was a representative cross-section of the community and usually included several women with their children and one or two men. Living close to villages and participating occasionally in village life allowed an understanding of natural resource management, obtained through participant observation and informal discussion.

All discussions were recorded on tape and later transcribed the same day. This proved to be an effective way to collect data as we were not fluent in Malagasy and did not want to slow down the flow of discussion. Because of this, time was saved through not writing during the interview, more questions were covered in the time given and the overall discussion flowed more easily and only limited notes of key words/issues arising

[2] PRA methodology is a development of the qualitative methods undertaken by social anthropologists, and has come to be better suited to meeting the needs of the people themselves, by including and involving them in decision making and implemtation (Kapila and Lyon 1994) and emphasises community participation.

6.3 Results

Demography

The social organisation of the Antandroy depends on the structuring and the size of the family unit which consequently affects how the family functions. Migrations, births and deaths are the three factors that cause fluctuations in population size and structure.

The villages within the Ifotaka forest consist of large extended families which are usually originally started by one migrating man and several of his wives, as they practice polygamy. The Antandroy are one of the remaining tribes in Madagsacar of this kind and each man can have between two to eight wives. Once the man is settled, he will usually remain in his village (either the one in which he is born or the new one he has founded) and the women will migrate to join him. The revered and powerful men within the community, such as the Mayor and the *Ombiasy*[3], are most likely to have the most wives and consequently a larger than average number of offspring. It is not unlikely for each woman to have up to 10 children. The Antandroy livelihood in the Ifotaka area consists of subsistence farming and cattle herding supplemented by trade so the family structure and size will affect the division of labour. Having more children means more hands to help our in the fields and with tending the cattle.

A village usually consists of many generations of the same lineage; long distance migrations are limited therefore there is much inter-relatedness between villages. When population exceeds capacity, part of the family may decide to migrate to a different area and set up a new village, which will then expand through further childbirth and marriage.

The Economy

Agriculture

To create space for a settlement for his growing family and more significantly for cultivation, the Antandroy men need to cut areas of the forest. The agricultural cycle in the forest begins in October when the men clear forested areas for agriculture, by cutting and burning trees and shrubs, exposing the soil. From the beginning of the wet season (November) the women and children plant. A variety of crops are grown: maize *(balaharzo)*, white beans *(antake)*, sweet potato *(bageda)*, marrow *(vozavu/taboara)*, peanuts, spring onions, sugar cane and cassava are all grown in these cleared areas, as well as fruits such as melon, mango, *lamot* (red and small), *sasavy* (round and dark red, like grapes) and *farehita* (spiny fruit). In some areas of the forest, such as in *Pisu Pisu,* tobacco is also grown and near *Mangil* the villagers grow rice. Throughout the wet season until March the women tend the crop[4] and then in April, after the rainy season, the harvesting begins. This is a time when all families help each other, and at the end celebrate with a harvest feast.

According to the Antandroy living within the Ifotaka forest, the forest has recently experienced three climatic periods which have affected their agricultural supplies

[3] Medicine man or witch-doctor (look under section on Ombiasa)
[4] planting, hoeing and weeding

Villagers come to the market to sell their surplus agricultural produce which they have cultivated locally or collected in the forest and which is beyond their family needs. They also bring their livestock, handicrafts and forest products to sell in the hope of generating income. They then use the money they generate to buy imported goods from Ambosary: clothes, rice, and "basic needs", or in Haviland's words "needed items", such as matches, petrol, sugar, salt, oil, soap and medication. He also describes:

"In peasant or agrarian societies, market places...provide the opportunit e-gions to exchange some of their livestock and produce for needed items...it is a gathering place where people renew friendships, see relatives, gossip, and keep up with the world"[5]

Such is the character of the Ifotaka and Fenaivo markets, which attract local villagers in the area to come together to exchange both their surplus for basic needs and also their news. Ifotaka is completely self-sufficient in fresh produce and none is exported to or imported from Ambosary. Table 6.2 below shows the origin of the vendors in the Ifotaka Friday market and the Fenaivo Thursday market:

Figure 6.2 - The market in Ifotaka

[5] Haviland, W.A., 1996 *Cultural Anthropology*, Harcourt Brace, p207

The women occupy another part of the market where they sell their agricultural produce, which is grouped into piles/bundles/cupfuls (*kapuk*) and sold in a set quantity.

Table 6.3 Prices of crops and location of areas where they are cultivated

CROP	LOCAL NAME	PRICE (Fmg)	Location of Cultivation
Maize*	*Balaharzo*	70-150(0.7p-1.5p)	Close to the Mandrare.
Cassava* (dried)	*Manioc sec*	380 (3.8p)	Further away from the Mandrare.
Potatoes	*Patate*	290 (2.9p)	Further away from the Mandrare.
Sweet potatoes* (the leaves[6] are sold separately)	*Bageda*		Close to the Mandrare.
Red Beans	*Taboara*	750 (7.5p)	In the forest
White Beans	*Antake*	750 (7.5p)	In the forest
Tobacco (braided into a rope and sold by the hand length)	*Tabac*	500 (5.0p)	In the forest
Rice	*Vari/ Riz local*	650 (6.5p)	On the banks of the Mandrare after the rainy season (flooding).
Tomatoes (big and small)			Close to the Mandrare.
Peanuts			Further back from the Mandrare.

* Main staple crop
[6] often cooked and eaten with chicken dishes.

Transport

Trade is very much dependent on transport provision. With uneven and poorly maintained roads in the Ifotaka region, the wide Mandrare river difficult to cross and 'zebu chariots' as the main mode of transport, trading is not easy. For the locals it is difficult and expensive to travel long distances by public transport (*taxi-brousses*[9]), especially when buying and selling food, so most agricultural produce is brought to the local market by foot. In the forest there is little road access which means that many villagers are fairly cut off from national communication. However, the World Food Programme[10] (WFP) in collaboration with two other Non-Governmental Organisations (NGOs)[11] built a 7km road in the forest from Morafeno to Mangily to improve access and help in times of famine. No motorised transport can reach villages such as these due to the difficulty of crossing the Mandrare river. To cross the Mandrare river in the wet season when the river level is high, the Antandroy of Ifotaka use long thin "pirogues", paddle boats carved from tree trunks.

Figure 6.4 - Pirogues (dugout canoes) on the banks of the Mandrare.

[9] A type of bush canvas awned truck operating like a bus with fares for transport between major villages.
[10] Programme Alimentaire Mondial in Madagascar.
[11] CGDIS and Sekalina

Although zebu are rarely killed for their meat in rural areas, their milk is an important source of nutrition for the Antandroy. *"Habubu"* is fermented zebu milk (almost like yoghurt), which is mixed with the pulp of tamarind *(kil* [13] and then left for 2-3 days before serving. It is very cooling and is often eaten in the heat of the midday sun with sweet potato *(bageda).*

Figure 6.5 - Two Zebu pulling a Cart in the Ifotaka Forest

[13] Fermenting agent *(Tamarindus indica)*

remote areas. Examples include the locally grown *voatavo* melon, *fitovy* which is used to scoop water and *korobo* used for holding "*habubu*" (curdled milk). They are all dried for several months before being made into containers.

Not only does the forest flora support the Antandroy livelihood, but so does the fauna. The young men catch wildlife to eat from the forest, including tenrecs (Tenrecidae), guinea fowl *(akanga),* fosa *(Cryptoproota Ferox)*, wild pig and birds such as the locally known *tivuke, soura, tsimitse, ribo, aliotse, vazagne, rietsu, fol* Birds' eggs are often found and eaten by the family or sold at the market. To catch these animals the men use slingshots[14], catapults or spears and more often they use a gun to kill guineafowl and other birds. Dogs play a significant role in hunting wild animals in the day as well as protecting the herdsman's village at night. If a man catches many wild animals he will firstly give them to his family, and then sell the rest at market. However, thanks to a number of *fady* (taboos), beliefs and the Antandroy respect for living creatures, the lemurs and the great land tortoises, for example proliferate today and are not hunted. However, it is important for the issue of harvesting tortoises in the area to be more fully investigated as broken carapaces (often the sign of harvesting (O'Brien pers.comm.)) were found in the forest.

It is evident therefore, that the spiny forest is used by the Antandroy community for a variety of purposes, enabling them to survive in the harsh, dry and remote conditions of the Ifotaka forest. However climatic and economic pressures continue to force the Antandroy to exploit the forest in an unsustainable way. Land is the most important and valuable asset to this rural community as their livelihood depends on it; both socially and economically. Losses of land are particularly apparent today in the Ifotaka forest as sisal plantations gradually encroach into the forest.

Flooding in the wet season, drought in the dry season which bring on famines are only some of the many severe problems encountered by the Antandroy. Bad roads continue to leave remote villages vulnerable to the effects of annual climatic disasters and pest invasion, such as by locusts. *Morafeno* for example, particularly since 1995, has had swarms of locusts descend on their fields, destroying their crops, and because of the bad roads the village has not received pesticide to kill them off.

Accessibility to other villages suffering from severe droughts, remoteness and locusts are real problems for development in the area of *Mangil Amboetsy, Fangidrat Fangaliedraky* and *Mahabo* villages. Ever since the severe drought of 1992 when locusts appeared in the region of Ifotaka, they have destroyed the crops and the shrubs in the forest (on which the zebu graze), which subsequently killed the livestock through starvation. With the threat of livestock death, the Antandroy of Ifotaka burn cacti leaves *(raketa)* as substitute fodder. Apart from the locusts, there are other pests which destroy the crops grown or stored further within the forest, these include pigs, mice, guinea fowl and even lemurs.

The village of Ifotaka receives little money from the government and local NGOs, and none is received by the more remote villages further in the spiny forest, such as *Amboetsy* and *Mangil* There infrastructure and implementation capability of the government remains weak and this is obvious by the bad transport system, the lack of a secondary school and the lack of basic knowledge on health, nutrition and sanitation. There

[14] These are, however, largely used for guarding zebu herds against robbers.

Off-farm jobs

After the wet season of planting, the men look after the zebu and try to earn money through adopting off-farm jobs to raise their income. Having enough money to buy more zebu and material to build a new house is vitally important to the Antandroy men, however, others spend it on alcohol. Young men frequently go to Tulear or south of Ifotaka (*Ancoubay* and *Andranondambo*) in search for precious stones such as sapphires and mica or go and work in the sisal plantations[17] in the region of Ambosary. More recently, some families have begun earning a living by selling forest products, such as firewood, charcoal or even trunks of *fantiolotse* (*Alluaudia procera*) which are cut into planks by small saw mills. This outside employment provides a "safety valve" for the Antandroy, whose agriculture, as we have seen, is continually threatened by climatic and social problems, and therefore provides them with opportunities for finding additional sources outside the farming sector.

Figure 6.7 - Planks of wood for construction of local houses.

[17] to work in the processing plant to produce rope.

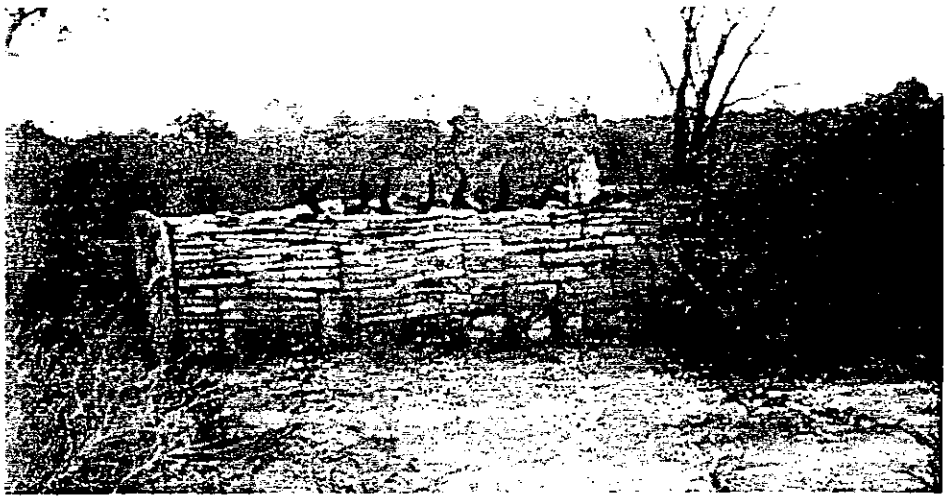


Figure 6.8 - A Traditional Antandroy Tomb in the Ifotaka Forest with Zebu horns adorning it.

THE ROLE OF THE OMBIASY

"*Ombiasy*" is the Malagasy name for the medicine man, who collects medicinal plants from the forest or calls on the spiritual world to cure his patients. Through various actions the *Ombiasy* protects the individual. He heals or prevents misfortune (illness, various harmful forces) and promotes prosperity (Berenty;1998). These traditional healers or "witchdoctors" learn their extensive knowledge of natural plant remedies and receive their powers to heal and communicate with the spirits from their ancestral heritages. Owing to this quality they are highly respected by their fellow villagers.

There are two types of *Ombiasy*; one type learns the knowledge from his ancestral *Ombiasy*, while the other acquires the knowledge from the evil spirit *(kokolampo)* and is possessed. The former is more powerful and has a more deep understanding than the latter since he is directed by his own instinctive ideas and experience based on his studies with the previous *Ombiasy* who as he gets older tries to encourage followers. The team worked closely with both types of *Ombiasy*: *Manahira, Fanibisoa* and *Vunuke.*

All *Ombiasy* have their own special medicine and treatments which they remain secretive about. This is because they do not want other *Ombiasy* to know, as this will risk them being able to discern the "*fady*" of the spirit, which can then be exploited to gain power over the other *Ombiasy.* Each *Ombiasy* has their own territory, for example Vunuke's territory extends between *Ampaipaiky* and *Ifotaka* and within their territory they can help people with illnesses. It is believed that if they change *Ombiasy* people die as they are carrying the *fady* of their original *Ombiasy.*

Belief in the *kokolampo* is strong and traditional. *Kokolampo* are invisible spirits that live in certain natural sites in the forest (hilltops, trees, ponds) and often intervene in human affairs. The *Ombiasy* begins each consultation with the *kokolampo* with divination (*sikid*) forming patterns with symbolic stones which act as mediums to reveal the cause of the troubles and the possible remedies (Berenty:1998). By using "*sikid*", which is usually accompanied with the sacrifice of a goat, the *Ombiasy* (acting as a kind of sorcerer) can tell what the *kokolampo* is doing to the person and thus change their future by rearrange-

cutting of hair, using the colour red, wearing certain clothing and the presence of sharp objects such as the axe or spear, are all linked to respecting the ancestral spirits.

The *kokolampo* can provoke illness, particularly epilepsy in children. Epilepsy, according to the *Ombiasy*, is when there is a conflict between the horoscope of the child and the spirit. It is a sign of spiritual possession and the *Ombiasy* is the only one who can cure it. To help a child over epilepsy the *retsara* wood is scrapped and the child must smell it before the scrappings are placed in the centre of the child's forehead or the child bathes in it for treatment. These scrapings are supposed to remove the devil's spirit when combined with the *Fagnota* plant, which in turn removes the bad horoscope, which is in conflict with the spirit. The horoscope is therefore changed, so that it is no longer in conflict with the spirit and there is no longer any epilepsy.

Ombiasy gain power through spiritual energy generated through the use of medicinal plants for both curing people with illnesses and poisoning others. They carry a stick, which is used to protect them against illness - this stick is called *boakandromahazo* or *volil* [20], which means "to always win"[21]. With one, he wins either way - if he can treat the person then he wins as he gets zebu, if he cannot treat the disease he still wins as he has not contracted the disease. The wood is also used to protect against illness and other *Ombiasy*.

"Spiritually blessed" salty water (from the sea), water from *Mahavelo* or from the mountain *Vuimashiu* (all considered as special water) is often thrown on an ill person or over the medicine. Sea water and sea products (shells or the endoskeleton of cuttlefish seen sold at Fenoive market) is incorporated into traditional beliefs.

Vunuke showed us a drum he beats to bring out the harmful spirit in the patient and his various pieces of wood whose use are divinised by the spirit: *hororoke* ("to be rich") is one where scrappings are collected and then rubbed on skin; it can also be used as a talisman on the body, *manjakabetany* ("you are king") is a stick with which he bathes, *five* is used for the small carved boat which contains the sea water), *tsihone*[22] is used for protection, *retsara* is used to "make everybody like him", *mangary* is used as a boat paddle, which carved on it are *sikid*), and *mandakolahy* is used to protect the him from other *Ombiasy*. All Vunuke's woods were found in the forest as are the roots, bark and leaves he uses for his work as "witchdoctor".

The *Ombiasy*'s role is not limited to medicine, he can also determine and affect people's destiny, wealth, the weather and natural phenomena. Vunuke quotes *"the spirit gives me many solutions"*. The spirit guides on house construction[23], marriage, sacrifices, protection and taboos. If a person is unsuccessful, it is due to bad spirits, and because the *Ombiasy* know the spiritual world, they can remove them. He is the specialist of the *aloy*[24], which is an object or a substance that can remedy or ward off troubles for a person or family; ailments of humans or their livestock, witchcraft, lightening or epidemics.

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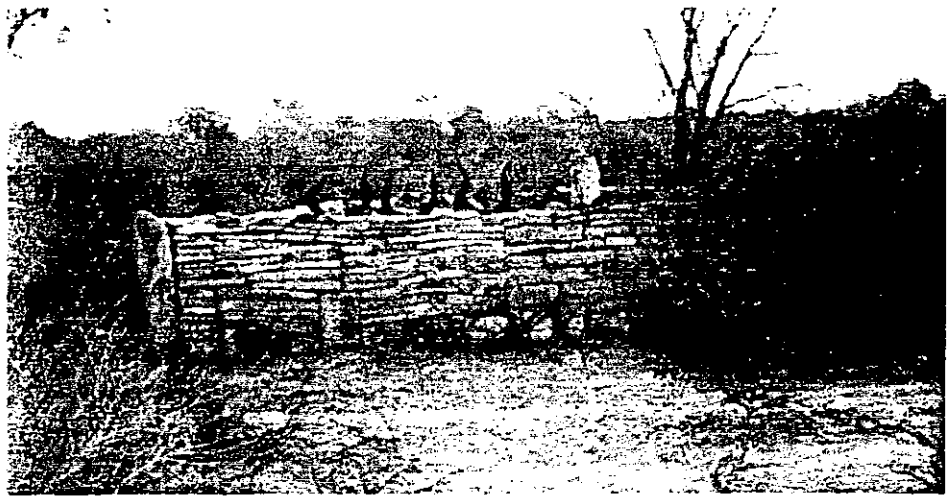
[20] a strong creeper

[21] *mahazo* - to win, *akandro* - day, *boaka* - to show

[22] "don't kill"

[23] how many doors, what wood etc

[24] They take the form of talismans which are worn on the body, kept in the house or buried in specific places (Berenty:1998)



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Wives, as well as zebu, are seen as important possessions by the spirit *(kokolampo)*, and Vunuke, for example, has sixteen wives. This reflects the number of his birthdate and his birth order, and is also the number of beads he has on his chain round his neck which he has been wearing since he was a child.

Figure 6.10 - A Zebu, a sign of wealth, Ifotaka, August 1999.

ine, or stolen by zebu robbers[28], the household falls into a spiral of poverty and destitution. Entitlement, erosion of food and assets therefore needs to be solved in order to reduce vulnerability and solve poverty of the Antandroy. Assets, such as livestock and entitlements to food and the forest's natural resources need to be restored or protected as they are critical to the functioning and survival of Antandroy households and productive and social units for the future.

6.5 CONCLUSION AND RECOMMENDATIONS FOR FURTHER STUDY

Antandroy knowledge of forest resources is the most valuable asset to the conservation of the Ifotaka forest. Respect and encouragement of this cultural knowledge is catalytic to their participation to the sustainable use of their forest. However, with remoteness, vulnerability to pests, disease, drought and famine, this poor rural community needs partnership with government. While conservation of nature and natural resources can complement economic development (e.g. through sustainable use of natural resources) it needs to be tailored to local needs. One way which has been suggested by Joel Swerdlow in his article is to encourage the traditional *Ombiasy* to work closer with the clinic. This study is an attempt to provide an understanding of, and data on, the local economy of the Antandroy community particularly concerning the use of the forest. The future of the Antandroy community and the rich biodiversity of the forest is therefore threatened unless a conservation plan, sympathetic to all stakeholders, is put in place, and is properly monitored, integrating local tradition into development.

[28] The herdsmen carry slingshots and guns to use against possible zebu robbers who raid the herds usually at night.

7.3 Phase Two – At the two village schools in Ifotaka.

During the third field phase of the expedition a project was conducted with the children in the two Primary Schools in Ifotaka. This relied on the charisma of Jimmy and Yves as translators. We started by showing the kids an inflatable globe (Plate 7.2) and world maps to illustrate that we had come from the other side of the world to research their unique wildlife, this was followed by an animal noises game which used further posters brought from the UK. For the third part we used a much more hands on approach. Depending on the age of the children we provided them with outlines of lemurs or paper and crayons (Plate 7.3). They drew lemurs or coloured the outlines in and the work was mounted on card, then Polaroid photographs were taken of the kids with their drawings for display on the walls of the schools as a reminder of the project. Each child was also given a sticker with the project logo. These drawings and stickers made it back to the family houses in the village where we saw them proudly displayed. At the end of the visit to each school we presented the projects by the kids from Durham to the teachers.

Plate 7.2 Show the Ifotaka Kids where we had come from.

Plate 7.3 The lemur outlines in the Public School.

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Medical Report

Medical Officer: Julian Mallinson

1. PREVENTATIVE MEDICATION

All UK team members were vaccinated against Polio, Tetanus, Hepatitus A, Rabies, Diptheria and Typhoid prior to embarkation. Recommended prophylactics (Larium) were taken throughout the expedition to protect against malaria.

2. TRAINING

All UK team members held certificates of proficiency in basic first aid. Julian Mallinson (Medical Officer) gained further experience of expedition medicine on a 'Wilderness Medical Training' programme.

All UK team members were fully briefed by Julian Mallinson (Medical Officer) regarding the contents of the team medical kit and the appropriate use of all items contained.

3. INSURANCE

The team was suitably covered by comprehensive expedition insurance.

4. MEDICAL KITS

Team Medical Kit

Julian Mallinson (Medical Officer) was properly in charge of the assembly and security of the team medical kit and the appropriate administration of all items contained. In the absence of the medical officer, Barry Ferguson (Leader) took charge. Quantities of medical items included were appropriate for a group of twenty embarking on a twelve-week expedition.

Medical items	***Quantity***
Antimicrobials / Antibiotics	
Amoxycillin (500mg)	100
Chloramphenicol (ointment, 4g)	3 tubes
Ciprofloxacin (250mg / 500mg)	30 / 20
Flucloxacillin (500mg)	100
Tetracycline (250mg)	40
Metronidazole (200mg)	100
Trimethoprim (200mg)	100
Quinine Sulphate (200mg)	40
Fansidar (525mg)	20
Painkillers	
Paracetamol (500mg)	96
Co-codamol (508mg)	100
Distalgesic (Co-proxamol, 357.5mg)	100
Ibuprofen (200mg / 400mg)	50 / 50
Amethocaine (eye drops)	20 minims
Other Medication	
Altacite Plus	40
Strepsils	48
Imodium	48
Senokot	100
Piriton	120
Stemetil (Prochlorperazine) (5mg)	50

Field Manuals

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Webb, M., Scott, R. & Beale, P. (1997a). First aid manual. Dorling Kindersley, London.
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Documentation

Medical notes for each UK team member, including personaldetails, medical history, immunisations and blood group.
Official letter authorising the carriage of medical supplies for the use of expedition members.

Personal Medical Kit

All UK team members carried personal medical kits for which they were individually responsible. Personal medical kits contained basic first aid supplies and additional medication, as required by the individual.

5. SAFETY PROCEDURE

Water collected for internal consumption was filtered using a 'millbank' bag and treated with an iodine tincture. All team members carried an adequate supply of drinking water with them at all times and were encouraged to maintain adequate fluid intake. All catering materials were washed with detergent and disinfected by rinsing in two dilute solutions of bleach.

Malaria and sunstroke were avoided by wearing appropriate clothing during risk periods.

As far as possible, food was prepared to western standards of hygeine.

All fieldwork excursions from base camp were carried out by teams of at least two people, including a local guide. All team members carried SOS whistles in case of emergency.

Accidents were avoided by careful and vigilant progress through the terrain.

6. CASUALTY TREATMENT AND EVACUATION

All medical conditions encountered received early and appropriate treatment. Subsequent monitoring and treatment was necessary to prevent worsening and promote recovery.

In the event of an emergency, all team members were familiar with a predetermined casualty evacuation plan. Barry Ferguson (Leader) would take charge of the situation and Julian Mallinson (Medical Officer) would advise on casualty treatment and care. In the absence of the leader, Chris Perceval (Deputy Leader) would take control. All other members of scientific and support teams would provide further assistance, as required.

Casualties would be taken to the local hospital in Itotaka for the treatment of minor injuries. For more serious injuries, radio contact would be used to arrange rapid transport to Fort Dauphin and subsequent transfer by aeroplane to a European standard hospital on Reunion.

At no stage during the expedition was it necessary to implement casualty evacuation.

Logistics Report

1. Research Materials

Scientific literature is not readily available in Madagascar, the library of the University in Antananarivo is reported to be well stocked, Parc Tsimbazaza has some literature but lacks some journals and key texts. It is recommended that teams bring all necessary literature and leave copies with the libraries of their collaborators. The Library in the Libanona Ecology Centre (Fort Dauphin) is extremely well stocked with conservation and development books.

A good selection of Maps is available from the national mapping agency Foiben – Taosarintanin'I Madagasikara (FTM) in Antananarivo on Rue Dama-Ntsoa Razafintsalama JB. They stock a 12 sheet 1:500 000 series covering the whole island, and also a 1:100 000 series. Both of these series of maps may be quite old (some were produced as long ago as 1956) and so for land cover may not be accurate, we did find them to be accurate for topographical features. WWF Madagascar also have a remote sensed map (satellite image) which is useful for determining the limits of the forest. For a good map covering the whole island IGN (The French National Mapping Institute) sell a 1: 2 000 000 map.

2. Training

Team training was carried out in Edinburgh in February at the Scottish Universities Primate Day at Edinburgh Zoo where we were familiarised with the basics of primate ecology. Further scientific training was given by the workshops run by the BP Conservation Programme and RGS in London in April 1999. Medical training consisted of Julian Mallinson attending the Wilderness Medical Training Course at the Royal Geographical Society and all UK team members attended Red Cross Basic First Aid courses. The whole team was informed of the casualty evacuation procedure prior to deploying to the field. A further training weekend was held in the Lake District in June to familiarise all members with basic fieldcraft skills, map reading and operation of field equipment. This expedition found that running training weekends was an excellent way of team bonding prior to departure.

3. Permissions

Permission for this project was issued by the Department of Eaux et Forets of the Malagasy Government. As the project was in an unprotected area it was not required to obtain permits from ANGAP (The protected areas authority). Project Ifotaka 1999 was run under a protocol of collaboration between Durham University and Parc Botanique et Zoologique de Tsimbazaza (PBZT). PBZT obtained research permits for an administrative charge of 2 000 000 FMg (about £200 in 1999) this took one week from arrival – in future it is recommended that expeditions ensure that collaborators collect the permits prior to their arrival as there seemed to be no reason for the wait. The Malagasy Consul in London issued study visas on production of the signed protocol of collaboration. Export permits for the plant and faecal material were issued by the Department of Eaux et Forets, again this took a week to organise for no apparent reason. Phytosantiation certificates were issued by SQVCPF an agency beside the Department of Eaux et Forets after some discussion. It appears that previous researchers have been issued certificates for one set of materials and have exported another set (namely orchids) and this will result in a tightening of the regulations. Once

Transport from Fort Dauphin to Ifotaka was by chartered Taxi-Brousse (Bush Taxi) this costs between £50 and £80 depending on the quality of the vehicle, not all drivers are willing to drive on the unsurfaced tracks between Amboasary-Sud and Ifotaka. It takes about four hours provided you have no breakdowns en-route. From Ifotaka to the field camp at Mahavelo Zebu carts can be chartered to take equipment to 500m from the campsite, local men are keen to be employed as porters.

Freighting equipment for short projects is not recommended as previous expeditions have had major difficulties (Wilson 1990; Nagy pers. comm.) getting items released from customs on time.

7. Communication

The nearest public telephone to Ifotaka was reported to be in Amboasary-Sud. We used the telephones (card operated) and post office in Fort Dauphin, which proved to be quite reliable. E-mail facilities are available at the Libanona Ecology Centre and one of the better hotels in town, their reliability is deemed somewhat dubious. We used the post box number for the Libanona Ecology Centre for incoming mail. The small army base in Ifotaka and Berenty Private Reserve have radios, which could be used in emergencies. However, local people may not be admitted to the Berenty by the guards so a non Malagasy team member should accompany anybody going for help – further details of the casualty evacuation procedure are in the Medical and Safety report.

8. Field Administration

For the first two phases the team were based at Mahavelo, a flat area at the side of the Asantoria Riverbed (See Map 3) around 4Km from the village of Ifotaka. The research team and local guides lived in tents and improvised shelters with a cooking and eating area centrally located. There were pools of still water within easy reach of the camp for drinking/cooking water and washing water. Drinking water was purified using a Millbank bag filter and Iodine tincture. Powdered fruit flavourings available in Fort Dauphin made the Iodinated water much more palatable. Food is easily available in Ifotaka from the small daily market/small shops or the larger weekly market. The staple diet of the team was:

Breakfast - Rice, Omelette, Tomato;
Lunch – Rice, Carrots, Potatoes, Tinned Fish;
Dinner – Rice, Beans, Chicken;
Sundries – Coffee, Sugar, Biscuits, Condensed Milk.

Very little fresh fruit was available in Ifotaka but most of the other items used were available. Ifotaka currently has no hotely's (cafes) and so food must be prepared over open fires. We employed two local men to prepare food and water for the team. For security it is important to ensure a guide/porter always remains in the camp.

All guides, porters and cooks should be given an oral and written agreement of the employment conditions (including wages) as many had not worked for an employer previously. The guides were paid weekly.

9. Medical and Safety Arrangements

These are fully described in the Medical Report.

22nd	July	Arrive Ifotaka Village, meet Tompotamy Remanisy (Mayor), Organise team of guides, depart for field camp (Mahavelo).
23rd	July	Arrive Mahavelo, set up camp.
24-28	July	Devise survey methodologies.
29th to 14th	July Aug	*Phase One* of Research Conducted : Lemurs : Population estimation, habitat use, diet, time allocation; Vegetation Surveys; Ornithological Surveys; Ethnobotanical Inventory, PRA[1] Methodology devised, Claudine Niny, Clarisse , Tatjana and Sylvain arrive in Ifotaka
14-19	Aug	Rest and recuperation at the Libanona Ecology Centre, Fort Dauphin. Helene Razamatso departs for Antananarivo. Phase Two Research Plan Confirmed.
20th	Aug	Travel from Fort Dauphin- Ifotaka – Mahavelo.
21st to 4th	Aug Sept	*Phase Two* of Research Conducted : Lemur :habitat use, diet, time allocation, PRA interviews commence, Ethnobotanical inventory. Reconnaissance of the northern part of the forest (Barry and Jimmy).
5th to 10th	Sept Sept.	Rest and Recuperation at Libanona Ecology Centre, Fort Dauphin. Research plan for Phase Three confirmed. Clarisse and Niny return to Tulear.
11th to 23rd	Sept to Sept	*Phase Three* of research conducted (PRA, Lemur diet, Ethnobotanical inventory) Team were based in Ifotaka Village rather than forest camp. Education Project Conducted in two Ifotaka schools.
24th	Sept	Farewells said depart Ifotaka for Fort Dauphin. Field Equipment donated to Libanona Ecology Centre.
26th	Sept	UK team Members travel to Antananarivo (Air Madagascar).
27th to 30th	Sept to Sept	Export visas applied for and collected. Preliminary Report Submitted to Direction des Eaux et Forets. Field Equipment donated to PBZT team visit Perinet and Ranomafana reserves.
1st	Oct	UK Team depart Antananarivo for London.

[1] Participatory Rural Appraisal

Publicity and Results Dissemination

Newspaper Articles

Palatinate (DU Newspaper), November 1998, '*Lemur Aid*'

Stanstead Guardian, December 1998, '*Living Deep in the Forest*'

Newtownards Chronicle, January 1999, '*Local Student to lead Madagascar Expedition*'.

Grantham Journal, January 1999, '*African Island Adventure for former Kings Pupil*'

Basingstoke Gazette, January 1999, '*Set For a Wild Time in Madagascar*'

Durham Advertiser, February 1999, '*Five Go Off on Nature Study.*'

Northern Echo, March 1999, '*In Search of Hope in a Disappearing World*'

Belfast Newsletter, April 1999, '*Travelling Man – Young Ecologist Barry is Leader of the Pack.*'

Stanstead Guardian, July 1999, '*She's Bound for the spiny forest of Madagascar*'

The Newcastle Chronicle, February 2000, '*Deep in a Secret Forest Grow Plants which Cure Disease*'

Radio Interviews

BBC Radio Ulster - Morning Extra, January 1999. (Barry Ferguson).
BBC Radio Newcastle, March 1999. (Barry Ferguson).

Public Presentations

October 1999, Durham University Expedition Society.
November 1999, Explore 1999, RGS-IBG, London.
February, 2000, Expediton Roadshow, University of Newcastle.
February 2000, University of Durham Seminar, Department of Biological Sciences.
April 2000, People Orientated Projects Workshop, RGS-IBG, London.

Poster Presentations

British Ecological Society Winter Meeting (December 1999).
Cambridge Conservation Science Conference (March 2000).
Mammal Society Easter Conference (April 2000).
Posters left on permanent display in each of the collaborating institutions from July 2000.

Other Events

Project Ifotaka Post Expedition Reception, The Senate Suite, Durham Castle, February 2000.

Project Ifotaka 1999 Final Report

University of Durham Expedition to Madagascar

15th July – 1st October 1999

A Collaboration between : The Libanona Ecology Centre, Durham University and Parc Botanique et Zoologique de Tsimbazaza.

University of Durham

RESUME DES TRAVAUX

Le projet Ifotaka 1999 était une expédition, pendant trois mois (Juillet-Octobre 1999) pour un programme de recherche pour la conservation, dans la forêt d'Ifotaka au Sud de Madagascar . C'était un projet anglo-malagasy dans la cadre de la collaboration entre l'Université de Durham (Royaume-Uni), Parc Botanique et Zoologique de Tsimbazaza (Madagascar) et le Centre Ecologique Libanona (Madagascar).
L'équipe, composée de vingt-deux membres a effectué ses observations dans une zone de forêt épineuse aux environs immédiats du village Ifotaka. Cette zone a été identifiée par le WWF dans le Sud de Madagascar.

Les études écologiques et anthropologiques ont été complétées par des activités d'education-conservation visant à mettre en contact des écoles primaires de Durham (Royaume Uni) et d'Ifotaka (Madagascar). Les études ont pu être effectuées grâce aux louables autorisations du Département des Eaux et Forêts malagasy et de Monsieur Tompotamy Remanintsy, Maire de la commune rurale d'Ifotaka. Les sujets de recherche:

1- **Ecologie des Lémuriens-** La densité de population de *Propithecus v. verreauxi* dans une forêt non perturbée est estimée à 37.25 individus par Km carré en utilisant des points de comptage. Les études de l'utilisation des habitats et des comportements des animaux ont montré l'importance des arbres adultes de l'espèce *Allaudia procera* pour les Sifakas.

2- **Ornithologie-** Un total des quarante deux espèces d'oiseaux ont été inventoriées dont trois non enregistrées auparavant dans la zone. Il s'agit du Cormoran à longue queue (*Phalocrocorax africanus*), du Gobe mouche de paradis (*Terpsiphone mutata*) et du Héron crabier blanc (*Ardeola idea*). Une étude de l'abondance relative de la communauté de l'avifaune a été aussi entreprise.

3- **Etude de la végétation-** Pour l'étude de la densité et de l'abondance de la couverture des arbres, on a pu enregistrer, dans un quadrat, 162 espèces pour 52 familles parmi lesquelles les plus communes sont les Euphorbiaceae, les Fabaceae, les Mimosaceae et les Rubiaceae.

