

TANZANIA FOREST CONSERVATION GROUP

TECHNICAL PAPER 7

PANDE GAME RESERVE

A Biodiversity Survey

Nike Doggart (Ed.)
2003



Tanzania Forest
Conservation Group
Shirika la Kuhifadhi
Mitu ya Asili Tanzania

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The Tanzania Forest Conservation Group

The surveys described in this report were conducted by the Tanzania Forest Conservation Group (TFCG). TFCG is a Tanzanian non-governmental organisation registered in 1985. TFCG works with the mission of promoting the conservation of the high biodiversity forests in Tanzania. TFCG operates field-based participatory forest management projects at eight sites in the Eastern Arc and Coastal Forest. TFCG has also been promoting greater awareness of and improved management for Pande Game Reserve. TFCG has also been documenting the biodiversity of these forests and has conducted surveys in the Rubehos, Kimboza and at various of its project sites.

The Misitu Yetu Project

The Misitu Yetu Project (MYP) is an Integrated Conservation and Development Project (ICDP). It is a partnership between CARE Tanzania, the Tanzania Forest Conservation Group (TFCG) and the Wildlife Conservation Society of Tanzania (WCST). The project works in collaboration with the Wildlife Division (WD) and the Forestry and Beekeeping Division (FBD) of the Ministry of Natural Resources and Tourism; the District Natural Resource Office (DNRO) for Kisarawe and Kibaha and the Municipal Natural Resource Office of Kinondoni and Ilala.

The MYP aims to support communities to manage and benefit from the biodiversity rich forests of Eastern Tanzania. The Final Goal of the project is that:

'The livelihood security of households in communities adjacent to Eastern Arc / Coastal Forest is improved whilst the globally important biodiversity of these areas continues to flourish.'

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CARE-International seeks a world of hope, tolerance and social justice where poverty has been overcome and people live in security and dignity.

CARE – Tanzania works in five sectors: health; HIV/AIDS; conservation and development; economic development and education.

CARE-Tanzania is a partner in the Misitu Yetu Project.

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The Wildlife Division of the Ministry of Natural Resources and Tourism are the owners and managers of Pande Game Reserve.

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Executive Summary

Pande Game Reserve is an area of Eastern African Coastal Forest in Dar es Salaam Region. The Game Reserve was gazetted in 1990 having previously been a Forest Reserve. It covers 1,226 ha between 80 – 126 metres above sea level encompassing disturbed forest, thicket, grassland and woodland.

Pande Game Reserve is part of the Eastern Arc / Coastal Forest Biodiversity Hotspot, one of the highest priority areas for biodiversity conservation in the world. Pande has also been classified as an 'Important Bird Area' by Birdlife International.

Between 3rd and 17th February 2003, the Tanzania Forest Conservation Group in collaboration with the Wildlife Division conducted a biodiversity survey in Pande Game Reserve. The survey was financed by CARE-Tanzania through the Mimitu Yetu Project.

This report presents the results of these surveys including an inventory of the plants, mammals, birds, reptiles, amphibians and butterflies recorded in the reserve. Results of the surveys have been combined with those of previous surveys most notably the Frontier-Tanzania survey of Pande in 1989. Observations on forest change are included and management recommendations are provided.

Table 1. Summary of the species richness and endemism in Pande Game Reserve.

Taxon	Total no. of species	No. of coastal forest endemics	No. of coastal forest near endemics
Plants	164	52	n/a
Animals			
Mammals	38	1	6
Birds	142	1	7
Reptiles	25	1	0
Amphibians	23	1	3
Butterflies	56	4	3
TOTAL	448	60	19

Pande has two endangered, one vulnerable and four near-threatened animal species based on IUCN threat classifications. Plants of conservation concern include the three taxa which are thought to be strictly endemic to Pande: *Tricalysia bridsoniana* var. *pandensis*, *Shirakiopsis* sp. nov. and *Leptactina* sp. A of FTEA. The reserve has a high diversity of bats.

Pande was once a fine example of an Eastern African Coastal Forest. Since the 1950s the forest has been mined for timber, poles and charcoal. Most large trees have been removed and the forest area appears to have declined by approximately 60%. In some areas forest has been replaced by extensive areas dominated by grass and weeds which are maintained by regular fires. As a result some species appear to be heading towards extinction within the reserve including black and white colobus, the plain-backed sunbird and two of the strictly endemic plants. Degradation of the reserve continues despite the availability of project staff, transport and other resources.

Political support and concerted action by the Wildlife Division and other stakeholders is necessary to halt the current trend of forest loss otherwise there is a real danger that the reserve will simply be taken over by the growth of the city. Pande offers an opportunity for recreational and educational use by people from nearby Dar es Salaam.

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Permission

Permission to conduct this survey was kindly provided by the Wildlife Division of the Ministry of Natural Resources and Tourism

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1) Introduction

By Nike Doggart and Charles Msuya

1.1 Coastal Forests and their biodiversity values

This report documents the results of a biodiversity survey conducted in Pande Game Reserve in February 2003 by the Tanzania Forest Conservation Group. Pande is an Eastern African Coastal Forest. The Eastern African Coastal Forests together with the neighbouring Eastern Arc Forests are considered to be a biodiversity hotspot of global significance. This is in part due to the high concentration of endemic species in the area (Hawthorne, 1993; Burgess, *et al.*, 1993; Lovett 1998; Myers *et al.* 2000; Brooks *et al.* 2002). The Eastern Arc / Coastal Forest biodiversity hotspot is classified as 'hyperhot' due to the high risk of plant and vertebrate extinctions for a given loss of habitat (Brooks *et al.* 2002). The high endemism is believed to be due to the long period of isolation from the forests of Central and West Africa, and because the Indian Ocean has maintained a stable temperature over the past 40 million years (Clarke 2000).

There are about 83 coastal forests in Tanzania. Most are small forest patches around 1 – 10 km² which lie below 600 m a.s.l. Over 82.3% of forest patches are in forest reserves (Burgess & Muir 1994).

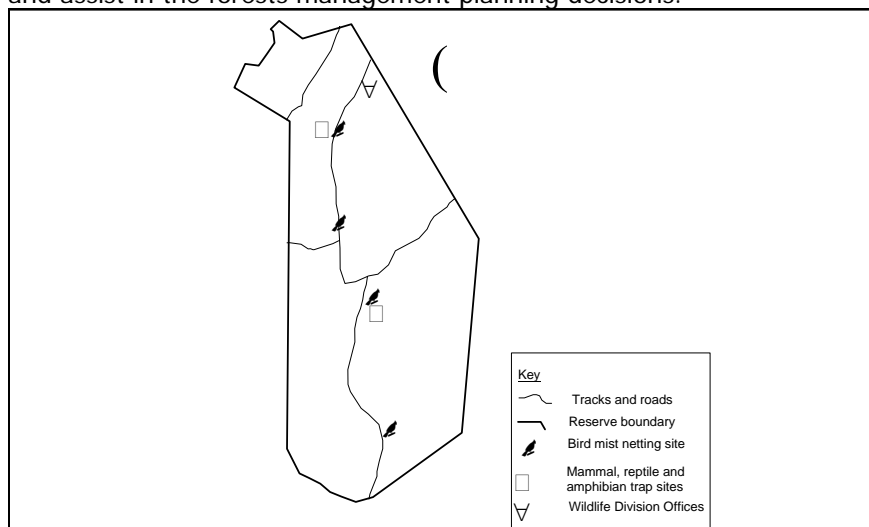
The coastal forests of Eastern Africa were more extensive formerly than they are now due to clearance for cultivation, timber and charcoal production. Recently weak management, poverty and expanding populations amongst adjacent communities have contributed to a progressive degradation of forest habitat. Pande is now found on the northern margins of the urban areas of Dar es Salaam and is a centre of significant in-migration.

1.2 About the survey

1.2.1 Aim

The aim of the survey as stipulated in the Scope of Work between the Tanzania Forest Conservation Group and CARE-Tanzania is:

'To survey Pande Game Reserve in order to document the reserve's biological richness and establish a baseline for developing long term ecological monitoring and assist in the forests management planning decisions.'



Map 1. Sketch map showing Location of trap sites in Pande Game Reserve

1.2.2 Sampling points and survey team

The zoological survey was conducted by specialists Dr Charles Msuya (herpetofauna), B. Hayes (bats), A. Perkin (other mammals) and Njano Mbilinyi (birds) with coordination from staff of the Tanzania Forest Conservation Group. Surveys were conducted between the 3rd – 17th February. Staff of the Wildlife Division and Field Assistants recruited from nearby villagers also participated. There were two principal trapping sites (see Map 1). Botanical surveys were conducted separately.

1.3 Status of Pande Game Reserve

Area:	1226 ha
Boundary length:	15 km
Gazettement notice:	(Gazetted as a Forest Reserve in 1952) then as a Game Reserve GN 461 (1990)
Status:	Game Reserve managed by the Wildlife Division
Municipality:	Kinondoni
Region:	Dar es Salaam
Altitude:	80 m – 186 m above sea level
Maps:	Series Y742; Sheet Kawe 186/1 (186/2 part of); 1: 50 000

1.4 Physical description

1.4.1 Location

Pande Game Reserve is located approximately 25km northwest of the centre of Dar es Salaam and 16km inland from the Indian Ocean (6° 40' 32"S - 6° 44' 10"S; 39° 04' 10"E - 39° 05' 40"E). The reserve can be accessed from the Bagamoyo Road via Bunju B or the Morogoro Road via Mbezi.

Map 2. Location of Pande Game Reserve in relation to Dar es Salaam



The reserve lies on the edge of the city and is surrounded by five villages, Msumi, Msakuzi, Mabwe Pande, Mpiji Magoe and Mbopo.

1.4.2 Soils

The reserve lies on a low ridge of clay-bound sands and gravel of Miocene to Pliocene age which rises up to 186 m above sea level. The ridge is a continuation of the Pugu Hills to the south-southwest. The soil is a mixture of red sandy loams of Miocene era overlying a gritty kaolin soil (Masongo, 1984).

1.4.3 Climate

The rainfall pattern is bimodal with a period of short rains between October and December and a more prolonged rainy season between March and May. Pande and Pugu Forest

Reserves, which are close to Dar es Salaam have a mean, total rainfall of about 1200 mm per annum (Bargman, 1971). The mean daily air temperature is 26°C, with a seasonal variation of 4°C and a daily range of 8°C. The highest air temperature is 31°C during the dry seasons.

1.5 History

Until the 1950s, few people were living around Pande. There were isolated Zaramo clan dwellings scattered amidst a landscape of dense bushed woodland in which lions, warthogs and wild pigs roamed freely.

During the 1950s the population began to increase as people were attracted to the area, in part by the resources within the Pande forest. This included people from the Makonde tribe of Southern Tanzania and Northern Mozambique who are famous for their woodworking skills and were attracted by the valuable timbers within the forest.

In 1952, Pande was gazetted as a Forest Reserve. When the reserve was gazetted areas of scrubland were left out of the reserve to meet the needs of the growing communities. Between 1950s – 1970s harvesting within Pande increased. The rare ebonies were removed and there was widespread pole cutting (Lupala 1997).

During villagisation in the 1970s, there was an informal relaxation of laws regarding cutting in the reserve so that people could harvest building poles to construct the new villages. Also during villagisation many of the Zaramo people migrated away from the forest while the Makonde, Ngindo and Matumbi people opted to stay so that they would have continued access to the wood resources of the reserve. Lupala (1997) notes that between 1970 and 1980 approximately 273 ha of woodland were depleted within the reserve equivalent to 22% of the reserve.

In 1987 a private developer, John Msemblera, initiated a proposal to turn the Pande Forest Reserve into a zoo through his company Pande Game Reserve Limited. This gained support from the Ministry of Natural Resources and Tourism and from the District Council and in 1988 the Ministry of Natural Resources and Tourism issued a revocation order (18.10.1988) and in 1990 the reserve was regazetted as a Game Reserve (GN 461).

The transfer of responsibility for the management of the reserve from State to Private developer met with resistance from local NGOs concerned at whether a private developer would have the capacity to conserve the unique biodiversity of the reserve. Illegal extraction continued within the reserve although it is difficult to assess the extent of this. The developer prepared a network of fire control lines that also facilitated access for charcoal producers, pole cutters and grass cutters. Shortly after gaining rights to the reserve the private developer died and the concession for the management of the reserve was revoked in 1996.

Once returned to the Wildlife Division, the WD staff managed the reserve according to standard practices for a game reserve with a focus on law enforcement. Boundaries were cleared using a bulldozer and guards were stationed at the northern gate. A Project Manager equipped with a 4WD vehicle was appointed for the reserve. Despite this, disturbance within the reserve continued amongst other things to supply charcoal and poles to the army camp at Lugalo. No management plan was written.

In the eleven years between 1989 and 2001 much of the centre of the reserve was completely cleared of forest (Burgess and Hipkiss 2002).

In 2001 the Tanzania Forest Conservation Group began to work with communities around the reserve in an attempt to promote greater community support for the sustainable management of the reserve. Initially this met with little support from the Wildlife Division concerned that the villages would develop expectations of Joint Management as is being

practised in some Tanzanian Forest Reserves. At the time (and to date) neither the Wildlife Policy (1998) nor the Wildlife Act (1974) support joint management for Game Reserves.

Recognising this, the Tanzania Forest Conservation Group focused on raising awareness within the surrounding villages on the importance of forest conservation and good governance. The project also assisted the villages to organise active village environmental committees and a 'Local Area Conservation Network' known as MWAPA (Mtandao wa Wanamazingira Pande). The communities have approached the Wildlife Division to urge them to halt the illegal activities that have continued within the reserve.

Since the start of the project there has been a gradual improvement of relations and cooperation between the communities and the Wildlife Division. The Wildlife Division has begun to employ members of the Village Environmental Committees to clear the reserve boundaries rather than using a bulldozer; the Project Manager has attended MWAPA meetings and there has been closer follow up by WD staff on illegalities reported by villagers. The Wildlife Division and the Tanzania Forest Conservation Group are now looking to see how a management plan can be developed for the reserve with input from the communities.

1.6 Data storage

Zoological data from the survey have been recorded on the National Biodiversity Database held at the University of Dar es Salaam.

Plant specimen data are stored on the botanical database of the Tanzania Forest Conservation Group and on TROPICOS, the botanical database of the Missouri Botanical Gardens, USA.

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2) Vegetation

By Leonard Mwasumbi, Nike Doggart, H. Lyaruu and Moses Mwangoka

2.1 Introduction

Pande Game Reserve is an example of Eastern African Coastal Forest. In White's (1983) classification of the vegetation of Africa the area fits into the 'Zanzibar-Inhambane' phytochorion. This was subsequently sub-divided by Clarke (1998) into a northern 'Swahilian Centre of Endemism' and a southern 'Swahili-Maputaland regional transition zone'. Pande being in the former.

The coastal lowland vegetation of Eastern Africa (of which Pande is a part) is characterised by its variability. This has made it a challenge to classify.

Within the Zanzibar-Inhambane phytochorion, White (1983) recognised four vegetation types:

- a) Zanzibar-Inhambane lowland rain forest
- b) Swamp forest
- c) Zanzibar-Inhambane scrub forest
- d) Zanzibar-Inhambane undifferentiated forest

Clarke (2000) notes that these four vegetation types may appear as a mosaic over a relatively small area. With this in mind the term 'Coastal Forest' has been applied to the vegetation mosaic along the coastal strip of East Africa.

The Coastal Forests have affinities with other phytochoria including the Afromontane, Zambezi, Madagascan and Guineo-Congolian phytochoria sensu White (1983). Although there are affinities, Lovett et al. (1988) speculate that the forest may have been isolated from other African blocks since the Miocene (30 – 40 million years ago).

The Coastal forests are rich in endemics, particularly the northern forests i.e. the 'Swahilian Centre of Endemism'. Clarke et al. (2000) identified 554 species of vascular plants restricted to the coastal forests. Three taxa are thought to be strictly endemic to Pande: *Tricalysia bridsoniana* var. *pandensis*, *Shirakiopsis* ?sp. nov. (formerly *Sapium* sp. nov.) and *Leptactina* sp. A of FTEA (Burgess 1990). Several other species found in Pande are known from only a few other coastal forest sites including *Uvaria pandensis*, *Uvaria* sp. nov. and *Ecobolium umbrosum* (Burgess 1990).

Various researchers have investigated the vegetation of Pande Game Reserve and the reserve has been well collected (e.g. Frontier-Tanzania in 1989; Z.K Rulungaranga, F.M. Mbago and H.O. Suleiman in 1998 and Mwangoka in 2002 and 2003). Studies that have looked at the vegetation of Pande include Hawthorne's (1984) ecological study of the Coastal Forests. Burgess (1990) describes a vegetation survey conducted by Frontier-Tanzania in 1989 which included botanical collections and a systematic study of botanical species composition using transects. This was then analysed further by Mwasumbi et al. (1994). In 1990 students from the University of Dar es Salaam conducted botanical research in the reserve e.g. Mwakalema (1991) and Mtui (1991). Data on the vegetation of Pande is included in a number of chapters of Burgess and Clarke (2000).

The research outlined above has included various efforts to classify the vegetation of Pande. Hawthorne (1984) described Pande as dry forest dominated by *Julbernardia magnistipulata*. Mwasumbi et al. (1994) identified five species assemblages found in Pande (Table 2). Lowe and Clarke (2000) included Pande in an analysis of coastal forest types within Tanzania concluding that Pande is 'dry forest' dominated by *Scorodophleus fischeri* and *Manilkara sulcata* with *Baphia kirkii* and *Manilkara sansibarensis*. Both studies concur on the dominance

of legumes in the vegetation structure of Pande with Lowe and Clarke (2000) estimating more than 75% dominance by legumes.

Table 2. Plant species assemblages found in Pande Game Reserve (based on Mwasumbi et al. (1994).

Species Group	Description
A	Somewhat disturbed dry coastal forest. Amongst those the most frequently occurring species are <i>Haplocoelum foliolosum</i> , <i>Combretum harrisii</i> , <i>Tricalysia allocalyx</i> and <i>Acacia adenocalyx</i> . Typical trees are <i>Baphiosis africana</i> , <i>Brachylaena huillensis</i> , <i>Bombax rhodognaphalon</i> and <i>Tarenna drummondii</i> .
B	Highly disturbed forest. Amongst the most frequently occurring species are <i>Panicum trichocladum</i> and <i>Nesogordonia holtzii</i> .
C	Relatively undisturbed drier forest on shady valley sides. The most frequent species are <i>Scorodophloeus fischeri</i> , <i>Combretum illairii</i> and <i>Hugonia castaneifolia</i> .
D	Drier coastal forest on exposed ridge-tops. The most frequent species are <i>Millettia impressa</i> , <i>Landolphia kirkii</i> , <i>Uvaria</i> sp. and <i>Whitfieldia stuhlmannii</i> .
E	Shady undisturbed parts of the reserve. The most frequent species are <i>Uvaria pandensis</i> , <i>Diospyros squarrosa</i> , <i>Trichaulax mwasumbii</i> and <i>Salacia elegans</i> . Dominant trees include <i>Baphia kirkii</i> and <i>Manilkara sansibarensis</i> .

2.2 Methods

2.2.1 Botanical collections

Specimens were taken of all species fruiting or flowering at the time of the surveys. Collections were made of trees, shrubs, herbs, lianas and vines. For each collection number notes were made on the locality, habitat and local name. The form and colour of the plant were also described. Specimens were pressed and dried.

Where possible six duplicates were collected for each collection. These have been sent to:
National Herbarium, Arusha, Tanzania (1)
Missouri Botanical Garden, USA (4)
TFCG Herbarium (1)

The collections are part of Moses Mwangoka's (MM) series.

2.2.2 Vegetation descriptions

Descriptions were made of the vegetation types found within the reserve based on observations of species composition and structure. This was based on casual observations only and no systematic plots were established.

2.2.3 Disturbance

Throughout the survey observations were made of disturbance within the reserve. These observations were combined with historical records of forest use.

2.2.4 Change in forest cover

To estimate recent changes in forest cover the survey has used two sources of data. Firstly we used published forest area estimates for Pande e.g. Lupala 1997. Secondly, satellite images showing Pande G.R. provided by CARE-Tanzania were imported into Map Info. Using a combination of our experience in the field including GPS points for different habitat types we were able to prepare a rough sketch map of the area covered by grassland, disturbed forest and woodland / thicket. Using the analysis tools in Map Info we were able to estimate the rough area covered by the three habitat types.

2.2.5 Assessments of endemic plant species

Particular effort was made to map the distribution of the endemic plant species and to collect material to facilitate the completion of the descriptions of *Leptactina* sp. A. FTEA and *Shirakiopsis* ?sp. nov..

2.3 Survey effort

The botanical collector spent 11 days in Pande Game Reserve during March and July 2002. Collections were made throughout the reserve. A total of 166 collections were made (MM 2801 – 2942 and MM 3026 – 3049).

Table 3. Sampling intensity for the botanical survey.

Area	Dates	No. days	No. collections
South-east of the reserve	15/03/02 & 14/07/02	2	25
South west of the reserve	5,6,13 & 21/03/02 & 14/07/02	5	65
North-west of the reserve	11 & 20/03/02	2	30
West of the reserve	7 & 23/03/02 & 13/07/02	3	46
Total			166

Additional visits were made by LM and HL for four days during October 2003. LM was responsible for original collections of the two undescribed species thought to be endemic to Pande. LM returned to areas of the reserve where the original collections were made in the early 1990s to assess their current status.

2.4 Results

2.4.1 Botanical collections

During the TFCG surveys, a total of 166 botanical specimens were collected within the reserve. Roy Gereau from the Missouri Botanical Garden has provided identifications for 34 of these specimens. At the time of preparing this report, the identification of the remaining specimens had not been finalised. The results from the TFCG survey are presented in Table 4 combined with records from previous surveys in Pande Game Reserve. Collections have been made for at least 164 herb, shrub, climber and tree species from 45 families.

Table 4. Annotated list of plant species collected in Pande Game Reserve.