4-**Investigation ethnobotanique-** Les travaux effectués principalement avec deux "*Ombiasy*" (guérisseurs locaux -Manahira et Fanahisoa), 169 espèces (nom locale - 100 ont été identifiées de nom scientific) de plantes médicinales ont été identifiées et qui entrent dans 312 utilisations. Les spécimens en herbier de ces plantes ont été déposés au Parc Botanique et Zoologique de Tsimbazaza.

5-**Investigation anthropologique-** En utilisant les "techniques PRA"(question-réponse) , une investigation sur l'attitude des paysans envers les ressources forestières et leurs utilisations locales ont été effectuées. A partir de la transcription de 32 interviews informelles, le thème majeur qui apparaissait était que les sols pauvres pour l'agriculture associés à l'accroissement des demandes conduisent les populations locales Antandroy à des utilisations inconscientes des ressources.

6- **Projet d'éducation-** Un projet d'éducation en quatre étapes a été entrepris au cours duquel ont été effectuées des visites d'écoles primaires à Ifotaka et Durham. En même temps l'équipe a fait des jeux avec tous les enfants d'Ifotaka.

Executive Summary

Project Ifotaka 1999 was a three-month conservation research expedition in the Ifotaka Forest in southern Madagascar (July-October 1999). The project was an anglo-malagasy collaboration between the University of Durham (UK), Parc Botanique et Zoologique de Tsimbazaza (Madagascar) and The Libanona Ecology Centre (Madagascar). The team of twenty-two members conducted research in a patch of spiny forest adjacent to the village of Ifotaka, this patch was identified by the WWF in southern Madagascar.

Ecological and Anthropological research was complemented by an education project linking Primary Schools in Durham (UK) with Primary Schools. Research was carried out with the kind permission of the Dept. des Eaux et Forets of the Malagasy Government and Mr Tompotamy Remaninisy, Mayor of the rural community of Ifotaka. Research topics were:

1. Lemur Ecology – Population Density of *Propithecus v. verreauxi* in undisturbed forest was estimated at 37.25 individuals per sq Km using point counts. Studies of habitat use and behaviour showed the importance of mature trees of the species *Allaudia procera* to the sifakas.

2. Ornithology – A total of forty-two bird species were recorded in a species inventory three of which are not known to have been recorded at the site before (Long-tailed Cormorant (*Phalocrocorax africanus*), Madagascar Paradise Flycatcher (*Terpsiphone mutata)* and Madagascar Pond Heron (*Ardeola idea)*). Of the forty two species recorded, two are considered to be Near Threatened (Madagascar Pond Heron and Verreaux's Coua). A study of relative abundance was also conducted.

3. Vegetation Survey – A Quadrat survey recording density and cover abundance of trees recorded 162 species in 52 families with the most common families being Euphorbiaceae, Fabaceae, Mimosaceae and Rubiaceae.

4. Ethnobotanical Investigation – Working principally with two local *Ombiasy* (Manahira and Fanahisoa) an inventory of 169 medicinal plants with a total of 312 uses was recorded (100 of these were identified with scientific names). Herbarium specimens were lodged at Parc Tsimbazaza.

5. Anthropological Investigation - Using PRA techniques an investigation into local resource use and attitudes was conducted. From 32 transcribed informal interviews, the major theme appearing was that poor agricultural soils and increasing demands caused unsustainable use of the forest resources by the local Antandroy People.

6. Education Project – A four phase education project was conducted with visits to primary schools in Ifotaka and Durham. In addition the team performed a play for all the children of Ifotaka.

Management Themes

The consideration of the themes outlined below should contribute to the development of a Management Plan for the Ifotaka Forest. Any management plan would be most effective if it is incorporated into National and Regional Environmental Action Plans (Hannah *et al.*, 1998) and should be implemented by means of collaborations between government agencies and conservation and development NGO's. It should consider not only biological data but also the economic and socio-cultural factors, which are central to tropical forest conservation (Brown and Brown, 1992). This is not intended to be an exhaustive list of the management issues, but simply lists some of the issues that became apparent during the expedition.

1. **Vegetation Status surveys** - these should be conducted to determine the extent of primary and secondary forest, scrub vegetation and cleared areas in the Ifotaka area. Aerial photographs complemented with ground-truthing surveys would allow this to be assessed.

2. **Allocation of areas for restricted use** – One approach to the management of the forest could be by allocating some areas within the forest as conservation zones or restricted use areas. This must be done with full consideration of all the stakeholders and decisions should be made by the local hierarchy to ensure it is effective with the local people. This approach would require further surveys of the vegetation status (see 1. above).

3. **Promotion and development of sustainable uses of the forest** - Potential activities include ecotourism and the use of non-timber forest products eg for medicinal uses. The potential for forest regeneration should be investigated. In addition the possibility of using the planting of exotic species for firewood and timber should be considered.

4. **Conservation of Ethnobotanical Knowledge** – The people of the Ifotaka area, in particular the *Ombiasy's*, have a huge amount of knowledge of uses of the plants of the area. This is at grave risk of being lost so it should be recorded and people encouraged to record and continue using it. Schemes such as that outlined in Swerdlow (2000) have potential, i.e. where *Ombiasy's* work as clinic herbalists, alongside practitioners of western medicine.

   Further investigations of the medicinal properties of the plants of the area should be carried out, as this is potentially of great importance (Prance, 2000). The intellectual property rights of the ethnobotanical knowledge of the Antandroy people must be respected (Dobson, 1985).

5. **Sustainable Agriculture** - With current agricultural practices being a major threats to the forest, developing sustainable agricultural techniques should be a priority.

6. **Population Growth** – This is a further threat to the forest as the quickly growing population in the forest is putting extra demands on timber and firewood trees. It also necessitates the creation and extension of areas for cultivation and grazing to produce food for the population.

7. **Further Research - Research into the following areas would provide information for the development of a Management Plan:**

- Investigate the effects of degradation on the composition of the plant communities in the area and identify vulnerable species.
- Conduct further vegetation surveys in relatively intact forest in order to identify any plant associations unique to the Ifotaka area.
- Investigate the dependence of animal taxa other than *Propithecus verreauxi verreauxi* on mature forest e.g.: reptiles, small mammals, other lemur species.
- Investigate the significance of forest degradation on the composition of animal communities; e.g. a comparison of bird species abundance and distribution along a gradient of forest degradation.
- Monitoring of the population density of *Propithecus v. verreauxi* and conduct surveys in other parts of the Ifotaka forest.
- Investigate the importance of the role of the Ombiasa, how this relates to Christian religion and western medicine in the area and how this varies with remoteness of the Antandroy People.
- Quantify the forest resource use and demographic change by the local people and use this data as a predictive tool for future changes in these variables.
- Investigate the local land rights system in order to make suggestions for the realistic and effective sustainable management of the area.
- Investigate the role of the Fosa (*Cryptoprocta ferox)* in stabilising lemur populations (L. Dollar pers. comm.; Terborgh, 1992), as well as in local folklore and predation on livestock and assess the threat posed by local hunting of this species.

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Project Ifotaka 1999 was a three-month conservation research expedition in the Ifotaka Forest in southern Madagascar (July-October 1999). The project was an anglo-malagasy collaboration between the University of Durham (UK), Parc Botanique et Zoologique de Tsimbazaza (Madagascar) and The Libanona Ecology Centre (Madagascar). The team of twenty-two members conducted research in a patch of spiny forest adjacent to the village of Ifotaka, this patch was identified by the WWF in southern Madagascar. Ecological and Anthropological research was complemented by an education project linking Primary Schools in Durham (UK) with Primary Schools. Research was carried out with the kind permission of the Dept. des Eaux et Forets of the Malagasy Government and Mr Tompotamy Remanintsy, Mayor of the rural community of Ifotaka.

Le projet Ifotaka 1999 était une expédition, pendant trois mois (Juillet-Octobre 1999) pour un programme de recherche pour la conservation, dans la forêt d'Ifotaka au Sud de Madagascar . C'était un projet anglo-malagasy dans la cadre de la collaboration entre l'Université de Durham (Royaume-Uni), Parc Botanique et Zoologique de Tsimbazaza (Madagascar) et le Centre Ecologique Libanona (Madagascar). L'équipe, composée de vingt-deux membres a effectué ses observations dans une zone de forêt épineuse aux environs immédiats du village Ifotaka. Cette zone a été identifiée par le WWF dans le Sud de Madagascar. Les études écologiques et anthropologiques ont été complétées par des activités d'education-conservation visant à mettre en contact des écoles primaires de Durham (Royaume Uni) et d'Ifotaka (Madagascar). Les études ont pu être effectuées grâce aux louables autorisations du Département des Eaux et Forêts malagasy et de Monsieur Tompotamy Remanintsy, Maire de la commune rurale d'Ifotaka.

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Cover Photograph : White Footed Sportive Lemur (Lepilemur leucopus) (Barry Ferguson)

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Introduction

1.1 Background to Conservation of the Spiny Forest

Madagascar, the fourth largest island in the world, is renowned for its diversity of natural ecosystems and its unique flora and fauna. High levels of endemism followed isolation from the African continent between 65 and 100 Million Years Ago. It is estimated that as much as ninety per cent of Madagascars' flora and fauna are found nowhere else on earth (Durrell, 1992). Madagascar supports an estimated 7000-12000 plant species, 109 mammal species, 250 bird species, 26 reptile species and 150 amphibian species (Harcourt, 1990). Madagascar has, this year, been identified as one of the top three global biodiversity hotspots (Myers *et al.* 2000).

The island is perhaps best known, however, for its more than thirty species of lemur, representing the highest level of primate endemism (93.5%) in the world (Mittermeier, 1992). In less than 2000 years, following the arrival of man, six genera and at least fourteen species of lemur have become globally extinct (Harcourt, 1990). Habitat destruction and hunting continue to threaten lemur populations, with ten species considered 'Endangered' by the IUCN (International Union for the Conservation of Nature) and a further fifteen 'Rare' or 'Vulnerable' (Harcourt, 1990). Assessing the conservation status of each species is particularly difficult in the absence of complete population census data, currently no lemur species has been accurately censused outside of protected areas (Simons, 1997). It is commonly recognised that all lemur species are declining annually. The significance of lemurs as indicators of habitat quality and seed dispersers has also been inadequately researched.

The unique semi-arid southern domain of Madagascar is characterised by thickets and forests of xerophytic vegetation, dominated by members of the Euphorbiaceae and Didiereaceae, it is estimated to have 48% generic and 95% species based endemism (Jenkins, 1987). Madagascar's dry forest supports a number of lemur species of which *Lepilemur leucopus* (White-footed sportive lemur), *Lemur catta* (Ring-tailed lemur) and *Propithecus verreauxi verreauxi* (Verreaux's Sifaka) are restricted to the spiny forests of the southern domain. Only a small number of studies have investigated the population density and ecology of these lemurs outside the protected areas of Berenty, Andohahela and Beza Mahafaly.

Current rates of human population expansion, habitat destruction and decline in lemur population numbers, make Madagascar the world's highest primate conservation priority (Harcourt, 1990). The IUCN and World Wide Fund for Nature (WWF) have, consequently, requested research support in order to appreciate the geographical and ecological limits on existing lemur populations (Mark Fenn pers. comm.; Harcourt, 1990; Mittermeier *et al.*, 1992).

1.2 Background to Project Ifotaka

During a reconnaissance visit to southern Madagascar in September 1998 Barry Ferguson and Chris Perceval approached Mark Fenn, (Technical Co-ordinator to WWF Madagascar) requesting a topic of study for a conservation expedition the following summer. He suggested a study on the lemurs and vegetation of the Ifotaka Forest, one of the areas identified by the WWF Eco-region Programme/Dry Forest[1] as holding significant conservation potential. The subsequent visit to the village of Ifotaka and its adjacent forest led to the creation of Project Ifotaka 1999. The Ifotaka area has also been identified as a priority area on the map in Hannah *et al.* (1998) which was produced during the development of Madagascar's National Environmental Action Plan. Ifotaka was highlighted because of the lack of knowledge of its biodiversity.

A protocol of Collaboration was established between Durham University and Parc Botanique et Zoologique de Tsimbazaza (PBZT) with the project providing field experience for two technicians from the park and fieldwork equipment in exchange for the permission for the research being arranged by PBZT. A collaboration was also established between Durham University and the Libanona Ecology Centre (LEC) in Fort Dauphin, this involved LEC making the arrangements for student collaborators from the University of Tulear and providing accommodation for R&R periods in exchange for fieldwork equipment.

Initially, the aims of the project were to estimate the population densities of the four lemur species known to inhabit the Ifotaka Forest (*Lemur catta, Propithecus verreauxi verreauxi, Lepilemur leucopus, Microcebus murinus*) and to make an inventory of locally used medicinal plants. The scope of the project, while keeping conservation as its central theme, was developed over the 9 months in the UK before returning to Madagascar to allow a more holistic view of the issues of the area. These are outlined in section 1.4.

The research of the project covered five main areas (Lemur Ecology, Vegetation, Ornithological, Ethnobotany, and Anthropology) and was supported by an environmental education project. This allowed a more complete view of conservation issues in the area than if the research had been restricted to fewer topics.

Plate 1.1 : The Project Ifotaka Team at Mahavelo (The Basecamp).

[1] See Chapter Two for further information on the WWF Eco-region Programme/Dry Forest.

1.3 Background to the Ifotaka Area

The rural community of Ifotaka, with an estimated population 17,000 (Remanintsy, 1998), is located approximately 42Km north of the village of Amboasary Sud (in the prefecture of Amboasary-Sud) in the centre of southern Madagascar. The ethnic group to which the people belong is the Antandroy (Jenkins, 1987). The local economy is largely based on agriculture. The major livestock includes Zebu Cattle, Goats and Sheep; the dominant cultivated crops are Maize, Manioc, Sweet Potato and Beans.

The Mandrare River traverses the community and provides the major source of water for many of the villages along its banks. The climate in the region is hot from August to March with rainfall in this period typically being in the region of 200mm. The colder season from April to July is typically very dry with only very rare rainfall (Remanintsy, 1998).

The Ifotaka Forest on the Northern Side of the Mandrare River is estimated to be approximately 30 000 hectares in size (estimated from WWF remote sensed map see Map 2), it is currently unprotected and has numerous small settlements within its boundaries. Much of the forest has been affected to some degree by human activities (pers. obs.), although a significant amount of forest is still in relatively pristine condition. The forest ranges in altitude from 60 –520m and contains a small number of areas protected from exploitation by 'Fady' or local taboo, it also houses ancestral tombs from the surrounding population.

Plate 1.2 : A Family (a man, his two wives and four children) who live in the Ifotaka Forest at Pisu Pisu, a small remote settlement in the centre of the forest.

1.4 Aims of Project Ifotaka 1999

The expedition had 11 aims, which were tied together with a central objective.

Central Objective:
To contribute towards the conservation of the Ifotaka forest by increasing the academic understanding of the whole forest system and by facilitation of future conservation and development activities in the area.

Aims:

1. To compile a species inventory of the plants present in the Ifotaka forest and to collect data on their relative abundance.
2. To estimate the population density of Verreuax's Sifaka, *Propithecus verreauxi verreauxi.*
3. To investigate the characteristics of the habitat used by *Propithecus verreauxi verreauxi.*
4. To investigate the partitioning of time by *Propithecus verreauxi verreauxi.*
5. To confirm the presence of other lemur species in the area.
6. To compile a species inventory of the birds present in the Ifotaka forest along with data on their relative abundance.
7. To compile an ethnobotanical database for the area noting plants used for medicines and other cultural uses and to leave specimen samples of the plants in the Herbarium in Parc Tsimbazaza.
8. To conduct a preliminary investigation into the use of forest resources by the people of Ifotaka.
9. To establish a link between primary schools in Durham and Ifotaka by means of a conservation education project.
10. To train team members in ecological and anthropological fieldwork techniques.
11. To develop the collaboration between Durham University, The Libanona Ecology Centre and Parc Tsimbazaza and to set in place the necessary arrangements for a longer-term project in Ifotaka to be implemented.

Plate 1.3 : A typical landscape from the Ifotaka Forest

1.5 Project Impacts

- Management issues relevant to the conservation of the Ifotaka forest identified and presented to the Dept des Eaux et Forets and the stakeholders in Ifotaka.

- Data from the research entered into the WWF GIS (Geographical Information System) for southern Madagascar.

- Final Report containing scientific information distributed to all sponsors, advisors, British Copyright Libraries and conservation and development NGO's interested in Madagascar.

- The production of an 'Ifotaka Newsletter' in Malagasy which will be distributed to all the stakeholders of the Ifotaka area to explain the findings of the 1999 phase of the Project and the issues which the people should consider for the future of the project.

- Training of 5 British students, 3 Malagasy students, 3 Malagasy technicians, 2 Malagasy Interpreters and 8 Local Guides in ecological and anthropological fieldwork techniques.

- Implementation of the first stage of a collaboration between The University of Durham (UK); Parc Botanique et Zoologique de Tsimbazaza and Centre Ecologique de Libanona.

- Establishment of a Primary school Link between primary schools in Durham (UK) and Ifotaka (Madagascar).

- Information on the project made available on the world-wide web (the internet) at www.ifotaka.freeservers.com

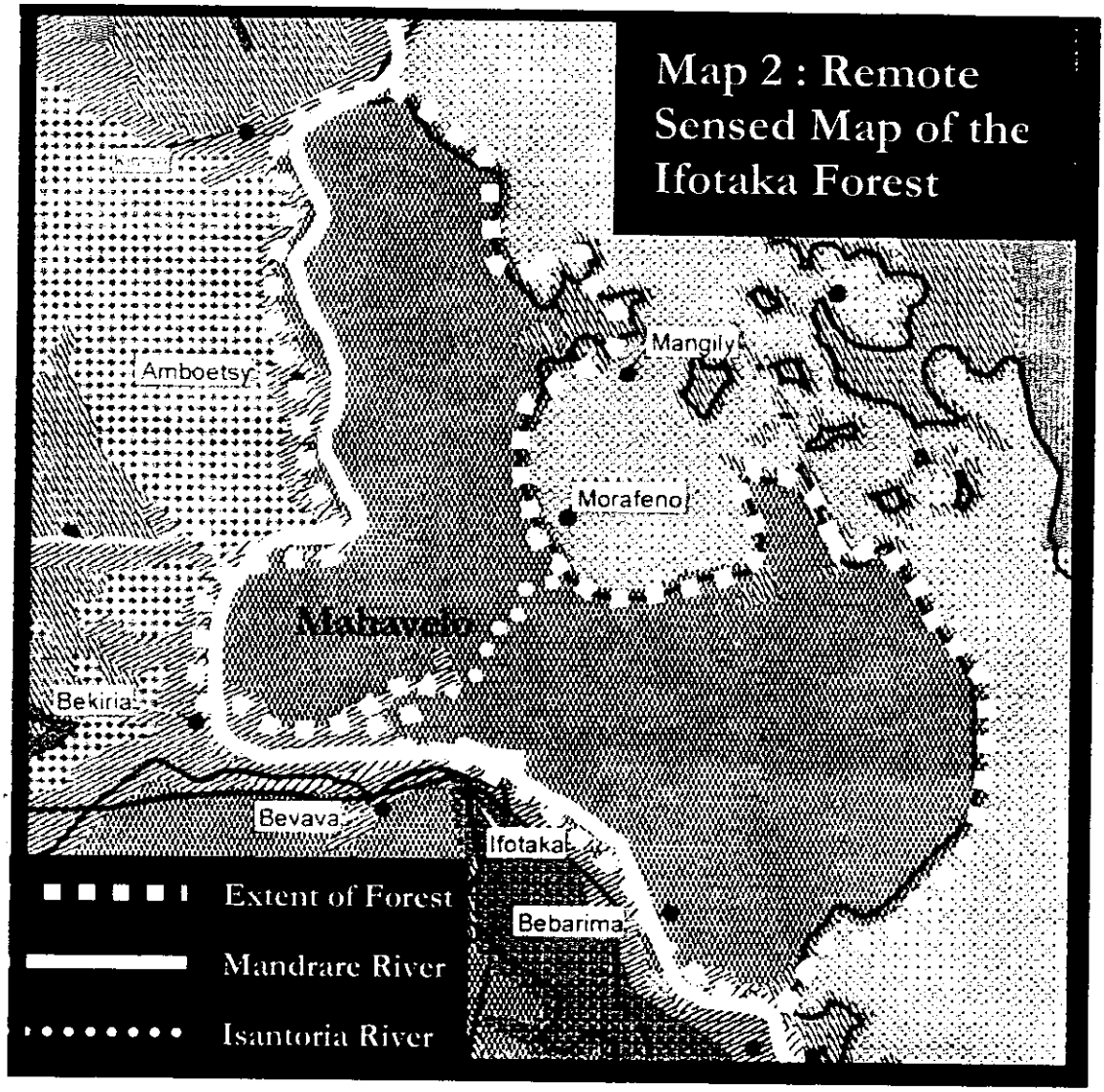
- Posters presented at three academic conferences in the United Kingdom: The British Ecological Society Winter Meeting, The Mammal Society Easter Conference and The Cambridge Conservation Conference.

- Posters put on permanent display at Parc Tsimbazaza, University of Durham (Dept of Biological Sciences) and Centre Ecologique de Libanona illustrating research results of the project.

- Oral presentations at the Royal Geographical Society (Explore '99; People Oriented Projects Workshop 2000; RGS Expedition Roadshow in Newcastle February 2000); University of Durham (Expedition Society; Department of Biological Sciences).

- Extensive Media Coverage including radio interviews on BBC Radio Newcastle and BBC Radio Ulster and numerous local and regional newspaper articles.

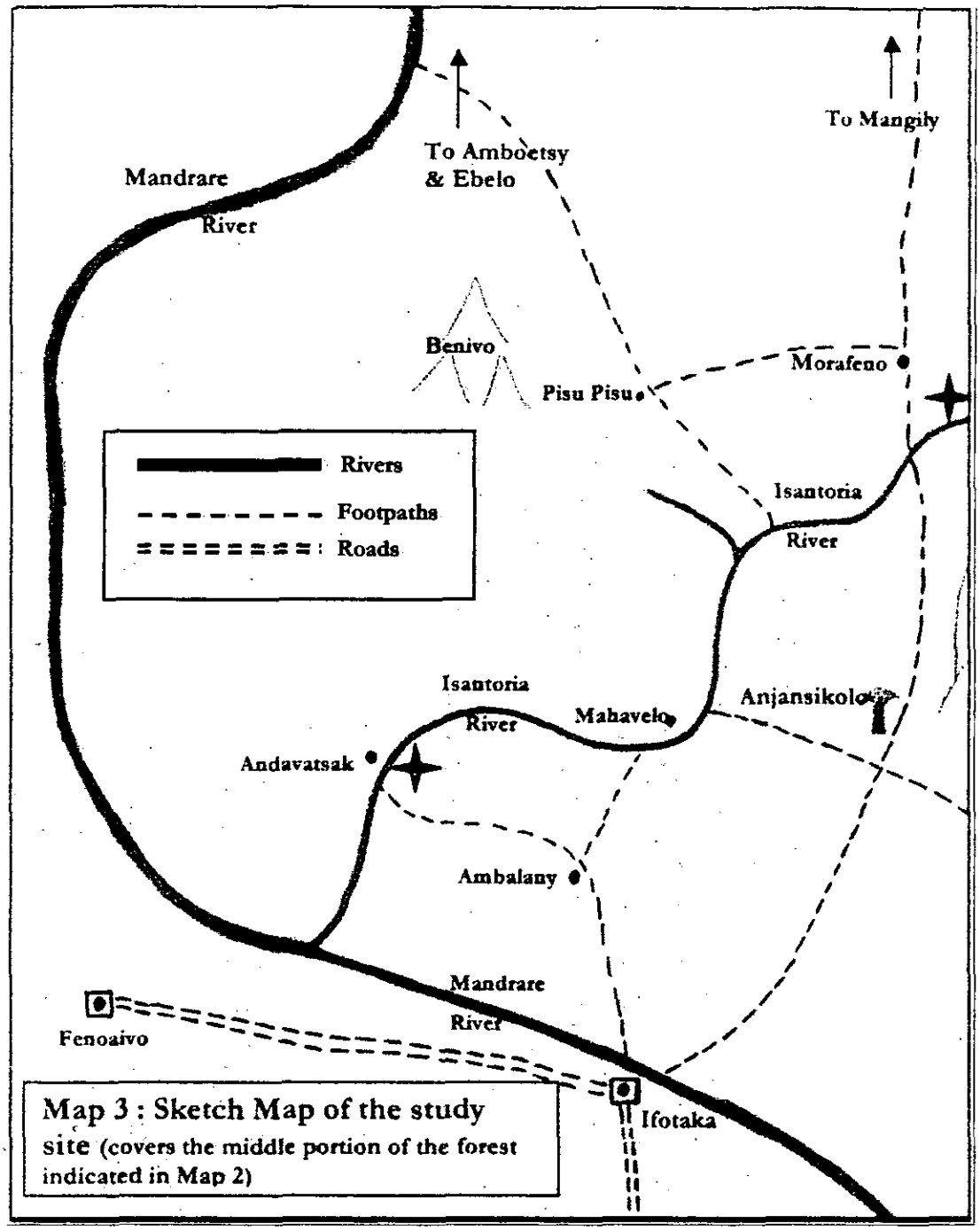
1.6 Maps and location of the study site



Map 2 above shows the outline of the Ifotaka Forest as detected by satellite, illustrated on the map is the extent of the remaining forest, the Mandrare River and the Isantoria River (map kindly supplied by WWF). The Ifotaka Forest is located at 24°50'S, 46°10'E.

Almost all of the Ifotaka forest is located to the north of the Mandrare River and is accessed by wading through the Mandrare during the dry season (May-October) and by pirogue during the wet season (November-April). Project Ifotaka had its research centred around the Isantoria River, the forest around it and the nearby villages. Because the expedition was carried out during the dry season the riverbed was dry for the duration of the project.

A good topographical map (1:100 000) is available for the area from the FTM Office in Tana - Sheets K61 (Ebelo), L61 (Tranomaro), K62 (Ambovombe) and L62-63 (Amboasary-Atsimo) are needed to cover the whole forest, although the topography is clearly and accurately represented the land cover and location of settlements are not accurately represented on the maps which were produced in 1956/1957.



Map 3 : Sketch Map of the study site (covers the middle portion of the forest indicated in Map 2)

Map 3 above shows the geographical contest of the study area within the Ifotaka forest. The studies were conducted along a 11.5km stretch of the Isantoria River with the ends indicated by stars on the map - northern end indicated by a star near the village of Morafeno and the southern end indicated by a star near the village of Andavatsak.

1.7 Personnel

Research Team

Barry Ferguson, 22, — **Expedition Leader**
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University of Durham, England — BSc (Hons) Ecology; PhD Ecology

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Georgina Combes, 22, — **Education and Logistics Officer**
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Ifotaka Support Team

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	Fanahisoa		**Mikasoa**	**Resitahaka**
			Manoasy	**Tombosoa**

VEGETATION SURVEY

2.1 Introduction

WWF-Living Planet Project have identified two hundred global 'eco-regions' that are in need of conservation initiatives and programmes. The dry tropical forests and spiny forests of Madagascar are particularly unique eco-regions of the African sub-continent. Detailed, participative research programmes are much needed, however, to address the current lack of knowledge regarding the biology and socio-economics of each eco-region and their potential for conservation.

To address this, WWF initiated the Eco-region Conservation Programme in the south and south-west of Madagascar. Of the twenty-three eco-region sites identified, the forest at the north of the Ifotaka commune was considered particularly valuable because of its size (30,000 hectares) and high biological diversity. However, traditional cultural and pastural practices currently represent a significant threat to the conservation of this unique habitat and its flora and fauna. Habitat loss is of particular concern since the arid climate and the severity of edaphic conditions (stony soils of low organic content) restrict secondary re-growth potential once primary forest has been degraded.

As a contribution to the WWF Eco-region Programme/Dry Forest, WWF co-ordinated a vegetation survey in collaboration with Project Ifotaka and the Etablissement Superieur de Science (ESS) of the University of Tulear. The field research programme also provided specialised training for research students from the University, as well as supporting the regional natural resource management programmes of the National Office of the Environment and complementing the research on Lemur populations undertaken by Project Ifotaka.

Although the Ifotaka Forest had been broadly described and characterised, a detailed survey of the vegetation had not been conducted. The aim of the present study was to;

- **Determine the identity, relative density and relative cover-abundance of tree species comprising the Ifotaka Forest (Plate 2.1 below).**

Plate 2.1 View over the Ifotaka Forest, including riverbed transect and study area (background) and characteristic vegetation (foreground).

2.2 Methods

The study area was consistent with that previously surveyed for lemur populations (Chapter 1). The vegetation survey was conducted using nineteen 32m x 16m quadrats, each positioned at random and geographically referenced using a Global Positioning System (GPS). Within each quadrat, the identity (vernacular and scientific name), relative density and relative cover-abundance of all trees greater than 2.5cm diameter at breast height (dbh) were recorded. Relative density and relative cover-abundance were estimated using the following indices;

Index of density
1 – Very dispersed (1-4 individuals/quadrat)
2 – Dispersed (5-14 individuals/quadrat)
3 – Not very numerous (15 – 29 individuals/quadrat)
4 – Numerous (30 – 99 individuals/quadrat)
5 – Very numerous (>100 individuals/quadrat)

Index of Cover-Abundance
X – Few individuals, low coverage
1 – Numerous individuals, low coverage
2 – Very numerous individuals covering a minimum of 5% of surface
3 – Few or many individuals covering 25-50%
4 – Individuals covering 51 – 75%
5 – Individuals covering 76 – 100%

2.3 Results

A total of 162 tree species were recorded during the vegetation survey, representing 52 families. *Enterospermum sp.* (Rubiaceae), *Alluaudia procera* (Didiereaceae), *Euphorbia leucodendron* (Euphorbiaceae), *Strychnos madagascarensis* (Loganiaceae), *Combretum sp.* (Combretaceae), *Croton bevilaniensis* (Euphorbiaceae) and *Grewia sp.* (Tiliaceae) had the greatest median density and cover-abundance scores (2 and 1, respectively) and were recorded in sixteen or more of the nineteen quadrats. The estimated density of these species, based on the median density score, would have been equivalent to 98-273 individuals per hectare. The abundance of *Alluaudia procera* was particularly significant since it was the species on which *Propithecus v. verreauxi* (Verreauxi's Sifaka) was most frequently encountered during investigations of habitat preference (Plate 2.2).

Plate 2.2 *Propithecus v. verreauxi* commonly sighted resting on an adult tree of *Alluaudia procera (Didiereaceae).*

Euphorbiaceae was the most common family with a total of sixteen species recorded and three species within the twelve most abundant trees. Fabaceae, Mimosaceae and Rubiaceae were the next most commonly represented families with six, seven and eight species recorded, respectively. A full species list including the identity (vernacular name and scientific name), relative density (median Index of Density coefficient and proportion occurrence) and relative cover-abundance (median Index of Cover-Abundance coefficient) of tree species recorded during the vegetation surveys is included in Section 2.3 below.

Vegetation Results Table.

The identity (vernacular name and scientific name), relative density (median Index of Density Coefficient (IDC) and proportion occurrence) and relative cover-abundance (Median Index of Cover-Abundance Coefficient (ICAC) of tree species recorded during vegetation surveys. Proportion occurrence was determined from the number of quadrats surveyed in which each species was recorded. Estimated tree density per hectare is included for each Index of Density coefficient.