	Species	Life form	End. Status	Record
	ACANTHACEAE			
1	<i>Ecbolium umbrosum</i> (Nees) Kuntze	H	N	3
2	<i>Megalochlamys tanzaniensis</i> Vollesen	H	W	4
3	<i>Sclerochiton obtusisepalus</i> C.B. Clarke	S	W	4
4	<i>Whitfieldia stuhlmannii</i> (Lindau) C.B. Clarke	S	W	3
	ANACARDIACEAE			
5	<i>Lannea schweinfurthii</i> (Engl.) Engl. var. <i>stuhlmannii</i> (Engl.) Kokwaro	T	W	1,2,3
6	<i>Ozoroa obovata</i> (Oliv.) A. Fern. & R. Fern.	T	N	4
7	<i>Rhus glaucescens</i> A. Rich.	S	W	1

	Species	Life form	End. Status	Record
	ANNONACEAE			
8	<i>Asteranthe asterias</i> (S.Moore) Engl. & Diels	T	N	2, 3
9	<i>Monanthes fornicata</i> (Baill.) Verdc.	S	N	3
10	<i>Monanthes trichocarpa</i> (Engl. & Diels) Verdc.	S	N	2, 3
11	<i>Monodora minor</i> Engl. & Diels	S	N	2, 3
12	<i>Uvaria acuminata</i> Oliv.	S	N	3,4
13	<i>Uvaria lucida</i> subsp. <i>virens</i> (N.E. Br.) Verdc.	S	W	4
14	<i>Uvaria pandensis</i> Verdc.	C	N	2,3,4
15	<i>Xylopiya mwasumbii</i> D.M. Johnson	T	N	4
	APOCYNACEAE			
16	<i>Ancylobotrys tayloris</i> (Stapf) Pichon	C	N	4
17	<i>Carissa spinarum</i> L.	S	W	4
18	<i>Holarrhena pubescens</i> Wall. ex G. Don	T	W	2,3,4
19	<i>Landolphia buchananii</i> (Hallier f.) Stapf	C	W	4
20	<i>Landolphia kirkii</i> Dyer	S	W	3
21	<i>Oncinotis glabrata</i> (Baill.) Stapf ex Hiern	S	W	4
22	<i>Saba comorensis</i> (Bojer) Pichon	C	W	3
23	<i>Strophanthus petersianus</i> Klotzsch	C	W	3
	ARALIACEAE			
24	<i>Cussonia zimmermannii</i> Harms	T	N	4
	ASTERACEAE			
25	<i>Ageratum conyzoides</i> L.	H	W	3,4
26	<i>Bidens pilosa</i> L.	H	W	3
27	<i>Blumea aurita</i> DC.	H	W	3
28	<i>Crassocephalum crepidioides</i> (Benth.) S. Moore	H	W	4
29	<i>Tridax procumbens</i> L.	H	W	3
30	<i>Vernonia cinerea</i> (L.) Less.	H	W	3
31	<i>Vernonia zanzibarensis</i> Less.	S	N	4
	BIGNONIACEAE			
32	<i>Markhamia lutea</i> (Benth.) K. Schum.	T	W	4
	BORAGINACEAE			
33	<i>Ehretia bakeri</i> Britten	S	N	2, 3
34	<i>Ehretia cymosa</i> Thonn.	S	W	4
	CELASTRACEAE			
35	<i>Loeseneriella apocynoides</i> (Welw. Ex Oliv) var. <i>apocynoides</i>	C	W	1
36	<i>Maytenus mossambicensis</i> (Klotzsch) Blakelock var. <i>ambonensis</i> (Loes.) N. Robson	S	W	1,2
37	<i>Maytenus undata</i> (Thunb.) Blakelock	S	W	2,3,4
38	<i>Salacia elegans</i>	S	W	2, 3
39	<i>Salacia erecta</i> (G. Don) Walp.	C	W	4
40	<i>Salacia madagascariensis</i> (Lam.) DC.	S	W	2,3,4
	CHRYSOBALANACEAE			
41	<i>Hirtella zanzibarica</i> Oliv.	T	W	4
	CLUSIACEAE			
42	<i>Vismia orientalis</i> Engl.	S	W	2,3
	COMBRETACEAE			
43	<i>Combretum harrisii</i> Wickens	T, S	N	2, 3
44	<i>Combretum illairii</i> Engl.	C, S	N	2, 3
45	<i>Combretum microphyllum</i> Klotzsch	T	W	4
46	<i>Combretum schumannii</i> Engl.	S	W	4
47	<i>Combretum xanthothyrsus</i> Engl. & Diels	S	N	4
48	<i>Pteleopsis myrtifolia</i> (M. A. Lawson) Engl. & Diels	T	W	2,4
	CONVULVULACEAE			
49	<i>Bonamia mossambicensis</i> (Klotzsch) Hallier f.	S	N	3,4
	CYCADACEAE			
50	<i>Encephelartos hildebrandtii</i> A.Br. & Bouché	T	W	2, 3

	Species	Life form	End. Status	Record
	CYPERACEAE			
51	<i>Scleria lithosperma</i> (L.) Sw.	H	W	3
	DICHAPETALACEAE			
52	<i>Dichapetalum mossambicense</i> (Klotzsch) Engl.	T	N	3,4
53	<i>Dichapetalum stuhlmannii</i> Engl.	T	W	2, 3
	DILLENACEAE			
54	<i>Tetracera boiviniana</i> Baill.	S	N	4
	EBENACEAE			
55	<i>Diospyros verrucosa</i> Hiern	T, S	N	1,2,3
56	<i>Euclea divinorum</i> Hiern	T	W	4
	EUPHORBIACEAE			
57	<i>Antidesma venosum</i> E. Mey. ex Tul.	T	W	2,4
58	<i>Bridelia cathartica</i> G.Bertol.	S	W	2,4
59	<i>Croton sylvaticus</i> Hochst.	S	W	4
60	<i>Drypetes arguta</i> (Müll.Arg.) Hutch.	S	W	2, 3
61	<i>Hymenocardia ulmoides</i> Oliv.	T	W	2,4
62	<i>Margaritaria discoidea</i> (Baill.) G.L. Webster	S	W	4
63	<i>Suregada zanzibarensis</i> Baill.	S	W	2,4
	FABACEAE			
64	<i>Acacia adenocalyx</i> Brenan & Exell	T	N	1,3
65	<i>Acacia nilotica</i> (L.) Willd. ex Delile subsp. <i>kraussiana</i> (Benth.) Brenan	T	W	1
66	<i>Acacia robusta</i> Burch. subsp. <i>usambarensis</i> (Taub.) Brenan	T	W	1
67	<i>Albizia versicolor</i> Welw. ex Oliv.	T	W	4
68	<i>Baphia cordifolia</i> Harms	S	W	4
69	<i>Baphia kirkii</i> Baker	T	N	3
70	<i>Brachystegia spiciformis</i> Benth.	T	W	1
71	<i>Cassia afroistula</i> Brenan var. <i>afroistula</i>	S	N	1, 2
72	<i>Crotalaria goodiiiformis</i> Vatke	S	W	1,2
73	<i>Cynometra greenwayi</i> Brenan	T	N	4
74	<i>Dalbergia obovata</i> E. Mey.	T	W	1,2
75	<i>Dichrostachys cinerea</i> (L.) Wight & Arn.	T	W	2,4
76	<i>Erythrina sacleuxii</i> Hua	T	N	4
77	<i>Indigofera ormocarpoides</i> Baker	S	W	1
78	<i>Indigofera vohemarensis</i> Baill.	H	W	1
79	<i>Millettia impressa</i> Harms	C	W	3
80	<i>Millettia usaramensis</i> Taub. subsp. <i>usaramensis</i>	T	W	1,2,3
81	<i>Paramacrolobium coeruleum</i> (Taub.) J. Léonard	T	W	1
82	<i>Schefflerodendron usambarense</i> Harms	T	W	4
83	<i>Scorodophloeus fischeri</i> (Taub.) J. Léonard	T	N	1,3
84	<i>Senna petersiana</i> (Bolle) Lock	S	W	4
85	<i>Trachylobium verrucosum</i> (Gaertn.) Oliv.	T	W	1
	FLACOURTIACEAE			
86	<i>Flacourtia indica</i> (Burm. f.) Merr.	T,S	W	4
87	<i>Oncoba tettensis</i> (Klotzsch) Harv.	S	W	4
	ICACINACEAE			
88	<i>Apodytes dimidiata</i> E. Mey. ex Arn.	T	W	4
	LAMIACEAE			
89	<i>Hoslundia opposita</i> Vahl	H,S	W	2,4
	LILIACEAE			
90	<i>Asparagus aethiopicus</i> L.	H	W	4
	LINACEAE			
91	<i>Hugonia castaneifolia</i> Engl.	T	N	2,3
	LOGANIACEAE			
92	<i>Mostuea brunonis</i> Didr. var. <i>brunonis</i>	S	W	1
93	<i>Strychnos madagascariensis</i> Poir.	T	W	2,4

	Species	Life form	End. Status	Record
	MALVACEAE			
94	<i>Gossypiodes kirkii</i> (Mast.) Hutch.	C, S	N	2,3,4
95	<i>Pavonia leptocalyx</i> (Sond.) Ulbr.	S	W	4
96	<i>Sida cordifolia</i> L.	H	W	4
97	<i>Thespesia danis</i> Oliv.	T	N	2,4
	MENISPERMACEAE			
98	<i>Tinospora caffra</i> (Miers) Troupin	C	W	3
	MORACEAE			
99	<i>Ficus thonningii</i> Blume	T	W	4
100	<i>Maclura africana</i> (Bureau) Corner	S	W	4
	OCHNACEAE			
101	<i>Ochna afzelii</i> R. Br. ex Oliv	T	W	4
102	<i>Ochna holstii</i> Engl.	T	W	2,4
103	<i>Ochna inermis</i> (Forssk.) Schweinf	T	W	4
104	<i>Ochna mossambicensis</i> Klotzsch	T, S	N	2,4
	PASSIFLORACEAE			
105	<i>Basananthe zanzibarica</i> (Mast.) W.J.de Wilde	C	W	3
106	<i>Schlechteria mitostemmatoides</i> Harms	C	W	3
107	<i>Adenia gummifera</i> (Harv.) Harms var. <i>gummifera</i>	C	W	4
108	<i>Passiflora foetida</i> L.	C	W	4
	POACEAE			
109	<i>Digitaria milanjana</i> (Rendle) Stapf	H	W	3
110	<i>Eragrostis ciliaris</i> (L.) R.Br.	H	W	3
111	<i>Megastachya mucronata</i> (Poir.) P. Beauv.	H	W	4
112	<i>Panicum trichocladum</i> K.Schum.	H	W	3
113	<i>Pennisetum purpureum</i> Schumach.	H	W	3
	POLYGALACEAE			
114	<i>Securidaca longipedunculata</i> Fresen.	S	W	4
	RHIZOPHORACEAE			
115	<i>Cassipourea malosana</i> (Baker) Alston	T	W	3
	RUBIACEAE			
116	<i>Agathisanthemum bojeri</i> Klotzsch subsp. <i>bojeri</i>	T	W	4
117	<i>Catunaregam spinosa</i> (Thunb.) Tirveng. subsp. <i>taylorii</i> (S. Moore) Verdc.	S	W	4
118	<i>Chassalia umbraticola</i> Vatke subsp. <i>umbraticola</i>	S	N	2,4
119	<i>Cladoceras subcapitatum</i> (K. Schum. & K. Krause) Bremek.	S	N	1,2,3
120	<i>Coffea pseudozanguebariae</i> (K. Schum. & K. Krause) Bremek.	T	N	2,4
121	<i>Crossopteryx febrifuga</i> (Afzel. ex G. Don) Benth.	T	W	1
122	<i>Heinsia crinita</i> (Afzel.) G. Taylor subsp. <i>parviflora</i> (K. Schum. & K. Krause) Verdc.	S	W	1
123	<i>Kraussia kirkii</i> (Hook. f.) Bullock	S	N	1,2
124	<i>Lamprothamnus zanguebaricus</i> Hiern	S	N	1
125	<i>Leptactina platyphylla</i> (Hiern) Wernham	S	W	2, 3
126	<i>Leptactina</i> sp. A. of FTEA	S	E	1
127	<i>Oxyanthus zanguebaricus</i> (Hiern) Bridson	S	N	1,2
128	<i>Polysphaeria parvifolia</i> Hiern	T	W	1,2
129	<i>Pyrostria bibracteata</i> (Baker) Cavaco	S	W	1
130	<i>Rothmannia macrosiphon</i> (Engl.) Bridson	T	N	2,3,4
131	<i>Rytigynia decussata</i> (K. Schum.) Robyns	S	N	4
132	<i>Rytigynia microphylla</i> (K. Schum.) Robyns	S	W	3
133	<i>Tarenna drummondii</i> Bridson	S	N	2,3,4
134	<i>Tricalysia allocalyx</i> Robbr.	S	N	2, 3
135	<i>Tricalysia ovalifolia</i> var. A of FTEA	S	W	1,3
136	<i>Uncaria africana</i> G. Don	S	W	4
	RUTACEAE			

	Species	Life form	End. Status	Record
137	<i>Zanthoxylum holtzianum</i> (Engl.) P.G.Waterman	S	N	3
	SAPINDACEAE			
138	<i>Allophylus pervillei</i> Blume forma <i>pervillei</i>	S	W	1
139	<i>Allophylus rubifolius</i> (Hochst. Ex A. Rich.) Engl. var. <i>rubifolius</i>		W	1
140	<i>Blighia unijugata</i> Baker	T	W	3
141	<i>Haplocoelum foliolosum</i> (Hiern) Bullock subsp. <i>mombasense</i> (Bullock) Verdc.		W	4
142	<i>Haplocoelum inoploeum</i> (Radlk.)	S	W	3
143	<i>Pancovia hildebrandtii</i> Gilg.	S	W	3
	SAPOTACEAE			
144	<i>Manilkara sulcata</i> (Engl.) Dubard	T	N	3,4
145	<i>Mimusops obtusifolia</i> Lam.	T	W	4
	SIMAROUBACEAE			
146	<i>Harrisonia abyssinica</i> Oliv.	T	W	4
	STERCULIACEAE			
147	<i>Cola clavata</i> Mast.	T	N	3
148	<i>Cola microcarpa</i> Brenan	T	N	3
149	<i>Dombeya acutangula</i> Cav.	T, S	W	4
150	<i>Nesogordonia holtzii</i> (Engl.) Capuron	T, S	N	3
151	<i>Waltheria indica</i> L.	S	W	4
	THYMELAEACEAE			
152	<i>Synaptolepis kirkii</i> Oliv.	S	N	3
	TILIACEAE			
153	<i>Carpodiptera africana</i> Mast.	T, S	N	4
154	<i>Grewia bicolor</i> Juss.	S	W	4
155	<i>Grewia conocarpa</i> K. Schum.	T, S	N	4
156	<i>Grewia forbesii</i> Harv. ex Mast.	T, C, S	N	4
157	<i>Grewia leptopus</i> Ulbr.	S	N	3
	ULMACEAE			
158	<i>Trema orientalis</i> (L.) Blume	S	W	4
	VERBENACEAE			
159	<i>Clerodendrum capitatum</i> (Willd.) Schumach.	C	W	3
160	<i>Vitex bunguensis</i> Moldenke	T	W	4
161	<i>Vitex payos</i> (Lour.) Merr. var. <i>payos</i>	S	W	4
	VITACEAE			
162	<i>Cissus producta</i> Afzel.		W	3
163	<i>Cyphostemma buchananii</i> (Planch.) Wild & R.B.Drumm.		W	3
164	<i>Cyphostemma hildebrandtii</i> (Gilg) Wild & R.B.Drumm.		W	3

KEY TO ABBREVIATIONS FOR TABLE 4Life Form:

- H – Herb
 S – Shrub
 C – Climber
 T – Tree

Data taken from Burgess and Clarke 2000 Appendix 3, List of East African Plants and the Flora of Tropical East Africa.

Endemic (End.) status:

- E – Endemic: Species with ranges restricted to Pande.
 N – Near endemic: Species with ranges limited to the Swahilian Regional Centre of endemism (including coastal forests).
 W – Widely distributed species.

Data taken from Burgess and Clarke 2000 Appendix 3

Record

- 1 – Species recorded during the Tanzania Forest Conservation Group survey in 2002 and 2003. Identifications confirmed by Roy E. Gereau of the Missouri Botanical Garden.

- 2 – Botanical records for Pande from B. Mwakamela (1991). Studies of the floristic composition of Pugu and Pande forests: shrubs. Botany Project Report BT313, University of Dar es Salaam.
- 3 – Botanical records for Pande from N.D. Burgess (1990). Preliminary results of biological surveys in seven coastal forests of Tanzania: July to September 1989. The Society for Environmental Exploration Interim Report. Identifications by Leonard Mwasumbi.
- 4 – Botanical records for Pande from TROPICOS, the botanical database of the Missouri Botanical Garden provided to TFCG by R.E. Gereau in 2003. This excludes those collected by TFCG and listed as 1 although these area also recorded in TROPICOS.

2.4.2 Endemic status

Burgess and Clarke (2000) identified 554 plant species endemic to the East African coastal forests and 1050 to the Swahilian Regional Centre of Endemism. Of these 52 are found in Pande Game Reserve, equivalent to 5% of the Swahilian Regional endemic plant species. This includes only those species listed in Table 4.

Table 5. Summary of the endemic status of plants recorded in Pande.

Endemic status	Number of species	% of total species
Endemic (E)	1	1
Near endemic (N)	51	31
Widespread (W)	112	68
Total	164	100

See Key to Table 4 for definitions of endemic status.

Burgess (1990) also mentions three taxa thought to be strictly endemic to Pande: *Tricalysia bridsoniana* var. *pandensis*, *Shirakiopsis* sp. nov. and *Leptactina* sp. A of FTEA. LM and HL searched for these three species for four days in October 2003. They found that *Leptactina* sp. A of FTEA is widespread across the reserve (e.g. at S 060 41 728' E 0390 04 677'; S 060 41 643' E 0390 04 552'; S 060 41 629' E 0390 04 527'; S 060 41 601' E 0390 04 481'; S 060 41 235' E 0390 04 389'). A possible plant of *Shirakiopsis* sp. nov. was found at S 060 41 023' E 0390 04 219' however it had no flowers or fruits and so it was not been possible to confirm its identification. The *Shirkakiopsis* was no longer present in the area where LM first recorded it in 1987. No *Tricalysia bridsoniana* var. *pandensis* were recorded.

2.4.3 Vegetation description

Much of the vegetation in Pande at present is secondary growth rarely exceeding 8 m in height. Most of the canopy trees and emergents have been removed. Six main vegetation types can be identified within the reserve.

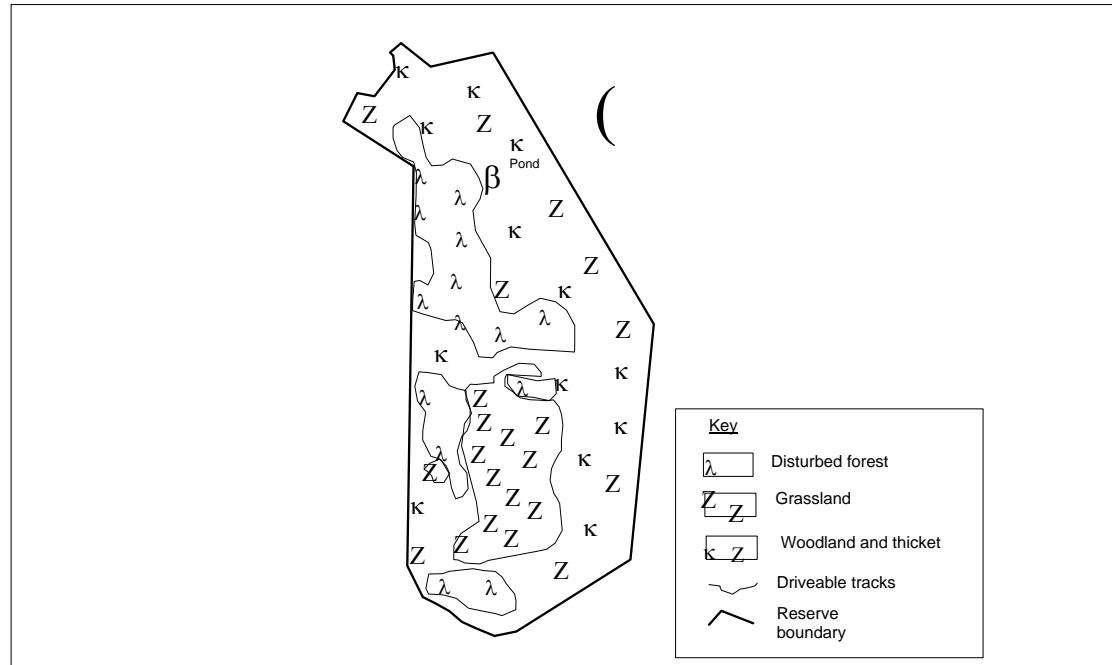
A) Eastern African coastal dry forest – Legume dominated dry forest

This habitat covers approximately 240 ha equivalent to 20% of the reserve and is indicated as disturbed forest in Map 3. This vegetation type is based on Clarke and Robertson (2000) classification of the Eastern African Coastal Forests.

Remnant patches of disturbed legume-dominated forest exist in shallow valleys in the north-west of the reserve with other patches in the south and west of the reserve. This vegetation type is mainly dominated by leguminous species of the subfamily Caesalpinioideae. Occasional trees reach up to ca. 25 m high, and include *Cynometra webberi*, *Hymenaea verrucosa*, *Scorodophloeus fischeri*, *Paramacrolobium coeruleum*, *Milletia usaramensis* and *Vitex zanzibarica*. These trees are found in associations with some deciduous species such as *Bombax rhodognaphalon*, *Nesogodonia holtzii*, *Cussonia zimmermannii* and *Erythrina sacleuxii*. There is no distinct stratification in the tree layers as most of the crown species have been selectively removed for timber and other purposes. The shrub layer comprises of dense entangling masses of lianescent species. In this vegetation community, the common shrubs are *Asteranthe asteriaris*, *Monodora minor*, *Maytenus undata*, *Drypetes arguta*, *Suregada zanzibarensis*, *Cassipourea malosana*, *Heinsia crinita*, *Gardenia transvenulosa*, *Leptactina platyphylla*, *Rothmannia macrosiphon*, *Blighia unijugata*, *Haplocoelum* spp., *Cola* spp., *Mildbraedii carpinifolia* and *Teclea* spp., Dominant lianas include *Strophanthus kombe*,

Strophanthus petersianus, *Adenia gummifera*, *Uvaria pandensis*, *Uvaria puguensis*, *Strychnos* spp., *Cissus rotundifolia*, *Salacia madagascariensis*, *Schlechterina mittostematoides* and *Hugonia castaneifolia*.

In the north-east of the reserve there is a small valley with many *Hyphaene* sp. palms and *Acacia nilotica*.



Map 3. Sketch map of vegetation types in Pande G.R.

B) Eastern African coastal scrub forest

This vegetation type is based on Clarke and Robertson (2000) classification of the Eastern African Coastal Forests. This vegetation type has a dense canopy cover (>50%), 3 – 7 m in height with very few emergent trees. It is dominated by woody plants including an impenetrable tangle of lianas and climbers. This is the most extensive vegetation type in Pande Game Reserve and is indicated as woodland and thicket on Map 3 (combined with woodland). It is most common in the East of the reserve. This vegetation type is seral resulting from the removal of most large trees for timber or charcoal. Coppicing stumps are a common feature.







The emergent trees are species inappropriate for timber or charcoal production such as *Adansonia digitata*, *Erythrina sacleuxii*, *Bombax rhodognaphalon*, and small sized trees of *Scorodophloeus fischeri*, *Manilkara discolor* and *Milletia usaramensis* coppicing from stumps.

The understorey is dominated by entangling masses of lianas and climbers making it difficult to pass through. The common lianas include *Combretum harrisii*, *Combretum iliaris*, *Saba comorensis*, *Salacia madagascariensis*, *Dichapetalum mossambicensis*, *Strychnos* spp. and *Milletia impressa*. The shrub layer is dominated by saplings and seedlings of *Scorodophloeus fischeri*, *Brachylaena huillensis*, *Leptactina* sp A of the FTEA, *Uvaria pandensis* and *Vepris* spp. In this type of vegetation, the regeneration of *Encephalartos hildebrandtii*, which is a CITES protected species, is being suppressed by the dense thicket. More open woodland occurs to the southeastern part of the reserve with some elements of introduced species such as *Agave sisalana*.

C) Woodland

Patches of woodland occur in the South and West of the reserve. These are deciduous woody formations on reddish grey sandy soils with a ground cover of the tall grass *Hyparrhenia filipendula*. It has a single stratum with a sparse shrub layer. The vegetation type was

completely deciduous by October 2003 when LM visited the reserve. The association of *Pteleopsis-Pseudolachnostylis-Spirostachys africana* probably developed here in response to frequent fire episodes. Generally the height of the vegetation is 5 - 10 metres with a canopy of ca. 20 - 30%. Unlike the Eastern African Coastal Dry forest, it is devoid of the common leguminous species. Common species include *Pseudolachnostylis maproneifolia*, *Spirostachys africana*, *Pteleopsis myrtifolia*, *Acacia robusta*, *Strychnos mdagascariensis*, *Ozoroa insignis* and *Dalbergia melanoxylon*. The shrub layer is composed of seedlings of the dominant species.

	
<p>The central are of the reserve, now almost completely devoid of trees. This area has been regularly burnt over the last decade.</p>	<p>Eastern African coastal dry forest (to the right of the picture) to the west of the central burnt area</p>
	
<p>Recently burnt coastal dry forest near trap site 1</p>	<p>Eastern African coastal scrub forest (in the background)</p>
	
<p>The pond near the WD office</p>	<p>Scrub forest to the south-east of the reserve</p>

D) *Wooded grassland*

In some areas the woodland opens up into wooded grassland, an open deciduous woody formation with perennial grasses, notably *Hyparrhenia filipendula* and *Cymbopogon* spp..

This covers a sizeable part of Pande game Reserve. In this vegetation community are found isolated stands of *Hyphaene compressa*, *Dalbergia melanoxylon*, *Strychnos madagascariensis* and *Zanthoxylum chalybeum*.

E) Induced weedy communities

The area in the centre of the reserve has been heavily disturbed by fire and tree cutting. The area was formerly Eastern African dry forest and scrub forest but is now primarily dominated by annual species. Many factors have contributed to the formation of this vegetation type including timber harvesting and fire. Fire is an important tool that modifies the vegetation of a particular area differently depending on its frequency of occurrence and its intensity (Huston 1994). Fire prone areas become dominated with annual species, and when the frequency and severity increases, the recruitment of woody species is totally suppressed, favoring the ephemeral species. Such vegetation is common in Pande Game reserve where weedy communities dominate disturbed areas as a consequence of human interventions and frequent fire incidences. Where there has been intense and frequent fires, the landscape is dominated by annual weedy species which are usually pioneers. These include *Milletia impressa*, *Bonania mossambicensis*, *Ricinus communis*, *Trema guineensis*, *Pennisetum purpureum*, *Panicum trichocladum*, *Ageratum conyzoides* and *Tridax procumbens*. Where human settlements have been abandoned there are perennial fruit crops like *Mangifera indica* and *Syzygium cumini*. At the edge of these areas there are occasional cycads of the species *Encephalartos hildebrandtii* some of which appear to have been killed by repeated fires.

F) Thickets

Patches of thicket (clumps of scrub forest or dry forest) are found along the forest margin particularly in the South and the East. The tree layer closely resembles forest remnant conditions, but are more restricted in extent. Common emergent trees are *Hymenaea verrucosa*, *Euphorbia nyikae*, *Albizia petersiana*, *Apodytes dimidiata*, *Ficus bussei* and *Zanthoxylum chalybeum*. Shrubs are the same as in the scrub forest and include *Vepris* spp., *Polysphaeria* spp., *Cola* spp., *Drypetes arguta*, *Lamprothamnus zanguebaricus* and *Suregada zanzibarensis*.

This type of vegetation is characterized by entangling lianas and climbers similar to other forest remnants, except that *Acacia adenocalyx* and *Landolphia* spp. form dense covers on the outskirts of the thickets thus protecting them against fire effects.

2.4.4 Disturbance and forest use

a) Fire

Currently fire poses the greatest threat to the coastal forest in Pande. Coastal forests depend on an absence of fire to perpetuate themselves (Clarke 2000). Unlike woodland, they are not a 'fire-climax' vegetation type. Fire can kill mature forest trees and shrubs as well as animals unable to escape. By preventing the build-up of woody vegetation and opening the canopy, fire enables a grass layer to develop and encourages conditions more favourable for widespread woodland species.

The main areas that have been most severely affected by recent fires are those areas classified as grassland in Map 3.

In discussions with Wildlife Division staff and with the Village Environmental Committees, several sources of fire were mentioned:

- Spreading from shambas adjacent to the reserve: many farmers use fire to clear their fields.

In some cases farmers burning their shambas do not properly control the fire and it then spreads into the reserve. For example MWAPA leaders reported that a fire which burnt between 15th – 16th March 2003 spread from a shamba adjacent to the reserve. The fire affected 25% of the reserve between Msumi and Kibesa sub-village.

- Grass cutters

It was reported that some grass cutters annually burn areas of the reserve in order to stimulate the production of a fresh crop of grass.

- Arson

Following a boundary dispute between Wildlife Division and two of the villages adjoining the reserve (Msumi and Mpiji Magoe), a number of fires were started in the middle of the reserve. These are alleged to have been started by villagers dissatisfied with the Wildlife Division.

b) Timber

During the survey, three large trees were observed that had recently been cut for timber. While there has been occasional poaching of timber recently, most of the large trees have already been harvested. Most timber was removed in the 1970s and 1980s.

 <p>Timber harvesting in the reserve. Jan 2003</p>	 <p>Tractor laden with grass collected within the reserve. Jan 2003</p>
 <p>Cut poles Jan 2003</p>	 <p>Recent charcoal kiln in Pande G.R. near Kibesa Feb 2003</p>

Burgess and Hipkiss (2002) noted that by 1989, already most of the large trees had been harvested.

c) Pole cutting

During the survey there was evidence of active pole cutting on the western side of the reserve near Mpiji Magoe and in the East near Msakuzi (members of the survey team heard cutting and upon investigating further found the cut poles).

d) Grass cutting

The reserve has been used as a source of fodder for zero-grazing cattle in Dar es Salaam. Cattle owners and dealers from Dar es Salaam come into the reserve with pick ups and tractors to harvest grass for use or sale in the city.

e) Firewood

Dealers from Dar and workers from the Lugalo and Ukonga Army camps have used Pande as a source of firewood. Although no such activity was recorded during the survey, members of the survey team have observed this at other times.

f) Charcoal

Old charcoal kilns were observed throughout the reserve. No active kilns were observed. In part the reduced production of charcoal may be due to the lack of suitable material as most has already been harvested.

g) Hunting

Members of the survey team have observed snares inside the reserve, particularly in the vicinity of Kibesa. WD staff reported that they had observed bush pig traps near Msakuzi. During the survey some dogs came to the camp site. These are likely to be dogs used for hunting within the reserve.

h) People within the reserve

In addition to the people heard cutting poles, a lone man came to the survey camp in the middle of the night apparently having lost his way.

i) Cultural activities

There are graves near Kibesa. The Wildlife Division has permitted villagers to visit this site.

j) Water collection

Villagers from Kibesa sub-village collect water from two shallow wells within the reserve.

k) Change in forest area

Using aerial photographs Lupala (1997) noted that forest area declined from 1172 in 1950 to 657 ha in 1981.

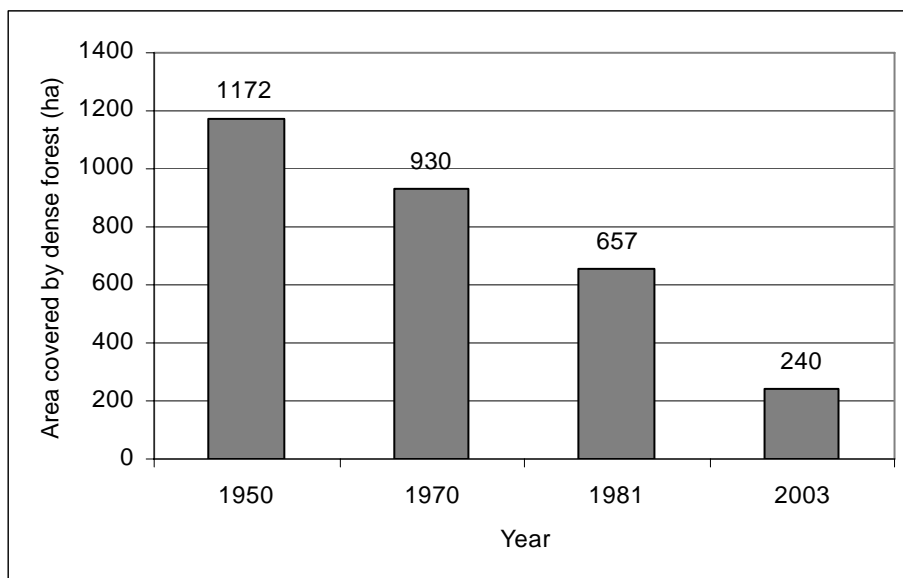


Chart 1. Change in forest area between 1950 and 2003.

Remote sensing data collated by the Misitu Yetu Project (in prep.) shows that the densest vegetation type covers approximately 15% of the reserve. This may be an overestimate of

'dense forest cover' as there are now no significant areas with a closed forest canopy although areas of what was once forest understorey remain.

The decline in forest area is shown graphically in Chart 1. This uses data from Lupala combined with the estimated area remaining of disturbed forest based on the MYP satellite images. While this data shows a clear decline in forest area there is a need for a more detailed analysis of the historical data. Complicating factors include getting a uniform definition of 'forest'.

Forest loss over the last decade appears to have been most serious in the centre of the reserve as Burgess (1990) noted that in 1989 'extensive areas of closed canopy forest exist in the forest interior'. Most of this forest has been cleared and subsequently the area has been repeatedly burnt.

2.5 Discussion

Pande has a mosaic of vegetation types. Areas of disturbed Eastern African coastal dry forest persist in the west of the reserve with Eastern African coastal scrub forest in the East. In the centre of the reserve there are extensive areas of induced weedy communities. This report lists 164 species of plant that have been collected and identified from the reserve. This is an underestimate. Firstly because common species such as *Azelia quanzensis* and *Bombax rhodognaphalon* were not collected and secondly because only 34 of the 166 specimens collected by the TFCG surveys have so far been identified.

The current survey observed some differences with previous surveys in terms of species composition. While Mwasumbi et al. (1994) observed that *Scorodophleus fischeri* and *Nesogordonia hotzii* were common, these species appear to have declined.

Removal of trees for timber and poles combined with repeated fires have changed the vegetation structure and composition significantly over the last 50 years. This is combined with an overall loss in forest area. Our rough calculations estimate that there is approximately 240 ha of disturbed Eastern African coastal dry forest remaining although little of this has the structural complexity that might once have been found in Pande. Further research is needed in order to assess the actual area remaining.

Despite this disturbance it appears that Pande continues to have populations of plant species endemic and near-endemic to the coastal forests. The viability of these populations given the loss of forest habitat is unknown.

The populations of two of the three taxa endemic to the reserve appear to be extremely low or possibly extinct. Further research is necessary to clarify their status.

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3) Mammals (excluding bats)

By Andrew Perkin

3.1 Introduction

Apart from a brief biodiversity survey by Frontier-Tanzania in 1989 little mammal survey work has been conducted in Pande GR. Pande GR contains moist coastal thicket and coastal forest remnants, which might once have resembled the forests of the nearby Pugu/Kazimzumbwe forests. Pande GR also contains areas of mixed woodland and grassland. This has been a product of the continued disturbance by fire, logging and charcoal making over the last 20 or more years. The threats to Pande GR have been noted previously as being severe and requiring urgent attention (Burgess and Clarke 2000, Burgess and Hipkiss 2002). The resulting mosaic of degraded coastal forest, woodland and grassland means that many non-coastal forest species of mammals could be expected to occur in the reserve. Staff of the Wildlife Division reported that a few large game species used to occur in the reserve e.g. buffalo but that now these game species have been extirpated. The survey therefore expected to record a wide variety of small species (from shrews to duiker sized mammals). It was necessary to survey all the different habitat types to gain a full picture of the mammal assemblage.

3.2 Methods

Various methodologies were employed to survey different mammal groups.

3.2.1 Bucket pitfall traps

Small mammals, amphibians and reptiles were sampled using bucket pitfall traps. Three 50m linear transects were created at both survey sites. Each bucket line had eleven 10 litre plastic buckets sunk into the ground with their rims flush to ground level. Buckets contained small holes to allow rainwater to drain from them and each bucket was positioned 5m apart. A sheet of vertical plastic (approximately 0.5m high, and no less than 0.2m) was run along the bucket line crossing the centre of each bucket to form a 'drift fence'. A 10-15cm lip of plastic sheeting was left flat on the ground onto which soil and leaf litter was placed to prevent any gap in the drift fence at ground level. Animals moving into the area from either side would be channelled along the plastic towards the bucket traps.

Each line was placed no more than 50m apart, but was located to encompass a range of micro-habitats. Traps were checked early each morning for the duration of the trap site period and data recorded on standardised data sheets regarding the identification of each animal captured.

3.2.2 Sherman traps

Small rodents and terrestrial insectivores were sampled using 45 Sherman traps (standard size) baited with toasted coconut and peanut butter and sometimes dagaa (dried small fish). Traps were placed in three habitat types in each sample area to gain a representative sample of the different habitats. Traps were set in three groups of 15 in different habitat type and set at least 2m apart in groups of three in a line. Traps were baited each evening (16.00hr or later) for the duration of the trap site and checked early the following morning (08.00hr or earlier). Traps were closed during each day of the trap site.

Data were recorded on standardised sheets regarding the identification, sex, breeding status and biometrics of each animal captured, as well as habitat notes. Specimens were retained when species level could not be ascertained and in cases where sexed specimens were required; these specimens were subsequently sent to international taxonomic experts.

3.2.3 Chardonneret traps for Galagos

Chardonneret box traps (Charles-Dominique, 1977), were specifically used to trap galagos and non-specifically other arboreal mammals such as squirrels, dormice, and carnivores. These were baited with bananas and an alcoholic drink locally brewed from coconut tree sap. Insects and geckos were also used as bait. Traps were set at a variety of heights (up to 5 m) in places where dwarf galagos were seen. All galagos trapped were removed, examined and measured, and kept quiet and safe in the trap until release the next evening. Length measurements, body mass, pelage, penile morphology, and face 'mask' were used to identify the captured specimens (Anderson, 1998; Bearder, 1999).

3.2.4 Tape recording and night surveys for galagos and other nocturnal fauna

Trails and roads within Pande GR were walked slowly each night and with the aid of torches and binoculars galagos and other nocturnal mammals could be observed. This is assisted by the reflective properties of the eyes of nocturnal mammals which greatly help researchers to locate animals. Tape recordings of galago vocalizations were also made to help identify species. A Sony WM-C6C tape recorder and Sennheiser K6-ME66 directional microphone were used.

3.2.5 Mist-netting for galagos

Galagos were sometimes caught using mist-nets. Galagos are known to often use the same routes as they leave their sleeping sites to go and forage for food or they can be observed to use a regular feeding site such as a flowering or fruiting tree. These routes can pass over paths, gaps or roads in the forest where mist nets can be placed. Nets were placed across known 'jump points. Nets were opened at dusk (approximately 18.30hr) and constantly checked and then again from 05.00hr until dawn.

3.2.6 Camera trapping

Camera traps are small cameras that are attached to infrared sensors. When an animal enters the infrared beam it triggers the camera to take a picture. Depending on the size and types of the animals to be photographed, the sensitivity of the infrared sensor can be adjusted. This method is very useful to survey elusive and nocturnal animals. Typically this method is best suited to take pictures of ground dwelling mammals including carnivores, antelopes and rodents. In Pande GR the camera traps were set to take pictures of small mammals such as elephant shrews, genets, and small duikers. Two TrailMaster TM550 attached to two Olympus weatherproof T-35 camera kits and 400 ASA rated film was used. Some sites were baited with beef, fruit and dried fish to attract animals within the range of the camera trap.

3.3 Survey effort

3.3.1 Location of sampling points

Mammals were surveyed systematically in two areas within the reserve (Table 6.).

Table 6. Location of mammal trapping sites.

Method	Sampling point A	Sampling point B
Bucket pitfalls	S: 06° 41. 72' E: 039° 04. 68'	S: 06° 42. 72' E: 039° 04. 93'
Sherman traps	S: 06° 41. 72' E: 039° 04. 68'	S: 06° 42. 72' E: 039° 04. 93'
Mist nets (for galagos)		S: 06° 42. 72' E: 039° 04. 93'
Camera traps	S: 06° 41. 72' E: 039° 04. 68'	S: 06° 42. 72' E: 039° 04. 93'
Galago traps	S: 06° 41. 72' E: 039° 04. 68'	S: 06° 42. 71' E: 039° 04. 98' S: 06° 42. 76' E: 039° 04. 87'

Survey sites were selected to enable sampling in a variety of habitats including forest edge, woodland and grassland species. At each site traps and observation surveys were placed and conducted to reflect these different habitat types.

3.3.2 Sampling intensity

Various different methodologies were tried to most effectively sample the area during the survey time period (Table 7). Some methods, Sherman and Chardonneret trapping, and observational surveys were employed continuously but other methods such as galago netting were employed opportunistically. The camera traps were programmed to switch on in the evenings and then off in the morning. This was because dappled sunlight on the forest floor tends to trigger the heat/motion sensor even when no animals are present. Ideally it would be best to have camera traps working 24 hours per day. It was hard to calculate the survey effort of the combined observational survey effort of all of the 6 biologists and other field workers present during the survey.

Table 7. Sampling effort for the mammal survey.

Method	Study effort Site 1	Study effort Site 2	TOTAL
Sherman trapping (trap nights)	315	315	630
Mist netting for galagos (hours)	7	17	24
Galago trapping (trap nights)	32	24	56
Camera trapping (hours) From 2 camera traps set	182	144	326
Night surveys (hours)	48	36	84
Diurnal surveys	Approximately 6 hours/day by AP but other members of the team opportunistically conducted surveys throughout the day.		>84

3.4 RESULTS

3.4.1 Small mammals (not including bats)

A total of 26 mammals from 16 families (Table 8) were recorded during 14 survey days in Pande Game Reserve at two survey sites and, of these, 14 specimens were retained for museum based identification purposes (Table 9). Of the mammals so far identified there were 3 monkeys, 4 galagos, 3 insectivores, 1 hare, 11 rodents, 1 carnivore, 1 pig and 4 ungulates. Some identifications in this report remain tentative while awaiting taxonomic verifications of some of the rodents and shrews. The specimens collected represent at least 7 species from 3 families. A summary of trapping data is shown in Table 9 and, a species list of mammals with their corresponding ecological, endemic and threat status is presented in Table 8. The galago trapping data and biometrics are given in Appendices 2 and 4.

Table 8. Annotated list of mammal species recorded in Pande Game Reserve.

SPECIES	Ecol. type	End. status	Evidence	IUCN & CITES status
Diurnal primates or old world monkeys CATARRHINI				
Baboon <i>Papio anubis</i>	O	W	obs, hd	II
Vervet Monkey <i>Cercopithecus (a.) pygerythrus</i>	O	W	obs, hd	II
Sykes Monkey <i>Cercopithecus mitis</i>	F	W	obs, hd	II

SPECIES	Ecol. type	End. status	Evidence	IUCN & CITES status
Nocturnal primates or prosimians STREPSIRHINI				
Large eared greater galago <i>Otolemur crassicaudatus</i>	O	W	obs, hd,	II
Small eared greater or Garnett's galago <i>Otolemur garnettii</i>	F	N	obs, hd	II
Zanzibar galago <i>Galagoides zanzibaricus</i>	F	N	obs, hd, tr	LR/NT II
Rondo galago <i>Galagoides rondoensis</i>	F	E	obs, hd, tr	EN II
Insectivores INSECTIVORA				
Shrews SORCIDAЕ				
White toothed shrews <i>Crocidura</i> spp.			tr	
Elephant shrews, or Sengis MACROSCELIDAE				
Four toed elephant shrew <i>Petrodromus tetradactylus</i>	F	W	obs, hd, pa, ct	
Black and rufous elephant shrew <i>Rynchocyon petersi</i>	F	N	obs, hd, ct, pa	EN
Hares LAGOMORPHA				
Cape hare <i>Lepus capensis</i>	O	W	obs	
Rodents RODENTIA				
Squirrels SCIURIDAE				
Red-bellied coast squirrel <i>Paraxerus palliatus</i>	F	N	obs, hd,ct	
Ochre bush squirrel <i>Paraxerus ochraceus</i>	O	W	obs	
Porcupine HYSTRICIDAE				
Crested porcupine <i>Hystrix cristata</i>	O	W	spines	
Gerbils GERBILLINAE				
Tatera (naked-soled) gerbils <i>Tatera</i> sp.	O	W	Tr, ct	
Pouched rats CRICETOMYINAE				
Lesser pouched rats <i>Beamys hindei</i>	F	N	tr	LR/NT
Giant pouched rat <i>Cricetomys gambianus</i>	F	W	ct	
Murid rats and mice MURIDAE				
Spiny mouse <i>Acomys spinosissimus</i>		W	tr	
Soft-furred rats <i>Praomys</i> sp.			tr	
Common mice <i>Mus</i> sp.			tr	
Zebra mice <i>Lemniscomys</i> sp.			tr	
Carnivores CARNIVORA				
Mongooses HERPESTIDAE				
Slender mongoose <i>Herpestes sanguinea</i>	O	W	obs	
African civet <i>Civettictis civetta</i>	O	W	obs	
Ungulates ARTIODACTYLA				
Pig SUIDEA				
Bush pig <i>Potamochoerus larvatus</i>	F	W	obs,dig	
Spiral- horned bovines TRAGELAPHINI				
Bushbuck <i>Tragelaphus scriptus</i>	F	W	obs	
Duikers CEPHALOPHINI				
Forest duikers <i>Cephalophus</i> spp.	F	w	hd, sp	
SPECIES	Ecol. type	End. Status	Evidence	IUCN & CITES status
Dwarf antelopes NEOTRAGINI				
Suni <i>Neotragus moschatus</i>	F	W	Hd, sp	

KEY TO TABLE 8

Nomenclature follows Wilson and Reeder 1993

Ecological (Ecol.) type (Data based on Wilson and Reeder 1993)

- FF – Forest dependent species: Species confined to primary forest only; not including forest edge or secondary forest.
 F – Forest dwelling but not forest dependent species: Species occurring in primary forest, forest edge or secondary forest.
 O – Non-forest species: Species that do not occur in primary or secondary forest or forest edge.

Endemic (End.) status (Data based on Wilson and Reeder 1993):

- E - Endemic: Species with ranges restricted to the Eastern African Coastal Forests.
 N – Near endemic: Species with limited ranges usually only including coastal forest and/or Eastern Arc lowland forests.
 W – Widely distributed species.

IUCN status based on Hilton-Taylor 2000

- EN – Endangered
 VU – Vulnerable
 LR/NT – Lower Risk/Near Threatened
 DD – Data Deficient

CITES listings (CITES, .):

- I – Appendix One listed species
 II – Appendix Two listed species
 (Appendix Three species not included in Table)

Evidence:

- hd - vocalisations/sounds heard
 sp - spoor
 obs - observed
 dig - diggings
 hair - fur/hair/quills found
 tr - trapped
 pa - path
 ct - photo trapped

Table 9. Summary of small mammal trapping results.

Species		Ecol. type	End. status	Total nos. captured	No. of specimens taken	Trap type
PRIMATES						
<i>Galagoides zanzibaricus</i>	Zanzibar galago	F	N	2	0	Ch
<i>Galagoides rondoensis</i>	Rondo galago	F	N	7	0	Ch
SORICIDAE						
<i>Crocidura sp.</i>	White-toothed Shrew	F	W	1	6	Sh, BP
CRICETOMYINAE						
<i>Beamys hindei</i>	Lesser pouched rats	F	N	1	1	Sh
MURIDAE						
<i>Acomys spinosissimus</i>	Spiny Mouse	F	W	23	1	Sh
<i>Praomys sp.</i>	Soft-furred rats	O	W	1	3	Sh
<i>Mus sp.</i>	Common mice	O	W	1	1	Sh
<i>Tatera sp.</i>	Naked soled gerbil		W	1	1	Sh
<i>Lemniscomys sp.</i>	Zebra mice		W	1	1	Sh

KEY TO TABLE 9

Ecological (Ecol.) type:

- FF - Forest dependent species: Species confined to primary forest only; not including forest edge or secondary forest.
 F- Forest dwelling but not forest dependent species: Species occurring in primary forest, forest edge or secondary forest.
 O - Non-forest species: Species that do not occur in primary or secondary forest or forest edge.

Endemic (End.) status:

- N - Near endemic: Species with limited ranges usually only including coastal forest and/or East African lowland forests.
 W - Widely distributed species.

Trap type

- Ch - Chardonneret trap
 Sh - Sherman
 BP - Bucket pitfall



3.5 Discussion

3.5.1 Overview

Despite the heavy levels of forest destruction in the past the remaining evergreen habitats which can be described as 'coastal forest thicket with tiny forest patches surrounded by small areas of denuded woodland and grassland', retain significant levels of mammal diversity. The coastal thicket/forest has many of the typical species found in other coastal forests including some rare and threatened species (Table 10). The forest edge and wooded grassland contains rodent species with widespread distributions within East Africa.

Table 10. Threat status and endemism of mammal species.

Categories	Species	Threat	Habitat
Coastal forest endemic species	*Undescribed species of shrew		Terrestrial
	<i>Galagoides rondoensis</i>	EN	Arboreal
Eastern Arc and coastal forest endemic species	<i>Galagoides zanzibaricus</i>	VU	Arboreal
	<i>Rynchocyon petersi</i>	EN	Terrestrial
CF/EA and a few other east African forests.	<i>Otolemur garnettii</i>	-	Arboreal
	<i>Beamys hindei</i>	-	Terrestrial

*The identification of the two species of shrew are still pending.