Index of Density	**Density estimate (Individuals hectare^{-1})**
1 – Very dispersed (1-4 individuals/quadrat)	20-78
2 – Dispersed (5-14 individuals/quadrat)	98-273
3 – Not very numerous (15 – 29 individuals/quadrat)	293-566
4 – Numerous (30 – 99 individuals/quadrat)	586-1934
5 – Very numerous (>100 individuals/quadrat)	>1953

Index of Cover-Abundance

X – Few individuals, low coverage
1 – Numerous individuals, low coverage
2 – Very numerous individuals covering a minimum of 5% of surface
3 – Few or many individuals covering 25-50%
4 – Individuals covering 51 – 75%
5 – Individuals covering 76 – 100%

Vernacular name	*Scientific name*		*Median IDC*	*Median ICAC*	*Proportion occurrence*
	Genus species	*Family*			
Marandoha	*Enterospermum sp.*	Rubiaceae	3	1	1.00
Fantiolitse	*Alluaudia procera*	Didiereaceae	3	1	0.89
Befoetse	*Euphorbia leucodendron*	Euphorbiaceae	2	1	0.95
Relefo	*Strychnos madagascarensis*	Loganiaceae	2	1	0.95
Vahipoty	*Combretum sp.*	Combretaceae	2	1	0.95
Sendreno	*Croton bevilaniensis*	Euphorbiaceae	2	1	0.84
Taolankafotse	*Grevvia sp.*	Tiliaceae	2	1	0.84
Daronaombe	*Commiphora sp.*	Burseraceae	2	x	0.95
Maintifo	*Diaspyros humbertii*	Ebenaceae	2	x	0.63
Fiha	*Euphorbia plagianta*	Euphorbiaceae	2	x	0.58
Dagoa	*Strychnos decussata*	Loganiaceae	1	x	1.00
Lambigna	*Baudounia fluggeiformis*	Fabaceae	1	x	0.84
Sognombarike	*Alluaudia humbertii*	Didiereaceae	1	x	0.84
Hazomatango	*Indigofera cloiselii*	Fabaceae	1	x	0.74
Zanampoly	*Croton menabensis*	Euphorbiaceae	1	x	0.74
Darosike	*Commiphora sp.*	Burseraceae	1	x	0.68
Sengatse	*Commiphora simplicifolia*	Burseraceae	1	x	0.68
Sogno	*Alluaudia ascendens*	Didiereaceae	1	x	0.68
Feka	*Pandaea sp.*	Apocynaceae	1	x	0.63
Lafikena	*Diaspyros sp.*	Ebenaceae	1	x	0.63
Tabarike	*Grevvia andronensis*	Tiliaceae	1	x	0.63
Katrafay	*Cedrelopsis grevei*	Ptaeroxylaceae	1	x	0.58
Magnary	*Dalbergia trichocarpa*	Fabaceae	1	x	0.58
Monongo	*Zanthoxyllum sp.*	Rutaceae	1	x	0.58
Tanatananala	*Croton sp.*	Euphorbiaceae	1	x	0.58
Farehitse	*Uncarina sp.*	Pedaliaceae	1	x	0.53
Fatra	*Terminalia fatrae*	Combretaceae	1	x	0.53
Herotse	*Euphorbia intisy*	Euphorbiaceae	1	x	0.53
Sirosiro	*Gyrocarpus americanus*	Hernandiaceae	1	x	0.53

Vernacular name	*Scientific name*		*Median*	*Median*	*Proportion*
	Genus species	*Family*	*IDC*	*ICAC*	*occurrence*
Somoro	*Croton mongy*	Euphorbiaceae	1	x	0.53
Takisakisabato	*Kalanchoe sp.*	Crassulaceae	1	x	0.53
Tsiongake	*Rhopalocarpus lucidus*	Rhopalocarpaceae	1	x	0.53
Vahipindy	*Hypocratea loesnerea*	Hypocrateaceae	1	x	0.53
Darotandroke	*Commiphora orbiculata*	Burseraceae	0	0	0.47
Hily	*Stereospermum nematocarpon*	Bignoniaceae	0	0	0.47
Sofasofa	*Mundulea sp.*	Fabaceae	0	0	0.47
Jabihy	*Operculicarya decaryi*	Anacardiaceae	0	0	0.42
Magne	*Hibuscus macrogonus*	Malvaceae	0	0	0.42
Roipitike	*Mimosa sp.*	Mimosaceae	0	0	0.42
Taranta	*Rhus tarantana*	Anacardiaceae	0	0	0.42
Vontake	*Pachypodium sp.*	Apocynaceae	0	0	0.42
Kolohoto	*Albizzia sp.*	Mimosaceae	0	0	0.37
Laza	*Cyphostema laza*	Vitaceae	0	0	0.37
Mangiriboky	*Asparagus sp.*	Liliaceae	0	0	0.37
Rohondroho	*Alluaudia dimosa*	Didiereaceae	0	0	0.37
Vahiranga	*Cynanchum sp.*	Asclepiadaceae	0	0	0.37
Hazomby	*Croton sp.*	Euphorbiaceae	0	0	0.32
Hazontsanda	*Dialium sp.*	Euphorbiaceae	0	0	0.32
Mangerivoriky	*Strychnos sp.*	Loganiaceae	0	0	0.32
Sambonto			0	0	0.32
Tarena	*Canthium sp.*	Rubiaceae	0	0	0.32
Kotrigny			0	0	0.26
Mendoravy	*Albizzia greviana*	Mimosaceae	0	0	0.26
Somangipake	*Boscia longifolia*	Capparidaceae	0	0	0.26
Tainoro	*Tarrena sp.*	Rubiaceae	0	0	0.26
Talytivoke	*Terminalia divaricata*	Combretaceae	0	0	0.26
Vala	*Dombeya sp.*	Sterculiaceae	0	0	0.26
Vinoa	*Hildegardia sp.*	Sterculiaceae	0	0	0.26
Fangitse	*Dolichos fangitsy*	Papilionaceae	0	0	0.21
Forofoke	*Diaspyros cupulifera*	Ebenaceae	0	0	0.21
Hazomena	*Securinega sp.*	Euphorbiaceae	0	0	0.21
Hororoke	*Boscia madagascarensis*	Capparidaceae	0	0	0.21
Retsiotse	*Protorhus sp.*	Anacardiaceae	0	0	0.21
Takisakisaka	*Xerocyrius perrieri*	Cucurbitaceae	0	0	0.21
Tatavankibo	*Mollugo decandra*	Aizoaceae	0	0	0.21
Tsiboragnala	*Brachiaria sp.*	Poaceae	0	0	0.21
Tsiborankibo		Graminaceae	0	0	0.21
Voaovy	*Tetrapteroe sp.*	Fabaceae	0	0	0.21
Unknown sp.1			0	0	0.21
Aveotse	*Asparagus sp.*	Liliaceae	0	0	0.16
Boroa	*Tetradenia nervosa*	Labiaea	0	0	0.16
Famata	*Euphorbia sp.*	Euphorbiaceae	0	0	0.16
Hazolava	*Neobeguca mahefeli*	Meliaceae	0	0	0.16
Hola	*Adenia sp.*	Passifloraceae	0	0	0.16
Kope	*Mystroxylon aethopicum*	Celastraceae	0	0	0.16
Reringitsy			0	0	0.16
Sahondra 2	*Plumbago aphylla*	Plumbaginaceae	0	0	0.16
Sakoandalitse	*Operculicarya hyphenoides*	Anacardiaceae	0	0	0.16
Tontonga	*Aristolochia sp.*	Aristolochiaceae	0	0	0.16
Vahondrandra	*Aloe sp.*	Liliaceae	0	0	0.16
Vakoanala	*Pandanus xerophylus*	Pandanaceae	0	0	0.16
Voafogna		Erythroxylaceae	0	0	0.16

Vernacular name	*Scientific name*		*Median IDC*	*Median ICAC*	*Proportion occurrence*
	Genus species	*Family*			
	Bauhenia madagascarensis	Cesalpiniaceae	0	0	0.16
Andaparo	*Grevvia sp.*	Tiliaceae	0	0	0.11
Andranahaky	*Commelina sp.*		0	0	0.11
Avoha	*Dicrostacus sp.*	Mimosaceae	0	0	0.11
Fandra	*Dioscorea fandra*	Dioscoreaceae	0	0	0.11
Fiofio	*Toxocarpus sp.*		0	0	0.11
Folotse	*Foulotsia sp.*	Asclepiadaceae	0	0	0.11
Hazomposa			0	0	0.11
Kapoke	*Cerbera veninis*	Apocynaceae	0	0	0.11
Keleogne	*Tylachium sp.*	Capparidaceae	0	0	0.11
Laisiky	*Abulilon sp.*	Malvaceae	0	0	0.11
Ma	*Dombeya sp.*	Sterculiaceae	0	0	0.11
Malamasafy	*Delonix audason*	*Cesalpiniaceae*	0	0	0.11
Mosesy	*Polyscias sp.*	Araliaceae	0	0	0.11
Nifinakanga	*Commelina sp.*	Commelinaceae	0	0	0.11
Roihafotsy			0	0	0.11
Sagnira	*Phyllanthus casticum*	Euphorbiaceae	0	0	0.11
Senjeny	*Croton sp.*	Euphorbiaceae	0	0	0.11
Solete	*Maerua nude*	Capparidaceae	0	0	0.11
Tainkoke	*Eretia sp.*	Boraginaceae	0	0	0.11
Tamboro	*Paedera sp.*		0	0	0.11
Tsangatse	*Contharathus roscus*	Apocynaceae	0	0	0.11
Tsiambara	*Leucosalpa pris*	Serophulariaceae	0	0	0.11
Valiandro	*Polyscias sp.*	Araliaceae	0	0	0.11
Voapotaky	*Eclinea cearicima*	Rubiaceae	0	0	0.11
	Euphorbia tulearenns	Euphorbiaceae	0	0	0.11
	Gardenia sp.	Rubiaceae	0	0	0.11
	Odosycios sp.	Cucurbicaceae	0	0	0.11
Ambilaza			0	0	0.05
Andriambolafy	*Croton sp.*	Euphorbiaceae	0	0	0.05
Angalora			0	0	0.05
Angosiloky	*Asparagus sp.*	Liliaceae	0	0	0.05
Ansiky		Liana	0	0	0.05
Beholitse	*Hymenodictum decaryi*	Rubiaceae	0	0	0.05
Bemaimbo			0	0	0.05
Benono	*Acacia rovumae*	Fabaceae	0	0	0.05
Entignetigny			0	0	0.05
Fatidronono	*Evonymopsis sp.*		0	0	0.05
Halomboronale	*Albizzia masiko*	Mimosaceae	0	0	0.05
Hazomalagny	*Moninga drouhardi*		0	0	0.05
Hazonta	*Rhigozum madagascarensis*		0	0	0.05
Hazontsoky			0	0	0.05
Hento	*Roupellina boivini*	Apocynaceae	0	0	0.05
Kirava	*Mimosa delicatula*	Mimosaceae	0	0	0.05
Kitohitohy	*Phylarthron sp.*	Bignoniaceae	0	0	0.05
Kompitse	*Gonocrypta grevei*	Asclepiadaceae	0	0	0.05
Kotry			0	0	0.05
Lay		Malvaceae	0	0	0.05
Mangarahara	*Stereospermum varibile*	Bignoniaceae	0	0	0.05
Maninjo	*Cedrelopsis microfoliata*	Ptaeroxylaceae	0	0	0.05
Mantsake	*Enterospermum sp.*	Rubiaceae	0	0	0.05
Nafaibelo	*Strychnos sp.*	Loganiaceae	0	0	0.05
Raketa	*Opuntia sp.*	Cactacea	0	0	0.05

Vernacular name	*Scientific name*		*Median IDC*	*Median ICAC*	*Proportion occurrence*
	Genus species	*Family*			
Retsilaitse	*Noronhia myrtyoides*	Oleaceae	0	0	0.05
Roivontsy	*Acacia sp.*	Mimosaceae	0	0	0.05
Sahondra 1	*Henonia sp.*		0	0	0.05
Sainty		Rubiaceae	0	0	0.05
Sasavy	*Salvadora sp.*	Salvadoraceae	0	0	0.05
Seta	*Humbertiella henri*	Nalvaceae	0	0	0.05
Sida			0	0	0.05
Taintsande		Euphorbiaceae	0	0	0.05
Taritarike	*Leptadenia madagascarensis*	Asclepiadaceae	0	0	0.05
Tsilaitsy	*Nhoronia sp.*	Oleaceae	0	0	0.05
Tsirambeimbosy			0	0	0.05
Vahemalo			0	0	0.05
Vahimasy			0	0	0.05
Velomihanto			0	0	0.05
Velomihotoky		Liana	0	0	0.05
	Angraecum sp.		0	0	0.05
	Carina edulus		0	0	0.05
	Celastracus sp.	Celastraceae	0	0	0.05
	Ecbolium linea	Acanthaceae	0	0	0.05
	Enterospermum purinosum		0	0	0.05
	Eocodades sp.	Orchidaceae	0	0	0.05
	Euphorbia francoisi		0	0	0.05
	Kalanchoe grandidieu	Crassulaceae	0	0	0.05
	Kalanchoe tubiflora	Crassulaceae	0	0	0.05
	Maba microphylla		0	0	0.05
Unknown sp.2			0	0	0.05
Unknown sp.3			0	0	0.05

2.4. Global Positioning System (GPS) Co-ordinates of Relevés.

		R11	----- -----
R2	24 45' 48.1" S 46 08' 07.1" E	**R12**	24 45' 76" S 46 09' 35" E
R3	24 45' 39.9" S 46 08' 04.8" E	**R13**	24 45' 61" S 46 09' 32" E
R4	24 45' 49.1" S 46 08' 32.3" E	**R14**	24 45' 53" S 46 09' 30" E
R5	24 45' 51.7" S 46 08' 36.9" E	**R15**	24 45' 16" S 46 09' 32" E
R6	24 45' 55.7" S 46 08' 45.0" E	**R16**	24 45' 02" S 46 09' 62" E
R7	24 45' 57.9" S 46 08' 52.2" E	**R17**	24 44' 88" S 46 09' 77" E
R8	24 45' 56.7" S 46 08' 59.3" E	**R18**	24 45' 09" S 46 09' 62" E
R9	----- -----	**R19**	24 44' 92" S 46 09' 80" E
R10	24 45' 65" S 46 09' 31" E	**R20**	24 45' 12" S 46 09' 55" E

Lemur Ecology

3.0 Summary

- The presence of *Propithecus verreauxi verreauxi* (Verreaux's Sifaka), *Lemur catta* (The Ring-tailed Lemur), *Lepilemur leucopus* (The White Footed Sportive Lemur) *Microcebus murinus* (Grey Mouse Lemur) is confirmed at Ifotaka
- The population density of *Propithecus v. verreauxi* was estimated as 33.77 individuals per square kilometre from a transect walk survey.
- The population density of *Propithecus v. verreauxi* was estimated as 37.25 individuals per square kilometre from point count surveys.
- Populations of *Propithecus v. verreauxi* tend not to occur in sections of the transect with agricultural disturbance present.
- Point counts are a more reliable method of population survey for sifakas than transect walks with coefficients of variation of 10.79% and 37.78% respectively. For this reason the estimate of **37.2 individuals per square kilometre** is recommended by this study.
- In the study of habitat use, 12 species of trees were found to be used for support by the sifakas, 50% of the trees recorded as being used by *Propithecus v. verreauxi* in this survey were of the species Fantiolotse (*Allaudia procera*). This tree species is at great threat from human use because it is the main tree species used for house construction timber.
- The proportion of trees used by sifakas that were food species was not different to the proportion of randomly selected trees in the forest, which were food species. This result does not account for actual presence of food items.
- The basal area and height of the four nearest neighbours of trees used by sifakas is greater than that of randomly selected trees in the forest suggesting that Sifakas depend on mature stands of trees or stands of larger tree species.
- Allocation of time by sifakas shows 46% of time was spent Feeding, 36% of time Resting and 11% of time Moving.
- Peaks in moving and feeding occur in mid morning and mid afternoon. Peaks in resting and grooming occur at the start of the day the end of the day with a further peak in resting in the middle of the day.

3.1 Aims of Lemur Ecology Studies

The following chapter presents the results the studies on the ecology of Verreaux's Sifaka in the Ifotaka Forest, *Propithecus v. verreauxi.* The aims of the study were :

- To estimate the population density of *Propithecus v. verreauxi*
- To investigate the characteristics of habitat uses by *Propithecus v. verreauxi*
- To investigate the partitioning of time by *Propithecus v. verreauxi*
- To investigate the diet of *Propithecus v. verreauxi*

3.2 *Propithecus verreauxi verreauxi* : Literature Review

Verreaux's Sifaka (*Propithecus verreauxi),* a member of the Family INDRIIDAE has up to 5 subspecies (Harcourt and Thornback, 1990; Richard and Dewar, 1991)) of which only *Propithecus verreauxi verreauxi* occurs in the spiny forest biotope. Its range extends north to the Tsiribihina River (Tattersall, 1982) in western dry deciduous forest and eastwards to Andohahela reserve (Harcourt and Thornback, 1990, Tattersall, 1982) as shown in Fig 2. This species thrives in all sorts of forest within its range from gallery forest (Jolly, 1966) to arid *Didierea* formations (Tattersall, 1982) although is not known to inhabit scrub vegetation (Sussman and Richard, 1986). It is renowned for its unique ability to leap between trees of the *Allaudia* genus (Richard 1985) on which it feeds (see Figure 3).

Plate 3.1 *Propithecus v. verreauxi* feeding on *Allaudia ascendens.*

Studies on this species have been focused mainly on protected areas, at Berenty (Jolly, 1966,1972; Jolly et al 1982; O'Connor, 1987; Oda, 1998; Howarth et al, 1986;

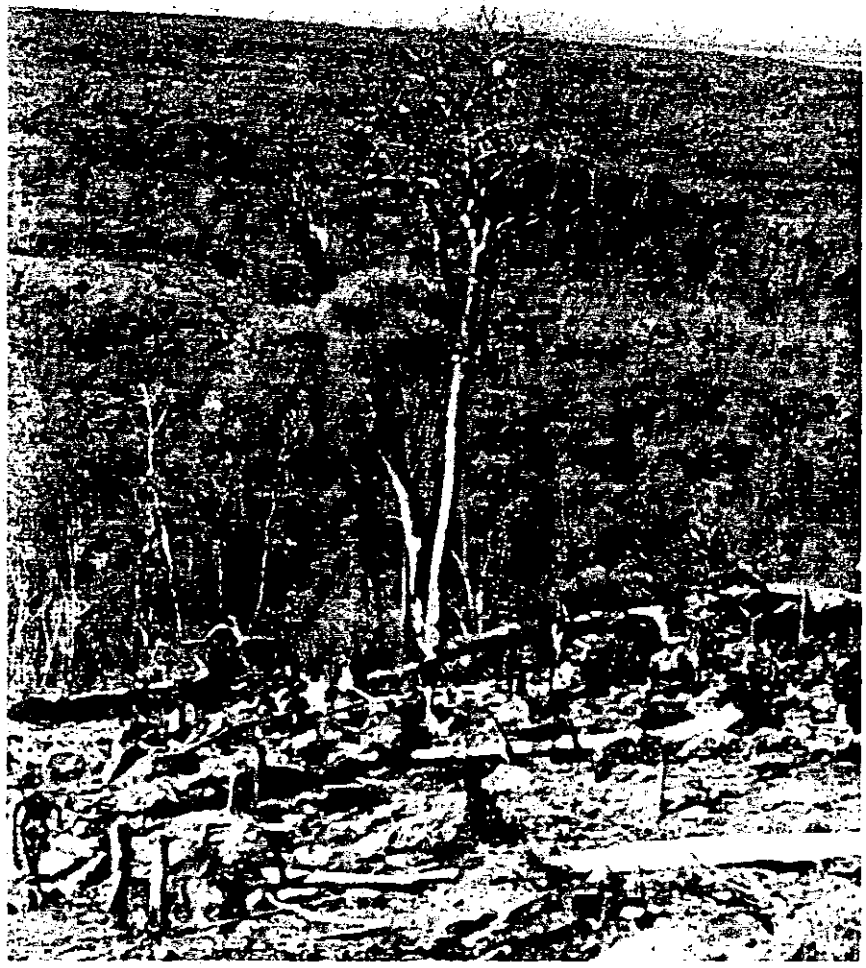
Sussman, 1974), Beza Mahafaly (Richard 1977, 1985, 1992; Richard and Dewar, 1991), Kirindy (Ralisoamalala, 1996; Ganzhorn and Kappeler 1996; Carrai and Lunardini, 1996, Scharfe and Schlund, 1996) and Andohahela/Hazafotsy (Richard, 1974, 1977a). One published study has been conducted in unprotected forest at Antseranomby (Sussman, 1974) and one unpublished study by Boggess and Smith (1963) is reported from Lambomakandro (Harcourt and Thornback, 1990).

Population density estimates of *Propithecus verreauxi verreauxi* range from a small population of 40 to 50 individuals at Antseranomby (equivalent to 400 and 500 individuals per sq. km) (Sussman, 1974) to the most recent estimate in the gallery forest of Berenty of 211 individuals per sq. km (O'Connor, 1987). O'Connor (1987) found that disturbed spiny forest at Bealoka beside Berenty held a population at a density of 47 individuals per sq. km. It has an IUCN conservation status of Vulnerable

A behavioural study by Howarth *et al.* (1986) found troops at Berenty to spend 46% of their time feeding, 19% resting and 15% moving. When studying feeding behaviour in the spiny forest at Hazafotsy, Richard (1977) found that individuals spent more time feeding in the wet season (32.8%) than in the dry season (24.2%). Dietary studies of *Propithecus v. verreauxxi* indicate that it is both folivorous and frugivorous (Richard, 1985). This diet is supplemented by flowers and bark (Jolly, 1966; Richard, 1977). It is widely agreed that this sub-species exhibits great seasonal variation in its diet (Harcourt and Thornback, 1990, Richard, 1977, Jolly, 1966) and is an opportunistic feeder, taking a wide range of food items as they become available (O'Connor, 1987 reported in Harcourt and Thornback, 1990). Its diet in the wild consists of more than 79 species, although only a small proportion make a significant component during any season. Richard found this to be between 5 and 8 species, varying with season, year and food availability (1977). O'Connor (1987) found troops in Bealoka to feed on 35 species, but less than half of these were eaten for more than 1% of the time and less than a quarter were eaten in all seasons. The diet of populations in the spiny forest areas is almost entirely different, in terms of species composition, from that of populations in the dry deciduous forest in the west of Madagascar (Richard, 1977). Jolly, 1966 found *Propithecus verreauxi verreauxi* to feed on 18 plant species and reported Boggess and Smith as observing it feeding on 12 species. As with *Lemur catta* Jolly (1966) observed *Tamarindus indica* to be the staple food at Berenty in a diet consisting 65% of fruit, 25% leaves and 10% flowers. Richard (1977) saw much greater variation in dietary composition at Hazafotsy with fruit contributing from 20 to 80% and adult leaves from 10 to 70%, young leaves never exceeded 20% and flowers 30%. The variation was correlated with the seasons, with a higher proportion of fruit being consumed during the wet season, when it is more available. The proportion of adult leaves consumed increased at the start of the dry season when less fruit was available. Richard also found that the proportion of flowers in the diet was most significant during the onset of the wet season in January before the time of maximum fruit availability, she showed that proportion of each food item consumed is strongly linked to the phenological state of the plants, supporting the idea that sifaka are opportunistic feeders and their apparent seasonal preferences for food types are dictated by availability. This idea is supported by O'Connor (1987) and Jolly (1966). This wide ranging diet in the wild has been suggested as one of the reasons for difficulty in keeping the species alive in captivity (Jolly, 1966; Ranorosoa pers. comm.) perhaps because switching feeding from species to species is necessary to minimise the accumulation of any toxins. Their lack of need to drink water directly (Harcourt, 1990) and their broad diet are likely reasons for the species survival in a wide range of habitat types (Jenkins, 1987) despite less efficient habitat utilisation than *Lemur catta.*

With this review, it becomes clear that feeding habits of *Propithecus v. verreauxi* have been extensively studied, indeed the extent of relevant behavioural studies makes it one of the most extensively studied of the Malagasy primates (Harcourt and Thornback, 1990). The dietary studies have been detailed, although located within a very limited extent of their range, almost entirely in protected or managed areas (it is uncommon for behavioural studies to be conducted out of protected areas (Ganzhorn pers. comm.)). Given the variable nature of the habitats occupied (Jenkins, 1987) it should be a priority to supplement the currently published information with new data from other parts of the species range. For this reason Project Ifotaka 1999 had as a central aim to conduct a preliminary investigation into the ecology of *Propithecus v. verreauxi* in Ifotaka.

Plate 3.2 Deforestation showing a direct threat to lemur habitat in Ifotaka, August 1999



3.3 Population Estimation of *Propithecus v. verreaxi*

3.31 Methods

Population densities of Malagasy lemurs outside protected or managed areas have not previously been estimated (Simons, 1997). For this reason a central objective of this study was to provide such estimates for the diurnal species inhabiting the forest. Two methods were employed.

a) Transect Walks:

The transect, based on the Isantoria River bed which is illustrated on Maps 2 and 3. It extended from the hamlet of Morafeno to the village of Andavatsak. The transect was 11.5Km in length and was dry during the survey period in July and August 1999. The transect was split into 500m sections and within each, the field of view along each side of the river was estimated visually, aided by FTM Map K-61 (FTM, 1956), so giving estimates of the survey area (See Figure 3.1 for schematic diagram). The 500m sections were then placed in four groups (Up Near, Up Far, Down Near and Down Far) and each of these four groups was surveyed by a pair of students four times, twice shortly after dawn (0700-0900)(once in each direction) and twice shortly before dusk (1530-1730) (again once in each direction). The pair accompanied by a local guide walked at a constant speed of ≈1.5Km/hr (Bibby *et al.*, 1992) scanning the area with the naked eye and 10X50 Binoculars. One person was responsible for each side of the river valley. Upon sighting a group of lemurs the team would stop for 10 minutes to determine the size of the lemur group, data recorded included species, group size, location (on sketch map) and time of sighting. The survey then continued. The mean of the results of the four surveys for each section was calculated to produce the density estimates in individuals per sq. km.

This method provided sufficient data to estimate population densities of *Propithecus v. verreauxi* and recorded the presence/absence of *Lemur catta*. A census of the human disturbance along the transect was also carried out by estimating the relative abundance of agricultural cultivation in each of the 500m sections (either adjacent to the riverbed or in the forest). Values on a scale from zero to five (with fractions) were allocated to each section, with zero indicating no cultivation and five indicating the maximum amount of cultivation (consisting of manioc, bageda, and maize as well as grazing by goats and zebu (cattle)).

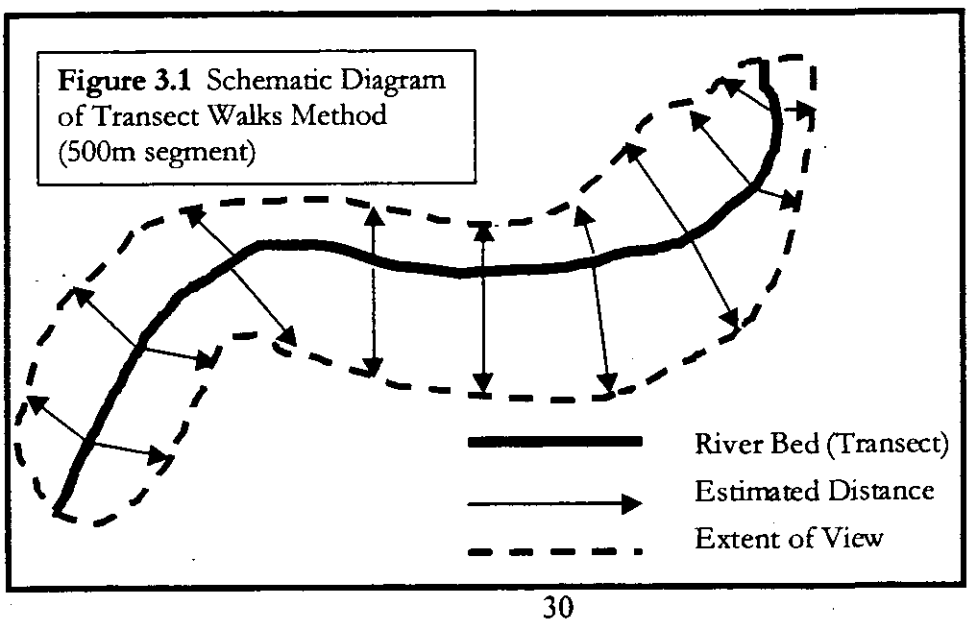


Figure 3.1 Schematic Diagram of Transect Walks Method (500m segment)

b) Point Counts

Upon completion of the transect surveys it was deemed necessary to compare that method with an alternative. This would determine if the vegetation visible from the riverbed supported different population densities to the hilltop vegetation (which was under-represented in the transect field of view) and to enable a review of two primate population census methods in order to make recommendations for possible future research.

Six survey points were chosen on prominent locations with large survey areas of habitat deemed to be suitable for habitation by sifakas visible. Survey points were located close to the Asantoria riverbed, with the exception of point D which was located on Benivo, a hill north of the area surveyed with transect walks, this was used because no other suitable locations existed along the river. The areas surveyed with this method were not comparable to the areas surveyed by transect walks. The survey teams, which consisted of two students assisted by one local guide, typically used hilltops and cliff tops and. The teams remained at each survey point from 0700 to 1700 for 2 consecutive days. The survey area was determined using FTM map K-61 and visual distance estimation areas ranged from 549157 sq. metres to 2016204 sq. metres. For each 15-minute period of the survey the number of lemur groups visible and the size of each of these groups was recorded along with their location on a sketch map (See Fig 5 for schematic diagram). The maximum number of individuals observed at any point during each day of the survey was used to estimate population density, so producing two values for each point. Using the maximum number of individuals visible at one time minimises the bias from the variation in detectability through the day.

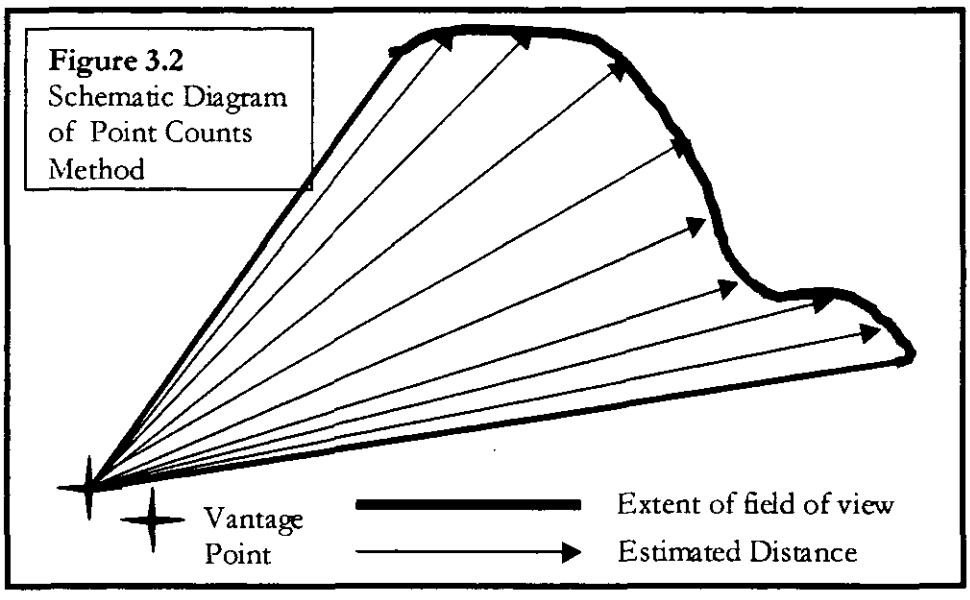


Figure 3.2
Schematic Diagram of Point Counts Method

3.32 Results

a) Transect Walks

Figure 3.3 below illustrates the *Propithecus v. verreauxi* population density estimates obtained along the Isantoria Riverbed from the transect walks method. They ranged from zero to 219.65 individuals per square kilometre with a mean of 33.77 (SE 11.37). There is an unequal distribution of population densities (chi-square[1]=1937, df=22; P<0.01), the pattern shows a general increase with distance from either end of the transect. The village of Morafeno is located at the start of the 0-0.5Km section and the village of Andavatsak is located at the end of section 11-11.5Km, the centre section (5-5.5Km) was the field camp for the research team.

The survey of human agricultural disturbance along the transect is illustrated in Figure 3.4, it has an unequal distribution along the transect (chi-square = 60.49, df=22, p<0.05). The pattern exhibited the highest values at either end of the transect and the smallest values at the centre of the transect.

A modest correlation between population density and agricultural disturbance was observed (Spearman Rank = 0.517, p>0.02) suggesting a dissociation between the presence of lemurs and agriculture.

Figure 3.3 Population density estimates of Propithecus v. verreauxi with SE along the Isantoria Riverbed (from Transect Walks)

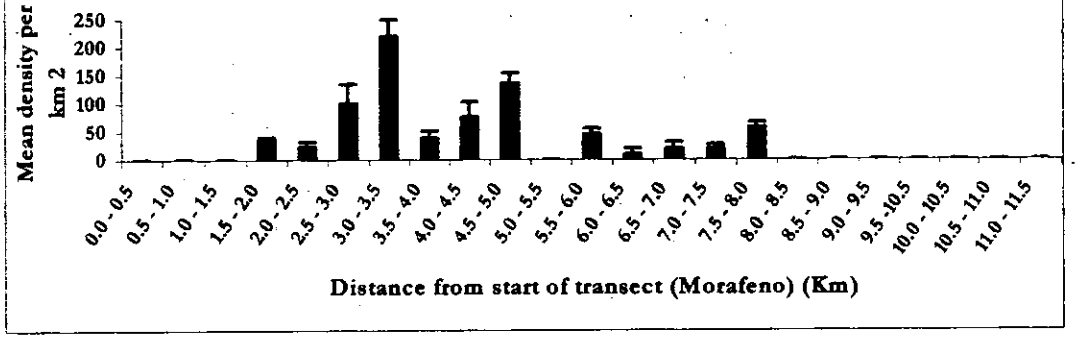
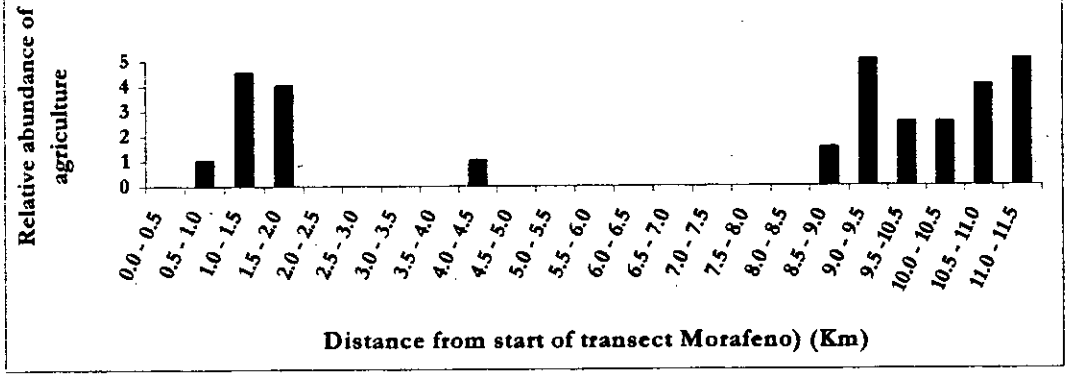


Figure 3.4 Agricultural Disturbance along the Isantoria Riverbed



[1] Using total counts over the four repetitions.

Table 3.1 Mean population density estimates of *Propithecus verreauxi verreauxi* for all sections of the Isantoria Riverbed surveyed by transect walks.

Section	Mean Population Density Individuals per sq km (n=4)	S.E.	Coefficient of Variation (S.Dev/Mean) (%)
UP11	0	0	0
UP10	0	0	0
UP9	0	0	0
UP8	35.33	5.38	30.48
UP7	23.61	8.34	70.71
UP6	100	35.13	70.26
UP5	219.64	30.15	27.45
UP4	38.26	13.41	70.13
UP3	76.27	27.04	70.92
UP2	135.48	19.35	28.57
UP1	0	0	0
D1	44.73	10.85	48.50
D2	9.65	9.65	199.99
D3	18.30	12.35	135.02
D4	18.78	7.67	81.64
D5	56.73	10.02	35.35
D6	0	0	0
D7	0	0	0
D8	0	0	0
D9	0	0	0
D10	0	0	0
D11	0	0	0
D12	0	0	0
SUM	776.84		869.02
Mean	33.77		[2]37.78
SD	54.54		
SE	11.37		

[2] Mean coefficient of Variation was calculated including only sections where animals were detected.

b) Point Counts

The point count surveys (illustrated in table 3.2) produced mean estimates from 7.34 to 95.07 individuals per square kilometre with a mean of 37.25 (SE 14.51) over the six sites surveyed.

Table 3.2 Estimated Population density of *Propithecus v. verreauxi* from Point Counts in the Ifotaka Forest (individuals per sq. km)

Point	Location relative to Transect Walks	Day One	Day Two	Mean	SD	SE	Coefficient of Variation (%)
A	D1	15.35	18.77	17.06	2.42	1.71	14.18
B	D4	10.41	12.40	11.40	1.41	0.99	12.36
C	UP4	89.97	100.18	95.07	7.22	5.11	7.59
D	UP5	21.67	30.00	25.84	5.90	4.17	22.83
E	NW[3] (Benivo)	7.69	6.99	7.34	0.49	0.35	6.68
F	UP2	66.25	67.29	66.77	0.74	0.52	1.11
Mean		35.22	39.27	37.25			10.79
SD		34.39	36.78	35.54			7.48
SE		14.04	15.02	14.51			3.05

c) Review of census methods

One of the aims of this study was to make a comparison between the two different population census techniques. As shown in tables 2 and 3 the mean population density estimates for the two techniques are close despite surveying slightly different areas. The mean coefficient of variation for the point counts method is lower than that for the transect walks method (10.79 and 72.42 respectively) despite the point counts having only two repetitions compared to the four repetitions for the transect walks. This suggests that the point counts provide a more reliable estimate of population density with less survey effort.

[3] NW = Not within the transect walk area. Benivo is a hill north of the Asantoria River within the Ifotaka Forest.

3.33 Discussion

a) Transect Walks

The population density estimates for *Propithecus v. verreauxi* from the transect walks (Figure 3.3 and Table 3.1) increased from both ends of the transect towards the centre. Chi-squared tests (Section 3.3b) showed that disturbance and population density estimates were not uniform along the transect. The Spearmans Rank Correlation (3.3b) showed those transect sections with agriculture present generally did not hold groups of sifakas. As in this study agriculture is the measure of disturbance, it may be a contributory factor for the absence of sifakas at the ends of the transect

It is vital to bear in mind that the index used only considered agricultural disturbance, which is frequently located along the flatter areas of land. The presence or absence and amount of agriculture may also be related to the topography of the land. For this reason it is suggested that in any future survey, other methods of classifying the habitat quality should be used. This will allow more detailed determination of the habitat characteristics of the areas inhabited by sifakas as well as the areas not inhabited by them. If for example, tree density was surveyed it may be a useful classification of the habitats with and without lemurs present.

The population density estimate for section up1, 5-5.5km from Morafeno, was zero individuals per square kilometre (Figure 3.3, Table 3.1). This may not be a true reflection of the population present in this section of forest as the field camp was located here and sifakas were sighted on many occasions in this area (pers. obs.), although not during the transect walk surveys. Their absence may be explained by the noise caused by the research team as well as the fact that the sifakas were not habituated to humans.

b) Point Counts

The point count surveys were not conducted in conjunction with a disturbance survey and were not strictly comparable to the transect walk surveys as they surveyed different areas. They covered only those areas which were deemed habitable (i.e. those without significant areas of scrub vegetation or cleared ground). Despite this, there was some overlap between the survey areas as both sets of surveys were conducted around the Isantoria Riverbed. The point counts covered some hilltop vegetation which was under-represented in the field of view of the transect walk. A mean population density estimate of 37.25 individuals per sq. km (SE 14.51) over the 6 survey areas was produced.

c) Review of Census Techniques

The coefficient of variation in the results obtained for each of the sections in the transect walks and in each of the areas in the point counts was calculated to assess the reliability of the results obtained in each survey. The surveys were not strictly comparable in terms of the resulting estimates but the point counts were found to provide a much more constant estimate over two surveys (mean coefficient of variation = 10.9) than the transect walks over four surveys (mean coefficient of variation for sections with lemurs present =72.42). This may be due to the smaller area surveyed by the transect walks which is likely only to compose part of the home range of the sifakas. Whereas the areas surveyed by the point counts are much larger and are likely to contain the whole range of at least some of the troops detected in it.

For future surveys of this species in spiny forest, I would suggest that where the landscape allows it, point counts from good viewing points might be the most effective and accurate population census technique. Perhaps the use of a telescope and tripod in addition to binoculars would allow more confident detection of group sizes.

3.4 Habitat Use by *Propithecus v. verreauxi*

3.41 Methods

An investigation into the habitat use by Verreaux's sifaka was conducted by examining the spatial association between the forest tree species and the lemur. Surveys were conducted by Barry Ferguson or Julian Mallinson accompanied by Claudine Ranorosoa from Parc Tsimbazaza and a local Ombiasa (Manahira or Fanahisoa). We searched for groups of lemurs between 0730h-0930h and 1500h-1730h between the 4th and 28th August 1999. On locating a lemur(s), the tree(s) on which the lemurs were resting at the time of first sighting was identified. The following variables were then recorded: Time of sighting, number of lemurs using tree, tree species (Identified by the Ombiasa), girth at breast height (gbh), phenology, status as a lemur food plant or not (data from Table 8 and Ombiasa knowledge). The Point Centred Quarter method was used to determine the tree density and canopy basal area of the trees surrounding the sample tree. Variables recorded for the nearest tree (gbh>10cm) were: species (food or not), gbh, distance from sample tree and phenology. This procedure was completed for 20 trees in the morning, 20 trees in the afternoon and 20 randomly selected trees.

3.42 Results

In this study sifakas were found to use 12 tree species for support in the morning and four of these in the afternoon. Randomly chosen trees were of 15 species, only 3 of which were found to be used by the lemurs. Half (20) of the trees used by lemurs in this survey (n=40) were Fantiolitse (*Allaudia procera*), 5 of the 40 trees surveyed were Siro Siro (*Gyrocarpus americanus*) and 4 were Kolohoto (*Albizzia sp.*). The other species found to be used were not recorded more than twice. 12 further species were recorded from the random sample, but were not in this instance found to be used by the sifakas (data illustrated in Figure 3.5).

Figure 3.5 Proportion of trees of each species used by *Propithecus verreauxi verreauxi* (am & pm) compared with random.

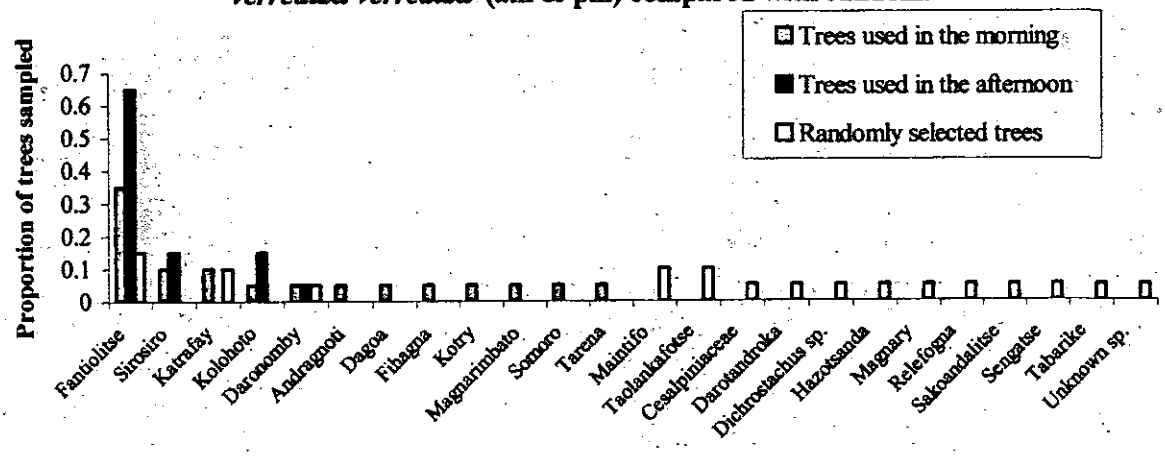


Plate 3.3 *Propithecus v. verreauxi* with infant on *Allaudia procera* (Fantiolotse).

Table 3.3 Vernacular and scientific names of tree species used by *Propithecus v. verreauxi.*

Vernacular Name	Family	*Genus*	*Species*
Fantiolitse	DIDIERACEAE	*Allaudia*	*procera*
Sirosiro	HERNANDIACEAE	*Gyrocarpus*	*americanus*
Katrafay	PTAEROXYLACEAE	*Cedrolopsis*	*grevei*
Kolohoto	MIMOSACEAE	*Albizzia*	*sp.*
Daronomby	BURSERACEAE	*Commiphora*	*marchanedia*
Andragnoti	RUBIACEAE	*Gardenia*	*ambovombensis*
Dagoa	LOGANIACEAE	*Strychnos*	*decussata*
Fihagna	EUPHORBIACEAE	*Euphorbia*	*plagianta*
Kotry	MORACEAE	*Ficus*	*sp.*
Magnarimbato	FABACEAE	*Dalbergia*	*sp.*
Somoro	EUPHORBIACEAE	*Croton*	*mongy*
Tarena	RUBIACEAE	*Tarena*	*sp.*
Maintifo	EBENACEAE	*Diopyros*	*humbertiana*
Taolankafotse	TILIACEAE	*Grewia*	*sp.*
Cesalpiniaceae	CESALPINACEAE	*unidentified*	*sp.*
Darotandroka	BURSERACEAE	*Commiphora*	*sp.*
Dichrostachus sp.	MIMOSACEAE	*Drichostachus*	*sp.*
Hazotsanda	EUPHORBIACEAE	*Gelonium*	*sp.*
Magnary	FABACEAE	*Dalbergia*	*trichocarpa*
Relefogna	LOGANIACEAE	*Strychnos*	*madagascarensis*
Sakoandalitse	ANACARDIACEAE	*Operculicarya*	*I*
Sengatse	BURSERACEAE	*Commiphora*	*simplicifolia*
Tabarike	TILIACEAE	*Grewia*	*andronensis*
Unknown sp.	-	-	-

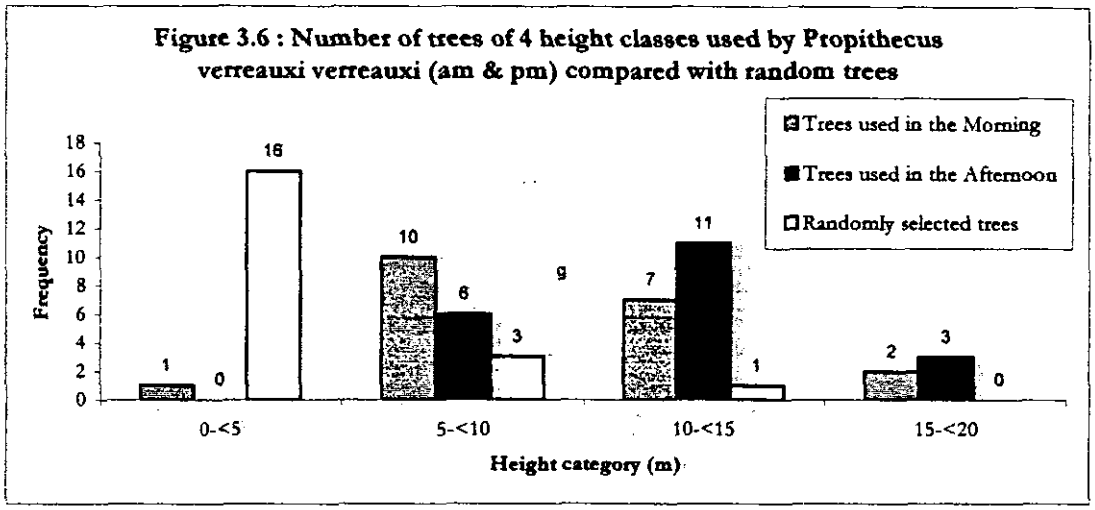


Figure 3.6 (above) illustrates the proportion of the trees used by the sifakas in the morning and afternoon and the randomly selected trees which are food species. Comparisons between the randomly chosen trees and those used in the morning shows no significant difference (Chi square = 0.00023; df=1; NS). Similarly there is no significant difference between the random trees and those used in the afternoon (Chi square = 0.01738; df=1; NS).

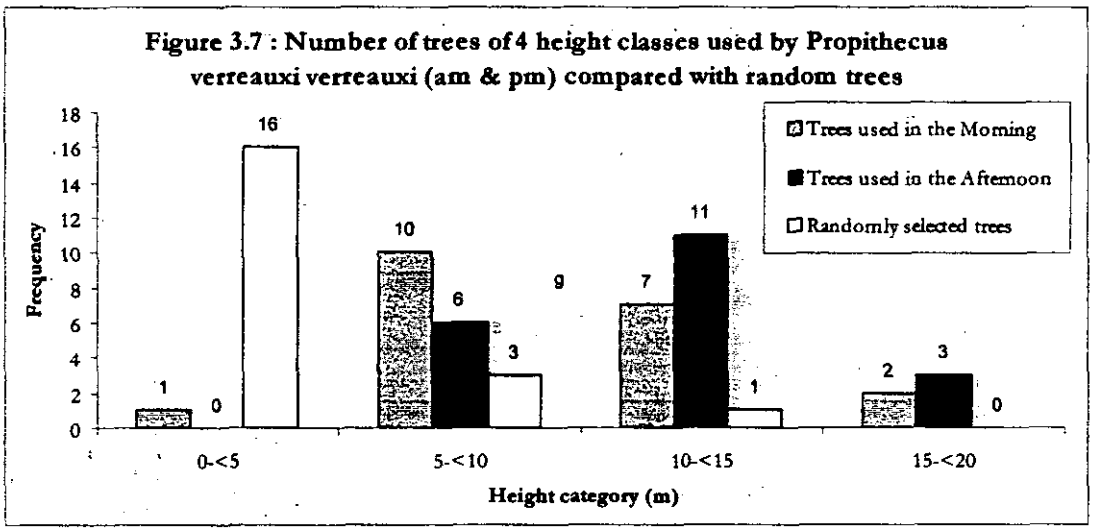
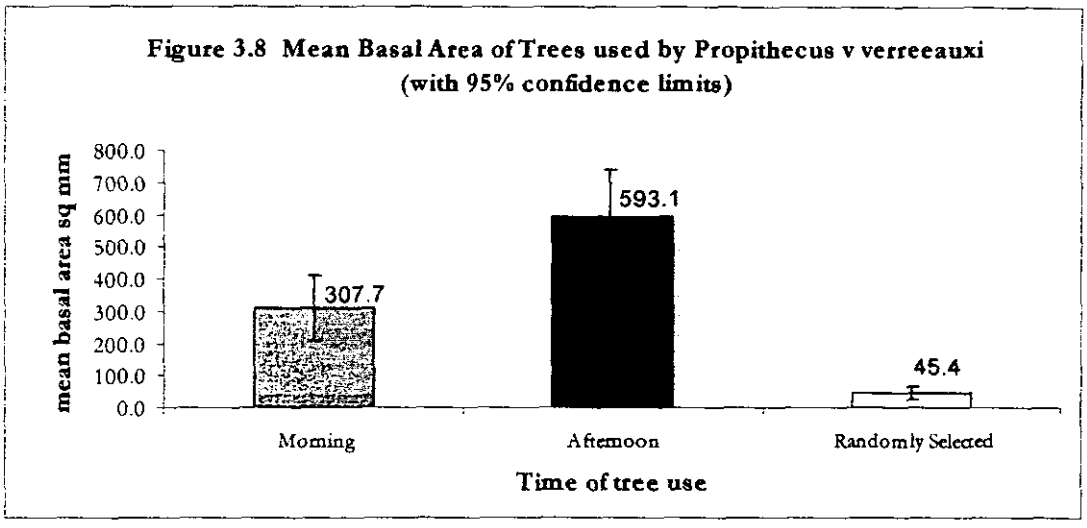
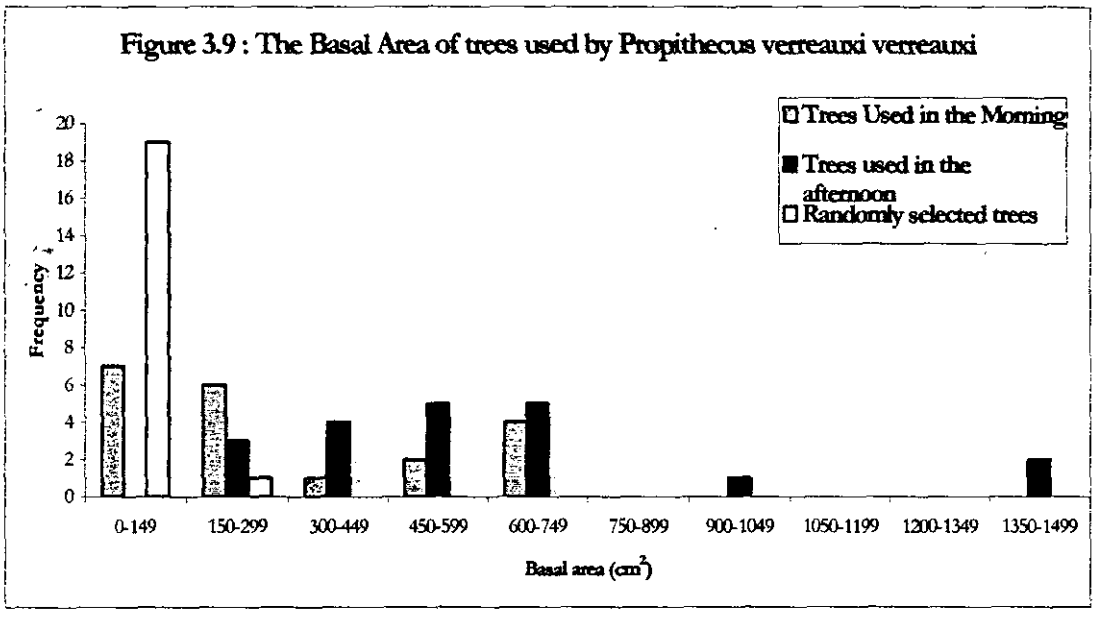


Figure 3.7 illustrates the height categories of the trees used by sifakas in the morning and afternoon and the randomly chosen trees. A Fisher Exact test comparing trees used in the morning to random (combining the 0>5m/5>10m and 10>15m/15>20m categories) shows that the sifakas use significantly taller trees than the randomly selected trees in the forest (Fisher Exact $p < 0.01$). The comparison between the afternoon trees and the random trees also shows a significant difference with the trees used in the afternoon being significantly taller than the random trees (Fisher exact $p<0.001$). The comparison between the heights of the trees used in the morning and afternoon does not show a significant difference (Chi Square x=2.56, df=1, NS), although Fig 3.7 indicates that in this sample a greater proportion of tall trees are used in the afternoon than in the morning (70% of the trees used in the afternoon were greater than 10m tall compared with 45% of trees used in the morning).





Figures 3.8 and 3.9 illustrate the basal area of trees used by *Propithecus v. verreauxi* in the morning and afternoon and of random trees in the forest. There are significant differences between the basal area of the trees used in the morning and afternoon and between both of these groups of used trees and randomly chosen trees in the forest (Kruskal-Wallis test $K=39.4$; $df=2$; $n=60$; $p<0.01$). The trees used in the afternoon have a significantly higher median basal area than the trees used in the morning ($U=92.5$; $p<0.05$, Mann-Whitney U-test) as well as the random trees ($U=0$; $p<0.05$, Mann-Whitney U-test). The trees used in the morning also have a significantly higher median basal area than the random trees ($U=24.5$, $p<0.05$, Mann-Whitney U-test).

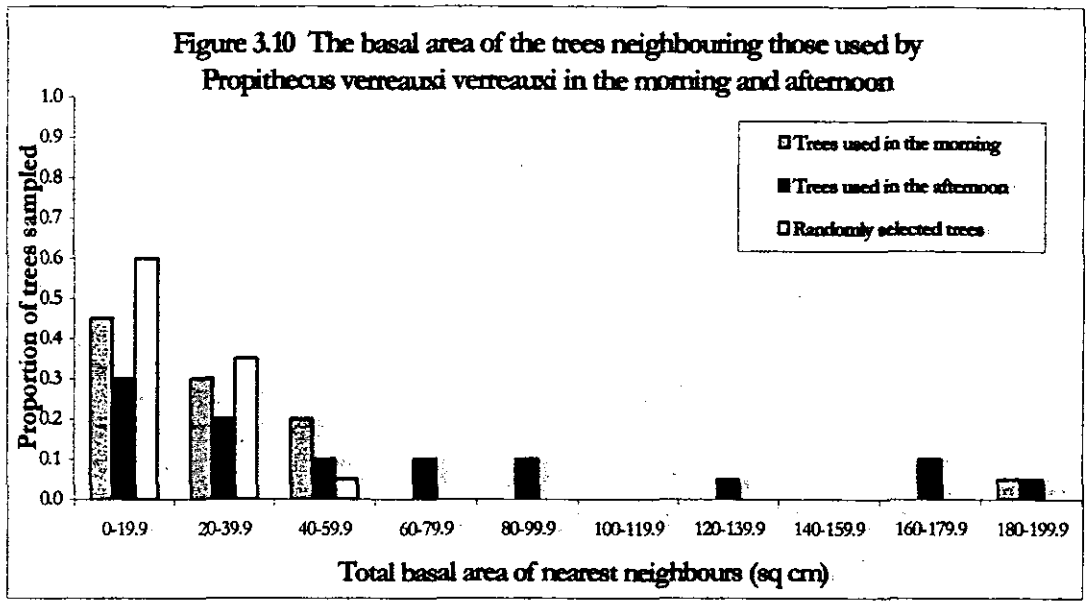


Figure 3.10 illustrates the distribution of total basal area of nearest neighbour trees to those trees used by sifakas in the morning, afternoon and random trees. Mann-Whitney *U*-tests were applied to comparisons between:

1) **Morning and afternoon** -showed no significant difference between the medians ($u=140; p>0.05$).
2) **Morning and random** - showed a significant difference with the median of morning being significantly greater than the median for the random trees ($u=112$; $p<0.05$). This shows that the communities around the trees used in the morning are composed of trees larger than the communities around the randomly selected trees.
3) **Afternoon and random** – showed a significant difference with the median of the afternoon trees being significantly larger than the median of the random trees ($u=71$; 0.05). This shows that the communities around the trees used in the afternoon are composed of trees larger than the communities around the randomly selected trees.

3.43 Discussion

The point quarter centre survey of Sifaka habitat use saw the sifakas using 12 tree species in the morning and 4 of these in the afternoon, the randomly selected trees were of 15 species, of which only 3 were found to be used by the lemurs. Fantiolitse, *Allaudia procera* proved to be the tree most used by the sifakas, with half of the records being on this species. This may be due to a range of benefits conferred by the features of the tree, including its great height relative to other species in the forest, the small proportion of non-vertical branches and the presence of food items. The first two will allow the sifakas a good view of the surrounding area and relatively easy movement, both of which are benefits in escape from predators. In addition, the sifaka is known to be primarily a vertical clinger and leaper (Jolly, 1966) so the vertical and near vertical branches will provide the most appropriate habitat.

As illustrated by figure 3.6 there was no significant difference in the proportion of food species used in the morning or afternoon compared to random, this may be due to the wide range of plant species consumed by the sifakas. However, as this study did not record the presence or absence of food items on individual trees any future study

could consider the proportion of trees used with food available at the time of survey. In addition it would be useful to conduct a study with a larger sample over a longer temporal scale to investigate any seasonality of this behaviour, especially considering the change in the range of species in the diet.

The sifakas appear to use higher trees than those typical of the forest (the randomly selected trees), this may be because taller trees tend to provide a more prominent location for protection from predators such as the fosa (*Cryptoprocta ferox*) and birds of prey. In addition other features such as the characteristics of the thorns and of non-vertical branches on trees may vary with height and influence the choice of tree for resting in. It is suggested that any further study could investigate more thoroughly the characteristics of the trees and surrounding communities used by sifakas, measuring such variables as the density of branches and foliage, the characteristics of thorns on trees, the visibility from branches used by the sifakas and availability of food items.

Statistically there was no difference between the heights of trees used in the morning and afternoon, however figure suggests that a pattern may exist with trees used in the afternoon tending to be higher than those used in the morning. If a true pattern does exist it could potentially be explained by lemurs selecting trees with certain attributes for use during the night. They tended to settle for the night in the trees in which they were resting in the late afternoon, these trees were typically used for the sunworshipping performed in the early morning to warm the sifakas up.

The mean basal area of the trees used in the afternoon was found to be significantly greater than for those trees used in the morning, which were also greater than the randomly chosen trees. Basal area dictates the strength of the tree and the basal area of the trees is strongly correlated with their height (Spearmans rank, $r=0.76$, $p>0.005$). As sifakas will choose trees that are best able to support their weight, this explains to some degree their choice of trees. The even greater basal area for trees used in the afternoon suggests, as does the suggested pattern of greater height, that individuals use taller, stronger trees in the afternoon as this is where they tend to spend the night (pers. obs.).

The pattern shown for the trees surrounding the trees being used, also show the mean basal area to be greater for the trees used in the morning and afternoon than the random trees. There is no statistically significant difference between the mean basal areas of the nearest neighbour trees in the morning and afternoon (despite the communities around the afternoon trees appearing to be greater - Figure). This is difficult to interpret in the absence of a comprehensive vegetation classification of the forest. It suggests that the tree communities around the trees used by the lemurs have greater densities of larger, maturer trees than the forest as a whole, this therefore further emphasises the importance of conserving areas with mature forest communities.

It is suggested that for any future studies of habitat characteristics, the categories under which the random trees are selected should be considered in more detail. Factors such as, the shape of the tree, number and distribution of non-vertical branches and the features of thorns on the trees should be considered. These may have a major influence on the trees used by sifakas in the spiny forest, it may be important to increase the minimum girth at breast height value when selecting random trees. In addition the potential of seasonal changes in habitat use should be investigated as the current study was restricted to the dry season.

3.5 Time Allocation by *Propithecus v. verreauxi*

3.51 Methods

An investigation was carried out to examine how Verreaux's Sifaka (*Propithecus v. verreauxi)* allocates its time. Observations were conducted by pairs of students from vantage points, from 0600 – 1800h, using the naked eye when possible supplemented by 10X50 Binoculars. After a trial period of two days, used to refine the method and to familiarise the team with the method the survey was started. The survey team would locate a group of Sifakas as early as possible after dawn, choose an appropriate observation point and then observe the behaviour of all visible members of the troop at five-minute intervals. Observed behaviours were classified into seven categories (resting, feeding, moving, and grooming, alert, vocalising, and aggressive). A total of 115.71 hours observations were obtained with a total of 4357 individual behaviour records.

3.52 Results

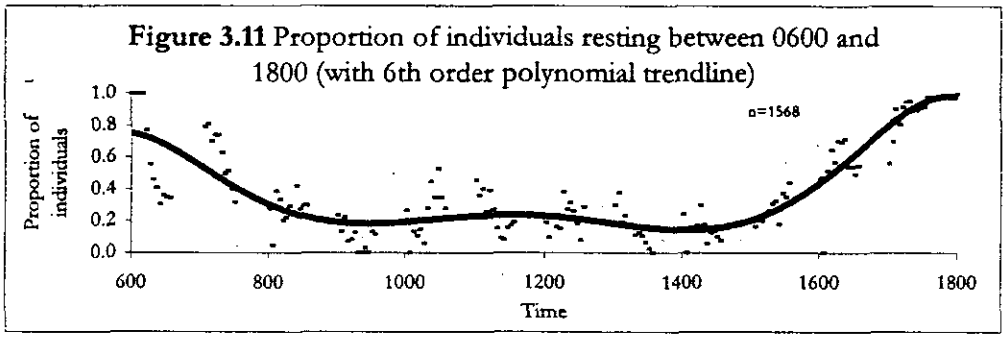


Figure 3.11 Proportion of individuals resting between 0600 and 1800 (with 6th order polynomial trendline)

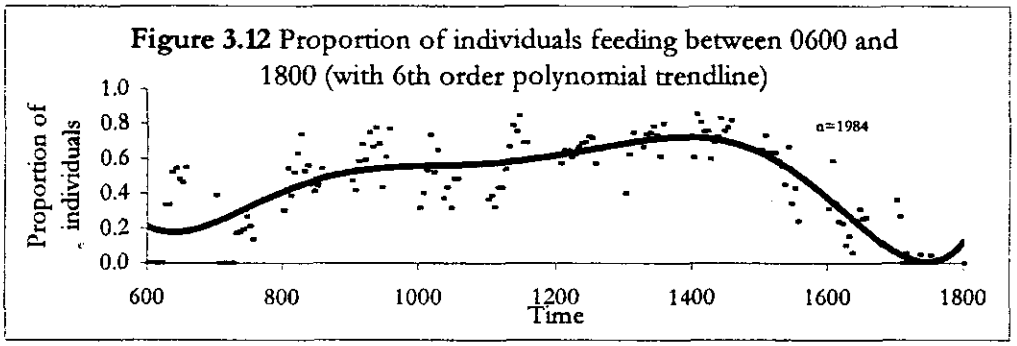


Figure 3.12 Proportion of individuals feeding between 0600 and 1800 (with 6th order polynomial trendline)

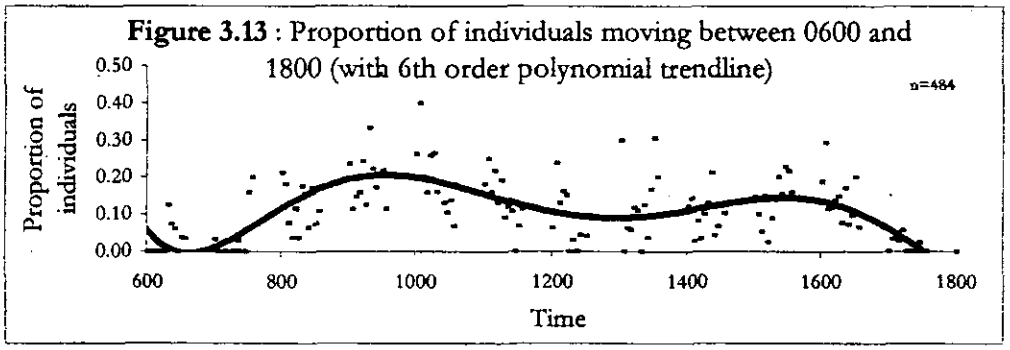


Figure 3.13 : Proportion of individuals moving between 0600 and 1800 (with 6th order polynomial trendline)

Figure 3.14 Proportion of individuals grooming between 0600 and 1800 (with 6th order polynomial trendline)

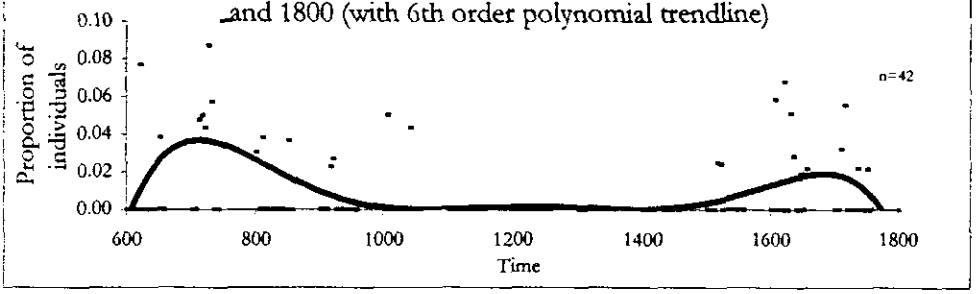


Figure 3.15 Proportion of individuals alert between 0600 and 1800 (with 6th order polynomial trendline)

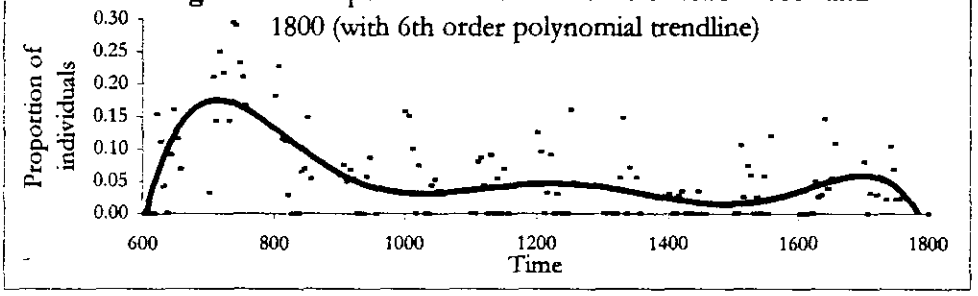
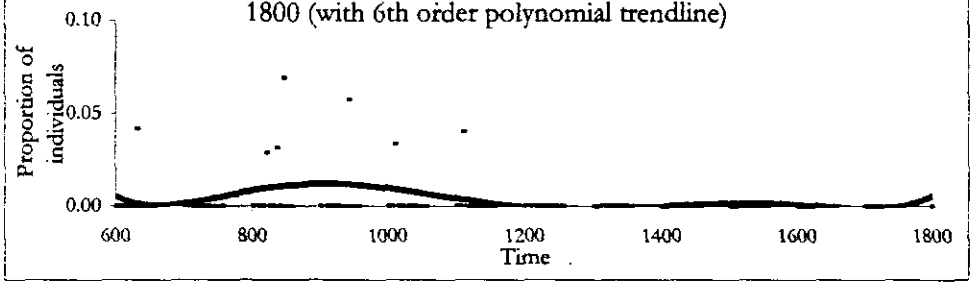


Figure 3.16 Proportion of individuals vocalising between 0600 and 1800 (with 6th order polynomial trendline)



Figures 3.11 to 3.16 illustrate the proportion of individual sifakas observed at any time between 0600hrs and 1800hrs performing each of the seven behaviour classes. Sifakas were observed to have peaks in resting first thing in the morning (when individuals were commonly seen to be warming up high in the trees) and late in the afternoon. A small increase in resting was also observed between 1100hrs and 1200hrs, corresponding to the hottest part of the day. Conversely feeding showed its low points first thing in the morning and late in the afternoon with apparent peaks in the mid morning (0900hrs - 1030hrs) and mid afternoon (1300hrs – 1500hrs). Peaks in movement were observed at similar times to the feeding (0900hrs - 1030hrs & 1400hrs – 1600hrs) with little movement before 0650hrs and after 1730hrs. Grooming appears to peak first thing in the morning and last thing in the evening, although with such a small sample size (n=42) caution should be used when interpreting the results. Alert behaviour peaks at approximately the same times as resting behaviour (0630hrs-0800hrs; 1145hrs-1300hrs; 1430hrs-1530hrs). Both vocalising and aggressive behaviours have very small frequencies (n=16 & n=15 respectively) so any conclusion is very tentative, however vocalising appears to have a peak at around 0900hrs.

Figure 3.17 Daily Time Allocation by *Propithecus v. verreauxi*

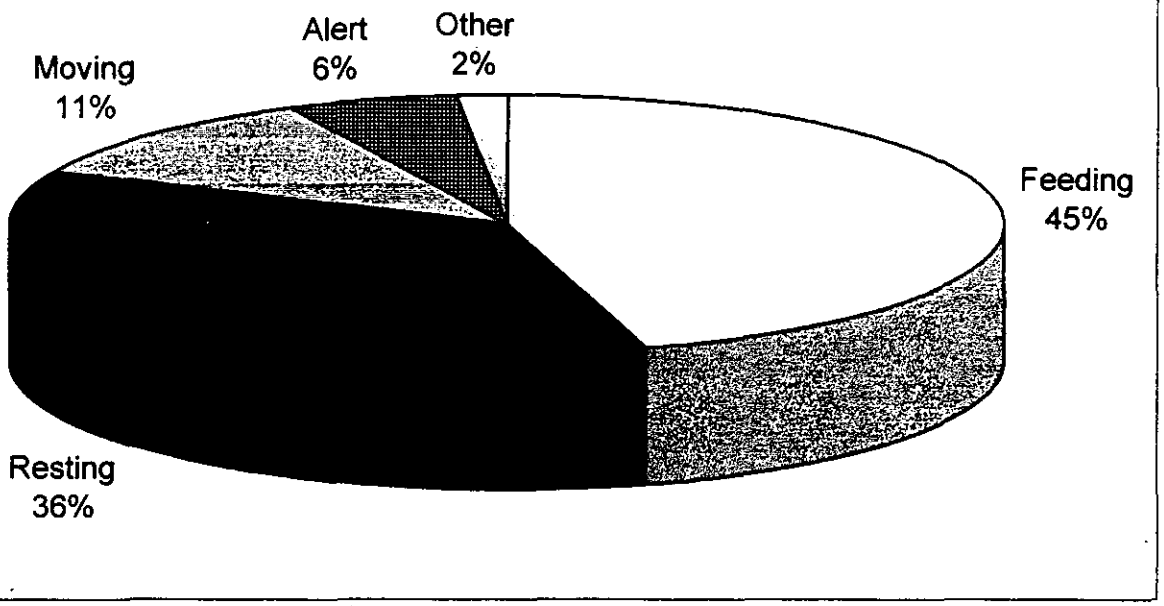


Figure 3.17 illustrates the overall division of time between 0600 and 1800 with the three dominant behaviours being feeding (46%), resting (36%) and moving (11%) despite the patterns exhibited by other behaviours they remain minor activities.

In general, sifakas were observed to start the day by resting and less frequently grooming, they would generally be feeding and moving by the mid-morning (0830). Resting would show a peak during the hottest part of the day and feeding and moving would take over as the dominant behaviours by the mid afternoon, the day would generally end in the same way as it started with individuals resting and grooming.

3.53 Discussion

The results presented in Figure 3.17 indicating the overall partitioning of time by *Propithecus v. verreauxi* shows that 46% of the time was spent feeding, the same result as Howarth *et al.* (1986) but higher than the 32.8% and 24.2% in Richard's study (1978). 36% of the time was spent resting and 11% moving (respectively), the resting value being significantly larger than Howarth's value of 19%, the 11% for moving is also slightly smaller than Howarth's 15%. A possible explanation for this may be that individuals may stay with a known food source for longer in Ifotaka than in Berenty. This was not directly measured in this study, as detailed information on feeding behaviour was not recorded. However from personal observation of the forest in Berenty and the forest in Ifotaka it was apparent that Berenty had much more lush vegetation and a higher abundance of food items than Ifotaka. Richards study (1978) found a greater proportion of time was spent feeding in the wet season than in the dry season. Future studies in Ifotaka could consider using a much longer temporal scale in order to investigate any seasonal variation in % of time spent feeding.

The allocation of the range of behaviours over the period from 0600hrs to 1800hrs was recorded and showed the patterns expected from the observations during the survey. The resting behaviour peaks (0600-0730; 1130-1230 & 1630-1800) can be explained by the cooler temperatures and lower light intensities in the morning and evening and the high temperatures in the middle of the day. Lemurs were frequently observed to 'sunworship' high up in trees (often *Allaudia procera*) first thing in the morning, typically prior to significant amounts of feeding and movement. The late afternoon typically saw them resting in the positions where they would spend that night. Feeding shows peaks when resting is at low points (0900-1100 & 1300-1500), these peaks roughly correspond to the peaks in movement, this pattern is as you would expect as the sifakas move around in search of food items. The dips in movement and feeding in the middle of the day also correspond to a small peak in resting, this is most likely to be due to the relatively high temperatures and light intensity at this time of day. During days with a lot of cloud cover, the feeding and moving did not decrease as much at the middle of the day as it did on days with a clear sky. As there was not enough data covering the range of observed weather conditions, no comparison could be drawn for this study. This makes another suggestion for questions for future studies, namely looking at the variation in time allocation over the day with variation in weather conditions. Although not quantitatively recorded, I observed that groups often stayed in an area in the morning to feed and rest and moved either before, or shortly after midday, to another location a significant distance away, often as much as 400m or more away.

Grooming has peaks first thing in the morning and late in the afternoon as you may expect, it occurs prior to and following the two main peaks of both feeding and moving. This is probably because grooming is a form of self-cleaning (Allaby, 1994) and so is carried out after sleeping and the activities during daylight cards. It is important to realise the small sample size for this behaviour (n=42) and hence take this conclusion with caution.

The distribution of alert behaviour is roughly similar to that of the resting behaviour, during the study it was observed that during periods which the group was resting there would often be one or more members of the group alert while others were resting.

The observations of vocalising behaviour and aggressive behaviour were very limited (n=16 & n=15 respectively). Vocalising was observed only when there were birds of prey such as the Madagascar Harrier –Hawk (*Pol radiatus*) and the Madagascar Kestrel (*Falco newtoni*) soaring above the sifakas. This is suspected to be an alarm and anti-predator call, however Goodman and Patterson (1997) call into question the theory that sifakas are preyed upon by raptors. Oda (1998) observed sifakas to react differently to tape recordings of anti-raptor and anti-carnivore calls by *Lemur catta* which showing that sifakas react to the threat of predation from both raptors and terrestrial carnivores. On one occasion during the fieldwork, I observed a troop of *Lemur catta* producing alarm calls, while a Harrier Hawk was circling overhead. This was soon followed by alarm calls from the nearby troop of Sifakas that I was observing, suggesting that the two diurnal lemur species in the forest may react to each other's alarm calls.