- Taxa not in Baillie and Groombridge (1996)

Source: Burgess and Clarke (2000)

The short amount of survey time allotted has meant that several more mammal species would probably be recorded with more survey effort and in the wet seasons. Species that were not recorded and that are likely to occur in Pande GR include: palm civet *Nandinia binotata*, dwarf mongoose *Herpestes parvula*, banded mongoose *Mungos mungo*, and the bushy tailed mongoose *Bdeogale crassicauda*. Camera traps set for longer periods of time would also probably confirm the presence of the red duiker *Cephalophus harveyi*, blue duiker *C. monticola* and the suni antelope *Neotragus moschatus*.

The fragmented nature and small size of the remaining forest means that there is a large 'edge effect' where by fire is a major threat to these species as well as reducing the effective area available for forest dependent species to live. Further several species will become

isolated within these patches and be unable to cross the gaps and maintain a rate of gene flow necessary to maintain viable and healthy populations.

Snaring is very common in other coastal forests (pers. obs.) but here there seemed to be little evidence of hunting using snares with the parts of PGR surveyed, and this is reflected by the presence of duikers, bush pig and bushbuck. This may not however be the case for the boundary parts of the PGR where non-species specific snaring may be taking place to deter potential crop raiding by these species, notably bush pig.

3.5.2 Species accounts

Primates PRIMATES

Diurnal primates or old world monkeys CATARRHINI

Baboon *Papio anubis*

Vervet Monkey *Cercopithecus (a.) pygerythrus*

Sykes Monkey *Cercopithecus mitis*

The baboon and vervet monkey are typical non-forest bushland species and the Sykes monkey, is a typical forest species. They are all however utilising the degraded forest patches in Pande GR for sleeping sites and food and are probably playing a valuable role in seed dispersal which will help forest regeneration.

No Black and white colobus were recorded. Local reports and sightings by one of the PGR staff remain unconfirmed. But at least one or possibly two troops were seen ten years ago (N. Burgess pers. comm.). This indicates a drastic decline or even a local extinction of this species. The local reports say that only 2-3 individuals which associate with a troop of Sykes monkeys remain, which if true, is too small a population to be viable in the longer term.

Nocturnal primates or prosimians STREPSIRHINI

Large eared greater galago *Otolemur crassicaudatus*

Small eared greater or Garnett's galago *O. garnettii*

Zanzibar galago *Galagoides zanzibaricus*

Rondo galago *G. rondoensis*

The recording of four species of galago is quite remarkable given the small and denuded nature of the habitat.

The large eared greater galago has a large range outside the coastal forest zone and is normally found in miombo acacia woodlands. To find this species in Pande was therefore surprising and may just reflect the presence of the denuded woodland. But what might be more likely is that the individuals heard were previously captive animals that were released in to the game reserve.

Garnett's galago and the Zanzibar galago are typical coastal forest species which were expected to be found in Pande GR given the known area of remaining coastal thicket/forest. Garnett's galago is able to utilise and move between many different habitats including farmland plantations and are therefore less effected by habitat fragmentation.

The Zanzibar galago is typical of coastal forests and thickets and will not utilise farm or woodland but it is possible that they are able to cross gaps between forest patches where tree stems are less than 3m apart. The Zanzibar galago is endemic to the lowland Eastern Arc and coastal forests and is threatened by habitat fragmentation and therefore the Pande GR population is important for the conservation of this species.

The Rondo galago is a very rare galago (possibly the rarest of all the galago species) with a highly discrete distribution within the Tanzania coastal forests. This species was only known to occur from; the Rondo plateau forests, Pugu/Kazimzumbwi, and Zaraninge FR. *The discovery of this species alone in Pande GR makes Pande GR a very important area for conservation.* Little is known about this species, which was only named in 1996. It seems to be a very conservative species requiring moist evergreen hilltop coastal forests where it occupies the under storey during its nightly foraging activities. It seems to be much less able to cross forest gaps than the Zanzibar galago and so is more vulnerable the effects of forest fragmentation. Population estimates of the PGR population range from 180-260 individuals (given 3-6 animals per ha and approximately 6km² of remaining coastal thicket/forest). This is a small but significant population given that there are only 4 other populations (Rondo 2km, Ziواني 7.7km², Pugu/Kazimzumbwi 33.5 km² and Zaraninge with 20 km² of forest), with a combined forest area of 63.2 km².

Insectivores INSECTIVORA

Shrews SORCIDAE

White toothed shrews *Crocidura* spp.

The identities of these shrews are not certain pending expert examination. At least two species seem to be present in PGR which occurred in both forest or open grassland habitats. These may be *Crocidura fuscomurina* and *C. hirta* or a third as yet unidentified 'Shrew species d' which occurs in Pugu/Kazimzumbwi FR (Burgess and Clarke, 2000).

Elephant shrews, or Sengis MACROSCOLIDAE

The four toed elephant shrew *Petrodromus tetradactylus*; and the Zanj or black and rufous elephant shrew *Rynchocyon petersi*

The four toed elephant shrew is a wide spread species in thickets and forested areas in eastern and central Africa. The Zanj elephant shrew is restricted to the lowland eastern arc and coastal forests between the Rufji area upto an area around Mombasa, Kenya and is considered 'Near Threatened' by the IUCN. They are affected by habitat loss and fragmentation, little is know about their biology and there are many taxonomic questions about these species (Nicoll and Rathburn, 1990).

Hares LAGOMORPHA

Cape hare *Lepus capensis*

The record of this species, which, is widespread in Tanzania, in scrubby dry habitats, is an example of how the destruction of the forest into dry grassland and degraded woodland has benefited other non-forest species.

Rodents RODENTIA

Squirrels SCIURIDAE

Red-bellied coast squirrel *Paraxerus palliatus*; Ochre bush squirrel *Paraxerus ochraceus*

Porcupine HYSTRICIDAE

Crested porcupine *Hystrix cristata*

Gerbils GERBILLINAE

Tatera (naked-soled) gerbils *Tatera*

Pouched rats CRICETOMYINAE

Lesser pouched rats *Beamys hindei*; Giant pouched rat *Cricetomys gambianus*

Murid rats and mice MURIDAE

Spiny mouse *Acomys* sp.; Soft-furred rats *Praomys* sp.; Common mice *Mus* sp.; Zebra mice *Lemniscomys* sp.

The rodent fauna represent a mixture of widespread grassland and open woodland dwelling species with a few forest living specialists. Of the rodents the red-bellied coast squirrel and the lesser pouched rat which, are widespread in the coastal forests of Eastern Africa, are Red Data species and considered vulnerable. The lesser pouched rat is more widespread than previously thought and was know to occur in three coastal forests in Kenya and seven in Tanzania (Fitzgibbon *et al.* 1995, Burgess and Clarke 2000). Its occurrence in Pande GR represents an eighth locality. Of the other rodents recorded the crested porcupine, giant pouched rat, soft-furred rats. are widespread forest and forest edge species. The spiny mouse, soft-furred rat, common mice and zebra mice are considered to be more typical of drier bushland and grassland and thus reflect the areas of grassland within PRG.

Carnivores CARNIVORA

Mongoose HERPESTIDAE

Slender mongoose *Herpestes sanguinae*

It was surprising that only one carnivore was recorded since there are several other mongoose species for example, dwarf mongoose, banded mongoose, the bushy tailed mongoose and the African civet, palm civet that may occur in PGR. The elusive nature of these species made them hard to locate.

Pig SUIDEA

Bush pig *Potamochoerus larvatus*

A widespread species in moist or forested habitats (in drier habitats it is replaced by the warthog) the bushpig was recorded from tracks made near the pond in the north of PGR. This species is often hunted because it is know to damage agricultural crops (as well as being a source of meat).

Even-toed ungulates ARTIODACTYLA

Bushbuck *Tragelaphus scriptus*

This is a common, widespread but elusive species is found within the moist forested and bushland of southern, eastern central and western Africa. However it is often heavily hunted and its presence in PGR is a good sign and the male and female seen together indicate the possibility of a breeding pair since they are normally strictly solitary. In a recent analysis this species has only been reported in eight out of 31 coastal forests, including the nearby Pugu/Kazimumbwe FR, (Burgess and Clarke, 2000) possibly reflecting their vulnerability to hunting.

Duikers CEPHALOPHINI

Forest duikers *Cephalophus* sp.

Dwarf antelopes NEOTRAGINI

Suni *Neotragus moschatus*

No forest duikers or suni were seen but several were heard running away when disturbed. Two types of dung pellets were found one of which maybe of a red duiker *Cephalophus harveyi* or a blue duiker *C. monticola* or suni. Further research is required to evaluate which species occur in Pande GR.

3.5.3 Biological affinities

This survey recorded 26 mammal species (not including bats) of which 18 are forest and forest edge species and 8 are species of broader drier habitat tolerance. This compares with 31, which are forest and forest edge species and 109 species of broader drier tolerance, which are known from the coastal forests as a whole (Burgess and Clarke, 2000). Some of the species such as the black and rufous elephant shrew, lesser pouched rat, Syke's monkey indicate affinities with the Eastern Arc mountains. When compared with other nearby individual coastal forests Pande GR has similar diversity of mammals (not including bats). For

example, the relatively well studied Pugu FR has 27 and Kiono/Zaraninge FR has 28 mammals (source; Burgess and Clarke 2000, Perkin 2000, and unpub. data).

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4) Bats

By Benjamin Hayes

4.1 Introduction

Bats (order Chiroptera) are among the most diverse and widespread group of mammals, and are distinguished by their capacity for true flight. More than 1,000 species are known, which are divided into two suborders, the Megachiroptera and Microchiroptera. Almost one third of species feed on nectar or fruit, and these bats play a crucial role in plant pollination and seed dispersal. Bats are the main agents of pollination of certain economically and ecologically important plants (e.g., Cox *et al.*, 1991) and, owing to the ability of many species to carry seeds over long distances, may make a significant contribution to the reforestation of cleared areas (Gorchov *et al.*, 1993). Most of the remaining species are insectivorous and these are thought to be the primary consumers of nocturnal insects (Kunz & Pierson, 1994).

At present there are 79 species of bats known from Tanzania (Hutson *et al.* 2001). However, there is a limited knowledge of the exact status and distribution of the great majority of species. Previous surveys have highlighted this lack of knowledge with 3 species new to Tanzania having been recorded in the Coastal Forests (Cockle *et al.* 1998.)

Prior to this survey, there has been no specific research undertaken on the bat fauna of Pande Game Reserve (PGR). However the coastal forests of Tanzania have been reasonably well studied and are known to contain more than 46 species of bat (Cockle *et al.* 1998.).

4.2 Methods

4.2.1 Mist netting

70- denier mist nets were used to capture bats. These were of variable lengths and set up across potential flight paths such as paths and clearings. Species requiring identification were collected as voucher specimens and preserved as "wet specimens" in 70% ethanol and injected with 10% formalin. The status and distribution of the bat species in Tanzania was taken from a number of sources including unpublished data of Frontier-Tanzania. Nomenclature and systematics follow Hayman and Hill (1971). All identifications are preliminary and are awaiting final taxonomic verification.

4.3 Survey effort

4.3.1 Location of sampling points and sampling intensity

The survey was carried out in February 2003, with 2 weeks of field work conducted in the reserve. Over the study period 13 net nights, comprising 2425 meter-net-hours (mnh) were achieved.

A list of the survey sites and dates worked are provided in Table 11.

Table 11. Sampling effort for the bat survey.

Site:	Site coordinates	Location/ habitat:	Net Nights:	Meter Net Hours:
1.	S: 06° 41. 729' E: 039° 04. 680'	Forest track, in scrub forest	2	840
2.	S: 06° 41. 831' E: 039° 04. 634'	Forest track, in scrub forest	1	210
3.	S: 06° 41. 747' E: 039° 05. 042'	Marshy area/ pond /grassland	3	456
4.	S: 06° 43. 288' E: 039° 05. 208'	Forest edge/ grassland	4	547

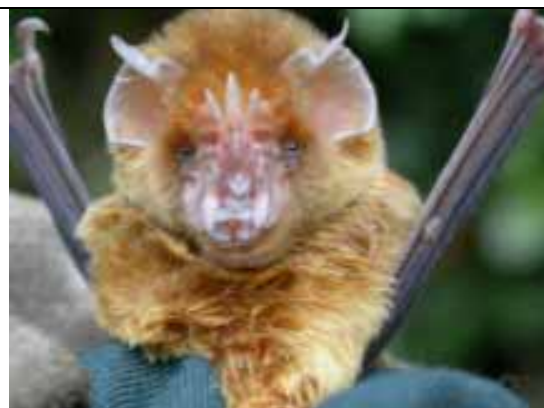
5.	S: 06° 42. 727' E: 039° 04. 933'	Forest track, in scrub forest	2	237
6.	S: 06° 42. 760' E: 039° 04. 873'	Forest track, in scrub forest	1	135

4.4 Results

Over the period of study, 59 individuals were caught, representing 12 confirmed species, two of these being IUCN listed. New species were still documented even on the last netting night of the survey. A full species list and numbers of individual species caught is given in Table 12.

Table 12. Annotated list of the bat species recorded in Pande Game Reserve.

Species/ Family	Common name	End. Status	IUCN 2001	No. caught
Pteropodidae				
<i>Myonycteris relicta</i>	E.African collared fruit bat	N	VU	1
<i>Epomophorus labiatus</i>	Ethiopian epauletted fruit bat	W	-	1
<i>Epomophorus wahlbergi</i>	Wahlberg's epauletted fruit bat	W	-	34
<i>Rousettus (Lissonycteris) angolensis</i>	Angolan soft furred fruit fat	W	-	3
Hipposideridae				
<i>Hipposideros commersoni</i>	Commerson's leaf-nosed bat	W	-	4
<i>Hipposideros ruber</i>	Noack's African leaf-nosed bat	W	-	4
<i>Triaenops persicus afer</i>	Persian leaf-nosed bat	W	-	6
Vespertilionidae				
<i>Scotophilus leucogaster</i>	Lesser yellow house bat	W	-	1
<i>Scotophilus nigrita</i>	Yellow house bat	W	LR: nt	1
<i>Pipistrellus</i> sp.	-	-	-	1
Nyctereridae				
<i>Nycteris</i> sp. 1	Slit faced bat	-	-	2
<i>Nycteris</i> sp. 2	Slit faced bat	-	-	1



The Persian leaf-nosed bat *Triaenops persicus afer*



Slit faced bat, *Nycteris* sp.

4.5 Discussion

4.5.1 Overview

Pande Game Reserve contains approximately 15% of Tanzania's known bat species and over 25% of the species known to occur within Tanzania's coastal forests. Only two other coastal forests, out of seventeen studied forests, are known to have a higher bat diversity, these being Genda Genda Forest Reserve (15 species) and Kazimzumbwi Forest Reserve (14

species), (Cockle *et. al.* 1998). This though is probably explained by the increased habitat diversity and larger number of netting nights at these two sites. Likewise the seemingly high diversity for PGR might reflect the more intense netting and larger number of meter net hours (mnh) employed throughout the reserve compared to some other surveys. For example a recent survey at Ruvu South Forest Reserve only recorded 5 species of bat (Frontier-Tanzania *In prep*). Though this reserve is considerably larger in size and has more habitat diversity, only 729 mnh were conducted and additionally nets were only opened for a limited period. Thus with more intensive netting it is likely that Ruvu South Forest Reserve would have a similar if not higher bat diversity compared to PGR.

Several families of bats recorded from other coastal forests were not recorded during the survey, these being *Megadermatidae*, *Rhinolophidae*, *Emballonuridae* and *Molossidae*. Based on previous research these families accounted for more than 25% of the total number of species from coastal forest reserves (Cockle *et. al.* 1998). Additionally few species from the *Vespertilionidae* family were recorded. This might be explained by the lack of potential roosting sites in the reserve. Many species prefer roosting in tree hollows, under dead bark etc, and the trees in the reserve that would provide this are mainly in the grassland areas where burning regularly occurs and thus would cause considerable disturbance to potential roosting bats. Additionally many mature trees are chopped down for timber and charcoal. This though presents less of a problem to fruit bats since many species roost in dense thickets and also some species are quite migratory.

However with the presence of 12 species, two of these being IUCN listed, Pande game Reserve is an area of high conservation significance for bats. Also with further research it is likely that new species will be recorded from the reserve. However, too little is known about the biogeography and status of the bats in Tanzania to determine the relative importance of the reserve's bat fauna in a national and regional context.

4.5.2 Species accounts

***Myonycteris relicta* Bergmans, 1980 IUCN: Vulnerable**

Only one individual of this species was recorded from the reserve (site 4). It was netted approximately 100m from the forest edge while flying over grassland. This species is known from several coastal forest reserves in Tanzania and was the most commonly recorded species from Ruvu South Forest Reserve (Cockle *et. al.* 1998). This is predominately a lowland forest species and is threatened by habitat loss and degradation (IUCN 2003 & Mickelburgh *et. al.* 1992). *Myonycteris relicta* known range extends from the Shimba Hills in southeast Kenya, the Usambara and Nguru Mts in Tanzania, several coastal forests in Tanzania and more recently from eastern Zimbabwe (IUCN 2003 & Cockle *et. al.* 1998).

***Epomophorus wahlbergi* (Sundevall, 1846)**

This was the commonest species recorded during the survey and was netted from all sites apart from site 3. This species is sometimes associated with *Epomophorus labiatus* and is known to share the same roosting trees (Kingdon. 1974). Towards the end of the survey one female was caught with young and overall very few male specimens were netted. *Epomophorus wahlbergi* is commonly recorded throughout Tanzania's coastal forests (Cockle *et. al.* 1998) and its known distribution extends from Somalia through E. Africa, the Democratic Republic of the Congo, Cameroon southwards to Angola and S. Africa (Hayman & Hill 1971).

***Epomophorus labiatus* (Temminck, 1837)**

Only one individual of this species was recorded from the reserve (site 4). This species is reasonably well known from Tanzania's coastal forests though has been caught less than *Myonycteris relicta* (Cockle *et. al.* 1998). *Epomophorus labiatus* known range extends through Chad, Ethiopia, Sudan, Nigeria, north east Democratic Republic of the Congo, E. Africa and Malawi (Mickelburgh *et. al.* 1992).

***Rousettus (Lissonycteris) angolensis* (Bocage 1898)**

Three individuals were recorded from the forest edge (site 4 & 5). This species is found from sea level up to 2200m and roosts generally in small groups (Kingdon. 1974). There are 3 subspecies of this subgenus and they range from Angola north to Cameroon, west to Sierra Leone and Guinea; east to Tanzania, Kenya, Zambia and Zimbabwe (Hayman & Hill 1971).

***Hipposideros ruber* (Noack 1893)**

Four individuals were recorded from the reserve (sites 1,2 & 6). This is one of the most commonly caught bats in Tanzania's coastal forests (Cockle *et. al.* 1998). *Hipposideros ruber* known range extends from Ethiopia, E. Africa, Zambia west to Angola, Democratic Republic of the Congo, Cameroon, northwards to Gambia (Hayman & Hill 1971).

***Hipposideros commersoni* (E. Geoffroy 1813)**

Four individuals were recorded from the reserve (sites 1 & 4). This species is most common in woodland and savanna and is sometimes caught for food (Kingdon. 1974). *Hipposideros commersoni* known range extends over much of sub Sahara Africa (Hayman & Hill 1971).

***Triaenops persicus afer* Dobson 1871**

This species was recorded throughout the reserve and was netted from all sites apart from site 3. It has been commonly documented from Tanzania's coastal forests (Cockle *et. al.* 1998) and is known to congregate in large numbers in caves (Kingdon. 1974). *Triaenops persicus afer* range extends predominately along the eastern coast of Africa to Iran and Arabia and within E. Africa is also recorded inland from Uganda and Kenya (Hayman & Hill 1971).

***Scotophilus nigrita* (Schreber 1774) IUCN: Lower Risk: near threatened**

Only one individual of this species was recorded from the reserve (site 3). This species is known to roost in roofs, hollow trees and caves; and the diet of this bat is thought to exclusively consist of small beetles (Kingdon. 1974). *Scotophilus nigrita's* range extends from Cape Province north to Sudan, Somalia, Eritrea and Ethiopia, west to Angola and Senegal (Hayman & Hill 1971).

***Scotophilus leucogaster* (Cretzschmar 1826)**

Only one individual of this species was recorded from the reserve (site 4). This is a possible new record for Tanzania's coastal forests as it was not mentioned by Cockle *et. al.* 1998. However it is a widely distributed species ranging over much of sub Sahara Africa (Hayman & Hill 1971) and therefore is likely to be present throughout many of Tanzania's coastal forests.

Other Species of Interest:

Three other species were recorded from the reserve during the period of study. These were two *Nycteris* species from the *Nycteridae* family and one *Pipistrellus sp.* from the *Vespertilionidae* family. However these are awaiting further identification and presently have only been identified to the family level.

4.5.3 Recommendations for further research

1. Further surveys over different seasons, combining both mist nets and harp traps, are required to obtain a more accurate knowledge of the bat community within Pande Game Reserve.
2. More specific surveys of *Myonycteris relicta*, to determine its conservation significance and to gain a better understanding of seasonal patterns in activity and movement of this species. Additionally further knowledge of the ecology and behavior of other species is needed.

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5) Birds

By Nike Doggart and Njano Mbilinyi

5.1 Introduction

The avifauna of the East African Coastal Forests comprises a mixture of species widespread in the lowlandss of East and West Africa combined with species unique to the Coastal Forest. There are five species strictly endemic to the Coastal Forest and a further eight whose ranges extend into the neighbouring Eastern Arc Mountains. Mlingwa et al. (2000) record 85 forest bird species (33 specialist, 52 generalist) in the Coastal Forests. An additional 55 species are regular forest visitors.

The bird fauna of Pande Game Reserve has been studied intermittently including a survey by Frontier-Tanzania in 1989 (Burgess 1990 and Burgess et al. 1991) and two other surveys in 1991 and 2002 the results of which are recorded in the database of the Tanzania Bird Atlas (Baker and Baker in prep.).

Pande is part of the 'Pande and Dondwe Coastal Forest' Important Bird Area Baker and Baker (2002). Pande is included in the important bird area on the basis of its populations of Southern banded snake-eagle (*Circaetus fasciolatus*) and Plain-backed Sunbird (*Anthreptes reichenowii*).

5.2 Methods

The TFCG surveys used two methods to record the bird fauna of the reserve, mist netting and observations.

5.2.1 Mist netting

Mist nets were set out in the mornings and late afternoons in a variety of habitats. Nets were checked at least every 20 minutes and more frequently around dawn and dusk. This method is especially important for sampling more cryptic understorey birds up to 2 m above ground level as well as other birds moving through the habitat.

All birds caught in the mist nets were extracted, identified and measured according to standard methods.

All birds caught were ringed with numbered metal bands from the National Museums of Kenya series. Data is stored by the Tanzania Ringing Scheme (Baker and Baker pers. comm.).

Birds were identified in the field using a combination of three guides Zimmerman et al. (1997), Stevenson and Fanshawe (2002) and Britton (1980). Where there was uncertainty regarding identifications digital photographs were taken.

Nets were moved every 3 - 4 days.

5.2.2 Observation

Observations were made throughout the day and night on the basis of sightings and from calls. Most effort on observations was made at dawn and dusk.

At night members of the bird survey team walked and drove along roads within the reserve to record nightjars, owls and other nocturnal birds.

5.3 Survey effort

Mist netting was conducted in four areas. Nets were also set opportunistically to capture individual birds where identifications were not possible on the basis of observations alone.

5.3.1 Mist netting sampling effort

The team had mist nets out for a total of 10,548 net metre hours at four sites (Table 13).

Table 13. Sampling intensity for mist netting.

Site number	Habitat	Dates	Coordinates	Net metre hours
1	Coastal thicket	3 rd – 6 th Feb 2003	S: 06° 41' 72" E: 039° 04' 68"	2745
2	Coastal thicket	7 th – 9 th Feb 2003	S: 06° 42' 13" E: 039° 04' 45"	2349
3	Coastal thicket	10 th – 12 th Feb 2003	S: 06° 42' 72" E: 039° 04' 93"	2784
4	Woodland	13 th – 17 th Feb 2003	S: 06° 43' 16" E: 039° 05' 13"	2670

Additional netting was also carried out briefly in the central grassland area in an attempt to catch an unidentified migrant warbler observed in that area.