With the relatively small sample size of this survey and the fact that the nature of the data does not allow statistical analysis, it is suggested that for any future studies a larger dataset should be collected in the field. Animals should preferably be habituated and accurate data on their feeding behaviour and use of trees recorded. In addition, a differentiation between movement and travelling should be made (as was done in studies by Richard (1978) and Jolly (1966)). This is because movement around a small area in search of food, a resting spot or for interaction with other group members, is different to individuals or the group travelling greater distances to a new part of the forest.

3.6 Lemur Food Plant Data

The data presented in Table 3.4 below was collected by a combination of direct observation (by Barry Ferguson or Julian Mallinson) and data from Malagasy collaborators.

Table 3.4 Lemur Food Plants in the Ifotaka Forest.

Local Name[4]	Family [5]	Species	Genus	Plant Type	Habitat Type	Part Eaten	Lemur Species[6]	Authority[7]
Kily	CESALPINEAE	*Tamarindus*	*indica*	Tree	Gallery/ Riverine	Fruit	Pvv & Lc	DO;C;Hel;oc Man;Jolly,66;S ussman79
						Leaves	Pvv & Lc	Mav;Jolly66,S ussman79
Tsivokintsifaka	VIOLACEAE	*Rinorea*	*greveana*	Tree	Gallery	Leaves	Pvv	Man;Fan; Jolly66,oc Sussman79
Katrafay	PTAEROXYLACEAE	*Cedrelopsis*	*grevei*	Tree/ Shrub	Spiny	Buds	Pvv & Lc	C;Hel;Man;Ric hard in Sussman79
						Leaves	Pvv & Lc	C;Hel;Man' Richard in Sussman79
Tsiongake	SPHAEROSEPALACEAE	*Rhopalocarpus*	*lucidus*	Shrub	Spiny	Leaves	Pvv & Lc	Man;C;Hel;D O
						Fruit	Pvv & Lc	Man;C;Hel;D O
Fihamy	MORACEAE	*Ficus*	*sp.*	Tree	Spiny & Gallery	Fruit	Pvv & Lc	DO;C;Hel;Ma n
Relefo/ Relefogna	LOGANIACEAE	*Strychnos*	*madagascarensis*	Shrub	Spiny	Fruit	Pvv & Lc	Hel;Fan Man
Valive		*Odosiegas*	*sp.*	Tuber	Gallery	Tuber	Pvv & Lc	Syl;Res;Man;F an
Dagoa	LOGANIACEAE	*Strychnos*	*decussata*	Tree/ Shrub	Spiny	Fruit	Pvv & Lc	DO;Fan;Hel;S yl
Kilimbazaha	MIMOSACEAE	*Pitocoelobium*	*dulce*	Tree	Gallery	Flowers	Pvv & Lc	Man;oc Sussman79
						Leaves	Pvv & Lc	Man;Jolly66
Sakoagna	ANACARDIACEAE	*Poupartia*	*caffra*	Tree	Spiny	Leaves	Pvv & Lc	Man; Sussman79
						Fruit	Pvv & Lc	Man; Sussman79
Boradoka	RHAMNACEAE	*Berchemia*	*discolour*	Shrub	Spiny	Leaves	Lc	Man
Bonara	MIMOSACEAE	*Albizzia*	*lebeck*	Tree	Gallery	Leaves	Pvv &Lc	Man
Lambigna	CESALPINEAE	*Baudouinia*	*flugeiformes*	Shrub	Spiny	Leaves	Lc	Man;Syl; Richard in Sussman79
						Fruit	Lc	Faeces
	RHAMNACEAE	*Colubrina*	*sp.*	Tree	Gallery	Fruit	Pvv & Lc	DO;C
Taolankafotse	TILIACEAE	*Grewia*	*sp.*	Shrub	Spiny	Fruit	Pvv & Lc	Man;Hel

[4] Local Name as informed by the local guides in Ifotaka.

[5] Species were collected and identified by Helene Razomatso from Parc Botanique et Zoologique de Tsimbazaza (PBZT).

[6] Lc represents *Lemur catta;* Pvv represents *Propithecus verreauxi verreauxi*

[7] Source of the information of the plant part being a food item: DO-direct observation; Man-Manahira (local elder); Fan-Fanihasoa (local elder); Syl-Sylvain (WWF Botanist); Hel-Helene Razomatso; Jolly 1966 (see references); Sussman 79(see references; Richard in Sussman (see references); C-Claudine Ranosoa (PBZT); oc-Oconnor 1987(see references).

3.7 Other Lemur Species in Ifotaka

The presence of four lemur species was recorded and is illustrated in Table 3.5 below. It may be possible that other species are present in the forest, most likely being *Cheirogaleus medius*, whose range is recorded by Tattersall (1982) as potentially extending to the area. Despite not being sighted during this expedition, *Daubentonia madagascarensis* and *Phaner furcifer* may potentially be present, both having been recorded in the spiny forest of Andohahela, the latter by O'Connor et al. (1986) and former by Russell and McGeorge (1977). Neither of these species have been recorded at Berenty Reserve the nearest studied site to the Ifotaka Forest.

Table 3.5 The lemur species observed in the Ifotaka Forest July-Sept 1999

English Name	Scientific Name	Local Name	Activity Period	Conservation Status (IUCN)
Ring-tailed Lemur	*Lemur catta*	Maki	Diurnal	Vulnerable
Verreaux's Sifaka	*Propithecus verreauxi verreauxi*	Sifaka	Diurnal	Vulnerable
White Footed Sportive Lemur	*Lepilemur leucopus*	Tsiongike	Nocturnal	Rare
Grey Mouse Lemur	*Microcebus murinus*	Hatak	Nocturnal	Abundant

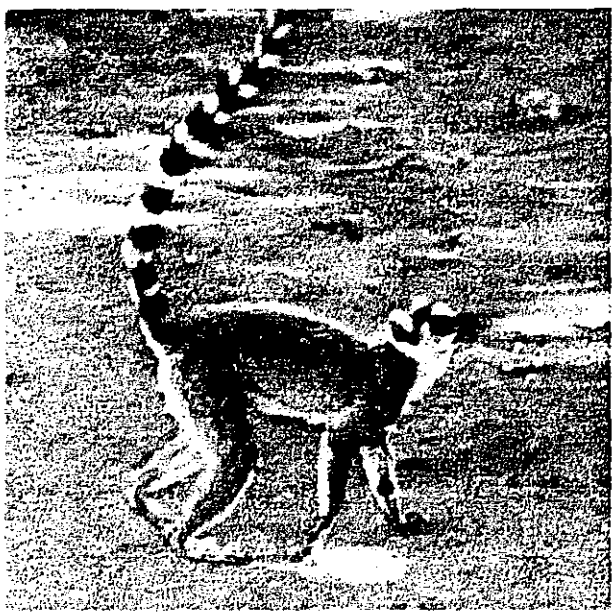


Plate 3.4 *Lemur catta*
The Ring-tailed Lemur

3.8 Conservation Context of this Study

The results of this study show that for the effective conservation of *Propithecus v. verreauxi* it is important to consider not only where populations are located and how large they are, but also the types of habitats in which the lemurs can live. As well as this the behaviours which influence the habitat use over different temporal and spatial scales are well worthy of consideration. Although this study has only been a preliminary investigation in each of the three aspects of the ecology of *Propithecus v. verreauxi*, I believe it indicates that for the future conservation of southern Madagascar's spiny forest it is important that more field research in ecology, as well as other disciplines such anthropology and geography, is carried out in collaboration with development activities.

Population censuses of lemurs in other forest fragments in the ecoregion will provide useful information for the conservation planners including the WorldWide Fund for Nature (WWF) and the International Union for the Conservation of Nature and Natural Resources (IUCN). In addition, estimates from parts of the Ifotaka Forest, not covered by this study, will provide a more accurate estimation of the status of *Propithecus v. verreauxi* in this Ifotaka. As with the conservation of any habitat type, it is important to consider the whole range of interactions including the human use of the spiny forest and to look for a sustainable management strategy for the use of the forest resources. This suggests that a multidisciplinary approach to the management advice produced for the forest may be most appropriate.

ORNITHOLOGY

4.1 Species Diversity

A species inventory of the birds in the forest was carried out by Julian Mallinson, Barry Ferguson and Claudine Ranorosoa, species were identified using Morris and Hawkins (1998) and the local guides Resitahaka, Masimbala, Manahira and Fanahisoa from the village of Ifotaka identified local names. The inventory was carried out from the 23rd July to 10th September 1999. One previous bird inventory had been carried out by a WWF rapid survey team (WWF, 1999). Project Ifotaka 1999 recorded the presence of 42 species, 3 of which had not previously been recorded at Ifotaka (Long-tailed Cormorant; Madagascar Paradise Flycatcher; Madagascar Pond Heron). Of the 42 species recorded, two have a conservation status of near threatened (Madagascar Pond Heron and Verreaux's Coua) all other species recorded in this survey are not globally threatened. 22 of the recorded species are endemic to Madagascar and a further 11 are endemic to the Indian Ocean region.

The WWF survey had recorded the presence of the Red-Shouldered Vanga (*Calicalicus rufocarpalis*) which was not known from this region (Hawkins pers. comm.) this expedition did not record its presence. A further 16 species recorded by the WWF survey were not recorded by this survey.

Table 4.1a Species inventory of birds recorded in the Ifotaka Forest (July – Sept 1999)

English name	Scientific Name	Local Name	PR	Status	Endemic
Barn Owl	*Tyto alba*	Vorondolo or Hekoheko	Y	NGT	Not Endemic
Chaberts Vanga	*Leptopterus chabert*	Voron'antake	Y	NGT	Endemic
Common Jery	*Neomixis tenella*	Tsimitse	Y	NGT	Endemic
Common Myna	*Acridotheres tristis*	Remaro	Y	NGT	Not Endemic
Common Newtonia	*Newtonia brunneicauda*	Andrebakia	Y	NGT	Endemic
Crested Coua	*Coua cristata*	Tivoke	Y	NGT	Endemic
Crested Drongo	*Dicrurus forficatus*	Relove	Y	NGT	Reg Endemic
Giant coua	*Coua gigas*	Eoke	Y	NGT	Endemic
Greater Vasa Parrot	*Coracopsis vasa*	Vazan-tsihotse	Y	NGT	Reg Endemic
Grey Headed Lovebird	*Agapornis canus*	Karyaka (or Farivaza)	Y	NGT	Endemic
Hamerkop	*Scopus umbretta*	Takatse	Y	NGT	Not Endemic
Helmeted Guinefowl	*Numida meleagris*	Akanga	Y	NGT	Not Endemic
Hook Billed Vanga	*Vanga curvirostris*	Tsilovanga	Y	NGT	Endemic
Lafresnayes Vanga	*Xenopirostris xenopirostris*	Fiok'ala	Y	NGT	Endemic
Lesser Vasa Parrot	*Coracopsis nigra*	Bolokikely (or Sihotse)	Y	NGT	Reg Endemic
Long-tailed Cormorant	*Phalacrocorax africanus*	unknown	N	NGT	Not Endemic
Madagascar Bulbul	*Hypsipetes madagascariensis*	Tsikonina	Y	NGT	Reg Endemic
Madagascar Buzzard	*Buteo brachypterus*	Hondria	Y	NGT	Endemic
Madagascar Coucal	*Centropus toulou*	Kotrohokha (or Toloho)	Y	NGT	Reg Endemic
Madagascar Harrier Hawk	Polyboroides radiatus	Bevortse (or Bobaka)	Y	NGT	Endemic
Madagascar Hoopoe	*Upupa marginata*	Tsikodara	Y	NGT	Endemic
Madagascar Kestrel	*Falco newtoni*	Hitikitike	Y	NGT	Reg Endemic
Madagascar Magpie-Robin	*Copsychus albospecularis*	Pitse	Y	NGT	Endemic
Madagascar Malachite Kingfisher	*Alcedo vintsioides*	Vintsy	Y	NGT	Reg Endemic
Madagascar Nightjar	*Caprimulgus madagascariensis*	Langopaka	Y	NGT	Reg Endemic
Madagascar Paradise Flycatcher	*Terpsiphone mutata*	unknown	N	NGT	Reg Endemic

Madagascar Pond Heron	*Ardeola idea*	unknown	N	NT	Reg.End.Br
Madagascar Red Fody	*Foudia madagascariensis*	Foly	Y	NGT	Endemic
Madagascar Sand Grouse	*Pterocles personatus*	Hatrahatrake	Y	NGT	Endemic
Madagascar Turtle Dove	*Streptopelia picturata*	Deho	Y	NGT	Reg Endemic
Namaqua Dove	*Oena capensis*	Tsikoloto	Y	NGT	Not Endemic
Pied Crow	*Corvus albus*	Koaka	Y	NGT	Not Endemic
Redcapped Coua	*Coua ruficeps*	Aliotse	Y	NGT	Endemic
Running coua	*Coua cursor*	Arefy	Y	NGT	Endemic
Sakalava Weaver	*Ploceus sakalava*	Folin-ja	Y	NGT	Endemic
Sickle-billed Vanga	*Falculea palliata*	Voranundry (or Voronjaja)	Y	NGT	Endemic
Souimanga sunbird	*Nectarinia souimanga*	Soimanga	Y	NGT	Reg Endemic
Stripe Throated Jery	*Neomixis striatigula*	Tsimitse	Y	NGT	Endemic
Verreaux's Coua	*Coua verreauxi*	Tivon-dranto	Y	NT	Endemic
White Browed Owl	*Ninox supercilaris*	Vorondolo	Y	NGT	Endemic
White Headed Vanga	*Artamella viridis*	Vanga	Y	NGT	Endemic
Yellow Billed Kite	*Milvus aegyptius*	Tsimalaho	Y	NGT	Not Endemic

1: When more than one vernacular name is known the locally used name at the study site is referred to first and any other name is recorded in brackets.

2: PR refers to the recorded presence or absence of each species during the WWF rapid survey in 1999.

3: Status refers to the conservation status of the species NGT=Not Globally Threatened & NT=Near Threatened.

4:Endemism - Endemic refers to species only occurring in the wild in Madagascar, Reg.Endemic refers to species only occurring in the Indian Ocean regi and Reg.End.Br refers to species whos breeding is restricted to the Indian ocean region. Not endemic refers to species with distribution extending outside the Indian Ocean region.

4.2 Relative Abundance of Bird Species in the Ifotaka Forest

During the first month of fieldwork patterns in the relative abundance of the inhabitant birds were noticed, in an attempt to put some quantification to this Mackinnon Lists were used (Mackinnon and Phillips, 1993 in Bibby *et al* 1998). Julian Mallinson and Tatjana Good conducted the survey over two days 11th and 12th August 1999. The Asantoria riverbed was used as the survey area with the upstream section between Mahavelo being surveyed on the 11th and the downstream section between Mahavelo and Andavatsak being surveyed on the 12th. Each of the sections was further divided in two (Upstream NEAR and FAR & Downstream NEAR and FAR). The NEAR sections were surveyed between 0730 and 1030 with the survey direction being away from Mahavelo. The FAR sections were surveyed between 1500 and 1730 with survey direction being towards the Mahavelo. The survey team would start a list with the first bird species sighted, each subsequent species sighted would be recorded on the list until ten separate species were recorded. On completion of a list a new list was started, again recording ten separate species. When species could not be identified it was recorded as unidentified species. Ten lists were completed on the 11th and eight were completed on the 12th. The results are shown in table 4.2a below

Table 4.2a The relative abundance of the bird species along the Asantoria Riverbed 11th/12th August 1999.

	Common Name	*Scientific Name*	Total	Abundance Index
1.	**Crested Drongo**	*Dicrurus forficatus*	18	1
2.	**Namaqua Dove**	*Oena capensis*	16	0.88
3.	**Crested Coua**	*Coua crestata*	14	0.77
4.	**Madagascar Magpie-Robin**	*Copsychus albospecularis*	13	0.72
5.	**Grey headed lovebird**	*Agapornis canus*	12	0.66
6.	**Madagascar Red Fody**	*Foudia madagascariensis*	12	0.66
7.	**Vasa Parrot sp.**	*Coracopsis sp.*	11	0.60
8.	**Madagascar Turtle Dove**	*Streptopelia picturata*	10	0.55
9.	**Madagascar Malachite Kingfisher**	*Alcedo vintsioides*	9	0.5
10.	**Common Jery**	*Neomixis tenella*	7	0.38
11.	**Chaberts Vanga**	*Leptopterus chabert*	6	0.33
12.	**Madagascar Coucal**	*Centropus toulou*	6	0.33
13.	**Pied Crow**	*Corvus albus*	6	0.33
14.	**Common Newtonia**	*Newtonia brunneicauda*	5	0.27
15.	**Madagascar Buzzard**	*Buteo brachypterus*	5	0.27
16.	**Sunbird sp.**	*Nectarinia sp.*	5	0.27
17.	**Madagascar Kestrel**	*Falco newtoni*	4	0.22
18.	**Lafresnayes Vanga**	*Xenopirostris xenopirostris*	3	0.16
19.	**Common Myna**	*Acridotheres tristis*	2	0.11
20.	**Madagascar Bulbul**	*Hypsipetes madagascariensis*	2	0.11
21.	**Madagascar Harrier Hawk**	Polyboroides radiatus	2	0.11
22.	**Madagascar Hoopoe**	*Upupa marginata*	2	0.11
23.	**White Headed Vanga**	*Artamella viridis*	2	0.11
24.	**Green Backed Heron**	*Butorides striatus*	1	0.05
25.	**Madagascar Paradise Flycatcher**	*Terpsiphone mutata*	1	0.05
26.	**Madagascar Pond Heron**	*Ardeola idea*	1	0.05
27.	**Stripe Throated Jery**	*Neomixis striatigula*	1	0.05
28.	**Unidentified FODY**	*Foudia sp.*	1	0.05
29.	**Unidentified Species 2**	*Unid2*	1	0.05
30.	**Unidentified Species1**	*Unid1*	1	0.05
31.	**Yellow-billed Kite**	*Milvus aegyptius*	1	0.05

The right hand column (in bold) shows the relative abundance of each of the species recorded in the lists, this figure is obtained by dividing the number of lists in which the species appears by the total number of lists completed.

The Mackinnon List survey recorded 31 species, two of which remain unidentified. Of the 31 two could only be identified to genus (Vasa parrot sp. and Sunbird sp.). This meant that up to 11 of the species recorded in the inventory did not appear in the relative abundance survey and therefore either may be relatively less abundant or that they may selectively use alternative habitat to that adjacent to the riverbed.

4.3 Discussion

The results from the species inventory and relative abundance survey record the presence of a total of 42 species of which two are considered to be 'Near Threatened' and twenty-two endemic. A further eleven are regional endemic species occurring only in the Indian Ocean area. Two of these species had not been recorded at this site previously, one of them, the Madagascar Pond Heron *(Ardeola idea)* being 'Near Threatened'. The results of the previous survey by WWF, which found 56 species, included 16 species not recorded in this study. The differences may be explained by the different season at the time of surveying, but nevertheless it highlights the fact that further follow up studies would be of considerable value, particularly to confirm the presence of the Red-shouldered Vanga (*Calicalicus rufocarpalis*) as well as making actual population estimates of the species more at risk.

Plate 4.1 *Coua crestata* (Crested Coua)

ETHNOBOTANY

5.0 SUMMARY

The role of the *Ombiasy* is significant in the human use of forest resources, especially for treatment of common complaints. Their role is less central in a changing social setting, although people in forest dwelling hamlets rely upon their knowledge more than those living in the village because they do not have such easy access to the hospital. Knowledge accumulated from a series of excursions conducted with two *Ombiasy* indicated the range of medical treatments that are commonly used. Local villagers consider plant remedies to be effective but not as permanent as the more expensive hospital treatments. The value of the investigation was that it showed that forest resources have a wide range of uses in village life, and pointed to the fact that this information is in need of further investigation before the changes associated with modernisation supersede traditional knowledge. 149 plant species with a total of 312 human uses were recorded by this survey.

5.1 INTRODUCTION

The Antandroy depend on forest resources for food, medicines, tools and building materials. The dynamics of the natural resource management by the tribe has changed with respect to certain resources, having become more sedentary agriculturists since the time of colonisation and more dependent upon introduced crop species than on less productive forest resources. The dependence of the *Ombiasy* on the plants for their medicinal and spiritual properties is a changing theme, with their expertise being replaced by trained medical doctors. By documenting the reported medical properties of forest plants, a database of current knowledge has been built in order to conserve traditional knowledge that has become increasingly threatened by the changes occurring within the society.

5.2 AIMS

The purpose of our investigation was to produce database of plants used by *Ombiasy* for treatment of illness and those used more widely by society in their everyday lives. The database is not intended to be exhaustive as time restricted the amount of data collected A local perception of the role that the *Ombiasy* play in a changing social environment is reported in the Anthropological section and indicates how significant ethnobotanical knowledge is within the community.

5.3 METHODS

Participatory Rural Appraisal (Kapila and Lyon, 1994) was used to grasp an empowered vision of forest use by locals in general. Almost all the data was collected with two local *Ombiasy's,* One of the two *Ombiasy*, Manihira, had lived in the village of Ifotaka all his life and was locally respected for his extensive knowledge of and application of the uses of forest plants. He was accompanied on a series of excursions into the forest between July and September 1999. He gave information on how each plant could be used, as and when he came across them. Helene Razomatsoa identified the plants (both in the field and back in Tana in the Herbarium. She also translated the explanation of their use, preparation and abundance which Manahira had told her. On Helene's departure Claudine Ranorosoa took over her job.

The second *Ombiasa*, Fanahisoa, had been brought up in Ifotaka, but had learnt his knowledge of plants during years spent trading zebu between regions. Semi-

structured and open-ended interviews were used to gain an insight into which plants he would prescribe for various ailments and what he said other resources were used for. Herbarium specimens of these plants were collected where possible and identified in the Herbarium in Parc Tsimbazaza by Helene Razomatsoa. Several species were identified by Sylvain Eboroke in the field. Many of the plants described by Fanahisoa were not collected due to the restricted time, the other data on each plant was still collected.

Figure 5.1 - Claudine and Manahira collecting ethnobotanical data.

Figure 5.2 - Fanahisoa, a local Ombiasy in Ifotaka.

Human Use	Part used	Preparation	Local name	Scientific name	Family	Class
1. PREGNANCY						
(M)Abortion	Leaves	Boil and drink	Andrapasy	*Dichapetulum sp.*	DICHAPETALACEAE	V(2m)
(M)Anti-hemmorrage, and to	Leaves	Boil and drink	Andrapasy	*Dichapetalum sp.*	DICHAPETALACEAE	V(2m)
cause an abortion						
(F)Avoid miscarriage.	Leaves	Grind and mix with Tsimarefe, apply to	Soazanabazy			H(3m)
		body after taking a shower in a waterfall				
(F)Female hemmorhage	Leaves	Boil and drink	Andranahake			B
(M)Induces birth	Leaves	Grind, with water, and apply to genitals	Sagnira	*Phyllanthus seyrigii*	EUPHORBIACEAE	H(3-4m)
(M)Induces lactation	Bark, stem and root	Boil and drink	Manongo	*Zanthoxylum sp.*	RUTACEAE	H(6-7m)
(F)Morning sickness *1	Leaves	Boil and drink	Sakoa	*Poupartia caffra*	ANARDIACEAE	H(5-7m)
(M)Noisy foetus in womb *2	Roots	Suck or chew	Katsakatsa	*Crotalaria retusa*	PAPILIONACEAE	B(0.6m)
(M)Pregnancy pain relief	Stem and leaves	Boil and drink	Tarazofoana			
(M)Pregnancy pain relief	Stem and leaves	Boil and drink	Tarazofoana			B
(F)Reduce likelihood of miscarriage	Leaves	Grinded with Soazanabany, poured on	Tsimarefe			H(3m)
		body after washing in a waterfall				
(M)Reduces disturbance of fetus	Roots	Suck and chew	Katsakatsa	*Crotalaria refusa*	PAPILIONACEAE	B(0.6m)
(and noises) in pregnant women*2						
(M)Reduces labour pains	Leaves	Boil and drink	Lambigna	*Bauoninia fluggeiformis*	CESALPINAE	H(2-3m)
(M)Back pains&aching stomachs	Leaves and stem	Boil and drink	Fantakakoho	*Capparis cf chrysomeia*	CAPPARIDACEAE	H(3-4m)
in pregnant women						
(M)Relieves 'sovake'- pain in the womb	Leaves	Boil and drink	Sofa sofa	*Munduka stenophylla*	FABACEAE	H(2-4m)
wind in womb						
(G)Relieves 'sovake'- a pain in the womb	Leaves	Consume	Sofa sofa	*Munduka stenophylla*	FABACEAE	H(2-4m)
(M)Removal of blood from	Bark	Boil and drink	Hily	*Commiphora sp.*	BURSERACEAE	H(4-7m)
uterus after birth						
(F)Strengthen pregnant women	Roots	Boil with milk and drink	Tsiongake	*Rhopalocarpus lucidus*	SHAEROSEPACEAE	H(3-4m)
(F)To aid lobour	Leaves	Boil and drink	Ahibe			B(1.5m)
(F)Wash after giving birth	All	Mix and wash	Boroa	*Tetradenia goudotii*	LAMIACEAE	H(1m)
(M)Washing female genitalia *1	Bark	Boil and bathe	Sakoa	*Poupartia caffra*	ANARDIACEAE	H(5-7m)
(F)Morning sickness *1	Leaves	Boil and drink	Sakoa	*Poupartia caffra*	ANARDIACEAE	H(5-7m)
2. DIARRHOEA						
(M)Anti diuretic	Stem fibre	Boil and drink	Alomborona	*Albizia polyphylla*	MIMOSACEAE	H(1-7m)
(M)Anti diuretic, stomach aches	Root	Boil and drink	Ahidambo	*Heteropogon contortus*	POACEAE	B(1m)
(M)Anti-diuretic**C	Roots	Remove bark, boil and drink	Tamenaka	*Combretum coccinea*	COMBRETACEAE	V
(M)Anti-diuretic	Roots	Boil and drink	Pisopiso	*Pemphis madagascariensis*	LYTHRACEAE	H(2m)
(M)Anti-diuretic for babies	Bark	Boil and drink	Sely	*Grewia lavanalensis*	TILIACEAE	H(2-3m)
(M)Anti-diuretic	Branches	Boil and drink	Hentinentina	*Calyptostylis humbertii*	MALPIGHIACEAE	V(3-4m)

(M)Anti-diuretic with blood**B	Fruit pulp	Boil and drink	Kily	*Tamarindus indica*		
(M)Anti-diuretic	Leaves and flowers	Boil and drink 1-2 spoonfuls	Famonty and	*Pluchea grevei*	ASTERACEAE	H(2-3m)
			Felataboara			
(M)Anti-diuretic in babies	Leaves and stem	Boil and drink	Fipetaheengoky	*Ludwigia sp.*	OENOTHERACEAE	H(1-2m)
(M)Anti-diuretic	Leaves	Boil and drink	Dagoa	*Strychos decussata*	LOGANIACEAE	H(4-5m)
(F)Anti-diuretic	Stem	Grind and drink	Mangy			
(F)Anti-diuretic if blood present	Roots	Boil and drink	Vahatsognao			H
(M)Diuretic	All	Boil and drink	Aferontany	*Euphorbia prostata*	EUPHORBIACEAE	B
(M)Diuretic *3	Latex	1 spoon taken, with one spoon of honey	Famatandralitsaka	*Diporium sp.*	OCHNACEAE	H(5-6m)
(M)Diuretic, in order to clear gut	Leaves	Boil and drink before breakfast	Kitata	*Bridelia pervilleana*	EUPHORBIACEAE	H(3-4m)
(M)Digestant, anti-diuretic	Roots	Boil and drink	Kotike	*Lawsonia alba*	LYTHERACEAE	H(3m)
(F)Anti-diuretic if vomitting present	Stem only	Boil and drink or chew without swallowing	Sakoa	*Poupartia caffra*	ANARDIACEAE	H(5-7m)
(F)Anti-diuretic if blood present**B	Stem and leaves	Boil and drink	Kily			
3. STOMACH PROBLEMS						
(M)Anti-vomitting	Stem	Boil and drink	Lelagonab	*Polygonium mite*	POLYGONEACEAE	B(0.8m)
(M)Anti-indigestion	Latex	1 spoon taken, with one spoon of honey	Fandrivotse		EUPHORIABIACEAE	H(1-2m)
(F)Heartache	all, with feathers	Cook with water and salt, drink	Voromahilala			
		water and consume mconsume	(pigeon)			
(F)Heartache	One glass	Drink before breakfast in the morning	Water			
(M)Indigestion	Leaves	Mix with a little sofasofa, boil and drink	Ahibe			B (1.5m)
(F)Indigestion	Bark	Grind, dissolve in cold water as a drink	Rohondroho	*Alluaudia dumosa*	DIDERACEAE	H
(F)Indigestion	Fruit juice	Drink	Voasary			
(M)Indigestion in babies	Stem	Boil and drink	Taivorotsiloza			B(0.8m)
(M)Induces vomitting			Vontofosa			
(M)Relieve throbbing stomach	Leaves and stem	Boil and drink, or scrape bark into drink	Magerevoreke	*Strychnos sp.*	LOGANIACEAE	H(2-3m)
(F)Stomach ache	Leaves	Boil and drink, cook a consumehered	Ena			H
		chicken if diarrhoea is present too				
(M)Stomach ache	Stem	Boil and drink	Vahimihantona	*Cynanchium androgenesis*	ASCEPIADACEAE	V
(M)Stomach ache	Stem	Boil and drink	Fandotsara	*Cynodon dactylon*	POACEA	B
(M)Stomach ache	Stem	Boil and drink	Rohondroho	*Alluadia dumosa*	DIDERACEAE	H(3.5m)
(M)Stomach ache	Leaves	Boil and drink	Feka	*Tabernaemontana eoffeoides*	APOCYNACEAE	H(2.5m)
(M)Stomach ache	Leaves	Boil and drink	Fangitsy	*Dolichis fangitsa*	FABACEAE	V
(M)Stomach ache	Stem and leaves	Boil and drink	Pelamantsy			H
(F)Stomach ache without diarrhoea *1	stem	Boil and drink with Mangy leaves	Sakoa	*Poupartia caffra*	ANARDIACEAE	H(5-7m)
(M)Stomach ache, bad digestion and	Stem and root	Boil and drink	Marolary	*Monantothaxis sp.*	ANNONACEAE	H(1.5m)
coughing with blood						
(M)Stomach aches	Leaves	Boil and drink	Andriambolafotsy	*Croton sp.*	EUPHORBIACEAE	H(2-3m)
(F)Stomach aches	Leaves and stem	Grind and lick a tiny bit or boil and drink	Magerevoreke	*Strychnos sp.*	LOGANIACEAE	H(2-3m)
(M)Stomach aches	Branches	Boil and drink	Mamiaho	*Priva humberti*	VERBENACEAE	H(1m)

(M)Stomach aches	Stem	Boil and drink	Rohondroho			H(3.5m)
(M)Stomach pains	Stem	Boil and drink	Fandotsara			B
4. WOUNDS						
(M)Anti-inflammatory	Branches	Crush, use as cream	Volifitomboke	*Kalanchoe grandidieri*	CRASSULACEAE	H(1-2m)
(F)Antiseptic	Leaf and stem	Chew with saliva and apply	Filo filo			
(F)Antiseptic	Leaves	Chew up and apply without binding	Ravikalombarogne			H(5m)
(M)Antiseptic	Unripe fruit	Peel	Roy	*Acasia farmesiana*	MIMOSACEAE	H(2-3m)
(M)Antiseptic(stops bleeding)	Latex	Apply directly	Taritarika	*Leptadenia reticulata*	ASCLEPADIACEAE	V(-10m)
(F)Antiseptic for wounds *4	All	Grind and apply	Angamay	*Tridax procumbens*	ASTERACEAE	B
(M)Antiseptic wound dressing*4	All	Grind and apply	Angamay	*Tridax procumbens*	ASTERACEAE	B
(M)Blister healing, reduces puss	Leaves	Crush and apply	Taintaramo			B
(M)Heals wounds	Leaves	Crush and apply	Anambe	*Solanum nigrum*	SOLANACEAE	B
(M)Removal of cactus spines	Leaves and stem	Grind and apply	Folotse		EUPHORBIACEAE	V
(M)Removes puss from blisters	Leaves	Grind, and apply with eggs	Taintaramo			B
(M)Removes puss from boils	Branches and leaves	Crush scrapings and use as cream.	Kreléone	*Allophyllus bejerianus*	SAPINDACEAE	H(4-5m)
		Boil and drink				
(F)Stop bleeding	Bark	Grind with water and apply	Jabihy	*Operulicarya decaryi*	ANACARDIACEAE	H(4m)
(M)Stop bleeding after use	Bark	Boil, drink and apply	Jabihy	*Operulicarya decaryi*	ANACARDIACEAE	H(4m)
(F)Trconsumes thorn scratch	Leaves	Grind with water and apply	Hazomalangy	*Moringa drouhardi*	MORINGACEAE	H(4-5m)
(M)Wound dressing	Leaves	Grind, and apply juice	Anambe	*Solanum nigrum*	SOLANACEAE	B(2-4m)
5. IRRITATIONS						
(M)Aching eyes	Bark	Boil scrapings and bathe eye	Somotsoy	*Fernandoa madagascarensis*	BIGNONIACEAE	H(3m)
(M)Antiseptic for itches**G	White flowers	Crush flowers, bathe in it and drink	Kiraranamboa	*Solanum auriculatum*	SOLANACEAE	H(1-2m)
(M)Babies itches	Stem	Crush and apply	Tsimatavindrano	*Aristolochia acuminata*	ARISTOLOCHIACEAE	V
			Tamboroba			
			Boroa			
(F)Boils	Seeds	Grind, and apply around boil.	Vagnemba			Crop
		Press around head of boil.				
(F)Boils	Head	Cut head off and place on top of the boil	Fly			
(F)Eye trconsumement	Roots	Grilled and applied with water to bad eye	Banobo			
(F)Itches	Liquid from bark		Siro siro			H
(M)Itches, especially for children:	Leaves and stem	Bathe in water soaked with it, and drink	Boka with	*Pentopetia androsaemifolia*	ASCLEPIADACEAE	V
known as "Fandriandambo"		the water. Wrap in blanket	Fandriandambo	*Physena sessiflora*		
(M)Relieves itches	Leaves	Bathe in it, and drink	Fandriandambo	*Physena sessiflora*	PHYCENACEAE	H(3-4m)
(M)Relieves itches	Roots	Boil, drink and bathe	Tamboro			
6. CONSTRUCTION						
(M)Artisans	Trunk		Tanbazotsy			H

(M)Axe handle, construction	Trunk		Magna	*Hibiseus macrogonus*	MALVACEAE	H(5-6m)
(M)Boat building**A	Trunk		Fengoke	*Delonix adansonoides*	CESALPINAE	H(4m)
(F)Building house in forest	Trunk		Songo			
(M)Building house in forest only	Trunk		Sognogne			
(F)Children's toys, handicrafts	Trunk		Darontrandoke			
(F)Children's toys, handicrafts	Trunk		Darosike			
(M)Coffin construction	Trunk		Sohihy	*Protorhus grandidieri*	ANARDIACEAE	H(7-8m)
(G)Coffin making *5	Trunk		Hazobe			
(M)Constructing furniture	Trunk without bark		Magnary	*Dalbergia trichocarpa*	PAPILIONACEAE	H(6-7m)
(M)Construction	Trunk		Katrafay	*Cedrelopsis grevei*	MELEACEAE	H(3-4m)
(M)Construction (mandolins)	Trunk		Siro siro			H
(F)Construction of boats	Trunk		Siro siro			H
(M)Fabricating hats, husking mats, mats	Main part		Vindavato	*Cyperus flabelliformis*	CYPERACEAE	B
(M)Floors, boats, coffins, artisans	Trunk		Mendoravy	*Diospyros sp.*	EBENACEAE	H(~10m)
(M)Football construction	Latex	Blow into a ball	Komkopitse	*Gonocrypta grevei*	ASCELEPIADACEAE	V
(G)Furniture and village houses	Trunk	Construction	Fantiolotse	*Allaudia procera*	DIDEREACEAE	H(5-15m)
(M)Hat weaving	All	Scrape, and weave	Setsetse	*Cyperus rotondus*	CYPERACEAE	Vinda
(M)Horizontal beam of roof, and spoons	Trunk	Carve/Cut	Beholitse	*Hymenonietum decarui*	RUBIACEAE	H(5m)
(M)House support	Trunk		Harandrato			H(3-4m)
(M)House supports	Trunk		Taly	*Terminalia mantaly*	COMBRETACEAE	H(7-8m)
(M)Husking mats	Leaves		Bakaka	*Sorghum vertilliflorum*		B(2-3m)
(M)Mattress making	Flower	Stuff flowers into a sarong	Vognefotsy			B(1.2m)
(G)Pillar for houses	Trunk	Construction	Katrafay	*Cedrelopsis grevei*	MELEACEAE	H(3-4m)
(M)Planks for construction	Trunk	typically four planks from one trunk	Fantiolotse	*Allaudia procera*	DIDEREACEAE	H(5-15m)
(M)Roof of temporary house	Bark		Fihary	*Euphorbia plagianta*	EUPHORBEACEAE	H(4m)
(G)Sculptures and houses	Trunk	Construction	Hazomena	*Securinega perrieri*	EUPHORBIACEAE	H(3-4m)
(M)String	Inner bark	Rip out manually	Halomboro	*Abizzia polyphylle*	FABACEAE	H(5-6m)
(M)String	Bark marrow		Sely	*Grewia lavanalensis*	TILIACEAE	H(2-3m)
(M)String	Bark		Tabarike	*Grevia cyclea*	TILIACEAE	H
(F)String for coffins or fences	Bark marrow	rip from inside bark	Tsiongake	*Rhopalocarpus lucidus*	SHAEROSEPACEAE	H(3-4m)
(M)String for fences	All		Vahimpindy	*Loeseneriella sp*	CELATRACEAE	V
(F)String for thatched roof	Bark		Zabihy			
(M)Temporary house	Trunk		Sognogne			
7. PERSONAL HYGIENE						
(M)Antibiotic	Branches	Boil and drink	Vahiranga	*Cynanchum perrieri*	ASCLEPADIACEAE	V
(M)Mouth wash	Roots	Chew and spit	Rahovitsa	*Capparis sp.*	CAPPARIDACEAE	V
(M)Mouth wash	Leaves	Boil and drink	Tsimangipaka	*Boscia longifolia*	CAPPARIDACEAE	H(7-8m)
(M)Moutwash	Leaves	Boil, drink, wash	Sasavy	*Salvadora augustifolia*	SALVADORACEAE	H(3-4m)
(M)Perfume	Bark	Crush and add coconut oil	Somoro			H(2-3m)

(F)Shampoo	Leaves	Grind and use				
(M)Soap	Leaves		Magna	*Hibiseus macrogonus*	MALVACEAE	H(5-6m)
(F)Wash after giving birth	All	Mix and wash	Boroa	*Tetradenia goudotii*	LAMIACEAE	H(1m)
(G)Wash newborn babies for protection	Leaves	Bathe in water without boiling	Takisakisake			
(M)Washing female genitalia	Bark	Boil and bathe	Sakoa	*Poupartia caffra*	ANARDIACEAE	H(5-7m)
8. PSYCHOLOGICAL						
(M)Epilepsy	Bark and marrow	Boil and drink	Halamboro	*Abizzia polyphylle*	FABACEAE	H(5-6m)
(M)Epilepsy	Bark and marrow	Boil and drink	Halamboro	*Abizzia polyphylle*	FABACEAE	H(5-6m)
(F)Exorcise demon possession		Place with excreted snake skin and with	Fandotsara	*Cynodon dactylon*	POACEAE	B
		Viky around neck				
(F)Exorcise demons from people		Place, with excreted snake skin and	Viky			
		Fandotsara around neck				
(M)Exorcise ghosts	Leaves and branches	Burn leaves, mash, mix with water, spray	Tsimalelamba	*Homelium albiforum*	FLABORTIACEAE	H(6-7m)
		inside house				
(F)Fails to recognise young		Hang her from a tree for a short period	Goat which rejects offspring			
(F)Fails to recognise young		Take vaginal juices and spread onto young	Zebu which rejects offspring			
(M)Forces a divorce	Branches and leaves	Put under the pillow- causes fanaboka	Mampisaraka	*Rinorea sp.*	VIOLACEAE	H(3-4m)
		(altered destiny)				
(F)Psychological problems	Any part	Boil and drink	Fomakamy			H
(M)Relieve bad astrological alignments	Leaves	Bathe in tub of it	Fihamy	*Ficus sp.*	MORACEAE	H(7-8m)
(F)Relieve bad astrological alignments	Leaves	Bathe in tub of it	Fihamy	*Ficus sp.*	MORACEAE	H(7-8m)
(F)Spiritual protection against lightening			Fario	*Erehtia diospyroides*	BORAGINACEAE	H
(M)Spiritual protection from lightening	Branch		Relefo	*Strychnos madagascarensis*	LOGANIACEAE	H(3-4m)
(M)Special illnesses **D	Roots	Boil and drink	Fatiboay	*Argemana mexicana*	PAPVERACEAE	B
(F)Undiagnosed illnesses**D	Roots	Boil and drink	Fatiboay	*Argemane mexicana*	PAPAVERACEAE	B(0.8m)
9. POISONS						
(F)Fatal poison	Stomach	Consume	Lizard's stomach			
(M)Poison	Latex especially	Just the smell of the roots may be fatal.	Fio Fio	*Pervillia sp.*	ASCLEPEACACEA	V
	from roots	Found esp. at the top of cliffs				
(F)Poison	Main part and roots	Boil and drink	Fio Fio	*Pervillia sp.*	ASCLEPEACACEA	V
(M)Poison **F	Latex	Consume	Lombiro	*Cryptostegia madagascarensis*	ASCLEPIADACEAE	V
(F)Poison	Roots	Boil and drink	Vary			
10. FOODS						
(M)Animal food	Fruit, leaves	consume	Sakoandolitse	*Operculicarya hyphenoides*		H(3-4m)
(M)Food	Fruit	consume	Kopaipote	*Grewia sp.*	TILIACEAE	H(2-3m)
(M)Food	Fruit	consume	Sasavy	*Salvadora augustifolia*	SALVADORACEAE	H(3-4m)

(F)Food	Fruit	consume	Sasavy	*Salvadora augustifolia*	SALVADORACEAE	H(3-4m)
(M)Food		consume	Osana	*Xerophyta daryliroides*	VELLOZIACEAE	
(M)Food	Tubers	consume	Fangitsy	*Dolichis fangitsa*	FABACEAE	V
(M)Food	Roots	consume	Osana	*Xerophyta darylitiodes*	VELLOZIACEAE	
(M)Food	Fruit	consume	Kope	*Mystroxylon aethopicum*	CELASTRACEAE	H(3m)
(F)Food during famine**B	Fruit	consume (mix with chalk 'tany fotsy')	Kily			
(M)Food during famine**B	Fruit		Kily			
(F)Food during famines	Fruit	consume	Sakoandolitse	*Operculicarya hyphenoides*		H(3-4m)
(G)Food during famines	Tubers	consume	Fungatse			
(G)Food during famines	Herb	consume	Tala			
(G)Food during famines	Fruit	consume	Raketa			
(G)Food during famines	Nuts	consume	Sakoa	*Sceriocarya caffra*		
(G)Food during famines	Unripe fruit	consume	Zagne			
(G)Food during famines	Fruit	consume	Sakoandolitse	*Operculicarya hyphenoides*		H(3-4m)
(G)Food sold in market	Fruit	consume	Nato			
(M)Parrot food	Fruit	consume	Savoa	*Jatropa curcas*	EUPHORBIACEAE	H(2-3m)
(M)Reserve food (not preferred)	Fruit	consume	Raketa	*Opuntia sp.*	CACTACEAE	Cactus
(M)Zebu food	Leaves		Fofo			H
(M)Zebu food	Leaves		Harahaka	*Euphorbia stenoclada*	EUPHORBIACEAE	H(3-4m)
(M)Zebu food	Trunk	Remove bark and give to zebu	Vontaka	*Pachypodium geayi*	APOCYNACEAE	H
(M)Zebu food	All		Ahitoko			B(0.6m)
(M)Zebu food	All		Taintaramo			
(M)Zebu food	Fruit and leaves		Ahioali			B
(M)Zebu food	Leaves		Komkopitse	*Gonocrypta grevei*	ASCELEPIADACEAE	V
(M)Zebu food	All		Ahipoty			
(M)Zebu food	All		Ahibe			B
(M)Zebu food	All, without spines	Burn first	Raketa	*Opuntia sp.*	CACTACEAE	
(M)Zebu food	Bark		Bakaka	*Sorghum vertilliflorum*		B(2-3m)
(M)Zebu food	All		Tsaganday			B(2m)
(M)Zebu food	All		Ahitoko			B(0.6m)
(M)Zebu food	Fruit and leaves		Ahioali	*Cynodon dactylon*	POACEAE	B
(M)Zebu food	Leaves		Komkopitse	*Gonocrypta grevei*	ASCLEPIADACEAE	V
(M)Zebu food	All		Ahipoty			B
11. PRACTICAL						
(M)Firewood	Trunk	Burn	Magna	*Hibiseus macrogonus*	MALVACEAE	H(5-6m)
(M)Firewood	All	Burn	Mainty fo	*Diospyros humbertiana*	EBENACEAE	H(2.5m)
(M)Firewood	All	Burn	Solety	*Marena filiformis*	CAPPARIDACEAE	H(4M)
(G) Fire starters	Branch	Rub together	Fantiolotse			
(G) Fire starters	Branch	Rub together	Fushera			

(G) Fire starters	Branch	Rub together	Sely			
(M)Glue	Unripe fruit	Peel	Roy	*Acasia farmesiana*	MIMOSACEAE	H(2-3m)
(M)Haircream	Fruit	Boil and apply oil to hair	Savoa	*Jatropa curcas*	EUPHORBIACEAE	H(2-3m)
(F)Harden the soft head of a baby	Branches	Cut branch into sections, boil and drink				
(M)Improve sound of voice	Fruit	Consume	Fihamy	*Ficus sp.*	MORACEAE	H(7-8m)
(M)Making alcohol illegally**B	Fruit	Ferment	Kily			
(G)Making alcohol illegally**B	Fruit	Rice, water and sugar cane mixed	Kily			
		in a process of 'Alambique'				
(M)Perfume	Bark	Crush and add coconut oil	Somoro			H(2-3m)
(G) String			Yohakalomboro			
(G) String			Vahamangetse			
(G) String			Kolohoho			
(M)Walking stick	Trunk and stem		Mavarimbato			H(3-4m)
12. SEXUAL						
(F)Aphrodisiac	Bark	Scrape bark into cold water, and drink	Hazolava and	*Neobeguea mahafalensis*	MELIACEAE	H(5-6m)
			Katrafay			
(M)Aphrodisiac **E	Branches	Boil and drink	Vahiamalo	*Vanilla madagascarensis*	ARCHIDACEAE	V
(M)Gonnorohea	Leaves and stem	Boil and drink	Kotoke	*Diospyos sp.*	EBANACEAE	H(2-3m)
(F)Gonnorohea	Leaves	Boil and drink, on its own	Manongo	*Zanthoxylum sp.*	RUTACEAE	H(6-7m)
(F)Sexually Transmitted Diseases	Roots	Grind and sprinkle on like a powder	Vahamombirindoho			H
13. MUSCULAR						
(F)Lower back ache		Hconsume up and lie on it	Sand			
(F)Muscle cramps**B	Seeds	consume	Kily			
(M)Muscle pains, antibiotic	Leaves	Boil and drink	Boroa	*Tetradenia goudotii*	LAMIACEAE	H(1m)
(M)Musclular development	Bark and marrow	Boil and drink	Hazolava	*Neobeguea mahafalensis*	MELIACEAE	H(5-6m)
(F)Muscular development	Leaves	Drink without boiling	Katrafay	*Cedrelopsis grevei*	MELEACEAE	H(3-4m)
(G)Muscular development	Bark	Boil and drink	Katrafay	*Cedrelopsis grevei*	MELEACEAE	H(3-4m)
14. DIETARY SUPPLEMENTS						
(M)Source of vitamins	Marrow	Consume	Songatse			H(3m)
(F)Vitamin rich	Leaves	Cook and consume, with Atikakoho	Ravibalihazo			
(F)Vitamins	Fruit	consume	Tsiongake	*Rhopalocarpus lucidus*	SHAEROSEPACEAE	H(3-4m)
(M)Vitamins and strength, particularly	Bark	Boil, add milk and drink	Tsiongake	*Rhopalocarpus lucidus*	SHAEROSEPACEAE	H(3-4m)
for pregnant women						
(M)Vitamins for babies *6	Stem and leaves	Boil and drink	Obognobo			B
(M)Vitamins for babies	All	Boil and drink	Sarehisatse			B
(M)Vitamins for babies	All	Boil and drink	Sarehisatse			B

15. OTHER MEDICAL						
(F)Anti-parasite trconsumement	Leaves	Grind and drink with water every morning	Mafaibelo			
		or boil leaves from dry				
(F)Baldness	Leaves	Grind with water and apply	Tamboro			V
(M)Coughs	Leaves	Boil and Drink	Fatidronono	*Evonymopsis longipes*	CELASTRACEAE	H(1.5m)
(M)Coughs	Leaves	Boil and drink	Nonoke	*Ficus pyrifolia*	MORACEAE	H(1-2m)
(M)Coughs	Leaves	Boil and Drink	Vonoky	*Ficus sp.*	MORACEAE	B(0.75m)
(G)Energy**B	Fruit	Mixed with chalk	Kily			
(M)Eye drops	Water in stem	Bathe eye	Mosese			H(3-5m)
(M)Eye drops	Latex	Apply	Savoa	*Jatropa curcas*	EUPHORBIACEAE	H(2-3m)
(M)Eye drops *7, **C	Roots	Droplets	Tamenaka	*Combretum coccinea*	COMBRETACEAE	V
(F)Eye wash	Leaves	Grind or soak, then wash				
(F)Flu	Leaves and stem	Boil and inhale steam	Fihamy	*Ficus sp.*	MORACEAE	H(7-8m)
(F)Headache	Perietal bone of skull	Grind and mix with water before	Any animal			
		applying to head	skull			
(M)Increases appetite	Leaves	Boil and Drink	Zangapoly			
(M)Jaundice trconsumement**D	Roots	Boil and drink	Fatiboay	*Argemone mexicana*	PAPAVERACAE	B(0.5m)
(M)Juandice trconsumement	Bark	Boil and drink	Hazomalangy	*Moringa drouhardi*	MORINGACEAE	H(4-5m)
(F)Old age blindness	Bark	Grind and apply to eyes	Katrafay	*Cedrelopsis grevei*	MELEACEAE	H(3-4m)
(F)Pains	Fat	Warm up and apply	Zebu fat			
(M)Relieves aches and pains	All	Boil and drink	Sosa sosa	*Commelina sp.*	COMMELINACEAE	B
(M)Relieves coughs	Bark	Boil and drink	Singatse			H(3m)
(F)Relieves fever and headaches	Leaves	Boil, with orange fruit and inhale				
		steam, eyes closed				
(M)Relieves coughing	Bark and marrow	Boil and drink	Farehitra	*Unearia stelofera*	PEDALIACEAE	H(2m)
(M)Remove arm hair	Resin	Apply	Singatse			H(3m)
(M)Sedative	Leaves	Boil and drink	Katrafay	*Cedrelopsis grevei*	MELIACEAE	H(3-4m)
(F)Stimulant**B	Seeds	consume with Hazolava and Katrafay	Kily			
(M)Strengthen teeth	Fruit	Chew fruit	Tamboro			V
(M)Toothache	Bark	Boil and swill in mouth with salt	Kilambazaha			
(M)Toothache	Leaves	Boil, drink, wash	Sasavy	*Salvadora augustifolia*	SALVADORACEAE	H(3-4m)
(M)Toothache	Roots	Boil and swirl in mouth	Savoa	*Jatropa curcas*	EUPHORBIACEAE	H(2-3m)
(F)Toothache	Roots	Boil and chew	Tamboro			V
(M)Babies drink	Green fruit	Juice	Voafiaria	*Cardiospermum halicaccacum*	SAPINDEACEAE	V
(M)Babies itches	Stem	Crush and apply	Tsimatavindrano	*Aristolochia acuminata*	ARISTOLOCHIACEAE	V
			Tamboroba,			
			Boroa,			
			Vahontsoy			
(M)Baby with torn muscles	Roots	Boil and drink	Folotse		EUPHORBIACEAE	V

(F)Ceaselessly crying baby	Leave	Boil and drink	Vontofosa			
(M)Crying babies *8	Leaves	Grind, and rub on skin	Romba	*Ocimum gratissimum*	LAMIACEAE	B
(M)Crying babies	Leaves	Boil and drink	Andriambolafotsy	*Coton sp.*	EUPHORBEACEAE	H
			with Marolahy			
(M)Digestive problems in babies	Stem	Boil and drink	Taivorotsiloza			B(0.75m)
(F)Ear aches	Young sapling	Hconsume in fire to extract liquid, and then	Voazavo			
		pour a few drops into ears each morning				
(F)Removes problems that may	All	Boil and drink	Angamay	*Tridax procumbens*	ASTERACEAE	B
block babies throat						
(M)Strengthening babies' skulls	Leaves	Crush and apply	Solety	*Marena filiformis*	CAPPARIDACEAE	H(4M)
(F)Tetanus		Grill, and destroy, mix with	Kalalao(insect)			
		water and drink straight away				

(M) - Manahira as informant (F) - Fanihisoa as informant (G) - Group of four male informants from Ifotaka village

Plant Classes (local description) - H Hatay (shrub); V Vahy (Tree); B-Bozaka (small plant)

Plants listed that occur in "Plantes medicinales malgaches", Ravi-Maitso:

*1: Boil leaves and inhale the fumes to reduce fever in babies.

*2: Delirious infants, with fever, should boil with Voatavo Giga, and inhale fumes and drink one cup a day.

*3: Rub leaves into itches

Boil, add sugar, and drink for coughs.

Boil a small amount and drink half a spoon each morning for babies with coughs.

*4: Boil and drink to relieve problems with urinating.

*5: Babies with coughs or whooping cough should inhale fumes when it has been boiled with Sabita.

*6: boil and drink with kifafalahy to reduce tiredness

peel budding leaves and apply to wounds, and apply the juice on top.

*7: Pour juice into eye to remove speck.

*8: Grind leaves and put into the hole of a bad tooth

Boil 4 g of leaves and drink

Take the grains for a headache

Plants listed that occur in "Plantes medicinales de Madagascar", Boiteau:

**A: The gum is used against coughs

**B: Used for stomach problems, as a laxative and anti-spasmodic. Also used for skin problems

**C: Used as a vermifuge

**D: Used to induce hypnosis, to reduce coughs, convulsions. Large doses are dangerous. Roots, leaves, seeds all used for different things.

**E: Aphrodisiac

**F: Good for the heart, but must be in very small dose

**G: General disinfectant

5.5 DISCUSSION

The data from the two main informants (Manahira and Fanahisoa) was given in two different ways. Manihira gave information on the plants without discussing the spiritual context, whilst Fanihisoa was keen to move open-ended interviews into discussions about his powers of harnessing the spirit world through the plants. Manahira divulged little of his knowledge of the spiritual world and how it influenced his prescription of plants. Although informants in the anthropological research suggested that Manahira was renowned in the region for his spiritual power, he did not admit these strengths. This suggests that an investigation into the variation of the importance of the spiritual side of the *Ombiasy's* role would be valuable.

Uses were assigned by the two '*Ombiasy*' for 169 different plants with a total of 312 human uses, however only 100 of these have had their scientific names identified. Only twenty of these were mentioned by both men, eighteen of which were considered to have the same function. This represents a proportion of agreement of 0.12. This measure of overlap might not be a fair assessment of reliability since information was collected from each *Ombiasy* in a different way. Also, a low proportion of agreement is explained by the fact that the two men did not share their knowledge with each other since this would devalue their own skills. Their remedies were perceived to be effective and reliable by local informants, although they did tend to mention a preference for longer lasting hospital treatment if it could be afforded. A shift towards a preference for non-traditional remedies was reflected by the difficulty Manahira had with remembering certain plant uses, saying that he had not used them for many years. Despite this, he was still considered to be "one of the big *Ombiasy*" whose abilities gave him a prominent position within society.

The majority of the plant uses mentioned by both were used within the community for construction purposes or as food, but medical properties were largely unshared. The exception to this was *Argemana mexicana* which is used by both *Ombiasy* for "undiagnosed illnesses". It seems fair to assume that the range of plants used for different problems reflects the ailments that are most often suffered by the community, and so stomach problems and common side effects from pregnancy seem common. Problems like acne have no assigned remedy because it does not pose a major problem to the community. Comparing the remedies told by the *Ombiasy* with those of published material, eight of the plants that had been assigned Scientific names were found to have uses reported in Ravi-Matsoa's "*Plantes medicinales Malgaches*". Only one of these had exactly the same use, *Combretum coccinea*, used to remove specks in the eye. Compared with Pierre Boiteau and Lucile Allorge-Boiteau's "Plantes medicinales de Madagascar", seven of the plants in the database that had been assigned Scientific names had been mentioned in the book. *Vanilla madagascarensis* is noted by both for its potency as an aphrodisiac. The importance of plant medication for treatment associated with childbirth was identified by both *Ombiasy*. It is likely that plants associated with these pregnancy treatments will remain important in a rapidly expanding population, where such knowledge is of universal and ongoing value, whilst the removal of other (less frequently used) plants will be likely if the system continues to rely more and more on forest destruction for growing food, grazing livestock, the sale of wood, and has an increasing faith in the efficacy of hospital treatment.

The village doctor said that there was a noticeable change that had occurred in the community over the years. Zebu herders, who remained more dependent upon the

forest resources, were more reliant upon the ancestral spirits, and the powers of the *Ombiasy* to cure ailments and illnesses than those who worked in the fields along the river. They were more able to earn money, become more independent of the spirit mediums, and place more reliance on both the church and the hospital rather than forest resources which were more difficult to find and also less reliable. This was reaffirmed by those informants who said that if it was affordable, hospital treatment was preferable and more effective. Others mentioned their fear of unfamiliar western techniques. Hamlets that lie a day or more walk away from Ifotaka are still reliant upon the hospital in Ifotaka, and often patients die before reaching the hospital if local remedies have been ineffective. In addition to the changed use of forest resources for medicines, one of the village elders said that there had been a marked decrease in the reliance of villagers on forest resources for food, in preference for destroying sections and growing their own crops in the fertile space made available. A range of birds is hunted, often by children, and wild fruit such as *Opuntia sp* (The Prickly Pear Cactus) is sold in the market.

Misunderstandings due to the limitations of the interpreters (Helene, Claudine, Jimmy and Yves), such as attempting literal translation of Malagasy terms into English, may mean that the data is limited to a degree. This may be reflected in the database categories. For example, Manihira describes *Tetradenia goudotii* as being used to "wash female genitalia" and so was placed in a section on personal hygiene, whereas Fanishoa described it as being used to "wash after giving birth" and is under the section on pregnancy.

The main problem encountered with this ethnobotanical investigation was the difficulty in identifying the plants. Many plants were not collected because it was the wrong time of year (dry season), some of the plants were rare and so it was difficult to locate samples to collect. In addition much of the data from Fanahisoa was collected during the last week in the field and so there was not enough time to collect specimens for identification.

The importance of further research on ethnobotany in the region cannot be understated, and this expedition provided a useful reconnaissance that confirmed that local *Ombiasy* are willing to share their knowledge, and found that a large variety of plants and other forest resources are put to a range of uses. Not only could their use provide real medical value as pharmaceuticals, but their local manufacture could also boost local economic activity, and if exported, could also make a significant contribution to Madagascar's GNP. The greater value that ethnobotany could bring to the region would also result in the protection of other organisms, including lemurs. It is suggested that future studies attempt to produce a complete database of the knowledge of one *Ombiasy* before starting to collect data with another *Ombiasy*. Also for future surveys the importance of developing a good relationship of trust with the *Ombiasy* must be emphasised, this is likely to be made easier by dedicating one person from a research team to focus on this research.

5.6 CONCLUSION

The ethnobotanical data collected on this expedition was extensive, and the two *Ombiasy's* datasets differ providing a view of the common perception of the use and properties of the forest resources that are used. The ethnobotanical database identifies the value of conserving local knowledge as well as the forest itself, it shows the potential for an alternative use of the forest (exploitation of medicinal plants) which has implications for the future management of the area. This potential use must be carefully investigated in the future to assess the real potential of the knowledge plants, also, if exploited the intellectual property rights of the people from whom the knowledge is exploited must be respected. It complements the lemur research discussed in other chapters by identifying plant species used by humans and so the degree of threat posed by man to the forest.

Figure 5.2 - Manahira, a local Ombiasy in Ifotaka.

A PRELIMINARY ANTHROPOLOGICAL INVESTIGATION OF THE ANTANDROY OF THE IFOTAKA FOREST

6.1 SUMMARY AND INTRODUCTION

" 'Antandroy' means "the people of the land of thorns": a land where one goes thirsty, when one often goes hungry, where people are strong and proud"

The local community of the harsh, dry and remote spiny forest of Ifotaka is the Antandroy tribe[1]. They are shifting cultivators and their livelihood is centred round their zebu cattle, which they herd through the spiny forest. During the second and third phases of the expedition, social anthropological research was conducted in the villages within or on the margins of the Ifotaka forest, investigating the community's agricultural practices, their use of the forest's natural resources and their attitudes towards the forest. It emerged that the forest acts as the basis of survival for the Antandroy: food for humans and livestock, materials for construction and making handicrafts, firewood for cooking and medicinal plants for health and well-being of the population.

The method of preparing the land for cultivation practised by the Antandroy is the "slash and burn" or locally known *"Tavy"*, where the staple crops of manioc, sweet potato and maize is grown on cleared patches of land, the former two on the riverbed, while the latter in the forest. Areas of forest are also cleared to provide grazing areas for the herds, which after a year is then used for cultivation. After four years of an area being cleared and burnt for cultivation, the soil often becomes unproductive. It takes as long as seven years for the soil in these areas to become productive again (Quansah et al. 1986). This type of agriculture represents a serious threat to the forest, which is currently unprotected. Although forest guards are said to try and stop excessive felling of the forest, this has proven difficult to monitor and so if the current uses increase with the increasing population the forest and its flora and fauna are at risk of destruction.

[1] The team worked with only some of the Antandroy tribe for 3 months from July-September 1999, so the findings in this report are representative of only the Antandroy of the Ifotaka/Morafeno area.

6.2 METHODS

The aim of the Anthropological investigation of the project was to gain an appreciation of how villagers perceive and manage the forest area and the flora and fauna contained within it and to observe the current threats facing their livelihood today. In relation to this, the team sought to understand the organization and functioning of the Antandroy tribe living within the community of Ifotaka. The Participatory Rural Appraisal (PRA)[2] method was conducted where community integration and participation acted as an interdisciplinary and multi-level approach - this allowed for a balanced and unbiased collection of data, focusing particularly on the local people's knowledge and the way they organise and control their resources. This methodology has been described as rapid, holistic and interactive (Kapila & Lyon 1994); is designed for short duration and low cost research. It is particularly useful in investigating social issues and natural resource management.

The team concentrated on *the qualitative* side of PRA (i.e. non-statistical), which involves observation and questioning of the local community through semi-structured interviews – informal interviews with open-ended, interactive questions, which can be carried out with large groups, families and individuals. It was realised that *quantitative* information, such as the estimation of areas cultivated would be difficult to obtain, since the respondents may not accurately measure this; also it avoided controversial or difficult questioning. As a result, the survey was successful as there was good cooperation by the villagers.

There were six main areas of investigation which gave overall indications of human impact on the forest; social organisation, demography and the division of labour; traditional economic activities; the Antandroy's perception of the environment; the partitioning of the forest and the pressures on it, followed by descriptions and priorities for forest management. The Antandroy of the Ifotaka forest became full participants in the study, aided by Jimmy and Yves, our two Malagasy interpreters, who had origins in the Antandroy. Two members of the team went with an interpreter into the villages to interview the villagers. The semi-structured interviews lasted approximately one hour and were largely held in the respondents' households. The semi-structured method allowed the respondent to reply and talk freely about the various topics raised it was flexible enough to allow the question to be rephrased or simply left unanswered. An attempt was made to get an effective age and gender mix which was a representative cross-section of the community and usually included several women with their children and one or two men. Living close to villages and participating occasionally in village life allowed an understanding of natural resource management, obtained through participant observation and informal discussion.

All discussions were recorded on tape and later transcribed the same day. This proved to be an effective way to collect data as we were not fluent in Malagasy and did not want to slow down the flow of discussion. Because of this, time was saved through not writing during the interview, more questions were covered in the time given and the overall discussion flowed more easily and only limited notes of key words/issues arising

[2] PRA methodology is a development of the qualitative methods undertaken by social anthropologists, and has come to be better suited to meeting the needs of the people themselves, by including and involving them in decision making and implemtation (Kapila and Lyon 1994) and emphasises community participation.

during the interviews were taken during the interviews. Observations were also written down before and after the interview in a field note book. The informants were invited to suggest a suitable time for the discussion to be conducted during an advance visit. In total 32 interviews were carried out during the study. There were regular trips to the Ifotaka market to gain a reliable set of data about the livestock and agricultural produce sold and grown in the area. The interviews were carried out at an ideal time of the year because it was a time of agricultural "rest", a couple of months before the wet season. Had the surveys been carried out at any other time, people would have been more likely to be working in the fields tending or harvesting the crop, and may have had less time to talk. It was recognised that there was an inevitable bias during the interviews due to linguistic, cultural and educational differences between the team and the respondents, however Jimmy and Yves made efforts to minimise this. They acted as "go-betweens" among the guides, and then between the villagers and the our research team, with the aim of their presence allow the villagers more receptive and to let the informants understand our motives. The team were aware of the fieldworker- respondent relationships and realised that there can never be a true objective "transparency of representation" (Clifford, 1986).

The two main sources of literature that proved most useful in establishing and formulating the methodological approach were "Ethnobotany Handbook" by Gary Martin (1998) and PRA notes taken from a VSO workshop. When it came to sorting and analysing the data it was we decided it was best divided under sections: demography, agricultural economy, agriculture, natural resource management, traditions, religion, trade and transport.

Figure 6.1 - A Herd of Zebu returning from the Mandrare River in the evening.

6.3 Results

Demography

The social organisation of the Antandroy depends on the structuring and the size of the family unit which consequently affects how the family functions. Migrations, births and deaths are the three factors that cause fluctuations in population size and structure.

The villages within the Ifotaka forest consist of large extended families which are usually originally started by one migrating man and several of his wives, as they practice polygamy. The Antandroy are one of the remaining tribes in Madagsacar of this kind and each man can have between two to eight wives. Once the man is settled, he will usually remain in his village (either the one in which he is born or the new one he has founded) and the women will migrate to join him. The revered and powerful men within the community, such as the Mayor and the *Ombiasy*[3], are most likely to have the most wives and consequently a larger than average number of offspring. It is not unlikely for each woman to have up to 10 children. The Antandroy livelihood in the Ifotaka area consists of subsistence farming and cattle herding supplemented by trade so the family structure and size will affect the division of labour. Having more children means more hands to help our in the fields and with tending the cattle.

A village usually consists of many generations of the same lineage; long distance migrations are limited therefore there is much inter-relatedness between villages. When population exceeds capacity, part of the family may decide to migrate to a different area and set up a new village, which will then expand through further childbirth and marriage.

The Economy

Agriculture

To create space for a settlement for his growing family and more significantly for cultivation, the Antandroy men need to cut areas of the forest. The agricultural cycle in the forest begins in October when the men clear forested areas for agriculture, by cutting and burning trees and shrubs, exposing the soil. From the beginning of the wet season (November) the women and children plant. A variety of crops are grown: maize *(balaharzo)*, white beans *(antake)*, sweet potato *(bageda)*, marrow *(vozavu/taboara)*, peanuts, spring onions, sugar cane and cassava are all grown in these cleared areas, as well as fruits such as melon, mango, *lamot* (red and small), *sasavy* (round and dark red, like grapes) and *farehita* (spiny fruit). In some areas of the forest, such as in *Pisu Pisu,* tobacco is also grown and near *Mangil* the villagers grow rice. Throughout the wet season until March the women tend the crop[4] and then in April, after the rainy season, the harvesting begins. This is a time when all families help each other, and at the end celebrate with a harvest feast.

According to the Antandroy living within the Ifotaka forest, the forest has recently experienced three climatic periods which have affected their agricultural supplies

[3] Medicine man or witch-doctor (look under section on Ombiasa)
[4] planting, hoeing and weeding

on which they survive. Initially the forest was green, but then between 1991 and 1994 it became very dry as the Mandrare river dried up. Consequently, animals died and the Antandroy had to dig holes to get water. The last severe drought was in 1992, which prompted national and international aid. This was followed by a greener period between 1994 and 1997 when the forest was very productive. Since 1997 the forest has been dry and this year has been a bad year with only one month of rain all year. On average, in the Ifotaka area the rainfall is 600mm a year (Berenty;1998). It is the great lapse of time between erratic rainfall combined with the extreme heat that gives this region a dramatic variation of agricultural supplies typically in the wet season they are abundant, while in the dry season they are scarce.

The dry season lasts for nine months (February to November). During this time some of the Antandroy move to the banks of the Mandrare and out of the forest due to the shortage of water and the reliability of a constant water supply from the large Mandrare river. The land surrounding the Mandrare is often cleared by the Antandroy of Ifotaka to cultivate their crops. This causes the forest to be cut further and further back, exposing the soil and increasing the risk of more severe flooding when the wet season arrives.

In the first weeks of the wet season in November, the water level of the Mandrare rises and may eventually floods its banks, ruining many of the adjacent crops. This damage to agricultural produce, together with the limited space near the Mandrare, forces some of the Antandroy of Ifotaka to move further into the forest again, where some prefer to stay. One farmer who lives in the forest *(at Andavatsak)* states:

> *'This is a good thing, as one person can remove 10 tons of forest to grow maize!...last rain I moved here for the sole reason of agriculture".*

The Antandroy do not need permission to build in the forest, so new villages continue to spring up (although they remain very dispersed). However, a permit is required from the forest guard to cut trees down for agriculture. Although this has been an attempt to conserve the forest, clearances often go unreported and overall the forest is very difficult to monitor. The Antandroy choose carefully where to clear in the forest for settlement as accessibility to water and flat terrain suitable for their zebu are both important. The men therefore choose the greener areas of the forest, which indicates the availability of water. As an local elder exclaimed:

> *"Water comes from the forest...the trees 'call' the rain"*

Both flooding and the gradually growing rural population encourages some of the Antandroy population to settle in the forest to exploit the natural resources. This puts greater pressure on the forested land, which means more areas are cleared for agriculture to sustain the population. As a local herder said:

> *"More trees are cut nowadays because of the bigger population"*

As we have seen, the Ifotaka forest sustains many of the Antandroy community through providing areas for grazing and agriculture, which is the basis of their economy. The market is the best place to observe these basic needs and it is the main source of income and exchange of this rural community, where villagers from the area come together.

Villagers come to the market to sell their surplus agricultural produce which they have cultivated locally or collected in the forest and which is beyond their family needs. They also bring their livestock, handicrafts and forest products to sell in the hope of generating income. They then use the money they generate to buy imported goods from Ambosary: clothes, rice, and "basic needs", or in Haviland's words "needed items", such as matches, petrol, sugar, salt, oil, soap and medication. He also describes:

"In peasant or agrarian societies, market places...provide the opportunit e-gions to exchange some of their livestock and produce for needed items...it is a gathering place where people renew friendships, see relatives, gossip, and keep up with the world"[5]

Such is the character of the Ifotaka and Fenaivo markets, which attract local villagers in the area to come together to exchange both their surplus for basic needs and also their news. Ifotaka is completely self-sufficient in fresh produce and none is exported to or imported from Ambosary. Table 6.2 below shows the origin of the vendors in the Ifotaka Friday market and the Fenaivo Thursday market:

Figure 6.2 - The market in Ifotaka

[5] Haviland, W.A., 1996 *Cultural Anthropology*, Harcourt Brace, p207

Table 6.1 The Origin of vendors at Fenaivo and Ifotaka Markets

FENAIVO MARKET	Ifotaka, Morafeno, Andavatsaka, Mangily, D.P., Antamilami, Bekira, Anjamhavelo, Ambosary, Amboetsy, Tsivuri, Ebelu, Biakanga, Amorondrano, Mahabu
IFOTAKA MARKET	Fenaivo, Morafeno, Andavatsaka, Mangily, D.P., Ankazota, Tsarapioky, Somangy, Antazota

From this table it is obvious that vendors come from a number of different villages to the central market villages: Fenaivo and Ifotaka. The division of labour in the Antandroy society is obvious in the market place, where men and women are segregated. Men who herd livestock trade zebu and goats, while the women, who are responsible for the cultivation of the fields, trade agricultural produce. The livestock that is sold includes zebus, goats, chickens and turkeys and is co-ordinated by the men. They occupy an area of the market, apart from the women, just for them to barter with other men interested in buying. Although it is taboo *(fady)* for women to milk zebu, it is they who sell curdled milk *(babubu)* at the market, as well as the chickens and turkeys.