5.3.2 Sampling effort for bird observations

Bird observations were made each day by the leader of the bird survey team. Different sites were visited throughout the survey period and are outlined in Table 14.

Table 14. Bird observation sampling effort.

Day	Activity
1	In the vicinity of netting site 1.
2	In the vicinity of netting site 1.
3	Between netting site 1 and the pond to the North of the reserve.
4	In the vicinity of netting site 1.
5	3 hours in the open grassland in the north east of the reserve with a particular focus on nightjars and raptors
6	In the vicinity of netting site 2.
7	8 hours from site 2 north to site 1 and then west to the boundary returning to site 2.
8	1 person in the southern part of the reserve and 1 person between sites 1 and 2.
9	Moving camp
10	Along forest edge near site 3 for 2 km.
11	Additional netting in grassland to try to catch an unusual looking warbler observed the previous day.
12	East side of the reserve near Mbopo
13	Camp preparation
14	South east edge of the reserve

5.4 Results

5.4.1 Species richness

A total of 142 species from 46 families have been recorded from Pande of which 124 were recorded during the current survey (Table 15). The day list for the bird survey is presented in Appendix 6 and ringing data is presented in Appendix 7.

Table 15. Annotated list of bird species recorded in Pande Game Reserve.

Species	Scientific name	Ecol. Type	End. Status	IUCN Threat listings and CITES Listing	TZ	Last record
ARDEIDAE – BITTERNs, EGRETS and HERONS						
Night Heron	<i>Nycticorax nycticorax</i>	O	W		22	2003
Cattle Egret	<i>Bubulcus ibis</i>	O	W	CITES III GH	27	2003
SCOPIDAE – HAMERKOP						
Hamerkop	<i>Scopus umbretta</i>	O	W		38	2003
ACCIPITRIDAE – VULTURES, EAGLES, KITES, HAWKS etc						
*Bat hawk	<i>Macheiramphus alcinus</i>	F	W	CITES II	79	1989
Black-shouldered Kite	<i>Elanus caeruleus</i>	O	W	CITES II	80	2003
Palmnut Vulture	<i>Gypohierax angolensis</i>	O	W	CITES II	85	2003
White-backed Vulture	<i>Gyps africanus</i>	O	W	CITES II	89	2003
Brown Snake Eagle	<i>Circaetus cinereus</i>	O	W	CITES II	94	2003
Southern Banded Snake Eagle	<i>Circaetus fasciolatus</i>	F	N	LR/nt	95	2003
Bateleur	<i>Terathopius ecaudatus</i>	O	W	CITES II	97	2003
Gymnogone	<i>Polyboroides typus</i>	O	W	CITES II	98	2003
African Goshawk	<i>Accipiter tachiro</i>	F	W	CITES II	111	2003
*Lizard Buzzard	<i>Kaupifalco monogrammicus</i>	O	W	CITES II	115	1989
*Crowned Eagle	<i>Stephanoaetus coronatus</i>	FF	W	CITES II	131	1989
Martial Eagle	<i>Polemaetus bellicosus</i>	O	W	CITES II	132	2003
FALCONIDAE – FALCONS						
African Hobby	<i>Falco cuvierii</i>	O	W	CITES II	145	2003
PHASIANIDAE - FRANCOLINS and QUAILS						
Crested Francolin	<i>Francolinus sephaena</i>	O	W		155	2003
NUMIDIDAE – GUINEAFOWLS						
Crested Guineafowl	<i>Guttera pucherani</i>	F	W		168	2003
TURNICIDAE – BUTTONQUAILS						
*Common Buttonquail	<i>Turnix sylvatica</i>	O	W		173	1989
RALLIDAE – RAILS and CRAKES						
Black Crane	<i>Amauornis flavirostris</i>	O	W		183	2003
BURHINIDAE – STONE CURLEWS						
Water Thicknee	<i>Burhinus vermiculatus</i>	O	W		209	2003
COLUMBIDAE – PIGEONS and DOVES						
Ring-necked Dove	<i>Streptopelia capicola</i>	O	W		305	2003

Species	Scientific name	Ecol. Type	End. Status	IUCN Threat listings and CITES Listing	TZ	Last record
Red-eyed Dove	<i>Streptopelia semitorquata</i>	O	W	CITES III	306	2003
Emerald-spotted Wood Dove	<i>Turtur chalcospilos</i>	O	W		307	2003
Tambourine Dove	<i>Turtur tympanistria</i>	F	W	CITES III	309	2003
African Green Pigeon	<i>Treron calva</i>	F	W	CITES III	312	2003
PSITTACIDAE – PARROTS						
Brown-headed Parrot	<i>Poicephalus cryptoxanthus</i>	F	W	CITES II	318	2003
MUSOPHAGIDAE – TURACOS and GO-AWAY BIRDS						
Livingstone's Turaco	<i>Tauraco livingstonii</i>	F	W	CITES II	324	2003
Purple-crested Turaco	<i>Tauraco porphyreolophus</i>	O	W	CITES II	328	2003
CUCULIDAE – CUCKOOS						
Jacobin Cuckoo	<i>Oxylophus jacobinus</i>	O	W		336	2003
Levaillant's Cuckoo	<i>Oxylophus levaillantii</i>	O	W		337	2003
Black Cuckoo	<i>Cuculus clamosus</i>	O	W		340	2003
Emerald Cuckoo	<i>Chrysococcyx cupreus</i>	F	W		347	2003
Klaas' Cuckoo	<i>Chrysococcyx klaas</i>	O	W		348	2003
Didric Cuckoo	<i>Chrysococcyx caprius</i>	O	W		349	2003
CENTROPODIDAE – COUCALS						
Yellowbill	<i>Ceuthmochares aereus</i>	F	W		350	2003
White-browed Coucal	<i>Centropus superciliosus</i>	O	W		355	2003
STRIGIDAE – OWLS						
Verreaux's Eagle Owl	<i>Bubo lacteus</i>	O	W	CITES II	367	2003
African Wood Owl	<i>Strix woodfordii</i>	F	W	CITES II	371	2003
CAPRIMULGIDAE – NIGHTJARS						
Fiery-necked Nightjar	<i>Caprimulgus pectoralis</i>	F	W		376	2003
Gabon Nightjar	<i>Caprimulgus fossii</i>	O	W		385	2003
APODIDAE – SWIFTS						
Böhm's Spinetail	<i>Neafrapus boehmi</i>	F	W		392	2003
Palm Swift	<i>Cypsiurus parvus</i>	O	W		393	2003
Little Swift	<i>Apus affinis</i>	O	W		400	2003
COLIIDAE – MOUSEBIRDS						
Speckled Mousebird	<i>Colius striatus</i>	O	W		403	2003
Blue-naped Mousebird	<i>Urocolius macrourus</i>	O	W		405	2003
TROGONIDAE – TROGONS						
Narina Trogon	<i>Apaloderma narina</i>	F	W		407	2003

Species	Scientific name	Ecol. Type	End. Status	IUCN Threat listings and CITES Listing	TZ	Last record
ALCEDINIDAE – KINGFISHERS						
*Pygmy Kingfisher ²	<i>Ceyx picta</i>	O	W		413	1989
Brown-hooded Kingfisher	<i>Halcyon albiventris</i>	O	W		414	2003
Striped Kingfisher	<i>Halcyon chelicuti</i>	O	W		419	2003
MEROPIDAE – BEE-EATERS						
Little Bee-eater	<i>Merops pusillus</i>	O	W		422	2003
Swallow-tailed Bee-eater	<i>Merops hirundineus</i>	O	W		425	2003
White-throated Bee-eater	<i>Merops albicollis</i>	O	W		428	2003
Eurasian Bee-eater	<i>Merops apiaster</i>	O	W		432	2003
Northern Carmine Bee-eater	<i>Merops nubicus</i>	O	W		433	2003
CORACIIDAE – ROLLERS						
Lilac-breasted Roller	<i>Coracias caudata</i>	O	W		436	2003
Broad-billed Roller	<i>Eurystomus glaucurus</i>	O	W		439	2003
PHOENICULIDAE - WOOD HOOPES						
Green Wood Hoopoe	<i>Phoeniculus purpureus</i>	O	W		440	2003
BUCEROTIDAE - HORNBILLS						
Crowned Hornbill	<i>Tockus alboterminatus</i>	O	W		452	2003
Trumpeter Hornbill	<i>Bycanistes bucinator</i>	F	W		455	2003
LYBIIDAE – BARBETS and TINKERBIRDS						
Green Tinkerbird	<i>Pogoniulus simplex</i>	FF	N		464	2003
Red-fronted Tinkerbird	<i>Pogoniulus pusillus</i>	O	W		466	2003
Yellow-rumped Tinkerbird	<i>Pogoniulus bilineatus</i>	F	W		468	2003
Brown-breasted Barbet	<i>Lybius melanopterus</i>	O	W		477	2003
INDICATORIDAE - HONEYGUIDES						
Greater Honeyguide	<i>Indicator indicator</i>	O	W		488	2003
Lesser Honeyguide	<i>Indicator minor</i>	O	W		489	2003
PICIDAE – WOODPECKERS						
Nubian Woodpecker	<i>Campethera nubica</i>	O	W		493	2003
*Golden-tailed Woodpecker	<i>Campethera abingoni</i>	F	W		496	1989
*Little Spotted Woodpecker	<i>Campethera cailliautii</i>	O	W		498	1989
Cardinal Woodpecker	<i>Dendropicos fuscescens</i>	O	W		502	2003
Bearded Woodpecker	<i>Thripias namaquus</i>	O	W		507	2003
EURYLAIMIDAE – BROADBILLS						
African Broadbill	<i>Smithornis capensis</i>	FF	W		510	2003
ALAUDIDAE – LARKS						
Flappet Lark	<i>Mirafra rufocinnamomea</i>	O	W		518	2003
HIRUNDINIDAE – SWALLOWS and MARTINS						

Species	Scientific name	Ecol. Type	End. Status	IUCN Threat listings and CITES Listing	TZ	Last record
Mosque Swallow	<i>Hirundo senegalensis</i>	O	W		537	2003
Wire-tailed Swallow	<i>Hirundo smithii</i>	O	W		543	2003
European Swallow	<i>Hirundo rustica</i>	O	W		547	2003
MOTACILLIDAE – WAGTAILS, PIPITS, LONGCLAWS						
Yellow-throated Longclaw	<i>Macronyx croceus</i>	O	W		569	2003
CAMPEPHAGIDAE – CUCKOO SHRIKES						
*Black Cuckoo Shrike	<i>Campephaga flava</i>	O	W		573	1989
PYCNONOTIDAE – GREENBULS						
Zanzibar Sombre Greenbul	<i>Andropadus importunus</i>	O	W		588	2003
Yellow-bellied Greenbul	<i>Chlorocichla flaviventris</i>	F	W		592	2003
Terrestrial Brownbul	<i>Phyllastrephus terrestris</i>	F	W		594	2003
Fischer's Greenbul	<i>Phyllastrephus fischeri</i>	FF	N		598	2003
Yellow-streaked Greenbul	<i>Phyllastrephus flavostriatus</i>	FF	W		603	2003
Tiny Greenbul	<i>Phyllastrephus debilis</i>	FF	N		605	2003
Yellow-vented Bulbul	<i>Pycnonotus barbatus</i>	O	W		609	2003
TURDIDAE – THRUSHES, ROBINS, WHEATEARS, CHATS						
Red-tailed Ant-thrush	<i>Neocossyphus rufus</i>	FF	W		611	2003
Red-capped Robin Chat	<i>Cossypha natalensis</i>	F	W		647	2003
Bearded Scrub Robin	<i>Cercotrichas quadrivirgata</i>	O	W		652	2003
SYLVIIDAE – WARBLERS						
African Moustached Warbler	<i>Melocichla mentalis</i>	O	W		678	2003
Garden Warbler	<i>Sylvia borin</i>	O	W		718	2003
*Zitting Cisticola	<i>Cisticola juncidis</i>	O	W		727	1991
Rattling Cisticola	<i>Cisticola chiniana</i>	O	W		733	2003
Tiny Cisticola	<i>Cisticola nanus</i>	O	W		735	2003
Tawny-flanked Prinia	<i>Prinia subflava</i>	O	W		753	2003
Yellow-breasted Apalis	<i>Apalis flavida</i>	O	W		758	2003
*Grey-backed Camaroptera	<i>Camaroptera brachyura</i>	O	W		773	1989
Green-backed Camaroptera	<i>Camaroptera brevicauda</i>	O	W		774	2003
MUSCICAPIDAE – FLYCATCHERS						
Spotted Flycatcher	<i>Muscicapa striata</i>	O	W		788	2003
PLATYSTEIRIDAE – WATTLE-EYES and BATIS						
Vanga Flycatcher	<i>Bias musicus</i>	O	W		796	2003
Black-throated Wattle-eye	<i>Platysteira peltata</i>	F	W		808	2003
MONARCHIDAE – MONARCH FLYCATCHERS						
Little Yellow Flycatcher	<i>Erythrocercus holochlorus</i>	FF	E		810	2003

Species	Scientific name	Ecol. Type	End. Status	IUCN Threat listings and CITES Listing	TZ	Last record
*Crested Flycatcher	<i>Trochocercus cyanomelas</i>	FF	W		815	1989
African Paradise Flycatcher	<i>Terpsiphone viridis</i>	O	W		816	2003
NECTARINIIDAE -- SUNBIRDS						
*Plain-backed Sunbird	<i>Anthreptes reichenowi</i>	FF	N		844	1989
Uluguru Violet-backed Sunbird	<i>Anthreptes neglectus</i>	F	N		848	2003
Collared Sunbird	<i>Anthreptes collaris</i>	F	W		852	2003
Eastern Olive Sunbird	<i>Nectarinia olivacea</i>	O	W		854	2003
Mouse-coloured Sunbird	<i>Nectarinia veroxii</i>	O	W		856	2003
*Amethyst Sunbird	<i>Nectarinia amethystina</i>	O	W		860	1989
*Purple-banded Sunbird	<i>Nectarinia bifasciata</i>	O	W		879	1989
Bronze Sunbird	<i>Nectarinia kilimensis</i>	O	W		888	2003
ORIOLIDAE – ORIOLES						
Golden Oriole	<i>Oriolus oriolus</i>	O	W		895	2003
Black-headed Oriole	<i>Oriolus larvatus</i>	O	W		897	2003
LANIIDAE – SHRIKES						
Red-backed Shrike	<i>Lanius collurio</i>	O			902	2003
MALACONOTIDAE – PUFFBACKS, TCHAGRAS, BOUBOUS, BUSH SHRIKES						
Black-backed Puffback	<i>Dryoscopus cubla</i>	F	W		916	2003
Black-crowned Tchagra	<i>Tchagra senegala</i>	O	W		923	2003
Tropical Boubou	<i>Laniarius aethiopicus</i>	O	W		926	2003
Four-coloured Bush Shrike	<i>Malaconotus quadricolor</i>	F	W		933	2003
*Grey-headed Bush Shrike	<i>Malaconotus blanchoti</i>	O	W		934	2002
Eastern Nicator	<i>Nicator gularis</i>	O	W		937	2003
PRIONOPIDAE – HELMET SHRIKES						
*White Helmet Shrike	<i>Prionops plumatus</i>	O	W		938	1989
Chestnut-fronted Helmet Shrike	<i>Prionops scopifrons</i>	F	N		941	2003
DICRURIDAE – DRONGOS						
Square-tailed Drongo	<i>Dicrurus ludwigii</i>	F	W		942	2003
*Drongo	<i>Dicrurus adsimilis</i>	O	W		943	1991
STURNIDAE – STARLINGS						
Black-breasted Starling	<i>Lamprotornis corruscus</i>	O	W		954	2003
PLOCEIDAE - WEAVERS, QUELEAS, BISHOPS						
Village Weaver	<i>Ploceus cucullatus</i>	O	W		1011	2003
Dark-backed Weaver	<i>Ploceus bicolor</i>	F	W		1016	2003
Zanzibar Red Bishop	<i>Euplectes nigroventris</i>	O	W		1030	2003
Yellow Bishop	<i>Euplectes capensis</i>	O	W		1032	2003
Fan-tailed Widowbird	<i>Euplectes axillaris</i>	O	W		1033	2003

Species	Scientific name	Ecol. Type	End. Status	IUCN Threat listings and CITES Listing	TZ	Last record
Red-collared Widowbird	<i>Euplectes ardens</i>	O	W		1036	2003
Grosbeak Weaver	<i>Amblyospiza albifrons</i>	O	W		1041	2003
ESTRILDIDAE - WAXBILLS, CORDON-BLEUS, MANNIKINS etc						
Green-winged Pytilia	<i>Pytilia melba</i>	O	W		1046	2003
Peters' Twinspot	<i>Hypargos niveoguttatus</i>	F	W		1053	2003
Green-backed Twinspot	<i>Mandingoa nitidula</i>	FF	W		1054	2003
African Firefinch	<i>Lagonosticta rubricata</i>	O	W		1057	2003
Common Waxbill	<i>Estrilda astrild</i>	O	W		1064	2003
Bronze Mannikin	<i>Lonchura cucullata</i>	O	W		1077	2003
Pin-tailed Whydah	<i>Vidua macroura</i>	O	W		1087	2003
FRINGILLIDAE – CANARYS and SEED-EATERS						
Yellow-rumped Seedeater	<i>Serinus reichenowi</i>	O	W		1097	2003
Yellow-fronted Canary	<i>Serinus mozambicus</i>	O	W		1098	2003

Key to Table 15

Ecological Type

This describes the degree to which species are dependent on forest habitat. This follows the classification provided in Burgess and Clarke (2000).

FF - 'Forest specialist' species that are typical of the forest interior and likely to disappear when the forest is modified to any great extent.

F - 'Forest generalist' species that can occur in undisturbed forest but which are able to exist (and may even be more numerous) at the forest edge or in modified and fragmented forests. However, these generalists continue to depend upon forests for some of their resources, such as nesting sites.

Endemic status (based on Mlingwa et al. 2000)

E - Coastal Forest Endemic

N - Range restricted to the Coastal Forests and selected other east African forests

W - Widespread

TZ

Species number used by the Tanzania Bird Atlas.

IUCN Threat listings and CITES Listing based on Hilton-Taylor 2000

LR/NT – Low risk / Near threatened

CITES II – Species listed on CITES Appendix II.

CITES III – Species listed on CITES Appendix III.

Records

*Birds listed as being present in Pande by the Tanzania Bird Atlas but were not recorded during the current survey.

The date of the last record is provided in the final column of the table.

5.4.2 Species abundance

The most frequently caught species was *Hypargos niveoguttatus* (n=37) which was caught at all sites. Other frequently caught species were *Camaroptera brevicauda* (n=17) and *Chlorocichla flaviventris* (n=13).

Table 16. Capture frequency of birds in Pande Game Reserve.

Common name	Scientific name	Capture frequency
Peter's Twinspot	<i>Hypargos niveoguttatus</i>	32
Green-backed Camaroptera	<i>Camaroptera brevicauda</i>	17
Yellow-billed Greenbul	<i>Chlorocichla flaviventris</i>	13
Terrestrial Brownbul	<i>Phyllastrephus terrestris</i>	11

Common name	Scientific name	Capture frequency
Eastern Nicator	<i>Nicator gularis</i>	8
Red-capped Robin chat	<i>Cossypha natalensis</i>	6
Tropical Boubou	<i>Laniarius aethiopicus</i>	6
Yellow-rumped Tinkerbird	<i>Pogoniulus bilineatus</i>	6
Eastern Olive Sunbird	<i>Nectarinia olivacea</i>	5
Dark-backed Weaver	<i>Ploceus bicolor</i>	4
Tiny Greenbul	<i>Phyllastrephus debilis</i>	4
Black-throated Wattle-eye	<i>Platysteira peltata</i>	4
Grosbeak Weaver	<i>Amblyospiza albifrons</i>	3
Fischer's Greenbul	<i>Phyllastrephus fischeri</i>	3
Garden Warbler	<i>Sylvia borin</i>	3
Tambourine dove	<i>Turtur tympanistria</i>	3
Collared Sunbird	<i>Anthreptes collaris</i>	2
Four-coloured Bush Shrike	<i>Cercotrichas quadrivirgata</i>	2
White-browed Coucal	<i>Centropus superciliosus</i>	2
European Swallow	<i>Hirundo rustica</i>	2
Yellow-streaked greenbul	<i>Phyllastrephus flavostriatus</i>	2
Uluguru Violet-backed Sunbird	<i>Anthreptes neglectus</i>	1
Rattling cisticola	<i>Cisticola chiniana</i>	1
Gabon nightjar	<i>Caprimulgus fossii</i>	1
Speckled mousebird	<i>Colius striatus</i>	1
Brown-hooded Kingfisher	<i>Halcyon albiventris</i>	1
Green-backed Twinspot	<i>Mandingoa nitidula</i>	1
Red-tailed Ant-thrush	<i>Neocossyphus rufus</i>	1
Village weaver	<i>Ploceus cucullatus</i>	1
African Broadbill	<i>Smithornis capensis</i>	1
African Paradise Flycatcher	<i>Terpsiphone viridis</i>	1

5.4.3 Endemics

Pande has 20% of bird species endemic to the East African Coastal Forest and 47% of coastal forest near-endemic bird species (i.e. found in the Coastal Forests and in some lowland Eastern Arc forests).

Table 17. Summary of the geographical ranges of bird species recorded in Pande.


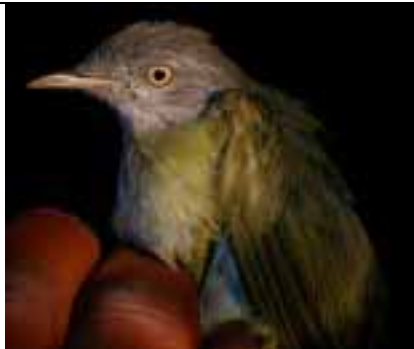




Endemic status	Number of species	% of total species
Endemic (E)	1	1
Near endemic (N)	7	5
Widespread (W)	134	94
Total	142	100

5.4.4 Ecological type

The majority of bird species in Pande are not forest dependent.

Table 18. Summary of the ecological types of bird species recorded in Pande.

Ecological type	Number of species	% of total species
Forest specialist (FF)	10	7
Forest generalist (F)	29	20
Not dependent on forests (O)	103	73
Total	142	100

 <p>Dark backed weaver</p>	 <p>Tiny greenbul</p>
 <p>Uluguru violet-backed sunbird</p>	 <p>Eastern nicator</p>
 <p>Eastern bearded scrub robin</p>	 <p>Peter's twinspot</p>

5.5 Discussion

5.5.1 Pande's coastal forest species

Pande Game Reserve contains 39 of the 85 forest dependent species in the Coastal Forests equivalent to 46% of the Coastal Forest bird species. This includes seven near-endemic and one endemic Coastal Forest species.

5.5.2 Bird species not re-recorded

Seventeen species previously recorded in Pande were not re-recorded during the current survey (Table 19). The Grey headed bush shrike was recorded in 2002 but other species have not been recorded for 10 years or more. The absence of these species may be in part due to seasonality and the relatively short survey time. Alternatively the damage to the reserve may be a factor behind the apparent absence of these species particularly for the two forest specialist and three forest generalist species that were not re-recorded.

Table 19. Bird species not re-recorded from Pande by the current survey.

Species	Ecological type
---------	-----------------

Lizard Buzzard	O
Crowned Eagle	FF
Bat Hawk	F
Button Quail	O
Pygmy Kingfisher	O
Golden-tailed Woodpecker	F
Little Spotted Woodpecker	O
Drongo	O
Black Cuckoo Shrike	O
Grey-backed Camaroptera	O
Zitting Cisticola	O
Crested Flycatcher	F
Grey-headed Bush Shrike	O
White Helmet Shrike	O
Plain-backed Sunbird	FF
Amethyst Sunbird	O
Purple-banded Sunbird	O

Despite the spread of the exotic Indian house crow in neighbouring Dar es Salaam, this bird was not observed within the reserve during the survey.