Table 6.2 Livestock Prices

LIVESTOCK	LOCAL NAME	PRICE (Fmg) in July-Oct 1999
Zebu	*Omby*	700,000-1,000,000 (£70-100)
Goat	*Orse*	50,000-125,000 (£5-12.50)
Chickens	*Akuhu*	6,000-8,000 (£0.60-£0.80)
Turkeys		8,000-10,000 (£0.80-£1.00)
Guinea Fowl	*Akanga*	6,000-8,000 (£0.60-£0.80)
Livestock Products		
Curdled zebu milk	*Habubu*	250 (per cup) (£0.025)
Eggs	*Atuli*	~350 (per egg) (£0.035)

Figure 6.3 A herd of Goats in Ifotaka.

The women occupy another part of the market where they sell their agricultural produce, which is grouped into piles/bundles/cupfuls (*kapuk*) and sold in a set quantity.

Table 6.3 Prices of crops and location of areas where they are cultivated

CROP	LOCAL NAME	PRICE (Fmg)	Location of Cultivation
Maize*	*Balaharzo*	70-150(0.7p-1.5p)	Close to the Mandrare.
Cassava* (dried)	*Manioc sec*	380 (3.8p)	Further away from the Mandrare.
Potatoes	*Patate*	290 (2.9p)	Further away from the Mandrare.
Sweet potatoes* (the leaves[6] are sold separately)	*Bageda*		Close to the Mandrare.
Red Beans	*Taboara*	750 (7.5p)	In the forest
White Beans	*Antake*	750 (7.5p)	In the forest
Tobacco (braided into a rope and sold by the hand length)	*Tabac*	500 (5.0p)	In the forest
Rice	*Vari/ Riz local*	650 (6.5p)	On the banks of the Mandrare after the rainy season (flooding).
Tomatoes (big and small)			Close to the Mandrare.
Peanuts			Further back from the Mandrare.

* Main staple crop
[6] often cooked and eaten with chicken dishes.

As men are busy with their livestock, for most of the day the village life is in the hands of the women. Their two main responsibilities are caring for the children and preparing meals for the family, which entails many separate tasks. These include, fetching firewood and water, daily harvesting or gathering of ingredients, and from a young age, they learn to weave traditional handicrafts – much of these tasks involve collecting from the forest. What is collected from the forest, is sometimes sold in the market, providing a significant source of income.

Table 6.4 Forest Products available at the market.

FOREST PRODUCT (edible)	LOCAL NAME
Cactus fruit[8] *(Opuntia sp.)*	*Rakeita*
Tamarind fruit *(Tamarindus indica)*	*Kil*
Mango	*Mange*
Red local fruit	*Lamouti*
Local fruit	*Sassavi*
Sugar Cane	*Fary*
Wood	*Bemako*
Small white bird	*Kibu*
Tree Oil (used to soothe aches, burns etc)	*Kinanga*

The Antandroy women are well known for their skill at making traditional mats and hats which they craft from wild plants from the forest (Berenty;1998). The women of Ifotaka go into the forest every 2 months to collect large quantities of these plants which are mainly the locally known reed *Vinda Vato* (cyperus), *Vondrona and Sal* (bark), *siro siro* (wood) and a type of raffia known as *kazanova,* together with a natural dye. The most common of these is the *vinda vato* (cyperus) reed. The stems are cut and then rolled in ash or sand. It is then left to dry under the sun for 2-3 days. During the 3rd night the stems are left to absorb moisture from the dew. In the morning of the fourth day, the women begin manufacturing the handicrafts (hats, husking mats, baskets); it takes them 5 days to make a mat, and 1 day to make a basket. Most women make enough traditional handicrafts, for their own family needs, but when they need to generate income they make extra to sell at the market.

[8] The peak season for this fruit is January to February (the time just before the crops in the fields are harvested).

Transport

Trade is very much dependent on transport provision. With uneven and poorly maintained roads in the Ifotaka region, the wide Mandrare river difficult to cross and 'zebu chariots' as the main mode of transport, trading is not easy. For the locals it is difficult and expensive to travel long distances by public transport (*taxi-brousses*[9]), especially when buying and selling food, so most agricultural produce is brought to the local market by foot. In the forest there is little road access which means that many villagers are fairly cut off from national communication. However, the World Food Programme[10] (WFP) in collaboration with two other Non-Governmental Organisations (NGOs)[11] built a 7km road in the forest from Morafeno to Mangily to improve access and help in times of famine. No motorised transport can reach villages such as these due to the difficulty of crossing the Mandrare river. To cross the Mandrare river in the wet season when the river level is high, the Antandroy of Ifotaka use long thin "pirogues", paddle boats carved from tree trunks.

Figure 6.4 - Pirogues (dugout canoes) on the banks of the Mandrare.

[9] A type of bush canvas awned truck operating like a bus with fares for transport between major villages.
[10] Programme Alimentaire Mondial in Madagascar.
[11] CGDIS and Sekalina

The Importance of Livestock

In a male-dominated and polygamous society, the primary aspiration of young Antandroy men is to own as many zebu as possible, as they give wealth[12], status and opportunity. Zebu are hump-necked impressively-horned cattle, similar to those found on mainland Africa and have become necessary for fulfilling the many obligations in personal and family life of the Antandroy. The man with the most zebu is highly respected and has considerable influence over the region, for example the mayor of Ifotaka has 215 zebu, and it is not surprising that Ifotaka village is considered the centre of the area. Similarly the *Ombiasy*, which literally means "to get zebu", is feared because of his powers and also the numerous zebu he owns. The bigger and stronger the zebu, the more they are worth. In the Ifotaka/Morafeno area zebu are worth 700,000-1 million Fmg each. This economic tradition seems to be firmly rooted; even the youngsters questioned by the team about their ambitions were adamant that they would become cattle herders. Also during one interview, a herdsman questioned about his sons' education said; "my sons work with zebu, that is their studies". Similarly when one mother said: "I love children as I want them to become zebu herders".

Zebu are used for a variety of purposes; they are exchanged as part of the dowry in marriage, pairs of zebu are used to pull wooden carts *(chariots)*, which is the main mode of transport for goods in many of southern Madagascar's rural areas. They are economic goods, sold off in times of need, notably to buy food during droughts and in the hope of increasing their wealth and status through these means. A village elder said,

"I never have enough zebu...I have ten. I would like to have one hundred"

Zebu are considered sacred and clean animals as they eat plants, and their horns and faeces are believed to contain goodness and sustenance. Individual and collective rituals, e.g funerals, or calling on the ancestral spirits (by the Ombiasy) require the sacrifice of zebu, as they are believed to be linked to the ancestral world. Since they are sacred, they are slaughtered only on special occasions such as during famine or at funerals. For example, at a funeral the zebu meat is shared amongst the guests (except the direct family of the deceased), the hide is used to make sandals, knife sheaths, slings etc. and the horns maybe used for knife handles. Yet, more importantly, because of the life-forces believed to be in the horns, they are ceremoniously laid around the tombs of their owner. As Raymond explains, the horns and skulls were used to protect the spirit of the deceased as they protected it during life.

Everyday the zebu roam and graze through the forest. Each herdsman recognizes his herd by their distinctively cut ears and markings, which show his clan and lineage. At night they are returned to their owner's village where they are kept in a fenced enclosure. The zebu graze on shrubs and during times of drought prickly pear cactus leaves – raketa *(Opuntia sp.)* are prepared as fodder (by removing the spines by burning). Although zebu eat husks of the maize crop, their fodder is scarce round the villages but abundant in the forest, making them and their herders highly dependent on the forest. Similarly goats, which are an important source of meat, leather and income, graze freely through the spiny forest. Therefore both zebu and goats cause damage to the forest plants.

[12] Having zebu is like having a bank account; they are the source of money and exchange.

Although zebu are rarely killed for their meat in rural areas, their milk is an important source of nutrition for the Antandroy. *"Habubu"* is fermented zebu milk (almost like yoghurt), which is mixed with the pulp of tamarind *(kil* [13] and then left for 2-3 days before serving. It is very cooling and is often eaten in the heat of the midday sun with sweet potato *(bageda).*

Figure 6.5 - Two Zebu pulling a Cart in the Ifotaka Forest

[13] Fermenting agent *(Tamarindus indica)*

Forest Resources

The Ifotaka forest supports the Antandroy, providing the basis for their survival in harsh conditions. It is vital to all aspects of the Antandroy livelihood; plants and wood are often used for construction, fuel, food, craft and medicine. As few materials are imported to the area for these purposes due to expense and its isolation, the Antandroy community have become incredibly resourceful in exploiting and managing the natural resources of the forest available to them. This resourcefulness has been based on their intimate knowledge, understanding and respect of the environment around them, which have been passed down generations. It is important to recognise their current and future dependence on the forest resources. As one old man said: *"All the trees have some use"*. The community as a result are not wasteful and do not use more than is necessary for their basic needs.

Medicinal plants, in particular, are still used frequently for psychological and physical ailments and illnesses not dealt with by standard medicine. Examples include problems of the respiratory system, the central nervous system, treatment of inflammatory disease, skin disorders, malaria and diarrhoea. One villager exclaimed:

"People get ill again after using the clinic, but the forest is better for curing malaria and other illnesses"

Although there is not a strict division, the general tendency, if the person is not Christian, is to consult the Ombiasy (medicine man) if they need a plant for medicinal purposes. If they are Christian they rely on their grandparents' indigenous knowledge and avoid consulting the Ombiasy.

In times of famine, the forest provides a variety of foods to sustain the hungry population, such as wild tubers, herbs, fruit and nuts (see Ethnobotany section). One main source of sustenance, which the locals claim is why their community have survived even the worst famines, is the mixture of the pulp of extremely sour tamarind fruit *(kil* with chalky/limestone rock *(tanyfotsy)*. This rock contains calcium and is found in areas such as *Mahavelo* (meaning "to give life"), where the research team camped.

To collect dry wood for cooking fuel is one of the most common reasons why the Antandroy villagers come into the forest (see Ethnobotany chapter). Wood from the forest is also used for the construction of boats, zebu carts, fences, furniture and traditional coffins. Most of the houses in the Antandroy villages are made out of a variety of local woods (see Ethnobotany chapter); the only exceptions are the church, school, the clinic, townhall, army base and doctors house which are built from bricks. For experienced builders to build an average size house, it takes up to 2 months. Typically, 4-5 houses are built per village per year, and with the growing local population and number of settlements in and around the forest this means there are a significant number of trees cut in the forest. Wooden constructions are typical of the south, compared to villages around Antananarivo *(the capital in the North)* where houses are typically made of mud bricks and reinforced with straw or mud over wooden frames. This difference suggests the varying accessibility of trees in these areas, as Ifotaka for example, has access to wood from the spiny forest.

Natural plants growing wild in the forest are important also for domestic purposes, such as soap, rope, string and containers (see Ethnobotany chapter). Calabash (shells of some forest fruits) are still used frequently as containers to hold water in more

remote areas. Examples include the locally grown *voatavo* melon, *fitovy* which is used to scoop water and *korobo* used for holding "*habubu*" (curdled milk). They are all dried for several months before being made into containers.

Not only does the forest flora support the Antandroy livelihood, but so does the fauna. The young men catch wildlife to eat from the forest, including tenrecs (Tenrecidae), guinea fowl *(akanga)*, fosa *(Cryptoproota Ferox)*, wild pig and birds such as the locally known *tivuke, soura, tsimitse, ribo, aliotse, vazagne, rietsu, fol* Birds' eggs are often found and eaten by the family or sold at the market. To catch these animals the men use slingshots[14], catapults or spears and more often they use a gun to kill guineafowl and other birds. Dogs play a significant role in hunting wild animals in the day as well as protecting the herdsman's village at night. If a man catches many wild animals he will firstly give them to his family, and then sell the rest at market. However, thanks to a number of *fady* (taboos), beliefs and the Antandroy respect for living creatures, the lemurs and the great land tortoises, for example proliferate today and are not hunted. However, it is important for the issue of harvesting tortoises in the area to be more fully investigated as broken carapaces (often the sign of harvesting (O'Brien pers.comm.)) were found in the forest.

It is evident therefore, that the spiny forest is used by the Antandroy community for a variety of purposes, enabling them to survive in the harsh, dry and remote conditions of the Ifotaka forest. However climatic and economic pressures continue to force the Antandroy to exploit the forest in an unsustainable way. Land is the most important and valuable asset to this rural community as their livelihood depends on it; both socially and economically. Losses of land are particularly apparent today in the Ifotaka forest as sisal plantations gradually encroach into the forest.

Flooding in the wet season, drought in the dry season which bring on famines are only some of the many severe problems encountered by the Antandroy. Bad roads continue to leave remote villages vulnerable to the effects of annual climatic disasters and pest invasion, such as by locusts. *Morafeno* for example, particularly since 1995, has had swarms of locusts descend on their fields, destroying their crops, and because of the bad roads the village has not received pesticide to kill them off.

Accessibility to other villages suffering from severe droughts, remoteness and locusts are real problems for development in the area of *Mangil Amboetsy, Fangidrat Fangaliedraky* and *Mahabo* villages. Ever since the severe drought of 1992 when locusts appeared in the region of Ifotaka, they have destroyed the crops and the shrubs in the forest (on which the zebu graze), which subsequently killed the livestock through starvation. With the threat of livestock death, the Antandroy of Ifotaka burn cacti leaves *(raketa)* as substitute fodder. Apart from the locusts, there are other pests which destroy the crops grown or stored further within the forest, these include pigs, mice, guinea fowl and even lemurs.

The village of Ifotaka receives little money from the government and local NGOs, and none is received by the more remote villages further in the spiny forest, such as *Amboetsy* and *Mangil* There infrastructure and implementation capability of the government remains weak and this is obvious by the bad transport system, the lack of a secondary school and the lack of basic knowledge on health, nutrition and sanitation. There

[14] These are, however, largely used for guarding zebu herds against robbers.

is only one doctor (no mid-wives) for the whole of the Ifotaka region, who deals with five common problems: childbirth, STDs[15] (e.g. Gonorrhoea, Syphilis), diarrhoea, malaria and sickle cell anaemia. One international NGO, PAM[16], however came to the area briefly to help solve the plague of locusts and bring vital vaccinations. PAM also runs a child nutrition programme in Ifotaka village for the school children.

Figure 6.6 - The sign at the start of the rehabilitation of the road from Mangily to Morafeno in the middle of the Ifotaka Forest.

[15] Sexually Transmitted Diseases
[16] Programme Alimentaire Mondial. (World Food Program)

Off-farm jobs

After the wet season of planting, the men look after the zebu and try to earn money through adopting off-farm jobs to raise their income. Having enough money to buy more zebu and material to build a new house is vitally important to the Antandroy men, however, others spend it on alcohol. Young men frequently go to Tulear or south of Ifotaka (*Ancoubay* and *Andranondambo*) in search for precious stones such as sapphires and mica or go and work in the sisal plantations[17] in the region of Ambosary. More recently, some families have begun earning a living by selling forest products, such as firewood, charcoal or even trunks of *fantiolotse* (*Alluaudia procera*) which are cut into planks by small saw mills. This outside employment provides a "safety valve" for the Antandroy, whose agriculture, as we have seen, is continually threatened by climatic and social problems, and therefore provides them with opportunities for finding additional sources outside the farming sector.

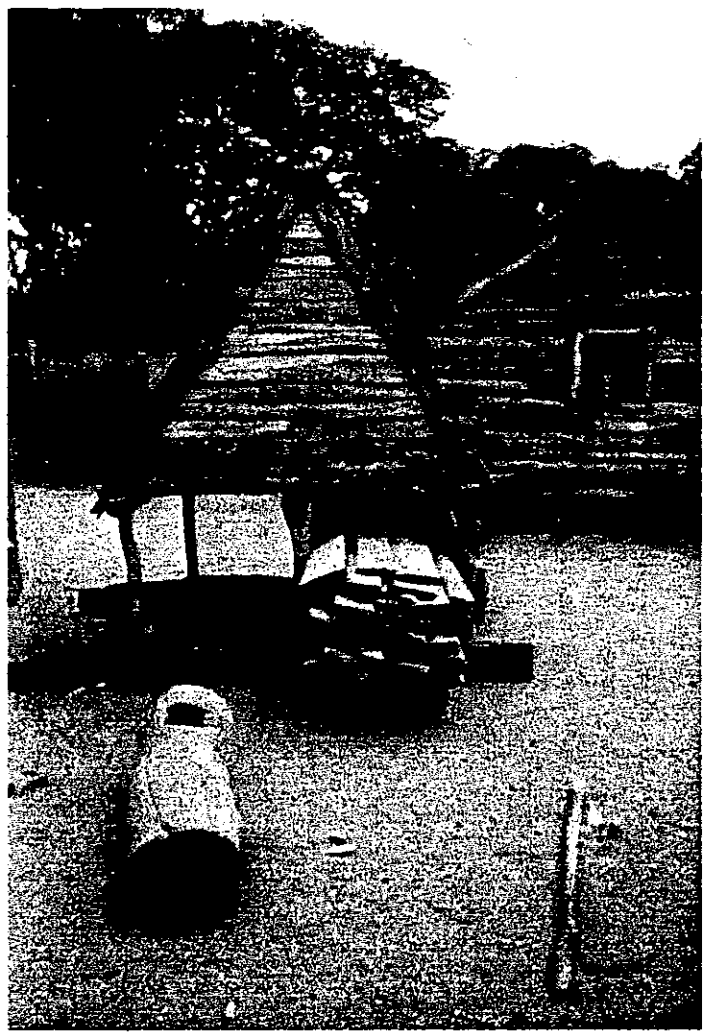


Figure 6.7 - Planks of wood for construction of local houses.

[17] to work in the processing plant to produce rope.

TRADITIONS

Tradition can be defined as the handing over, often in the form of an oral transmission, a belief or practice from generation to generation that will affect the continuity of life within a community, thus affecting the development, organisation and functioning of a society. The Antandroy community in the Ifotaka region are an example of a group of cohabitants that live under a highly traditional, self-defining, tribal regime. Traditional practices are affected by *"fady"* (taboo). It is a religious belief affects the functioning of society as it conditions what is and what is not acceptable behaviour.

The traditional role of the women is to serve and respect the man. A good example of male prestige is when the woman carries all the produce plus her baby to market, while the man will only carry his spear. Women are also considered to be more "earthly" and "natural" (due to their ability to reproduce) and so are consequently thought to be spiritually possessed. Therefore, a woman is forbidden by *"fady"* to milk the "sacred" zebu and must avoid entering their field when she is menstruating. Another *fady* rule which we were told by one woman was not to eat eggs; this comes out of a strict compliance with, and respect for, the words of their ancestors.

There are also certain areas of the forest which are considered *fady* and must not normally be entered. This is often because they house the tombs of important and influential ancestors. Death is surrounded by many traditional activities. This is because the after-life is considered better and therefore the loss of life is greeted by much celebration. The festivities include traditional dancing, for which the men must carry their spears, and the consumption of zebu meat and copious amounts of the local rum. For several days the male relatives run through the villages in an energetic procession chanting loudly as a way of publicizing the death. Behind these men are those dragging the coffin made from local wood (see the Ethnobotany section). These traditional coffins are made up of two main slabs of wood; which differs for males and females. It is usual for villagers to contribute towards financing the funeral and for the whole family to be present for the burial of a relative, regardless of their travelling distance. Although much of the traditional dress has been abandoned by the locals for modern Western clothing, at times of death the traditional woven burial shrouds are worn.

The tomb (usually a family one) is made out of cement and large stones and is prepared by decorating with zebu horns, wooden "totem-pole" sculptures and/or paintings about the life of the deceased. It was observed that further away from Ifotaka the intricacy of decoration seemed to decrease, leaving simple vast piles of stones, neither sculpted nor ornate. In contrast to funerals, marriage feasting and dancing only lasts for one day and no zebu are slaughtered for meat. When the first child is born the mother paints her face with chalk and it is at the age of 6 that boys are circumcised. Traditional rituals therefore play an important role amongst the Antandroy.

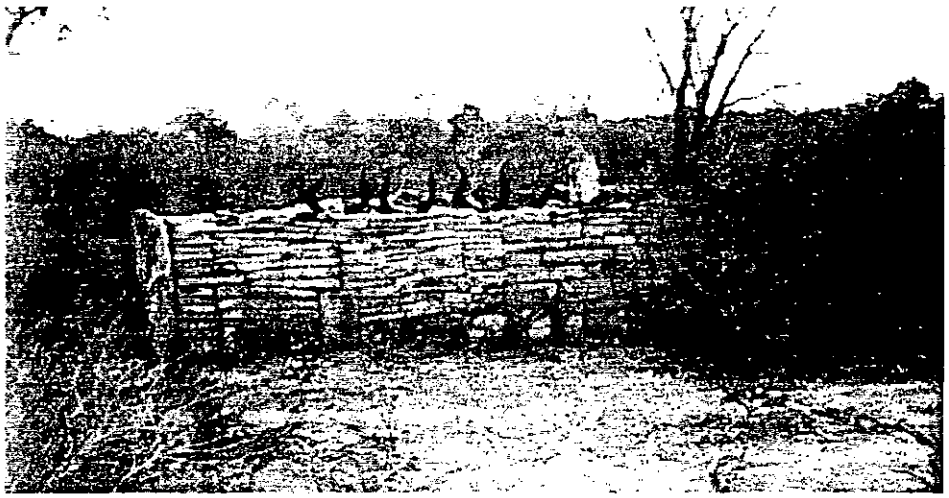


Figure 6.8 - A Traditional Antandroy Tomb in the Ifotaka Forest with Zebu horns adorning it.

THE ROLE OF THE OMBIASY

"*Ombiasy*" is the Malagasy name for the medicine man, who collects medicinal plants from the forest or calls on the spiritual world to cure his patients. Through various actions the *Ombiasy* protects the individual. He heals or prevents misfortune (illness, various harmful forces) and promotes prosperity (Berenty;1998). These traditional healers or "witchdoctors" learn their extensive knowledge of natural plant remedies and receive their powers to heal and communicate with the spirits from their ancestral heritages. Owing to this quality they are highly respected by their fellow villagers.

There are two types of *Ombiasy*, one type learns the knowledge from his ancestral *Ombiasy*, while the other acquires the knowledge from the evil spirit *(kokolampo)* and is possessed. The former is more powerful and has a more deep understanding than the latter since he is directed by his own instinctive ideas and experience based on his studies with the previous *Ombiasy* who as he gets older tries to encourage followers. The team worked closely with both types of *Ombiasy*: *Manahira, Fanihisoa* and *Vunuke.*

All *Ombiasy* have their own special medicine and treatments which they remain secretive about. This is because they do not want other *Ombiasy* to know, as this will risk them being able to discern the "*fady*" of the spirit, which can then be exploited to gain power over the other *Ombiasy*. Each *Ombiasy* has their own territory, for example Vunuke's territory extends between *Ampaipaiky* and *Ifotaka* and within their territory they can help people with illnesses. It is believed that if they change *Ombiasy* people die as they are carrying the *fady* of their original *Ombiasy.*

Belief in the *kokolampo* is strong and traditional. *Kokolampo* are invisible spirits that live in certain natural sites in the forest (hilltops, trees, ponds) and often intervene in human affairs. The *Ombiasy* begins each consultation with the *kokolampo* with divination (*sikid*) forming patterns with symbolic stones which act as mediums to reveal the cause of the troubles and the possible remedies (Berenty:1998). By using "*sikid*", which is usually accompanied with the sacrifice of a goat, the *Ombiasy* (acting as a kind of sorcerer) can tell what the *kokolampo* is doing to the person and thus change their future by rearrange-

ment of their constellatory influences[18]. The *Ombiasy* also knows the system of *vintane* (horoscope), based on Arab astrology, which determines good and bad days for carrying out activities, for example Sundays are bad for people to receive treatment.

The Atandroy villagers go to the doctor first for simple, more physical illnesses, e.g. for syphilis and malaria but for deeper, more spiritual illnesses they go to the *Ombiasy*. These more fundamental problems according to the *Ombiasy* are due to the derangements that can be cured using *sikid* which "rearranges" the bad spirits. There are three main components in the treatment given by the *Ombiasy* and they are all affected by the lunar cycle; the advice of the spirit *(kokolampo)*, the horoscope of the individual and the horoscope of the medicinal plant. Horoscopes of all things in the forest (rocks, plants) are related to the lunar cycle as well as people's personalities. A "balanced" personality, for example, of someone born on a certain day is destined to become an *Ombiasy*.

There are four main areas the *Ombiasy* deals with. The first two are internal and external medication, then he prescribes taboos and is involved with organising various ceremonies which usually is accompanied by the sacrifice of zebu, sheep or goat. The internal medication involves using the medicinal plants found in the forest, such as those he used for malaria and diarrhoea (see Ethnobotany section). The names used for these plants are the same for all *Ombiasy*, but the way and the part of the plant used alters between *Ombiasy*. When a medicinal plant is prepared the *Ombiasy* consults the *sikid*. From these he knows what part of the plant to use, how to prepare it and what dose to give.

External medication is the second area, which involves making talismans which are worn, or making marks on the body. For example, the treatment which the *Ombiasy* gives to the ill person consists of 10 parts: six plants[19] are used, followed by four birds' feathers which are then sprinkled with a handful of sand. Then the combination of the spirit's *(kokolampo)* power and the *Ombiasy*'s power expels the harmful spirit in the ill person. After the treatment has expelled the illness, and the two zebu have been given to the *Ombiasy* as a form of payment, the *Ombiasy* cuts the man's ear and collects some blood which is then mixed with sand and stones to make a talisman to protect the man from further illnesses. The potion is drunk for the inner well-being, as it takes out the spirit, the talisman is worn on the outside and the blood mixture is placed on the centre of the forehead.

Every *Ombiasy* has his own taboos *(fady)*, particularly food taboos. For example goats and sheep are not eaten as the former is seen as a brother to the *Ombiasy* in the spiritual world, while the latter are hated as they are "blessed by God". Pigs and chickens may also not eaten by *Ombiasy* for similar spiritual reasons. Also, taboos surround the

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[18] ***Horoscopes:*** People's destiny depends on which zodiac sign they were born under e.g. *Alakosy, Alizady, Adalo, Asimbola* - all Arabic names (these words come from the first generation of Malagasies). There are 12 signs of the zodiac (horoscopes). People with the same horoscope are like brothers and men and women sharing the same are very "confident". The luck you have in one place cannot be transferred to another place. Depending when you were born, some days of the week are lucky while others are not.
There are also horoscopes for the trees and the birds although the signs of the zodiac are different. The spirit helps to discern which "card" to play against the person's spirit. The "star signs" are the names of the *sikid*, which are names of days when you are born. Each day has a different *sikid* associated with it. Trees have different star signs and each species is different, as they come from the ancestors. Every tree with a sign contains the spirit of an ancestor.

[19] for example, *mandravasarotse, marolahi, solohotse, lelagnobe, ahibe, apolibe* (all woods).

cutting of hair, using the colour red, wearing certain clothing and the presence of sharp objects such as the axe or spear, are all linked to respecting the ancestral spirits.

The *kokolampo* can provoke illness, particularly epilepsy in children. Epilepsy, according to the *Ombiasy*, is when there is a conflict between the horoscope of the child and the spirit. It is a sign of spiritual possession and the *Ombiasy* is the only one who can cure it. To help a child over epilepsy the *retsara* wood is scrapped and the child must smell it before the scrappings are placed in the centre of the child's forehead or the child bathes in it for treatment. These scrapings are supposed to remove the devil's spirit when combined with the *Fagnota* plant, which in turn removes the bad horoscope, which is in conflict with the spirit. The horoscope is therefore changed, so that it is no longer in conflict with the spirit and there is no longer any epilepsy.

Ombiasy gain power through spiritual energy generated through the use of medicinal plants for both curing people with illnesses and poisoning others. They carry a stick, which is used to protect them against illness - this stick is called *boakandromahazo* or *volil* [20], which means "to always win"[21]. With one, he wins either way - if he can treat the person then he wins as he gets zebu, if he cannot treat the disease he still wins as he has not contracted the disease. The wood is also used to protect against illness and other *Ombiasy.*

"Spiritually blessed" salty water (from the sea), water from *Mahavelo* or from the mountain *Vuimashiu* (all considered as special water) is often thrown on an ill person or over the medicine. Sea water and sea products (shells or the endoskeleton of cuttlefish seen sold at Fenoive market) is incorporated into traditional beliefs.

Vunuke showed us a drum he beats to bring out the harmful spirit in the patient and his various pieces of wood whose use are divinised by the spirit: *hororoke* ("to be rich") is one where scrappings are collected and then rubbed on skin; it can also be used as a talisman on the body, *manjakabetany* ("you are king") is a stick with which he bathes, *five* is used for the small carved boat which contains the sea water), *tsihone*[22] is used for protection, *retsara* is used to "make everybody like him", *mangary* is used as a boat paddle, which carved on it are *sikid*), and *mandakolahy* is used to protect the him from other *Ombiasy.* All Vunuke's woods were found in the forest as are the roots, bark and leaves he uses for his work as "witchdoctor".

The *Ombiasy*'s role is not limited to medicine, he can also determine and affect people's destiny, wealth, the weather and natural phenomena. Vunuke quotes *"the spirit gives me many solutions".* The spirit guides on house construction[23], marriage, sacrifices, protection and taboos. If a person is unsuccessful, it is due to bad spirits, and because the *Ombiasy* know the spiritual world, they can remove them. He is the specialist of the *aloy*[24], which is an object or a substance that can remedy or ward off troubles for a person or family; ailments of humans or their livestock, witchcraft, lightening or epidemics.

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[20] a strong creeper

[21] *mahazo* - to win, *akandro* - day, *boaka* - to show

[22] "don't kill"

[23] how many doors, what wood etc

[24] They take the form of talismans which are worn on the body, kept in the house or buried in specific places (Berenty:1998)

People who enter into a relationship with his or her kokolampo during lively ceremonies are known as the *jiny* or *tchumba.* Such people still unite for worship at the sacred pole known as *"hazomanga"* in villages such as *Ambundrou* where ritual ceremonies are conducted round this totem of zebu humps and horns. This annual feast of celebration is accompanied by singing, dancing, clapping and musical instruments which are used to bring on a trance (Berenty Museum, 1998). Sacrificed zebu meat (killed by an elder) is eaten together with rice, and rum[25] *(toakygasy)* is drunk.

A method of healing is the *sandratse* ceremony (several days of dancing and singing) which is held to treat a lengthy illness. Vunuke described how he calls on the spirit by wearing two large necklaces, worn like a sash, under his arms. He then lights a fire under the small house where the *kokolampo* is meant to live, and either blows on his whistle, beats his drum or blows a conch shell. The invalid lies underneath the small spiritual house, which (balanced on a long wooden pole) is turned by the *Ombiasy* many times until the invalid is cured. Lambs are sacrificed over the spirit's *(kokolampo)* house with water, the blood that trickles down signifies the life of a human and the water signifies the cleaning as it gives the spirit more power to cure the person.

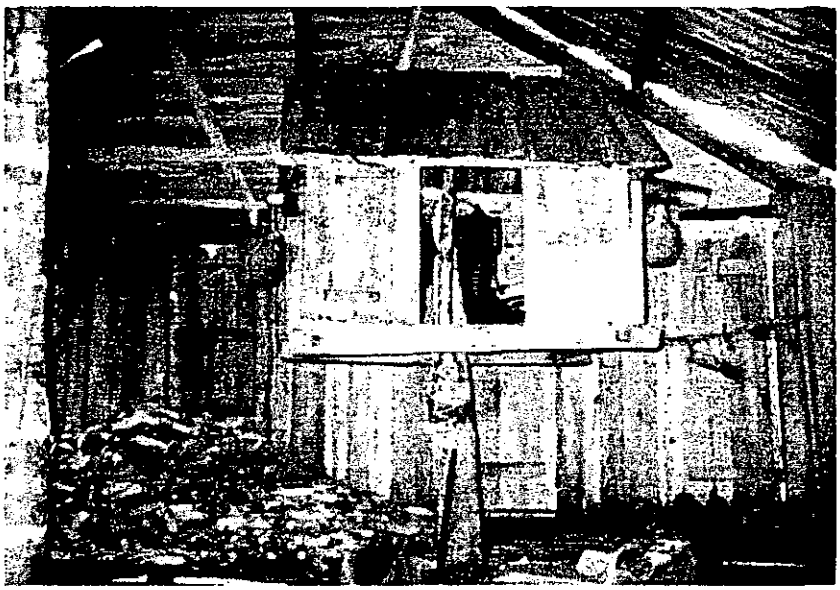

Figure 6.9 - The spiritual house of an Antandroy *Ombiasy*

Ombiasy accumulate wealth through acquiring zebu and wives

The word "*Ombiasy*" means "worker for zebu" ("omby" meaning zebu in Malagache and "asa" meaning 'work""). It is believed that the first *Ombiasy* was called *Asombolatokanakake,* which means "to be rich", and he said that whenever the future generation of *Ombiasy* uses the *sikid* they must not forget that they are doing it to get rich through accumulating more zebu. In exchange for curing an illness or expelling a harmful spirit the *Ombiasy* are paid with zebu, usually two[26]. Zebu are sacred, and the *Ombiasy* is considered to have a special spiritual connection through them, which he accumulates.

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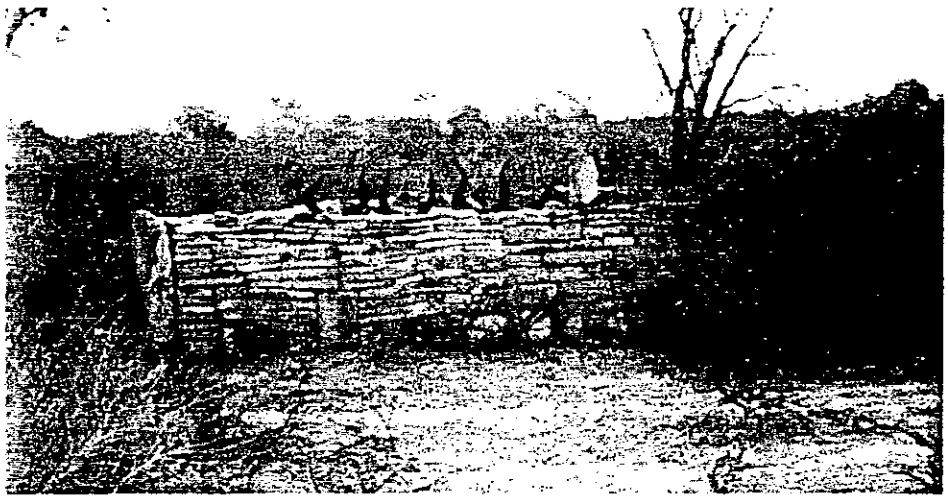
[25] The ingredients of sugar cane, tamarind, banana and *katrafay* tree are placed in a barrel, which is then left in the heat of the sun to ferment for a week.

[26] The Ombiasa always earns 2 of everything, one for him and one to be sacrificed to the spirit so that power can be returned to the spirit.



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The Atandroy villagers go to the doctor first for simple, more physical illnesses, e.g. for syphilis and malaria but for deeper, more spiritual illnesses they go to the *Ombiasy*. These more fundamental problems according to the *Ombiasy* are due to the derangements that can be cured using *sikid* which "rearranges" the bad spirits. There are three main components in the treatment given by the *Ombiasy* and they are all affected by the lunar cycle; the advice of the spirit *(kokolampo)*, the horoscope of the individual and the horoscope of the medicinal plant. Horoscopes of all things in the forest (rocks, plants) are related to the lunar cycle as well as people's personalities. A "balanced" personality, for example, of someone born on a certain day is destined to become an *Ombiasy*.

There are four main areas the *Ombiasy* deals with. The first two are internal and external medication, then he prescribes taboos and is involved with organising various ceremonies which usually is accompanied by the sacrifice of zebu, sheep or goat. The internal medication involves using the medicinal plants found in the forest, such as those he used for malaria and diarrhoea (see Ethnobotany section). The names used for these plants are the same for all *Ombiasy*, but the way and the part of the plant used alters between *Ombiasy*. When a medicinal plant is prepared the *Ombiasy* consults the *sikid*. From these he knows what part of the plant to use, how to prepare it and what dose to give.

External medication is the second area, which involves making talismans which are worn, or making marks on the body. For example, the treatment which the *Ombiasy* gives to the ill person consists of 10 parts: six plants[19] are used, followed by four birds' feathers which are then sprinkled with a handful of sand. Then the combination of the spirit's *(kokolampo)* power and the *Ombiasy*'s power expels the harmful spirit in the ill person. After the treatment has expelled the illness, and the two zebu have been given to the *Ombiasy* as a form of payment, the *Ombiasy* cuts the man's ear and collects some blood which is then mixed with sand and stones to make a talisman to protect the man from further illnesses. The potion is drunk for the inner well-being, as it takes out the spirit, the talisman is worn on the outside and the blood mixture is placed on the centre of the forehead.

Every *Ombiasy* has his own taboos *(fady)*, particularly food taboos. For example goats and sheep are not eaten as the former is seen as a brother to the *Ombiasy* in the spiritual world, while the latter are hated as they are "blessed by God". Pigs and chickens may also not eaten by *Ombiasy* for similar spiritual reasons. Also, taboos surround the

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[18] ***Horoscopes:*** People's destiny depends on which zodiac sign they were born under e.g. *Alakosy, Alizady, Adalo, Asimbola* - all Arabic names (these words come from the first generation of Malagasies). There are 12 signs of the zodiac (horoscopes). People with the same horoscope are like brothers and men and women sharing the same are very "confident". The luck you have in one place cannot be transferred to another place. Depending when you were born, some days of the week are lucky while others are not.
There are also horoscopes for the trees and the birds although the signs of the zodiac are different. The spirit helps to discern which "card" to play against the person's spirit. The "star signs" are the names of the *sikid*, which are names of days when you are born. Each day has a different *sikid* associated with it. Trees have different star signs and each species is different, as they come from the ancestors. Every tree with a sign contains the spirit of an ancestor.

[19] for example, *mandravasarotse, marolahi, solohotse, lelagnobe, ahibe, apolibe* (all woods).

cutting of hair, using the colour red, wearing certain clothing and the presence of sharp objects such as the axe or spear, are all linked to respecting the ancestral spirits.

The *kokolampo* can provoke illness, particularly epilepsy in children. Epilepsy, according to the *Ombiasy*, is when there is a conflict between the horoscope of the child and the spirit. It is a sign of spiritual possession and the *Ombiasy* is the only one who can cure it. To help a child over epilepsy the *retsara* wood is scrapped and the child must smell it before the scrappings are placed in the centre of the child's forehead or the child bathes in it for treatment. These scrapings are supposed to remove the devil's spirit when combined with the *Fagnota* plant, which in turn removes the bad horoscope, which is in conflict with the spirit. The horoscope is therefore changed, so that it is no longer in conflict with the spirit and there is no longer any epilepsy.

Ombiasy gain power through spiritual energy generated through the use of medicinal plants for both curing people with illnesses and poisoning others. They carry a stick, which is used to protect them against illness - this stick is called *boakandromahazo* or *volil* [20], which means "to always win"[21]. With one, he wins either way - if he can treat the person then he wins as he gets zebu, if he cannot treat the disease he still wins as he has not contracted the disease. The wood is also used to protect against illness and other *Ombiasy*.

"Spiritually blessed" salty water (from the sea), water from *Mahavelo* or from the mountain *Vuimashiu* (all considered as special water) is often thrown on an ill person or over the medicine. Sea water and sea products (shells or the endoskeleton of cuttlefish seen sold at Fenoive market) is incorporated into traditional beliefs.

Vunuke showed us a drum he beats to bring out the harmful spirit in the patient and his various pieces of wood whose use are divinised by the spirit: *hororoke* ("to be rich") is one where scrappings are collected and then rubbed on skin; it can also be used as a talisman on the body, *manjakabetany* ("you are king") is a stick with which he bathes, *five* is used for the small carved boat which contains the sea water), *tsihone*[22] is used for protection, *retsara* is used to "make everybody like him", *mangary* is used as a boat paddle, which carved on it are *sikid*), and *mandakolahy* is used to protect the him from other *Ombiasy*. All Vunuke's woods were found in the forest as are the roots, bark and leaves he uses for his work as "witchdoctor".

The *Ombiasy*'s role is not limited to medicine, he can also determine and affect people's destiny, wealth, the weather and natural phenomena. Vunuke quotes *"the spirit gives me many solutions"*. The spirit guides on house construction[23], marriage, sacrifices, protection and taboos. If a person is unsuccessful, it is due to bad spirits, and because the *Ombiasy* know the spiritual world, they can remove them. He is the specialist of the *aloy*[24], which is an object or a substance that can remedy or ward off troubles for a person or family; ailments of humans or their livestock, witchcraft, lightening or epidemics.

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[20] a strong creeper

[21] *mahazo* - to win, *akandro* - day, *boaka* - to show

[22] "don't kill"

[23] how many doors, what wood etc

[24] They take the form of talismans which are worn on the body, kept in the house or buried in specific places (Berenty:1998)

People who enter into a relationship with his or her kokolampo during lively ceremonies are known as the *jiny* or *tchumba.* Such people still unite for worship at the sacred pole known as *"hazomanga"* in villages such as *Ambundrou* where ritual ceremonies are conducted round this totem of zebu humps and horns. This annual feast of celebration is accompanied by singing, dancing, clapping and musical instruments which are used to bring on a trance (Berenty Museum, 1998). Sacrificed zebu meat (killed by an elder) is eaten together with rice, and rum[25] *(toakygasy)* is drunk.

A method of healing is the *sandratse* ceremony (several days of dancing and singing) which is held to treat a lengthy illness. Vunuke described how he calls on the spirit by wearing two large necklaces, worn like a sash, under his arms. He then lights a fire under the small house where the *kokolampo* is meant to live, and either blows on his whistle, beats his drum or blows a conch shell. The invalid lies underneath the small spiritual house, which (balanced on a long wooden pole) is turned by the *Ombiasy* many times until the invalid is cured. Lambs are sacrificed over the spirit's *(kokolampo)* house with water, the blood that trickles down signifies the life of a human and the water signifies the cleaning as it gives the spirit more power to cure the person.

Figure 6.9 - The spiritual house of an Antandroy *Ombiasy*

Ombiasy accumulate wealth through acquiring zebu and wives

The word "*Ombiasy*" means "worker for zebu" ("omby" meaning zebu in Malagache and "asa" meaning 'work""). It is believed that the first *Ombiasy* was called *Asombolatokanakake,* which means "to be rich", and he said that whenever the future generation of *Ombiasy* uses the *sikid* they must not forget that they are doing it to get rich through accumulating more zebu. In exchange for curing an illness or expelling a harmful spirit the *Ombiasy* are paid with zebu, usually two[26]. Zebu are sacred, and the *Ombiasy* is considered to have a special spiritual connection through them, which he accumulates.

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[25] The ingredients of sugar cane, tamarind, banana and *katrafay* tree are placed in a barrel, which is then left in the heat of the sun to ferment for a week.

[26] The Ombiasa always earns 2 of everything, one for him and one to be sacrificed to the spirit so that power can be returned to the spirit.

Wives, as well as zebu, are seen as important possessions by the spirit *(kokolampo)*, and Vunuke, for example, has sixteen wives. This reflects the number of his birthdate and his birth order, and is also the number of beads he has on his chain round his neck which he has been wearing since he was a child.

Figure 6.10 - A Zebu, a sign of wealth, Ifotaka, August 1999.

6.4 SUMMARY DISCUSSION

As the local population grows, the flooding of the Mandrare river in the wet season becomes more serious and the availability of water and flat terrain to graze zebu become more attractive so more of the Antandroy community are moving further into the forest to settle. This means there is a rapid expansion of "slash and burn" agriculture within the forest, while on the margins of the forest sisal plantations are encroaching, causing the spiny forest to shrink. The forest therefore faces unsustainable pressures and habitat destruction causing the indigenous knowledge of the Antandroy to be lost at a rapid rate, placing local traditional health and environmental systems at risk, as well as their livelihood.

In this Anthropological report we have sought to understand the natural and cultural heritage of the Antandroy and the current threats on these today. As has been discussed, the spiny forest of Ifotaka is central to the survival of the Antandroy community, and as it shrinks this community is threatened by poverty as they become deprived of their main assets: natural resources and land for grazing and agriculture. The Antandroy are becoming trapped in deprivation by four main integrated disadvantages: vulnerability, powerlessness, physical weakness and isolation which as they get worse by increasing threats on the forest, reducing the population further into poverty. The Antandroy will have increasing difficulty in producing and exchanging food as the forest resources become depleted.

Vulnerability is often characterised by physical weakness, while isolation is central to powerlessness. The Antandroy become vulnerable through natural and social disasters, of erratic rainfall, which causes drought and flooding and brings about famine, locusts and disease. These disasters cause their physical incapacity, through sickness, accidents and unproductive expenditure. The Antandroy are powerless which is unfortunately perpetuated by the fact that they are remote, limiting government and NGO help.

The traditional way of effectively reducing the occurrence of poverty is through local reciprocity and the moral economy, both forms of redistribution within the community. If resources are short, such as in the "starvation" time between Nov-February, the Antandroy families will always share among direct family whatever food they may collect from the forest, as one of the elders in the Ifotaka explains:

"even when there is not enough, we will always share"

The foundation of the moral economy has recently been undermined government organisations, and needs to be restored and preserved to provide a future strategy to reduce poverty amongst the Antandroy. Famine[27] or the "starvation" period for the Antandroy is between December and March every year, but the worst famine was in 1986 and 1987 when it was prolonged. It is at these times that the Antandroy are forced to sell their zebu - their productive assets. They are sold to buy surplus crops from other villages to enable the villagers to survive. However, if zebu are sold, as a result of fam-

[27] To the Antandroy, this means when the plants are dry and there are few leaves on the trees, people become thin, there is little water and there is little food. Food becomes more expensive (prices rise as demand increases) and surplus agricultural produce may be stored for longer in their store houses (up to 3-4 years) before they sell it, as they get better money for it.

ine, or stolen by zebu robbers[28], the household falls into a spiral of poverty and destitution. Entitlement, erosion of food and assets therefore needs to be solved in order to reduce vulnerability and solve poverty of the Antandroy. Assets, such as livestock and entitlements to food and the forest's natural resources need to be restored or protected as they are critical to the functioning and survival of Antandroy households and productive and social units for the future.

6.5 CONCLUSION AND RECOMMENDATIONS FOR FURTHER STUDY

Antandroy knowledge of forest resources is the most valuable asset to the conservation of the Ifotaka forest. Respect and encouragement of this cultural knowledge is catalytic to their participation to the sustainable use of their forest. However, with remoteness, vulnerability to pests, disease, drought and famine, this poor rural community needs partnership with government. While conservation of nature and natural resources can complement economic development (e.g. through sustainable use of natural resources) it needs to be tailored to local needs. One way which has been suggested by Joel Swerdlow in his article is to encourage the traditional *Ombiasy* to work closer with the clinic. This study is an attempt to provide an understanding of, and data on, the local economy of the Antandroy community particularly concerning the use of the forest. The future of the Antandroy community and the rich biodiversity of the forest is therefore threatened unless a conservation plan, sympathetic to all stakeholders, is put in place, and is properly monitored, integrating local tradition into development.

[28] The herdsmen carry slingshots and guns to use against possible zebu robbers who raid the herds usually at night.

Education

7.1. Introduction

Conservation Education, a facet of environmental education (Hurst, 1998) was something we considered to be of great importance to the overall aims of Project Ifotaka. The aim of the project was to increase the environmental awareness of children in Ifotaka, Madagascar and Durham, England. This was done by the establishment of a cultural link between the two primary schools in Ifotaka and three in Durham as well the performance of a play in Ifotaka at the end of our stay. The project was run in four main parts, two in Durham and two in Ifotaka:

7.2 Phase One – Initial Visit to Durham Primary Schools

In June 1999 we arranged to visit three primary schools in central Durham, Gilesgate Primary, St Hilds Primary and Blue Coat Primary. During these visits we gave a short hands-on presentation to the penultimate year classes, this included a short slide show to illustrate the location of Madagascar, the poverty apparent on the island and the nature of the wildlife as unique and threatened. We emphasised the endangered nature of the lemurs as these flagship species easily captivated the kids. We also showed them the equipment we would be using and illustrated the basic nature of our accommodation, by getting volunteers to experience the bivouac bag, mosquito net and rucksack that we would be using for the duration of the expedition. We also asked the children to produce a *'Day in the Life of a Durham School Kid'* Project in images which we would present to the kids in Ifotaka. For future projects we would suggest putting strong emphasis the 'Images only' idea, as the projects that were produced had a lot of text in English which the kids in Ifotaka were unfortunately unable to understand, however it did provide a very useful cultural exchange tool.

Plate 7.1 The initial visit to Blue Coat School Durham, June 1999.

7.3 Phase Two – At the two village schools in Ifotaka.

During the third field phase of the expedition a project was conducted with the children in the two Primary Schools in Ifotaka. This relied on the charisma of Jimmy and Yves as translators. We started by showing the kids an inflatable globe (Plate 7.2) and world maps to illustrate that we had come from the other side of the world to research their unique wildlife, this was followed by an animal noises game which used further posters brought from the UK. For the third part we used a much more hands on approach. Depending on the age of the children we provided them with outlines of lemurs or paper and crayons (Plate 7.3). They drew lemurs or coloured the outlines in and the work was mounted on card, then Polaroid photographs were taken of the kids with their drawings for display on the walls of the schools as a reminder of the project. Each child was also given a sticker with the project logo. These drawings and stickers made it back to the family houses in the village where we saw them proudly displayed. At the end of the visit to each school we presented the projects by the kids from Durham to the teachers.

Plate 7.2 Show the Ifotaka Kids where we had come from.

Plate 7.3 The lemur outlines in the Public School.

7.4 Phase Three – The Play for all the children in Ifotaka.

A couple of days before leaving Ifotaka after the final phase we put on a short sketch for all the children in Ifotaka. This had the dual aim of delivering a message to the children who didn't attend schools and also as a thank you to the village for hosting us for the summer. Jimmy narrated the play and it caricatured the story of our time in the village. Starting from our arrival in Ifotaka, setting up the camp and then going out and doing our research, although performed as a comedy Jimmy's narration did explain the reasoning behind our research methods, which at times may have seemed somewhat ridiculous to the people of the village. The finale was our appearance in the traditional Antandroy dress performing their traditional dance.

7.5 Phase Four – Return Visits to the Durham Primary Schools

After our return from Madagascar we prepared for the return visit to the Primary Schools in Durham to tell them about our expedition and to reinforce the conservation message from the previous visit. We produced a glossy poster a copy of which was left at each of the schools after our return visit - this gave some facts and figures about the wildlife of Madagascar along with some colourful images of people and wildlife. During the visit we showed the pupils some Malagasy artefacts and dressed a boy and girl volunteer in the traditional Antandroy dress while playing Malagasy pop music by Tarika. We also gave a short slide show, showed video clips illustrating lemur behaviour and life in Ifotaka. The final stage gave the pupils a chance to have a look at our camping equipment and the Malagasy Artefacts.

Plate 7.4 The children in St Hilds School, Durham dressing in traditional Antandroy Dress.

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Medical Report

Medical Officer: Julian Mallinson

1. PREVENTATIVE MEDICATION

All UK team members were vaccinated against Polio, Tetanus, Hepatitus A, Rabies, Diptheria and Typhoid prior to embarkation. Recommended prophylactics (Larium) were taken throughout the expedition to protect against malaria.

2. TRAINING

All UK team members held certificates of proficiency in basic first aid. Julian Mallinson (Medical Officer) gained further experience of expedition medicine on a 'Wilderness Medical Training' programme.

All UK team members were fully briefed by Julian Mallinson (Medical Officer) regarding the contents of the team medical kit and the appropriate use of all items contained.

3. INSURANCE

The team was suitably covered by comprehensive expedition insurance.

4. MEDICAL KITS

Team Medical Kit

Julian Mallinson (Medical Officer) was properly in charge of the assembly and security of the team medical kit and the appropriate administration of all items contained. In the absence of the medical officer, Barry Ferguson (Leader) took charge. Quantities of medical items included were appropriate for a group of twenty embarking on a twelve-week expedition.

Medical items	***Quantity***
Antimicrobials / Antibiotics	
Amoxycillin (500mg)	100
Chloramphenicol (ointment, 4g)	3 tubes
Ciprofloxacin (250mg / 500mg)	30 / 20
Flucloxacillin (500mg)	100
Tetracycline (250mg)	40
Metronidazole (200mg)	100
Trimethoprim (200mg)	100
Quinine Sulphate (200mg)	40
Fansidar (525mg)	20
Painkillers	
Paracetamol (500mg)	96
Co-codamol (508mg)	100
Distalgesic (Co-proxamol, 357.5mg)	100
Ibuprofen (200mg / 400mg)	50 / 50
Amethocaine (eye drops)	20 minims
Other Medication	
Altacite Plus	40
Strepsils	48
Imodium	48
Senokot	100
Piriton	120
Stemetil (Prochlorperazine) (5mg)	50

Avomine	56
Cetavlex concentrate (50g)	1 tube
Savlon concentrate (60g)	1 tube
First Aid Antiseptic Liquid (150ml)	1 bottle
Eurax cream (30g)	2 tube
E45 cream (50g)	1 tube
Canesten cream (20g)	2 tubes
Hydrocortisone 1% cream (15g)	2 tubes
Otosporin (ear drops, 5ml)	1 bottle
Betnesol-N (eye-ear-nose drops, 10ml)	1 bottle
Mycil (55g)	1 bottle
Tinaderm cream (15g)	2 tube
Otrivine (10ml)	1 bottle
Rehydration sachets	26
Tooth ache tincture (10ml)	1 bottle

Dressings / Instruments

Adhesive plasters (unmedicated)	250 assorted
Cotton wool	50g
Dental first aid kit	1
Disposable latex gloves	10 pairs
Sterile dressings - large / small	1 / 1
Eye dressings	2
Fluorescein eye test strips	5
Safety pins	18
Cling film	1 roll
Medi-swabs	100
Antibiotic dressing (Sofra-tulle)	3
Melonin wound dressing pads	20
Triangular bandages	6
Paraffin gauze	2
Gauze swabs	20
Micropore tape	2 rolls
Zinc-oxide tape	2 rolls
Thermometers - digital / disposable	1 / 12
Dumb-bell sutures	100
Cotton buds	100
Tongue depressors	10
Crepe bandages - large / medium / small / cohesive	2 / 6 / 7 / 1
Cold compresses	3
Cleansing wipes (alcohol free)	21
Blister pads	8

Aids Kit

Syringes	12
Green needles	6
Orange needles	6
Resuscitation aid	1
Scalpels (sterile, disposable)	10

Other Items

Insect repellent (75ml)	1 bottle
Rehydration fluid measuring spoon	1
Sun cream (SPF 25, 100g)	1 bottle
Aftersun lotion (200ml)	1 bottle
Lipscreen (SPF 30, 5g)	1 tube
Water purification tablets	550
Medicated soap	2 bars
Toxic waste bags	3

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Expedition medical training programme - Course manual, 1999. Wilderness Medical Training, Royal Leamington Spa.

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Documentation

Medical notes for each UK team member, including personaldetails, medical history, immunisations and blood group.

Official letter authorising the carriage of medical supplies for the use of expedition members.

Personal Medical Kit

All UK team members carried personal medical kits for which they were individually responsible. Personal medical kits contained basic first aid supplies and additional medication, as required by the individual.

5. SAFETY PROCEDURE

Water collected for internal consumption was filtered using a 'millbank' bag and treated with an iodine tincture. All team members carried an adequate supply of drinking water with them at all times and were encouraged to maintain adequate fluid intake. All catering materials were washed with detergent and disinfected by rinsing in two dilute solutions of bleach.

Malaria and sunstroke were avoided by wearing appropriate clothing during risk periods.

As far as possible, food was prepared to western standards of hygeine.

All fieldwork excursions from base camp were carried out by teams of at least two people, including a local guide. All team members carried SOS whistles in case of emergency.

Accidents were avoided by careful and vigilant progress through the terrain.

6. CASUALTY TREATMENT AND EVACUATION

All medical conditions encountered received early and appropriate treatment. Subsequent monitoring and treatment was necessary to prevent worsening and promote recovery.

In the event of an emergency, all team members were familiar with a predetermined casualty evacuation plan. Barry Ferguson (Leader) would take charge of the situation and Julian Mallinson (Medical Officer) would advise on casualty treatment and care. In the absence of the leader, Chris Perceval (Deputy Leader) would take control. All other members of scientific and support teams would provide further assistance, as required.

Casualties would be taken to the local hospital in Itotaka for the treatment of minor injuries. For more serious injuries, radio contact would be used to arrange rapid transport to Fort Dauphin and subsequent transfer by aeroplane to a European standard hospital on Reunion.

At no stage during the expedition was it necessary to implement casualty evacuation.

7. CONDITIONS REQUIRING MEDICAL TREATMENT

The following list describes all conditions requiring medical treatment encountered during the expedition. In the interest of medical confidentiality no further details are given.

Condition (Number of cases)

Travel sickness (2)
Indigestion (2)
Traveller's Diarrhoea (9)
Food poisoning (2)
Giardia (1)
Eye graze and infection (1)
Hand incision wound (1)
Foot incision wound (2)
Shin abrasion (1)
Elbow contusion (1)
Ankle sprain(1)
Skin blister (2)
Skin allergy (1)
Respiratory allergy (1)
Nasal congestion (2)
Sore throat (6)
Cough (1)
Headache (4)
Foot infestation by parasitic organism (4)
Fungal skin infection (1)

It was also necessary for two local team members to receive treatment for gonorrhoea during the expedition. A qualified doctor at the local hospital administered the appropriate penicillin injections.

Logistics Report

1. Research Materials

Scientific literature is not readily available in Madagascar, the library of the University in Antananarivo is reported to be well stocked, Parc Tsimbazaza has some literature but lacks some journals and key texts. It is recommended that teams bring all necessary literature and leave copies with the libraries of their collaborators. The Library in the Libanona Ecology Centre (Fort Dauphin) is extremely well stocked with conservation and development books.

A good selection of Maps is available from the national mapping agency Foiben – Taosarintanin'I Madagasikara (FTM) in Antananarivo on Rue Dama-Ntsoa Razafintsalama JB. They stock a 12 sheet 1:500 000 series covering the whole island, and also a 1:100 000 series. Both of these series of maps may be quite old (some were produced as long ago as 1956) and so for land cover may not be accurate, we did find them to be accurate for topographical features. WWF Madagascar also have a remote sensed map (satellite image) which is useful for determining the limits of the forest. For a good map covering the whole island IGN (The French National Mapping Institute) sell a 1: 2 000 000 map.

2. Training

Team training was carried out in Edinburgh in February at the Scottish Universities Primate Day at Edinburgh Zoo where we were familiarised with the basics of primate ecology. Further scientific training was given by the workshops run by the BP Conservation Programme and RGS in London in April 1999. Medical training consisted of Julian Mallinson attending the Wilderness Medical Training Course at the Royal Geographical Society and all UK team members attended Red Cross Basic First Aid courses. The whole team was informed of the casualty evacuation procedure prior to deploying to the field. A further training weekend was held in the Lake District in June to familiarise all members with basic fieldcraft skills, map reading and operation of field equipment. This expedition found that running training weekends was an excellent way of team bonding prior to departure.

3. Permissions

Permission for this project was issued by the Department of Eaux et Forets of the Malagasy Government. As the project was in an unprotected area it was not required to obtain permits from ANGAP (The protected areas authority). Project Ifotaka 1999 was run under a protocol of collaboration between Durham University and Parc Botanique et Zoologique de Tsimbazaza (PBZT). PBZT obtained research permits for an administrative charge of 2 000 000 FMg (about £200 in 1999) this took one week from arrival – in future it is recommended that expeditions ensure that collaborators collect the permits prior to their arrival as there seemed to be no reason for the wait. The Malagasy Consul in London issued study visas on production of the signed protocol of collaboration. Export permits for the plant and faecal material were issued by the Department of Eaux et Forets, again this took a week to organise for no apparent reason. Phytosantiation certificates were issued by SQVCPF an agency beside the Department of Eaux et Forets after some discussion. It appears that previous researchers have been issued certificates for one set of materials and have exported another set (namely orchids) and this will result in a tightening of the regulations. Once

this certificate is issued it is necessary to purchase a 100FMg tax stamp from the post office. The materials were not once examined on departure.

4. Finance and Fundraising

Project Ifotaka 1999 secured almost all of its fundraising from learned societies, trusts and charities. Despite a lot of hard work no commercial sponsorship was secured other than reduction in the costs of some equipment from Jessops. The project held a dual signatory charities account with Barclays Bank, which proved adequate. However when using some specialist services such as international money transfer and travellers cheque purchase it was necessary to put the money through members' student accounts to avoid huge charges.

When in Madagascar the expedition funds were carried in Travellers cheques, it is suggested that for security the cheques are split up among the team and a full record of numbers and encashment held with each set. Also it may be a good idea to have travellers cheques in more than one persons name in case of injury or evacuation of the signatory. The banks in Antananarivo were all helpful and did not impose limits on the transaction, however Fort Dauphin was a different story with *Credit Lyonaisse* not being willing to cash cheques on a Friday and having difficulty changing more that £400 at a time. Credit cards would be useful in both Antananarivo and Fort Dauphin (Visa or MasterCard) and it is recommended that all expedition members bring one in case of emergencies. Fort Dauphin had the closest banking facilities to the field site.

5. Insurance

Insurance was taken with AON Risk Services. We fully covered all UK team members, unfortunately it was prohibitively expensive to cover our Malagasy counterparts. Future teams should be warned that the quote of £660 in December 1998 rose to almost £1000 in June when the policy was taken out so shopping around and buying insurance early could well pay off. We were fortunate that we did not need to make any claims.

6. Travel, Transport and Freighting

International Transport was by Air Madagascar booked through Cortez travel in the USA. Future expeditions are advised to negotiate special group rates with Air Madagascar in the UK. The baggage allowance was 20 Kg on the London – Paris section (operated by British Midland) and 30 Kg on the Paris – Antananarivo section. This is sufficient for personal equipment but not for any significant amount of group equipment. It can lead to extortionate Excess baggage charges of more than £15 per Kg. The to departure taxes in IVATO total approximately £12 per person.

Transport in Antananarivo was by private taxi, prices need to be negotiated before starting the journey.

Transport from Antananarivo to Fort Dauphin was by chartered minibus, the journey took three days and one night. The cost was £250 it should be made sure with the owner what the price and conditions are, ensure that a receipt is signed by the owner and that the counting out of the money is witnessed by a third party. This journey can also be made by internal flight with Air Madagascar. Again excess baggage charges should be considered as only a 20-Kg allowance is given. All internal flights with Air Madagascar are discounted when you use them for the international section of travel. Normal rate for Antananarivo – Fort Dauphin One Way is £50 and there is a flight almost every day, although they may be heavily booked.

Transport from Fort Dauphin to Ifotaka was by chartered Taxi-Brousse (Bush Taxi) this costs between £50 and £80 depending on the quality of the vehicle, not all drivers are willing to drive on the unsurfaced tracks between Amboasary-Sud and Ifotaka. It takes about four hours provided you have no breakdowns en-route. From Ifotaka to the field camp at Mahavelo Zebu carts can be chartered to take equipment to 500m from the campsite, local men are keen to be employed as porters.

Freighting equipment for short projects is not recommended as previous expeditions have had major difficulties (Wilson 1990; Nagy pers. comm.) getting items released from customs on time.

7. Communication

The nearest public telephone to Ifotaka was reported to be in Amboasary-Sud. We used the telephones (card operated) and post office in Fort Dauphin, which proved to be quite reliable. E-mail facilities are available at the Libanona Ecology Centre and one of the better hotels in town, their reliability is deemed somewhat dubious. We used the post box number for the Libanona Ecology Centre for incoming mail. The small army base in Ifotaka and Berenty Private Reserve have radios, which could be used in emergencies. However, local people may not be admitted to the Berenty by the guards so a non Malagasy team member should accompany anybody going for help – further details of the casualty evacuation procedure are in the Medical and Safety report.

8. Field Administration

For the first two phases the team were based at Mahavelo, a flat area at the side of the Asantoria Riverbed (See Map 3) around 4Km from the village of Ifotaka. The research team and local guides lived in tents and improvised shelters with a cooking and eating area centrally located. There were pools of still water within easy reach of the camp for drinking/cooking water and washing water. Drinking water was purified using a Millbank bag filter and Iodine tincture. Powdered fruit flavourings available in Fort Dauphin made the Iodinated water much more palatable. Food is easily available in Ifotaka from the small daily market/small shops or the larger weekly market. The staple diet of the team was:

Breakfast - Rice, Omelette, Tomato;
Lunch – Rice, Carrots, Potatoes, Tinned Fish;
Dinner – Rice, Beans, Chicken;
Sundries – Coffee, Sugar, Biscuits, Condensed Milk.

Very little fresh fruit was available in Ifotaka but most of the other items used were available. Ifotaka currently has no hotely's (cafes) and so food must be prepared over open fires. We employed two local men to prepare food and water for the team. For security it is important to ensure a guide/porter always remains in the camp.

All guides, porters and cooks should be given an oral and written agreement of the employment conditions (including wages) as many had not worked for an employer previously. The guides were paid weekly.

9. Medical and Safety Arrangements

These are fully described in the Medical Report.

Planning and Expedition Schedules

Planning Schedule

October	**1997**	Initial Idea Developed (from Garbutt, 1997).
November	**1997**	Attend Explore '97 to make initial contacts and seek advice. Letters written to academics and NGO's in Madagascar.
January	**1998**	Initial UK Team Selection.
September	**1998**	Reconnaissance Phase in Madagascar (Barry and Chris). Collaborations with Libanona Ecology Centre and Parc Botanique et Zoologique de Tsimbazaza established. Field Site in Ifotaka visited and local contacts made.
October	**1998**	Final UK Team Selection, Expedition Proposal and research plan produced.
November	**1998**	Proposal Submitted to Durham University, Attend Explore '98.
December - February	**1998 1999**	Grant Applications Submitted.
March	**1999**	Expedition Medicine Course (Julian) Team training weekend (Edinburgh -University Primate Day).
April	**1999**	BP Conservation Programme Training Workshops International Travel and Insurance Purchased.
June	**1999**	Education Project Phase One implemented, equipment purchased 2nd Training Weekend – Lake District, Research Visas Issued.

Expedition Schedule

10th	**July**	UK Team fly to Antananarivo, Madagascar . London-Paris (British Midland), Paris- Antananarivo (Air Madagascar).
11-16	**July**	Arrange Research Permits, Register with British Embassy Seek advice from Frank Hawkins and Joanna Durbin. Meet Helene Razomatso and Claudine Ranorosoa.
17-19	**July**	UK team plus Helene travel by Taxi Brousse to Fort Dauphin.
20th	**July**	Meet Mark Fenn (WWF-Madagascar).
21st	**July**	Buy supplies, arrange Taxi Brousse Charter.

22nd	July	Arrive Ifotaka Village, meet Tompotamy Remanisy (Mayor), Organise team of guides, depart for field camp (Mahavelo).
23rd	July	Arrive Mahavelo, set up camp.
24-28	July	Devise survey methodologies.
29th to 14th	July Aug	*Phase One* of Research Conducted : Lemurs : Population estimation, habitat use, diet, time allocation; Vegetation Surveys; Ornithological Surveys; Ethnobotanical Inventory, PRA[1] Methodology devised, Claudine Niny, Clarisse , Tatjana and Sylvain arrive in Ifotaka
14-19	Aug	Rest and recuperation at the Libanona Ecology Centre, Fort Dauphin. Helene Razamatso departs for Antananarivo. Phase Two Research Plan Confirmed.
20th	Aug	Travel from Fort Dauphin- Ifotaka – Mahavelo.
21st to 4th	Aug Sept	*Phase Two* of Research Conducted : Lemur :habitat use, diet, time allocation, PRA interviews commence, Ethnobotanical inventory. Reconnaissance of the northern part of the forest (Barry and Jimmy).
5th to 10th	Sept Sept.	Rest and Recuperation at Libanona Ecology Centre, Fort Dauphin. Research plan for Phase Three confirmed. Clarisse and Niny return to Tulear.
11th to 23rd	Sept to Sept	*Phase Three* of research conducted (PRA, Lemur diet, Ethnobotanical inventory) Team were based in Ifotaka Village rather than forest camp. Education Project Conducted in two Ifotaka schools.
24th	Sept	Farewells said depart Ifotaka for Fort Dauphin. Field Equipment donated to Libanona Ecology Centre.
26th	Sept	UK team Members travel to Antananarivo (Air Madagascar).
27th to 30th	Sept to Sept	Export visas applied for and collected. Preliminary Report Submitted to Direction des Eaux et Forets. Field Equipment donated to PBZT team visit Perinet and Ranomafana reserves.
1st	Oct	UK Team depart Antananarivo for London.

[1] Participatory Rural Appraisal

Expedition Accounts

The Expedition Account was held with Barclays Bank, The Market Place, Durham.

Income	£
BP Conservation Programme	3000
Royal Geographical Society (Rio Tinto plc.)	2500
British and Foreign School Society (Sarah Walker Legacy)	1800
British Ecological Society	1500
Gilchrist Educational Trust	1000
Albert Reckitt Charitable Trust	750
Mr HM Ferguson	500
University of Durham (Council Grant)	450
The Percy Sladen Memorial Fund	400
Save and Prosper Trust	400
The Mammal Society	250
The Primate Society of Great Britain	250
The Peoples Trust for Endangered Species	200
Barry Ferguson	180
Mr & Mrs S Anderson	60
Mrs D Murdoch	50
Other Sponsorship	500
Personal Contributions	4250
Total Income	**18040**

Expenditure	£
Pre Expedition Administration	850
Equipment (Research [inc. sound recording], Camping)	2200
Medical (Training Courses and Equipment)	600
Training (Weekends in Edinburgh and Lake District)	240
Visas	200
Expedition Polo Shirts	300
International Flights	4900
Excess Baggage Charges	680
Insurance	960
Internal Transport (Flights and Vehicle Charter)	1370
Accommodation	1100
Food	1850
Wages (Technicians, Translators, Malagasy Students, Guides)	1095
Photographic (Slide and Print Film plus processing)	200
Permits, Fees and Gifts	320
Website Production	75
Report Production and Distribution	800
Poster Production	100
Project Ifotaka Reception (Senate Suite, Durham Castle)	200
Total Expenditure	**18040**
Balance (1st June 2000)	**NIL**

Remaining Income (University Of Durham)
(To be invested in the next phase of Project Ifotaka) **50**

Publicity and Results Dissemination

Newspaper Articles

Palatinate (DU Newspaper), November 1998, '*Lemur Aid*'

Stanstead Guardian, December 1998, '*Living Deep in the Forest*'

Newtownards Chronicle, January 1999, '*Local Student to lead Madagascar Expedition*'.

Grantham Journal, January 1999, '*African Island Adventure for former Kings Pupil*'

Basingstoke Gazette, January 1999, '*Set For a Wild Time in Madagascar*'

Durham Advertiser, February 1999, '*Five Go Off on Nature Study.*'

Northern Echo, March 1999, '*In Search of Hope in a Disappearing World*'

Belfast Newsletter, April 1999, '*Travelling Man – Young Ecologist Barry is Leader of the Pack.*'

Stanstead Guardian, July 1999, '*She's Bound for the spiny forest of Madagascar*'

The Newcastle Chronicle, February 2000, '*Deep in a Secret Forest Grow Plants which Cure Disease*'

Radio Interviews

BBC Radio Ulster - Morning Extra, January 1999. (Barry Ferguson).
BBC Radio Newcastle, March 1999. (Barry Ferguson).

Public Presentations

October 1999, Durham University Expedition Society.
November 1999, Explore 1999, RGS-IBG, London.
February, 2000, Expediton Roadshow, University of Newcastle.
February 2000, University of Durham Seminar, Department of Biological Sciences.
April 2000, People Orientated Projects Workshop, RGS-IBG, London.

Poster Presentations

British Ecological Society Winter Meeting (December 1999).
Cambridge Conservation Science Conference (March 2000).
Mammal Society Easter Conference (April 2000).
Posters left on permanent display in each of the collaborating institutions from July 2000.

Other Events

Project Ifotaka Post Expedition Reception, The Senate Suite, Durham Castle, February 2000.