5.5.3 Coastal Forest near endemic and endemic species recorded in Pande

This section looks at some of the species with restricted ranges.

Southern banded snake eagle Circaetus fasciolatus

A characteristic coastal forest bird found in >50% of coastal forests (Mlingwa et al. 2000). It is also found in the lowland East Usambaras and inland along major river systems. This species is shy and only occasionally soars over forest areas. Normally hunts from a perch. Considered to be near-threatened (Hilton-Taylor 2000). Observed once during the TFCG survey of Pande.

Green Tinkerbird Pogoniulus simplex

A characteristic coastal forest bird found in >50% of coastal forests (Mlingwa et al. 2000). It is also found in the East Usambara Mountains up to 900 m a.s.l. It prefers undisturbed forest typically foraging in tangled undergrowth (Stevenson and Fanshawe 2002 and Zimmerman et al. 1996). Observed once during the TFCG survey of Pande.

Fischer's greenbul Phyllastrephus fischeri

A characteristic coastal forest bird found in >50% of coastal forests (Mlingwa et al. 2000). It is also found in the East Usambara Mountains up to 600 m a.s.l. Shy but vocal preferring to forage on the forest floor in low vegetation (Stevenson and Fanshawe 2002 and Zimmerman et al. 1996). Captured three times during the TFCG survey of Pande.

Tiny Greenbul Phyllastrephus debilis

A characteristic coastal forest bird found in >50% of coastal forests (Mlingwa et al. 2000). Its range extends inland to the Nguru and Usambara Mountains. Pairs and small flocks are local and uncommon in the undergrowth and mid-canopy of forest (Stevenson and Fanshawe 2002 and Zimmerman et al. 1996). Captured four times during the TFCG survey of Pande.

Little yellow flycatcher Erythrocerus holochlorus

One of five bird species endemic to the East African coastal forests. This species is found in <50% of coastal forests (Mlingwa et al. 2000). Pairs or small flocks are common in coastal forests north of the Rufiji preferring the mid- and upper canopy. Sometimes in mixed flocks. In Pande a pair of little yellow flycatchers had prepared a nest close to Camp Site 1.

Plain-backed Sunbird Anthreptes reichenowi

A characteristic coastal forest bird found in >50% of coastal forests (Mlingwa et al. (2000). It is also found in the East Usambara Mountains up to 1000 m a.s.l.). The distribution of the Plain-backed Sunbird is shown in Appendix 8. Pairs often accompany mixed species flocks or feed alone in the forest canopy. This species was last recorded in 1989 in Pande. Burgess (1990) notes that it was amongst the most common bird species and was observed 2 – 3 times per day during the Frontier-Tanzania survey in 1989. Although it is unlikely to have gone extinct in Pande there has certainly been a significant population decline probably linked to the removal of much of the forest canopy.

Uluguru violet-backed sunbird *Anthreptes neglectus*

A coastal forest bird found in <50% of coastal forests (Mlingwa et al. 2000). It is also found in the Usambara and Uluguru Mountains. Pairs or small groups forage in forest or forest edge trees (Stevenson and Fanshawe 2002 and Zimmerman et al. 1996). A single Uluguru violet-backed sunbird was recorded from the coastal thicket to the north of the reserve.

Chestnut-fronted Helmet Shrike *Prionops scopifrons*

A characteristic coastal forest bird found in >50% of coastal forests (Mlingwa et al. 2000). Also recorded inland from the Meru and Ngaia forests of Kenya up to 1230 m a.s.l. Often flocks with other birds, foraging in the forest canopy. This species was recorded once during the current survey. Burgess (1990) reports that during the Frontier-Tanzania survey in Pande in 1989, this species was recorded once every 2- 3 days. That it was only observed once in 10 days may reflect a decline in the population of this species.

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6) Amphibians and reptiles

By Charles Msuya

6.1 Introduction

Tanzania has a rich herpetofauna including over 130 species of amphibians and 275 species of reptiles. These species represent the majority of the endemic vertebrate taxa in the country. Poynton (2000) lists five amphibian species endemic to the Coastal Forests and Broadley and Howell (2000) list 24 endemic reptile species. Eastern Arc mountain forests and lowland forest patches in the coast zone of East Africa are among areas considered as 'biodiversity hotspots' for small vertebrates (Howell, 1993; Evans et al., 1992).

Since 1989 there has been widespread recognition within the scientific community of a decline in amphibian populations (Wayman, 1990; Wake, 1991; Drost and Fellers, 1996; Fisher, 1996; Hero and Gillespie, 1997; Gardner, 2001). This is associated with habitat loss and pollution. In the developing world, species that are forest dependent are facing problems associated with habitat loss due to clearing for cultivation and overexploitation of forest products and burning. In most of Africa, there is a lack of quantitative data, which can be used for monitoring of amphibian population declines.

Pande Game Reserve is one of the areas along the coast of Tanzania whose fauna is poorly documented when compared to its vegetation (Wingfield, 1977; Rodgers et al., 1985; Rulungaranga, 1990; Clarke and Dickinson, 1993). This study focuses on the amphibians and reptiles of this highly disturbed remaining patch of forest.

6.2 Methods

The data collection methods used to survey the amphibians and reptiles of Pande G.R. follow the standard methods proposed by Vogt and Hine (1977), Heyer *et al.* (1994), Blomberg & Shine (1996) and Halliday (1996). Survey methods included pitfall traps, sound recordings and general searches. Sampling was conducted in each of the key habitat types within the reserve. Surveys were conducted during the day and night.

The location of trapping sites were recorded with a Garmin 12 GPS. Identification of animals in the field was based on Stewart (1967), Schiötz (1999), Broadley and Howell (1991) and Spawls et al. (2002). Where there was uncertainty regarding identification, animals were photographed and released or were preserved in 70% alcohol as museum specimens for use at the University of Dar es Salaam.

6.2.1 Bucket pitfall traps and Drift fences

Twelve bucket pitfall lines with drift fences were placed in different habitat types. Each line consisted of 11 pitfalls placed at an interval of 5m on a line. Pitfall traps were made from large plastic buckets (30 cm diameter, 40 cm deep) buried in the ground, with the opening flush with the surface. The efficiency of the traps was improved by including a drift fence alongside the buckets, whereby a 60 cm wide translucent plastic sheet was held on the ground and upright with staples on wooden stakes (Fig 1). Drift fences intercept small vertebrates moving on the ground and redirect them into a pitfall traps. Traps were checked every morning for amphibians and evening for reptiles. Observation time was six days minimum per trap line. Data was recorded in a field notebook. Detailed record of catches per Bucket pitfall trap line and the catch rates are presented in Appendix 10.

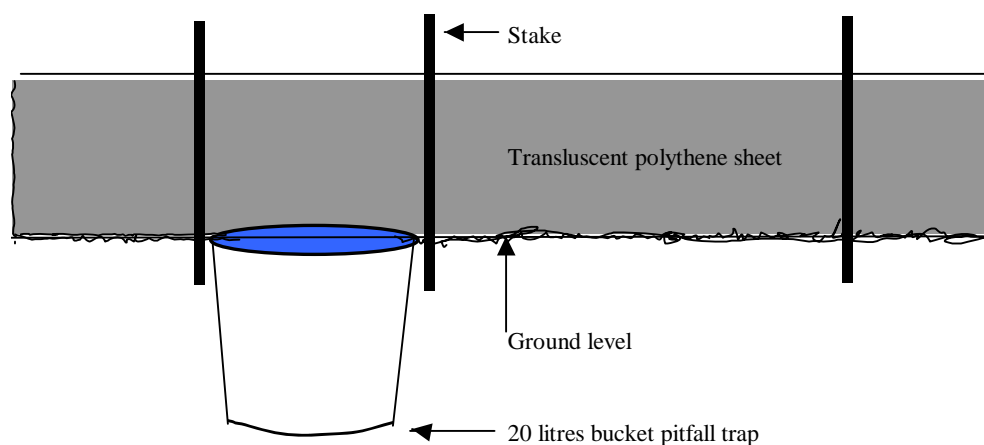


Figure 1. Basic design for bucket pitfall trap line with polythene sheeting drift fence

6.2.2 Time-constrained searching

Pitfall traps are extremely useful in obtaining information about movements of ground dwelling amphibians and reptiles; they capture some species more easily than others. Amphibians that are strong jumpers or climbers (*Ptychoadena* or *Hyperolius*) and large snakes are more difficult to trap. The opportunistic and time-constrained searching method was applied to cover this gap. Timed constrained and general searching was conducted during the day and night hours, involving driving on forest tracks and on-foot searching in different habitats by following service and boundary roads. The searching exercise involved four observers at a time walking through the forest and other habitats in search of herptiles. The time spent per habitat depended on the judgement of the investigators (when all of the available micro-habitats had been adequately searched or when no new species were likely to be found). Secretive species were sought in their refuges under stones, bark or fallen logs and in leaf litter. Night searches were carried out with the aid of headlamps and flashlights.

6.2.3 Audio recordings

A Marantz professional tape recorder with a directional microphone was used to detect and record the calls of amphibians in the habitats between 6.30pm and 10.00pm. Species of amphibians were identified in the field based on the onsite calls and playing back recorded calls. A rough estimate of the number of calling males at the pond was made.

6.3 Survey effort

6.3.1 Bucket pitfall sampling effort

Twelve bucket pitfall lines were laid out at different sites within the reserve. Each line was in place for 6 – 7 nights with a total of 777 bucket pitfall nights. 342 amphibians and 23 reptiles were trapped in the bucket pitfalls.

6.3.2 General searching sampling effort

During systematic searches, about 60 man-hours searching effort was spent during the day and 10 man-hours during the night. A total of 571 amphibians and 65 reptiles were recorded in this way (Table 20).

Table 20. Number of Amphibians and Reptiles recorded in Pande Game Reserve based on 70 man-hours Timed-constrained and general searches.

Species	Habitats	Animals
Amphibians:		
<i>Xenopus muelleri</i> (Muller's Clawed Frog)	Water pool near main gate	6
<i>Bufo gutturalis</i> (Guttural Toad)	Wooded grassland	2
<i>Mertensophryne micranotis</i> (Earless Toad)	Forest edge	4
<i>Phrynobatrachus acridoides</i> (East African Puddle Frog)	Around water pools.	87
<i>P. mababiensis</i> (Common Puddle Frog)	Around water pools.	150
<i>Hylarana galamensis</i> (Golden-backed Frog)	Water pool near main gate	3
<i>Ptychadena anchietae</i> (Savanna Ridged Frog)	Around water pools.	128
<i>P. mossambica</i> (Mozambique Ridged Frog)	Around water pools.	13
<i>P. oxyrhynchus</i> (Sharp-nosed Ridged Frog)	Around water pools.	5
<i>Chiromantis xerampelina</i> (Grey Foam-nest Frog)	Water pool near main gate	1
<i>Phrynomantis bifasciatus</i> (Red-banded Frog)	Forest	1
<i>Hyperolius argus</i> (Argus Reed Frog)	Water pool near main gate	10
<i>H. parkeri</i> (Parker's Reed Frog)	Water pool near main gate	3
<i>H. mitchelli</i> (Mitchell's Reed Frog)	Water pool near main gate	12
<i>H. tuberilinguis</i> (Tinker Reed Frog)	Water pool near main gate	60
<i>H. viridiflavus mariae</i>	Water pool near main gate	23
<i>Afrixalus brachycnemis</i> (Short-legged Banana Frog)	Water pool near main gate	1
<i>A. fornasinii</i> (Fornasini's Leaf-folding Frog)	Water pool near main gate	2
<i>Kassina maculata</i> (Red -legged Kassina)	Water pool near main gate	60
Reptiles		
<i>Hemidactylus mabouia</i> (Tropical House Gecko)	Wooded Grassland, Forest	3
<i>Lygodactylus luteopicturatus</i> (Yellow-headed Dwarf Gecko)	Wooded Grassland, Forest	5
<i>Lygodactylus capensis</i> (Cape Dwarf Gecko)	Wooded Grassland, Forest	10
<i>Lygosoma afrum</i> (Peter's Writhing Skink)	Forest	1
<i>Mabuya maculilabris</i> (Speckle-lipped Skink)	Forest	2
<i>Mabuya striata</i> (Striped Skink)	Wooded Grassland, Forest edge	2
<i>Mabuya varia</i> (Variable Skink)	Wooded Grassland	19
<i>Panaspis wahlbergii</i> (Wahlberg's Snake-eyed Skink)	Wooded grassland, Forest	5
<i>Cordaylus tropidosternum</i> (Tropical Girdled Lizard)	Forest	1
<i>Gerrhosaurus flavigularis</i> (Yellow-throated Plated Lizard)	Wooded Grassland, Forest edge	2
<i>Agama mossambica</i> (Mozambique Agama)	Wooded Grassland, Forest	2
<i>Chamaeleo dilepis</i> (Flap-necked Chameleon)	Forest, Forest edge	3
<i>Varanus niloticus</i> (Nile Monitor)	Water pool near main gate	1
<i>Typhlops</i> sp (Blind Snake)	Forest	1
<i>Python natalensis</i> (African Rock Python)	Water pool near main gate	1
<i>Philothamnus hoplogaster</i> ?(Green Snake)	Wooded Grassland	1
<i>Thelotornis capensis</i> (Twig Snake)	Water pool near gate, Forest	2
<i>Psammophis mossambicus</i> (Mossambique Sand Snake)	Wooded Grassland	1
<i>Naja melanoleuca</i> (Forest Cobra)	Forest	1
<i>Dendroaspis angusticeps</i> (Green Mamba)	Forest edge	1
<i>Causus defilippii</i> (Snouted Night Adder)?	Forest	1

6.4 Results

6.4.1 Species richness

The survey recorded 23 amphibian species from eight families and 25 reptile species from 10 families. A complete list of amphibians and reptiles recorded during the survey is presented in Tables 21 and 22 respectively. This includes a comparison with more general lists of the coastal forest herpetofauna for areas close to Pande for comparative purposes. Note that the animals listed in tables 21 and 22 do not fall under the IUCN threatened species (Hilton-Taylor, 2000).

Table 21. Common species of amphibians occurring in Dar es Salaam area and coastal forests north of the Rufiji River and species recorded in Pande Game Reserve.

Species	Coastal	Most recent record from Pande G.R	Endemic status
PIPIDAE			
<i>Xenopus muelleri</i> (Muller's Clawed Frog)	x	2003	W
BUFONIDAE			
<i>Bufo gutturalis</i> (Guttural Toad)	x	2003	W
<i>Bufo lindneri</i> (Lindner's Toad)	x	-	N
<i>Mertensophryne micranotis</i>	x	2003	E
<i>Stephopaedes arnotis</i>	x	-	E
HEMISIDAE			
<i>Hemisis marmoratum</i> (Mottled Shovel-snouted Frog)	x	2003	W
RANIDAE			
<i>Phrynobatrachus acridoides</i> (E. A.Puddle Frog)	x	2003	W
<i>P. mababiensis</i> (Common Puddle Frog)	x	2003	W
<i>P. natalensis</i> (Snoring Puddle Frog)	x	-	W
<i>Hildebrandtia ornata</i> (Ornate Burrowing Frog)	x	-	W
<i>Hylarana galamensis</i> (Golden-backed Frog)	x	2003	W
<i>Ptychadena anchietae</i> (Savanna Ridged Frog)	x	2003	W
<i>P. mossambica</i> (Mozambique Ridged Frog)	x	2003	W
<i>P. oxyrhynchus</i> (Sharp-nosed Ridged Frog)	x	2003	W
<i>P. mascareniensis</i> (Mascarene Frog)	x	-	W
<i>Pyxicephalus edulis</i> (African Bull Frog)	x	-	N
RHACOPHORIDAE			
<i>Chiromantis xerampelina</i> (Foam-nest Tree Frog)	x	2003	W
MICROHYLIDAE			
<i>Phrynomantis bifasciatus</i> (Red-banded Frog)	x	2003	W
<i>Breviceps mossambicus</i>	x	-	N
ARTHROLEPTIDAE			
<i>Arthroleptis stenodactylus</i> (Common Squeaker)	x	2003	W
<i>Schoutedenella xenodactyloides</i> (Dwarf Squeaker)	x	2003	N
HYPEROLIIDAE			
<i>Hyperolius argus</i> (Argus Reed Frog)	x	2003	W
<i>H. nasutus</i> (Sharp-nosed Reed Frog)	x	-	W
<i>H. pusilus</i> (water Lily Frog)	x	-	W
<i>H. parkeri</i> (Parker's Reed Frog)	x	2003	N
<i>H. mitchelli</i> (Mitchell's Reed Frog)	x	2003	W
<i>H. tuberilinguis</i> (Tinker Reed Frog)	x	2003	W
<i>H. viridiflavus mariae</i>	x	2003	N

Species	Coastal	Most recent record from Pande G.R	Endemic status
<i>Afrivalus brachycnemis</i> (Short-legged Banana Frog)	x	2003	W
<i>A. fornasinii</i> (Fornasini's Leaf-folding Frog)	x	2003	W
<i>Kassina maculata</i> (Red -legged Kassina)	x	2003	W
<i>K. senegalensis</i> (Bubbling Kassina)	x	2003	W
<i>Leptopelis argenteus</i> (Savannah Tree Frog)	x	-	W
<i>L. flavomaculatus</i> (Yellow-spotted Tree Frog)	x	-	N

Key to Tables 21 and 22

Endemic status

W – widespread

E – endemic to East African Coastal Forests

N – range restricted to the East African coastal zone but not restricted to forest. Range may also extended into neighbouring mountains e.g. Eastern Arc and Malawi.

Table 22. Common species of reptiles known from Dar es Salaam and Kibaha area, Tanzania coastal forests north of the Rufiji River and species recorded in Pande Game Reserve during the survey. (Based on Anfinsen, 1966; Spawls et al., 2002; Broadley and Howell, 2000).

Species	Coastal	Most recent record from Pande G.R	Endemic status
TESTIDUNIDAE			
<i>Geochelone pardalis</i> (Leopard Tortoise)	X	-	W
GEKKONIDAE			
<i>Lygodactylus broadleyi</i> (Broadley's Dwarf Gecko)	X	-	W
<i>L. capensis</i> (Cape Dwarf Gecko)	x	2003	W
<i>L. conradti</i> (Conradt's Dwarf Gecko)	x	-	E
<i>L. kimhowelli</i> (Kim Howell's Dwarf Gecko)	x	-	E
<i>L. uluguruensis</i> (Uluguru Dwarf Gecko)	x	-	N
<i>L. viscatus</i> (Copal Dwarf Gecko)	x	-	E
<i>Cnemaspis barbouri</i> (Uluguru Forest Gecko)	x	-	N
<i>Hemidactylus mabouia</i> (tropical House Gecko)	x	2003	W
<i>H. platycephalus</i> (Tree gecko)	x	-	W
<i>Phelsuma dubia</i> (Dull-green Gecko)	x	-	W
AGAMIDAE			
<i>Agama mossambica</i> (Mozambique Agama)	x	2003	W
CHAMAELEONIDAE			
<i>Chamaeleo dilepis</i> (Flap-necked Chameleon)	x	2003	W
<i>C. melleri</i> (Giant One-horned Chameleon)	x	1989	W
<i>Rhampholeon brevicaudatus</i> (Bearded Pygmy Chameleon)	x	-	N
SCINCIDAE			
<i>Mabuya maculilabris</i> (Speckle-lipped Skink)	x	2003	W
<i>M. striata</i> (Striped Skink)	x	2003	W
<i>M. varia</i> (variable Skink)	x	2003	W
<i>Lygosoma afrum</i> (Peter's Writhing Skink)	x	2003	W
<i>Panaspis wahlbergii</i> (Wahlberg's Snake-eyed Skink)	x	2003	W
LACERTIDAE			
<i>Holaspis guentheri</i> (Blue-tailed Gliding Lizard)	x	-	N

Species	Coastal	Most recent record from Pande G.R	Endemic status
<i>Gastropholis prasina</i> (Green Keel-bellied Lizard)	x	-	E
<i>G. vittata</i> (Striped Keel-bellied Lizard)	x	-	E
CORDYLIDAE			
<i>Corrdaylus tropidosternum</i> (Tropical Girdled Lizard)	x	2003	W
Gerrhosauridae			
<i>Gerrhosaurus flavigularis</i> (Yellow-throated Plated Lizard)	x	2003	W
<i>Gerrhosaurus major</i> (Great Plated Lizard)	x	2003	W
VARANIDAE			
<i>Varanus albigularis</i> (White-throated Savanna Monitor)	x	-	W
<i>V. niloticus</i> (Nile Monitor)	x	2003	W
TYPHILOPIDAE			
<i>Typhlops</i> sp (Blind Snake)	-	2003	
<i>Typhlops lineolatus</i> (Lineolate Blind Snake)	x	-	W
LEPTOTYPHLOPIDAE			
<i>Leptotyphlops macrops</i> (Large-eyed Worm Snake)	x	2003	E
<i>Leptotyphlops scutifrons</i> (Peter's Worm Snake)	x	2003	W
BOIDAE			
<i>Python natalensis</i> (Southern African Rock Python)	x	2003	W
VIPERIDAE			
<i>Bitis arietans</i> (Puff Adder)	x	-	W
<i>B. gabonica</i> (Gaboon Viper)	x	-	W
<i>Casus defilippii</i> (Snouted night Adder)	x	2003	W
<i>Atractaspis bibronii</i> (Bibron's Burrowing Asp)	x	-	W
ELAPIDAE			
<i>Naja melanoleuca</i> (Forest Cobra)	x	2003	W
<i>N. nigricolis</i> (Black-necked Spitting Cobra)	x	-	W
<i>Dendroaspis angusticeps</i> (Green Mamba)	x	2003	W
<i>D. polylepis</i> (Black Mamba)	x	-	W
COLUBRIDAE			
<i>Aparilactus capensis</i> (Cape Centipede-eater)	x	-	
<i>Psammophis angolensis</i> (Dwarf Sand Snake)	x	-	W
<i>P. mossambicus</i> (Olive Sand Snake)	x	2003	W
<i>P. sudanensis</i> (Northern Stripe-bellied Sand Snake)	x	-	W
<i>Lamprophis fuliginosus</i> (Brown House Snake)	x	-	W
<i>Dasypeltis medici</i> (Rufous Egg Eater)	x	-	W
<i>Amblyodipsas unicolor</i> (Western Purple-glossed Snake)	x	-	W
<i>Hemirhagerrhis nototaenia</i> (Bark Snake)	x	-	W
<i>Dipsadoboa flavida</i> (Cross-barred Tree Snake)	x	-	W
<i>Natriciteris olivaceae</i> (Olive Marsh Snake)	x	-	W
<i>Prosymna semifasciata</i> (Banded Shovel-Snout)	x	-	E
<i>P. stuhlmanii</i> (east African Shovel-Snout)	x	-	W
<i>Philothamnus macrops</i> (Usambara Green-snake)	x	-	E
<i>P. heterolepidotus</i> (Slender Green-snake)	x	-	W
<i>P. hoplogaster</i> (South-eastern Green-snake)	x	-	W
<i>P. semivariatus</i> (Spotted Wood Snake)	x	2003	W
<i>Mehelya capensis</i> (Cape File-snake)	x	-	
<i>Lycophidion capense</i> (Cape Wolf Snake)	x	-	W

Species	Coastal	Most recent record from Pande G.R	Endemic status
<i>Dispholidus typus</i> (Boomslang)	x	-	W
<i>Thelotornis capensis</i> (Savanna Vine Snake)	x	2003	W
<i>Crotaphopeltis hotamboeia</i> (White-lipped Snake)	x	2003	W
<i>Dasypeltis scabra</i> (Common Egg-eater)	x	-	W
<i>Rhamphiophis rostratus</i> (Rufous Beaked Snake)	x	2003	W
<i>Telescopus semiannulatus</i> (Tiger Snake)	x	-	W

6.4.2 Species abundance

The most frequently recorded species of amphibian were *Phrynobatrachus mababiensis* (n=150), *Ptychadena anchietae* (n = 128) and *Phrynobatrachus acridoides* (n = 87). Most of these animals were caught around the pond in the north-east of the reserve. Also common in this area were *Hyperolius tuberilinguis* (n = 60) and *Kassina maculata* (n = 60). The least frequently recorded species were *Chiromantis xerampelina*, *Phrynomantis bifasciatus* and *Afrivalus brachycnemis* (all n = 1).

The reptile species that were recorded most frequently were the skink *Mabuya varia* (n = 19) and the gecko *Lygodactylus capensis* (n = 10). *Lygodactylus luteopicturatus* (n = 5) and *Panaspis wahlbergii* (n = 5) also appear to be common. Ten reptile species were recorded only once.

The survey was conducted under generally dry conditions when the amphibians and reptiles were less active than would have been the case in the rainy season. As a result few amphibians were calling. Within the reserve boundaries, most amphibians and reptiles were found in areas near dried water pools and around the only semi-permanent water pool located at S. 06° 41.186', E. 39° 04.844' (about 300m west of Pande G.R. main gate).

6.4.3 Endemics

Pande has 20% of the amphibian species endemic to the Coastal Forests and 4% of the endemic reptile species.

Table 23. Summary of the geographical ranges of amphibian and reptile species recorded in Pande.

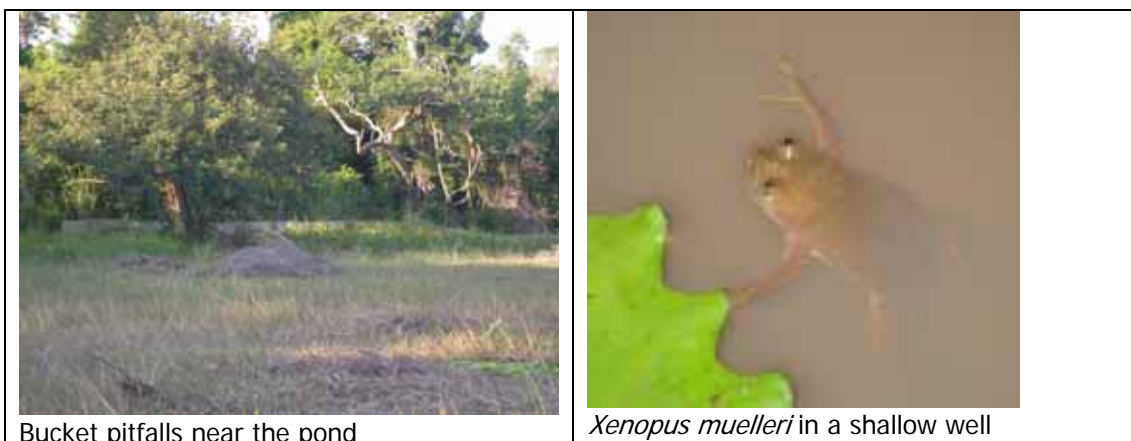
Taxon	Total no. of species	No. of coastal forest endemics	No. of coastal forest near endemics
Reptiles	25	1	0
Amphibians	23	1	3
TOTAL	48	2	3



Mertensophryne micranotis is endemic to the Eastern African coastal forests.



Lygodactylus luteopicturatus is one of the most abundant reptiles in Pande.



6.5 Discussion

6.5.1 Species diversity

Amphibians and reptiles in Pande G.R. were relatively less active under dry environmental conditions. Data collected for the amphibians during the survey is incomplete, making the interpretation of the results more difficult. For example, even the most common species known from the area (*Bufo lindneri*, *Dasyplettis scabra* and *Bitis arietans*) (Personal obs.) were not recorded (Tables 2 and 3).

Amphibians and reptiles occurring along the coast of East Africa have their annual activities influenced by the two wet seasons and the spells of dry seasons in between. During the long rains (between March and May) tree frogs and opportunistic breeding species breed. During the short rains (between October and December) all species breed although the success depends on the rainfall pattern (Msuya, 2001). The wet seasons along the coast of East Africa can be associated with high abundance and diversity of arthropods that serve as food for both amphibians and other vertebrates (Mlingwa, 1997). Amphibians tend to be more active in the early rains when they come out to feed, breeding then follows. Juveniles disperse from breeding sites to the surrounding areas in early rains and towards the end of the wet seasons. Reptiles are also more active during this period as they respond to the abundance of their food (frogs, small mammals and arthropods).

It is here recommended that more surveys need to be carried out during the two wet seasons so that a complete checklist and species diversity of the herpetofauna of Pande Game Reserve can be completed.

6.5.2 Effects of habitat disturbance

During this study it was evident that much of Pande Game Reserve forest habitat had been highly disturbed and big trees had been removed in the recent past and what is remaining is secondary growth with patches of open grassland. Almost all the big and small trees were cut down for charcoal burning and building poles. Such practices cause edge effects in forested areas (Murcia, 1995) and allow fires from outside to reach the forest. The impact of habitat disturbance in Pande Game Reserve is the loss of forest habitat and biological diversity, which is hard to measure. Generally, the number of animals caught in the Bucket pitfalls (Appendix 1) was relatively low even after some spells of rain in the reserve. Burning of leaf litter and dead tree holes or crevices, which serve as homes and breeding sites for some amphibians, reptiles and small mammals in the forest can affect their behavior, breeding success and distribution.

During the study period, there was no incidence of fire but due to the dry condition, both the amphibians and reptiles were either aestivating in burrows or were concentrated in moist areas near temporary pools and in grass vegetation surrounding forest areas. Common wetland or near wetland amphibian species (e.g. *Phrynobatrachus* spp, *Kassina maculata* and

K. senegalensis were recorded calling or caught in traps in the forest, suggesting that their preferred habitats were not suitable during the dry season. Forest dependent species were only three (*Mertensophryne micranotis* and *Schoutedenella xenodactyloides*, amphibians which breed in small water bodies trapped in tree holes or snail shells and moist leaf litter on the forest floor respectively) and *Cordylus tropidosternum*, a reptile which live and breed in the cracks and holes of trees). This emphasizes the need to protect the remaining patches of forest and vegetation in the surroundings of the water pools in Pande G.R. for the survival of different animal groups within the reserve and its surroundings.

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7) Butterflies

By Theron Morgan-Brown and Nike Doggart

7.1 Introduction

Butterflies (Lepidoptera) are the most thoroughly documented invertebrate taxa for the East African Coastal Forests (and probably for the world). A number of useful guides to butterflies of the region exist including Larsen (1991) and Kielland (1990).

Butterfly assemblages of the East African Mountain Forests and Coastal Forests are generally distinct from the Central African assemblages and are separated by extensive areas of drier vegetation. Kielland and Cordeiro (2000) estimate that there are approximately 400 butterfly species in the coastal forests of Eastern Africa. Amongst these there are 75 taxa endemic to the East African Coastal Forests although most of these are sub-species.

In the vicinity of Pande, collections have been made in the Pugu Hills (Grant 1984, Kielland 1990, N.J. Cordeiro (unpublished data) and Frontier Tanzania (unpublished data for Kazimzumbwi)) where 241 species have been recorded (Kielland and Cordeiro 2000). Frontier-Tanzania included butterflies in their survey of Pande in 1989 when they recorded 27 species.

7.2 Methods

7.2.1 Sweep netting

Butterflies were caught using a sweep net. They were placed in envelopes for a short time while being identified. Butterflies were then released. Where there was uncertainty the butterfly was photographed using a digital camera. Identifications were made using Larsen (1991) and Kielland (1990) as references.

7.3 Survey effort

The butterfly specialist visited the survey team for two days between 14th and 17th February.

Survey efforts were concentrated around Camp site 1 and Camp site 2. Butterfly netting was carried out for 12 hours by Theron Morgan-Brown.

7.4 Results

7.4.1 Butterfly species recorded in Pande Game Reserve

A total of 56 species from five families were recorded during the survey (Table 24).

Table 24. Annotated list of butterfly species recorded in Pande Game Reserve.

Genus	Ecological type	Endemic status
HESPERIIDAE – Skippers		
<i>Coeliades anchises</i>	O	W
<i>Coeliades forestan</i>	O	W
LYCAENIDAE – Blues and coppers		
<i>Hemiolaus caeculus littoralis</i>	O	N*
<i>Iolaus pallene</i>	O	W
<i>Ypthima impura?</i>	O	W
NYMPHALIDAE – Commodores		
<i>Acraea acrita</i>	O	W
<i>Acraea aganice</i>	F	W
<i>Acraea natalica</i>	O	W

Genus	Ecological type	Endemic status
<i>Acraea zonata</i>	F	E
<i>Aterica galene</i>	F	W
<i>Bebearia chriemhilda</i>	FF	E
<i>Bicyclus safitza</i>	O	W
<i>Byblia ilithya</i>	O	W
<i>Charaxes etesipe</i>	F	W
<i>Charaxes varanes</i>	F	W
<i>Charaxes violetta maritimus</i>	FF	E*
<i>Charaxes zoolina</i>	O	W
<i>Danaus chrysippus</i>	O	W
<i>Euphaedra neophron littoralis</i>	O	N*
<i>Euphaedra orientalis</i>	FF	E
<i>Eurytela dryope</i>	F	W
<i>Euxanthe wakefieldi</i>	FF	W
<i>Hamanumida daedalus</i>	O	W
<i>Hypolimnias anhedon</i>	F	W
<i>Hypolimnias deceptor</i>	F	W
<i>Hypolimnias missipus</i>	F	W
<i>Junonia natalica</i>	F	W
<i>Junonia oenone</i>	O	W
<i>Neptis carcassoni</i>	FF	W
<i>Phalanta phalantha</i>	O	W
<i>Physcaeneura pione</i>	O	W
<i>Pseudacraea boisduvali</i>	F	W
<i>Pseudacraea lucretia</i>	F	W
<i>Salamis anacardii</i>	O	W
<i>Tirumala petiverana</i>	F	W
PAPILIONIDAE – Swallowtails		
<i>Graphium angolanus</i>	O	W
<i>Graphium antheus</i>	O	W
<i>Graphium colonna</i>	F	W
<i>Graphium p. philonoe</i>	F	N*
<i>Papilio constantinus</i>	F	W
<i>Papilio dardanus</i>	F	W
<i>Papilio demodocus</i>	O	W
<i>Papilio nireus</i>	O	W
<i>Papilio ophidicephalus</i>	F	W
PIERIDAE – Whites		
<i>Appias lasti</i>	O	W
<i>Belenois aurota</i>	O	W
<i>Belenois creona</i>	O	W
<i>Belenois thysa</i>	O	W
<i>Catopsilia florella</i>	F	W
<i>Colotis auxo</i>	O	W
<i>Colotis euipe</i>	O	W
<i>Colotis ione</i>	O	W
<i>Eronia cleodora</i>	F	W
<i>Eurema floricola</i>	FF	W
<i>Nepheronia buqueti</i>	O	W

Key to Table 24

Ecological type

- FF – Forest dependent species: species confined to undisturbed forest
 F – Forest dwelling but not forest dependent species: Species occurring in primary forest, forest edge or secondary forest.
 O – Non-forest species: Species that do not occur in primary or secondary forest or forest edge.

Endemic (End.) status:

- E – Endemic: Species with ranges restricted to the East African Coastal Forests.
 N – Near endemic: Species with ranges limited to the Swahilian Regional Centre of endemism (including coastal forests).
 W – Widely distributed species.
 * – Endemic status refers to sub-species only.

An additional eight species were recorded by Frontier in 1989 from Pande including *Colotis regina*, *C. evenina*, *Eurema hecabe*, *Nepheronia angia*, *Bematistes epaea*, *Cyrestis camillus*, *Neptis trigonophora* and *Salamis parhassus* (Burgess, 1990).

7.4.2 Endemic status

Based on the TFCG survey Pande has 5% of the butterfly taxa endemic to the East African Coastal Forest.

Table 25. Summary of the geographical ranges of butterfly species recorded in Pande.

Endemic status	Number of species	% of total species
Endemic (E)	4	7
Near endemic (N)	3	5
Widespread (W)	49	88
Total	56	100

5.4.4 Ecological type

The majority of butterfly species in Pande are not forest dependent.

Table 26. Summary of the ecological types of butterfly species recorded in Pande.

Ecological type	Number of species	% of total species
Forest specialist (FF)	6	11
Forest generalist (F)	20	36
Not dependent on forests (O)	30	53
Total	56	100

7.5 Discussion

7.5.1 Species richness

The species richness is low relative to other coastal forests e.g. Kazimzumbwi (Kielland and Cordeiro 2000). This is due to the survey effort which was minimal and additional species were still being recorded at the end of the survey. This is therefore an incomplete record that mainly reflects the most common species from the reserve. In particular the fast flying Charaxinae are poorly represented as these are best sampled using butterfly traps which were not used during this survey. Additional survey time is necessary in order to obtain a more comprehensive inventory of the butterflies of Pande.

7.5.2 Endemism

Other species endemic to the Eastern African coastal forests which are found in the nearby Pugu Forest and which more intensive surveys might reveal from Pande include e.g. *Gorgyra subflavidus*, *Spialia confusa obscura*, *Graphium polistratus*, *Acraea c. cuva*, *Acraea egaea epitellus*, *Euptera*

kinugnana, *Neptis rogersi*, *Neptidopsis fulgurata platyptera*, *Charaxes c. contrarius*, *Charaxes l. lasti*, *Euxanthe t. tiberius*, *Hypolimnas usambarae*, *Axiocerces punicea*, *Axiocerces styx*, *Baliochila dubiosa*, *Baliochila latimarginata*, *Eresinopsides b. bichroma*, *Iolus s. silanus*, *Pentila rogersi parapetreia*, *Teriomima puella* and *Teriomima subpunctata*.

7.5.3 Ecological type

Most of the butterfly fauna recorded during this survey of Pande are widespread species and include a number of species not normally associated with forest.

7.6 References

- Kielland, N. and N.J. Cordeiro, 2000 Butterflies. In Burgess, N.D. and G.P. Clarke 2000 Coastal Forests of Eastern Africa pp 225 - 233
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8) Management Recommendations

The reserve is part of the Eastern Arc / Coastal Forest biodiversity hotspot. These forests have been recognised to be of global importance due to the high levels of faunal and floristic endemism. As such, **management activities should be geared towards the conservation and restoration of coastal forest** and particularly to maintenance of those species endemic to the hotspot. The animal species endemic to the hotspot and requiring particular management attention are listed in Table 27.

Table 27. Coastal forest endemic animal species found in Pande Game Reserve.

Scientific name	Common name
<i>Galagoides rondoensis</i>	Rondo lesser galago
<i>Erythrocercus cyanomelas</i>	Little yellow flycatcher
<i>Mertensophryne micranotis</i>	Amphibian without common name
<i>Leptotyphlops macrops</i>	Large-eyed worm snake
<i>Acraea zonata</i>	Butterfly species without common names
<i>Bebearia chriemhilda</i>	Butterfly species without common names
<i>Charaxes violetta maritimus</i>	Butterfly species without common names
<i>Euphaedra orientalis</i>	Butterfly species without common names

Restricted range species and those species dependent on forest habitat are the most vulnerable e.g. *Galagoides rondoensis*. Conserving the remaining areas of forest within the reserve is a priority. Particular attention should be paid to the protection of those species listed as threatened by the IUCN and to the plant taxa endemic to the reserve.

Table 28. Animal species from Pande Game Reserve listed as threatened by IUCN.

Scientific name	Common name	Status
<i>Galagoides rondoensis</i>	Rondo lesser galago	Endangered
<i>Rhynchocyon petersi</i>	Black and rufous elephant shrew	Endangered
<i>Myonycteris relicta</i>	E. African collared fruit bat	Vulnerable
<i>Galagoides zanzibaricus</i>	Zanzibar galago	Near-threatened
<i>Beamys hindei</i>	Lesser pouched rat	Near-threatened
<i>Scotophilus nigrita</i>	Yellow house bat	Near-threatened
<i>Circaetus fasciolatus</i>	Southern banded snake eagle	Near-threatened

The management recommendations included in this report deal specifically with activities relating directly to biodiversity conservation. Complementary research into issues such as land tenure, the socio-political context of the reserve, the state of the local economy and the resource needs of local communities are also necessary. These recommendations are intended to feed into further discussions as part of a management planning process.

1) Fire management

Mature coastal forest is not fire tolerant. The removal of most of the large trees from the reserve has made the area particularly vulnerable to fire. Fire should be prevented within the reserve. To prevent fires from outside of the reserve spreading into the reserve, the reserve boundary needs to be cleared regularly. There is also a need for awareness raising amongst farmers with shambas close to the reserve on appropriate agricultural practices. Similarly a strategy for fighting fires should they occur, needs to be further developed in collaboration with the communities. **Preventing further fires from damaging the remaining coastal forest should be a priority.**

2) Timber and pole cutting

The reserve can not tolerate any further harvesting of timber or poles until such time as the forest has been allowed to regenerate. Regular patrols and consistent implementation of the law are necessary to prevent this.

3) Grass collection

Harvesting grass for fodder is linked with some of the fires in the reserve. Regular patrols and consistent implementation of the law are necessary to prevent this.

4) Boundary marking

The boundary should be regularly cleaned. The process of planting trees around the boundary should be completed.

4) Environmental awareness

There needs to be a sustained effort to raise awareness about the reserve amongst people in the surrounding villages and more widely amongst people from Dar es Salaam and in the Kinondoni Municipality. Awareness raising should highlight the importance of the area as well as explaining the management objectives of the reserve. Interest in the biodiversity of the reserve should be encouraged through interpretation materials etc. The reserve could also be used for environmental education field visits from school children from Dar es Salaam.

5) Enrichment planting

Tree planting should be encouraged in the areas that have been most severely affected by fire (see Map 3). Species should be of local origin, preferably from seeds or wildlings from within the reserve. Species which are naturally pioneer species are likely to fare best. Tree planting should be conducted with the communities as this may foster a greater sense of stewardship for the reserve. Further research is needed to identify the optimal species for enrichment planting.

6) Community participation

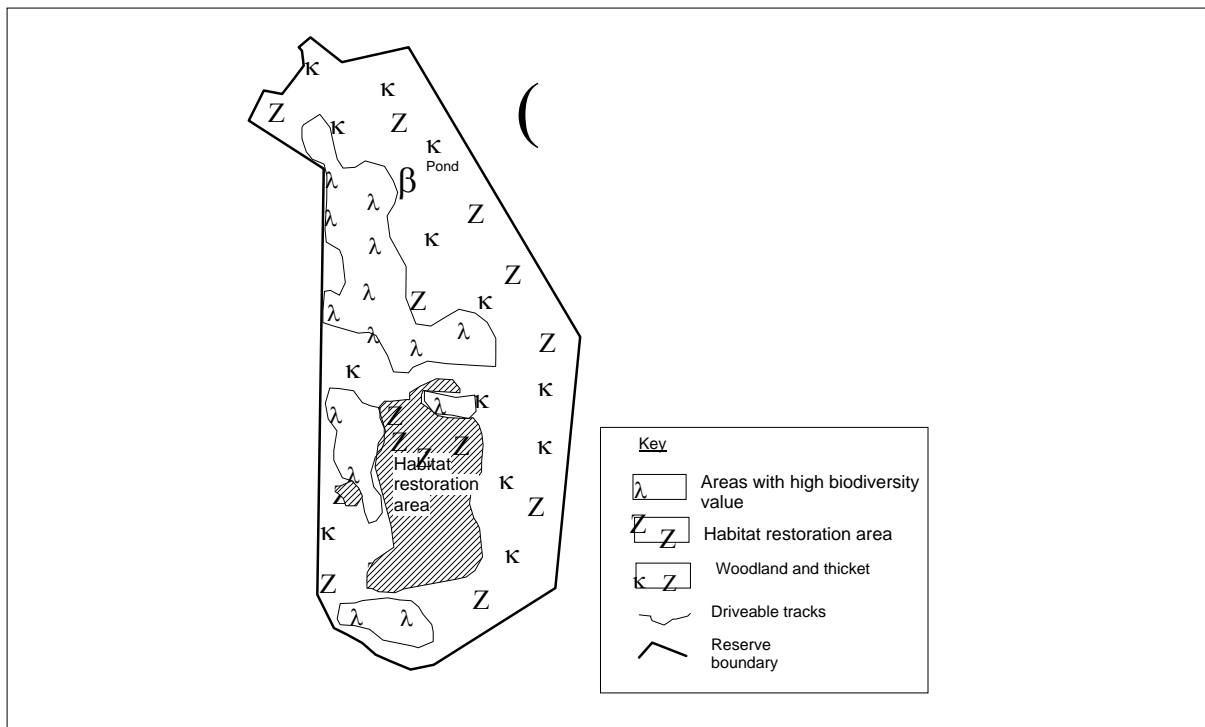
Where possible communities should be involved in activities related to the management of the reserve e.g. boundary clearing, joint patrols.

7) Tourism

As Dar es Salaam city expands there would seem to be considerable amenity value in Pande GR. The proximity to the city combined with the relatively wild landscape with good views would be a potential attraction for recreational visitors especially given the paucity of easy to reach 'wild areas' and parkland around Dar es Salaam. Management plans should incorporate imaginative plans to encourage ecotourism and visits to the reserve to boost revenues as well as environmental awareness.

There have been a number of suggestions to create a 'zoo' in Pande. Such plans should be treated cautiously. If species are to be introduced they should be species that would occur naturally in East African coastal forest. Species dependent on large areas of grassland should not be encouraged in order to be able to freely encourage forest regeneration.

Map 4. Map of Pande showing the location of areas requiring different management approaches.



8) Sensitive sites

- a) The areas of habitat highlighted in Map 3 as being of high biodiversity value, require particular protection from fire and other disturbance. If damaging activities can be prevented in these areas of the reserve, they may provide the source populations of forest species necessary for the regeneration of the forest in other parts of the reserve.
- b) The semi-permanent water pool near the northern gate provides important habitat for amphibians that breed and spend most of their life in water. It is also the principle watering hold for other animals. This site should not be disturbed. Another step that could be taken to enhance amphibian habitats would be to create more pools at selected and suitable locations within the reserve.
- c) The population of the coastal forest endemic toad *Mertensophryne micranotis* which breed in tree holes or water collected in shells is endangered due to unavailability of such microhabitats. Introducing some artificial breeding microhabitats such as broken porcelain pots, snail shells and other objects that will allow water to collect and thereby create additional microhabitats for this species.
- c) The remaining large trees should be stringently protected both as a source of seeds for forest regeneration and as providing nesting sites for many species of bird and mammals including the endangered *Galagoides orinus*.

9) Road

The main road which links the Morogoro and Bagamoyo roads cuts through the reserve. This poses a threat to animals crossing the road as well as a potential management problem. This road could be diverged and follow the northern boundary.

10) Fencing

Given the proximity to the city there may be a case for fencing some or all of the reserve. While fencing is not normally considered to be a management option in Tanzania, the extraordinary status of Pande as a Game Reserve within the city limits should be recognised.

11) Monitoring

A monitoring system designed to detect changes in habitat and populations changes for species of conservation concern should be developed as part of the management plan.

Appendix 1. Trap site details for rodents.

Species	Date within Feb 2003	No. trapped	Specimen No. (KMH No.)	Trap site	Trap type	Bait used	Alt.	Veg. type	Forest edge Or gap Or open	Canopy height	Micro-habitat	Water association	Water association distance
<i>Praomys</i> sp.	4	1	25814	1	Sh	CP	150	CT	FE/G	>10m	L	P	3m
<i>Praomys</i> sp.	7	1	25815	1	Sh	CP	150	CT	FE/G	>10m	L	P	3m
<i>Mus</i> sp.	7	1	25816	1	BP	CP	150	CT	FE/G	>10m	L	N	?
<i>Praomys</i> sp.	7	2	25817	1	Sh	CP	150	PCB	O	0	G	N	?
<i>Praomys</i> sp.	8	1	0	2	Sh	CP	150	PCB	O	0	G	N	?
<i>Mus</i> sp.	9	1	25818	1	Sh	CP	150	PCB	O	0	G	N	?
<i>Lemniscomys</i> sp.	9	1	25819	1	Sh	CP	150	PCB	O	0	G	N	?
<i>Praomys</i> sp.	9	2	0	2	Sh	CP	150	PCB	O	0	G	N	?
<i>Praomys</i> sp.	10	4	0	2	Sh	CP	150	PCB	O	0	G	N	?
<i>Praomys</i> sp.	11	2	0	2	Sh	CP	150	PCB	O	0	G	N	?
<i>Praomys</i> sp.	11	1	0	2	Sh	CP	150	PCB	F	>10m	G	N	?
<i>Praomys</i> sp.	11	3	0	2	Sh	CP	150	PCB	O	>10m	G	N	?
<i>Praomys</i> sp.	11	1	0	2	Sh	CP	150	PCB	FE/G	>10m	G	N	?
<i>Praomys</i> sp.	13	1	0	2	Sh	CP	150	CT	FE/G	>10m	L	N	?
<i>Beamys hindei</i>	13	1	25822	2	Sh	CP	180	CT	F	>10m	L	N	?
<i>Tatera</i> sp.	13	1	0	2	Sh	CP	180	CT	F	>10m	L	N	?
<i>Acomys</i> sp.	13	1	25825	2	Sh	CP	180	CT	F	0	L	N	?
<i>Tatera</i> sp.	13	1	0	2	Sh	CP	180	CT	F	>10m	L	N	?
<i>Praomys</i> sp.	13	4	0	2	Sh	CP	180	BG	O	0	G	N	?
<i>Praomys</i> sp.	14	2	0	2	Sh	CP	180	CT	FE/G	>10m	G	N	?
<i>Praomys</i> sp.	14	6	0	2	Sh	CP	180	BG	O	0	G	N	?
<i>Praomys</i> sp.	14	1	0	2	Sh	CP	180	CT	F	>10m	G	N	?
<i>Praomys</i> sp.	15	5	0	2	Sh	CP	180	CT	FE/G	>10m	G	N	?
<i>Acomys</i> sp.	15	1	25825	2	Sh	CP	180	CT	FE/G	>10m	L	N	?
<i>Praomys</i> sp.	15	6	0	2	Sh	CP	180	BG	O	0	G	N	?
<i>Praomys</i> sp.	16	1	0	2	Sh	CP	180	CT	FE/G	>10m	G	N	?
<i>Praomys</i> sp.	16	5	0	2	Sh	CP	180	BG	O	0	G	N	?
<i>Praomys</i> sp.	16	1	0	2	Sh	CP	180	CT	F	>10m	G	N	?
<i>Acomys</i> sp.	17	1	25825	2	Sh	CP	180	CT	F	>10m	L	N	?
<i>Praomys</i> sp.	17	3	0	2	Sh	CP	180	CT	F	>10m	G	N	?
<i>Praomys</i> sp.	17	8	0	2	Sh	CP	180	BG	O	0	G	N	?

Appendix 2. Trapsite details for shrews and galagos.

Species	Date within Feb 2003	No. trapped	Specimen No. (KMH No.)	Trap site	Trap type	Bait used	Alt.	Veg. type	Forest edge/gap	Canopy height	Micro-habitat	Water association	Water association distance
<i>Crocidura</i> sp.	4	1	25813	1	BP	-	150	CT	FE/G	>10m	L	N	?
<i>Crocidura</i> sp	8	1	25820	1	BP	-	150	CT	FE/G	>10m	G	P	3m
<i>Crocidura</i> sp	9	1	25821	1	BP	-	150	CT	FE/G	>10m	L	N	?
<i>Crocidura</i> sp	12	1	0	2	BP	-	180	CT	FE/G	>10m	L	N	?
<i>Crocidura</i> sp	13	1	25826	2	BP	-	180	CT	FE/G	>10m	L	N	?
<i>Crocidura</i> sp	15	1	25823	2	Sh	CP	180	BG	O	0	G	N	?
<i>Crocidura</i> sp	16	1	25829	2	BP	-	180	CT	FE/G	>10m	L	N	?
<i>Galagoides</i> sp.													
<i>Rondoensis</i>	6	1	0	1	Ch	P/F	150	CT	FE/G	>10m	Tree	N	?
<i>Rondoensis</i>	9	1	0	1	ch	P/F	150	CT	FE/G	>10m	Tree	N	?
<i>Zanzibaricus</i>	10	2	0	2	MN	P/F	180	CT	FE/G	>10m	Tree	N	?
<i>Zanzibaricus</i>	10	2	0	2	MN	P/F	180	CT	FE/G	>10m	Tree	N	?
<i>Zanzibaricus</i>	13	2	0	2	Ch	P/F	180	CT	FE/G	>10m	Tree	N	?
<i>Zanzibaricus</i>	16	2	0	2	Ch	P/F	180	CT	FE/G	>10m	Tree	N	?
<i>Zanzibaricus</i>	16	2	0	2	Ch	P/F	180	CT	FE/G	>10m	Tree	N	?
<i>Zanzibaricus</i>	16	2	0	2	MN	P/F	180	CT	FE/G	>10m	Tree	N	?
<i>Rondoensis</i>	17	2	0	2	Ch	P/F	180	CT	FE/G	>10m	Tree	N	?
KEY TO ABBREVIATIONS FOR APPENDIX 2													
<u>Trap site:</u>													
<i>Trap site 1</i>	<i>Forest edge/gap/inside</i>			<i>Bait used</i>				<i>Vegetation type</i>					
Trap site 2	FE/G – Forest edge and/or gap F – inside forest O – outside forest in bushland etc			CP - Coconut & peanut butter P/F – pombe and fruit				CT – Coastal thicket PCB – Previously cleared and burnt land BG – Bushed grassland					
<i>Trap type</i>	<i>Microhabitat</i>			<i>Water association</i>									
Sh – Sherman	L – leaf litter			P – pond									
BP – Bucket pitfall	G – grass			N – none				T - tree					

Appendix 3. Biometric details for rodents and shrew

Species	Date	Trap site	KMH number	Sex	Age	Head and body length (mm)	Tail length (mm)	Ear length (mm)	Hind foot length (mm)	Weight (g)	Belly	Back	Head	Leg	Tail
Praomys sp.	04/02/2003	1	25814	f	adult	85	104.4	18.4	21.6	31.5	grey white	grizzled brown	brown	brown	brown
Praomys sp.	07/02/2003	1	25815	f	adult	94.5	99.3	15.4	19.1	27	grey white	grizzled brown	brown	brown	light brown
Mus sp.	07/02/2003	1	25816	u	u	51.5	41.2	9.4	11.2	4.5	grey white	flanks; pale brown Back stripe brown	pale brown	pale brown	pale brown
Praomys sp.	07/02/2003	1	25817	m	adult	103.8	104.7	16.8	21.3	42	grey brown	grizzled brown	grizzled brown	light brown	brown
Praomys sp.	07/02/2003	1	0	m	adult		112.4	17.1	21.4	39	grey brown	grizzled brown	grizzled brown	light brown	brown
Mus sp.	08/02/2003	1	25818	f	u	48.4	36.1	8.2	9.5	4	grey white	flanks; pale brown Back stripe brown	pale brown	pale brown	pale brown
Lemoscomys sp.	09/02/2003	1	25819	m	adult	121.6	131.1	16.7	25.3	51	grey brown	grizzled brown	grizzled brown	grizzled brown	brown
Beomys hindei	11/02/2003	2	25823	m	adult	151	116.1	18.5	19.8	61	white	grey	top: grey bottom: white	grey	mottled grey and white
Acomys sp.	13/02/2003	2	25825	m	adult	102	70.8	13.5	15	28	white	dark brown, flanks: grizzled brown	dark brown	grey brown	grey

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Tatera sp.	13/02/2003	2	25827	m	adult	163.2	151.3	20.3	37.7	118	creamy white	dark brown, flanks: light brown	grizzled brown	light brown	light brown/grey & mottled
Crocidura	04/02/2003	1	25813	m	adult	95.5	55	9.1	14.5	13	ash grey	grey brown	grey brown		
Crocidura	08/02/2003	1	25820	f	adult	72.2	39.4	8.5	12.9	6	grey white	grey	grey	grey	brown
Crocidura	09/02/2003	1	25821	f	adult	93.5	51.3	8.9	13.9	12	pale grey	grey	grey	grey	mid brown
Crocidura	12/02/2003	2	0	f	adult	66.4	46.7	8.7	13.2	9.5	light grey	grey	grey	grey	brown
Crocidura	13/02/2003	2	25826	f	adult	93.8	58.9	10.4	13.6	13	pale grey	grey	grey	grey	brown grey
Crocidura	14/02/2003	2	25828	f	adult	90	51.9	8.6	12.4	19	grizzled pale brown	brown grey	brown grey	brown	pale
Crocidura	16/03/2003	2	25829	f	adult	70.3	53.7	8.2	13.5	12	pale grey	dark grey	dark grey	dark grey	blotched grey brown

Key: Sex: f – female, m – male, u – unknown.

Appendix 4. Biometric details for the galagos

Species	Date	Trap site	DNA sample number	Sex	Age	Head and body length (mm)	Tail length (mm)	Ear length (mm)	Hind foot length (mm)	Weight (g)
<i>rondoensis</i>	6/2/03	1	0	m	mature	121	161	23	44	80
<i>rondoensis</i>	9/3/03	1	1	m	immature	109	169	28	45	45.5
<i>zanzibaricus</i>	10/2/03	2	2	m	immature	182	209	30.5	67	150
<i>zanzibaricus</i>	13/2/03	2	3	f	mature	175	214	33	55	137
<i>zanzibaricus</i>	13/2/03	2	R of 2							
<i>zanzibaricus</i>	13/2/03	2	4	f	immature	124	124	25	48	61
<i>zanzibaricus</i>	16/2/03	2	5	f	mature	169	270	33	56	127
<i>zanzibaricus</i>	16/2/03	2	6	f	mature	163	240	32	55	118
<i>zanzibaricus</i>	16/2/03	2	7	m	immature	140	165	25	47	60
<i>rondoensis</i>	17/2/03	2	8	f	mature	132	183	28	49	69

Appendix 5. Galago pelage colour notes.

Species	Date	DNA sample number	Belly	Back	Head	Leg	Tail
<i>rondoensis</i>	6/2/03	0	grey under fur mainly white with a yellow wash	brown, mid-grey roots with grizzled light brown tips	white nose stripe up to mid forehead. Face mask: dark around eyes and either of muzzle chin white	shoulder; grizzled brown; grey brown whitening toward the foot	bottle brush shape; proximal half; brown, distal half dark
<i>rondoensis</i>	9/3/03	1	cream with yellowish wash with greyish under fur	reddish brown, mid-grey roots with grizzled light brown tips	top; mid pale brown, white long thin nose stripe to middle of forehead darkening towards nose, muzzle sides dark, ill defined eye rings, ear; yellowy green and inner ear yellow, bottom lip yellow.	mid brown thighs and shoulders paler towards feet and hands	tail shape; bottled brush; proximal half short sparse reddish hair, distal end reddish.
<i>zanzibaricus</i>	10/2/03	2	creamy yellow, scrotum hair yellow with grey under fur	grizzled grey brown; back; warm grey brown	grizzled grey brown, ear; brown, white nose stripe from lower forehead to mid muzzle, dark either side of muzzle, ill defined black eye rings, throat; yellowish white	legs; thighs grizzled grey brown with unusual line along left thigh,	not very bushy even hair length, proximal half; brown, distal half; darkening towards tip
<i>zanzibaricus</i>	13/2/03	3	white with yellowish wash around chest area	grizzled grey brown; same as thighs and forehead	top of head; grey brown, ears; brown, nose strip; white from lower forehead to nose. Dark either side of muzzle. Chin creamy white, faint black eye rings	grizzled grey brown thighs and forearms	uniform hair length, grizzled grey brown getting slightly bushier and darker towards tip
<i>zanzibaricus</i>	13/2/03	R of 2					
<i>zanzibaricus</i>	13/2/03	4	white with yellowish wash	grizzled grey brown; same as thighs and forehead	top of head; grizzled grey brown with grey under fur, ear; brown, nose strip; of white from lower mid forehead to nose	grizzled grey brown thighs and forearms	proximal half light brown, distal half; dark
<i>zanzibaricus</i>	16/2/03	5	creamy white with a yellow wash	grizzled grey brown; same as thighs and forehead	top of head; grizzled grey brown nose strip; white from lower forehead to nose. Dark either side of muzzle. Chin creamy white, faint black eye rings	grizzled grey brown thighs and forearms	proximal half light brown, distal half; dark
<i>zanzibaricus</i>	16/2/03	6	creamy white with a yellow wash	grizzled grey brown; same as thighs and forehead	top of head; grizzled grey brown nose strip; white from lower forehead to nose. Dark either side of muzzle. Chin creamy white, faint black eye rings	grizzled grey brown thighs and forearms	proximal half light brown, distal half; dark

Appendix 6. Day list for the bird survey of Pande Game Reserve

Species	bno	3rd	4th	5th	6th	7th	8th	9th	10th	11th	12th	13th	14th	15th	16th	17th
Black-headed Heron	27												/			
Cattle Egret	32										/			/		
Night Heron	40					/										
Hamerkop	42		/													
Palm-nut Vulture	84								/		/	/	/			
White-backed Vulture	85	/														
Harrier-Hawk	96						/	/	/	/	/		/			
Brown Snake Eagle	98						/									
Southern Banded Snake Eagle	99						/									
Bateleur	101						/	/				/				
African Goshawk	111			/												
Martial Eagle	134	/	/	/	/	/	/	/	/							/
Black-shouldered Kite	142						/									
African Hobby	152										/				/	
Crested Francolin	182						/			/	/					
Crested Guineafowl	187	/														
Black Crake	201					/										
Water Thicknee	290											/				
Ring-necked Dove	346	/	/	/	/	/	/	/	/							
Red-eye Dove	350	/				/	/	/	/	/	/	/	/	/	/	/
Emerald-spotted wood Dove	356	/													/	
Tabourine Dove	357			/	/	/	/	/	/	/	/			/		
Green Pigeon	358						/									
Brown-headed Parrot	365										/		/	/		
Livingstone's Turaco	382		/	/	/	/	/	/	/	/		/	/	/	/	
Violet-crowned Turaco	383		/													
Didric Cuckoo	388	/							/							
Emerald Cuckoo	389	/														
Klaas' Cuckoo	391	/	/	/	/								/			
Jacobin Cuckoo	393	/														
Levaillant's Cuckoo	394													/		
Black Cuckoo	396	/														
Yellowbill	401	/							/					/		/
White-browed Coucal	406		/	/	/	/	/	/	/	/	/	/	/	/	/	/
Verreaux's Eagle Owl	414		/													
African Wood Owl	416		/									/			/	
Gabon Nightjar	431			/												
Little Swift	443					/					/					
Palm Swift	452	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/
Bohm's Spinetail	454					/										
Speckled Mousebird	459								/	/						
Blue naped Mousebird	461		/													/
Narina's Trogon	462	/							/					/		
Brown-hooded Kingfisher	470		/												/	
Striped Kingfisher	472		/						/							
White-throated Bee-eater	479	/					/									
Eurasian Bee-eater	480	/										/				
Swallow-tailed Bee-eater	485		/													
Northern Carmine Bee-eater	487															/
Little Bee-eater	491										/			/		
Lilac-breasted Roller	496										/					
Broad-billed Roller	500										/					
Green wood Hoopoe	508		/					/								
Trumpeter Hornbill	510	/	/	/	/	/	/	/				/	/	/	/	/
Crowned Hornbill	515	/	/	/	/	/	/	/					/			
Brown-breasted Barbet	542	/														

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Yellow-rumped Tinkerbird	548		/			/	/	/	/	/	/	/	/	/	/
Red-fronted Tinkerbird	552												/		
Green Tinkerbird	554												/		
Black-throated Honeyguide	563		/												
Lesser Honeyguide	566			/											
Nubian Woodpecker	583		/												
Cardinal Woodpecker	585		/												
Bearded Woodpecker	594			/											
African Broadbill	596	/	/												
Flappet Lark	621												/		/
Barn Swallow	634				/										
Mosque Swallow	636				/	/		/	/		/		/		/
Wire-tailed Swallow	637					/									
Square-tailed Drongo	645	/				/									
Black-headed Oriole	649	/													
Golden Oriole	651								/		/	/			
Zanzibar Sombre Greenbul	700	/	/	/		/	/		/	/	/		/		/
Yellow-bellied Greenbul	710	/					/	/			/		/		
Eastern Nicator	716	/	/	/	/	/	/		/		/		/	/	/
Tiny Greenbul	722		/												
Fischer's Greenbul	723	/		/	/	/	/			/		/	/	/	
Terrestrial Brownbul	730						/		/		/		/		
Yellow vented Bulbul	732	/	/	/		/	/		/	/	/		/	/	/
Eastern Bearded Scrub Robin	746								/			/	/		
Red-capped Robin Chat	752	/				/		/		/	/	/	/		
Yellow-breasted Apalis	818						/								/
Green-backed Camaroptela	837	/	/	/	/	/	/	/	/	/	/	/	/	/	/
Rattling Cisticola	854					/		/		/				/	
Tiny Cisticola	865	/													
Tawny-flanks Prinia	913						/								
Moustached Warbler	915			/						/			/		
Garden Warbler	918								/	/		/		/	
Spotted Flycatcher	945									/					
Vanga Flycatcher	955				/										
Black-throated Wattle-eye	961			/											
Little Yellow Flycatcher	964	/	/	/	/							/			
Paradise Flycatcher	968													/	
Yellow-throated Longclaw	988									/					
Black backed Puffback	999	/	/	/	/	/	/	/	/	/	/	/	/	/	/
Tropical Boubou	1004	/	/	/	/	/	/	/	/	/	/		/	/	/
Four-coloured Bush-shrike	1018		/				/			/		/			
Black-crowned Tchagra	1022			/						/					
Red-backed Shrike	1030	/								/		/			
Chestnut-fronted Helmet Shrike	1046					/									
Violet-backed Starling	1048		/	/	/	/	/								
Black-belled Starling	1057			/		/									
Collared Sunbird	1080	/										/	/		
Uluguru Violet-backed Sunbird	1083			/											
Bronze Sunbird	1103	/													
Eastern Olive Sunbird	1112	/				/	/	/		/		/	/	/	
Mouse-coloured Sunbird	1129												/		
Grosbeak Weaver	1134					/		/	/	/		/	/	/	/
Red-naped Widowbird	1139												/		
Fan-tailed Widowbird	1140									/					
Yellow Bishop	1141	/		/			/	/	/	/					/
Zanzibar red Bishop	1149								/	/	/				/
Dark-backed Weaver	1161	/													
Black-headed Weaver	1165		/			/			/		/				
Pin-tailed Whydah	1216		/							/					

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Common Waxbill	1226					/		/				/	/	/	
Peters' Twinsport	1235	/	/	/	/	/	/	/	/	/	/	/	/	/	/
African Firefinch	1241									/					
Green-backed Twinsport	1242											/			
Green-winged Pytilia	1256	/													
Bronze Mannikin	1266	/	/							/					
Yellow-rumped Seed-eater	1280									/			/		/
Yellow-fronted Canary	1290												/	/	/

Appendix 7. Ringing data from birds recorded during a survey of Pande Game Reserve

Date	Locality	Ring #	Species	Re	Age	Sex	Weight (g)	Wing (mm)	Bill (mm)	Tarsus (mm)	Tail (mm)	Fat	BP	Moult
04-Feb-03	PANDE	A96501	<i>C. natalensis</i>		AD	-	30	91	15.9	25.2	76		3	NO
04-Feb-03	PANDE	T32964	<i>C. brevicauda</i>		AD	-	12	51	15.6	21.1	46		0	NO
04-Feb-03	PANDE	T32965	<i>N. olivacea</i>	-	AD	-	15	52	21.4	14.4	41		0	NO
04-Feb-03	PANDE	T32966	<i>N. olivacea</i>	-	AD	-	19	57	21.3	14.4	48	0	0	NO
04-Feb-03	PANDE	T32967	<i>C. brevicauda</i>	-	AD	-	11	50	15.5	20.4	36	0	0	NO
04-Feb-03	PANDE	X97514	<i>H. niveoguttatus</i>	-	AD	-	14	56	12.5	19	54	0	0	09
04-Feb-03	PANDE	T32968	<i>C. brevicauda</i>	-	AD	-	10	54	14.3	23.2	45	0	0	NO
04-Feb-03	PANDE	X97515	<i>H. niveoguttatus</i>	-	AD	-	29	55	13.8	17.1	49	0	0	NOw
04-Feb-03	PANDE	A96502	<i>C. flaviventris</i>	-	AD	-	32.5	101	20.5	27.9	95	0	4	NO
04-Feb-03	PANDE	X97012	<i>H. niveoguttatus</i>	-	AD	-	18.5	56	14	20.2	50	-	0	NO
04-Feb-03	PANDE	A96503	<i>P. bicolor</i>	-	AD	-	38	88	20.7	24.4	59	-	0	10
04-Feb-03	PANDE	A96504	<i>C. natalensis</i>	-	AD	-	42	96	19.6	30.7	81	-	0	NO
04-Feb-03	PANDE	X97013	<i>H. niveoguttatus</i>	-	AD	-	14	55	12.8	17.4	52	0	0	NO
04-Feb-03	PANDE	A96505	<i>P. fischeri</i>	-	AD	-	31	85	23	63	88	0	0	NO
04-Feb-03	PANDE	X97014	<i>P. debilis</i>	-	AD	-	16	64	15.4	18	67	0	0	NO
05-Feb-03	PANDE	X97015	<i>H. niveoguttatus</i>	-	AD	-	45	50	13.6	16.8	53	-	0	NO
05-Feb-03	PANDE	X97016	<i>P. debilis</i>	-	AD	-	38	68	17.2	21.3	65	-	3	NO
05-Feb-03	PANDE	A96506	<i>N- gularis</i>	-	AD	-	55	93	21.8	28.6	96	-	3	NO
05-Feb-03	PANDE	X97017	<i>H. niveoguttatus</i>	-	AD	M	17	56	15.6	18.9	42	-	0	NO
05-Feb-03	PANDE	A96507	<i>P. bicolor</i>	-	AD	-	40	94	19	17.3	61	-	0	12
05-Feb-03	PANDE	X97018	<i>P. peltata</i>	-	AD	F	19	61	17.3	19.6	49	-	0	NO
06-Feb-03	PANDE	A96508	<i>P. terrestris</i>	-	AD	-	19.5	81	22.1	26.9	80	-	0	NO
06-Feb-03	PANDE	X97019	<i>S. capensis</i>	-	AD	-	23	69	17.1	19	50	-	1	NO
06-Feb-03	PANDE	X97020	<i>A. neglectus</i>	-	AD	-	14	70	19.4	21.5	55	-	0	NO
06-Feb-03	PANDE	A96509	<i>P. bicolor</i>	-	AD	-	37	85	20.4	22.7	57	-	0	13
06-Feb-03	PANDE	X97021	<i>P. peltata</i>	-	AD	-	22.5	69	17	19	50	-	0	NO
06-Feb-03	PANDE	A96510	<i>P. flavistriatus</i>	-	AD	-	11	95	23.8	26.1	94	-	0	NO
06-Feb-03	PANDE	X97022	<i>P. debilis</i>	-	AD	-	16.5	70	16.4	18.6	68	-	0	NO
06-Feb-03	PANDE	A96511	<i>P. flavistriatus</i>	-	AD	-	46	61	21.5	27.5	0	-	0	NO
07-Feb-03	PANDE	T32969	<i>C. brevicauda</i>	-	AD	-	11	52	15.6	23.3	40	-	2	NO
07-Feb-03	PANDE	A96512	<i>N. gularis</i>	-	AD	-	37	90	20	28.3	88	-	3	NO

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07-Feb-03	PANDE	A96513	<i>L. aethiopicus</i>	-	AD	-	48	85	22.4	30.8	84	-	3	15
08-Feb-03	PANDE	A96514	<i>C. natalensis</i>	-	AD	-	34	95	18.2	28.7	76	-	0	NO
08-Feb-03	PANDE	T32970	<i>C. brevicauda</i>	-	AD	-	10	55	16.7	21.7	41	-	0	NO
08-Feb-03	PANDE	A96515	<i>L. aethiopicus</i>	-	AD	-	51	89	23	33	90	-	0	NO
08-Feb-03	PANDE	A96516	<i>L. aethiopicus</i>	-	IMM	-	50	94	24.5	32	95	-	0	16
08-Feb-03	PANDE	T32971	<i>C. brevicauda</i>	-	AD	-	10	49	14.6	22.3	35	-	3	NO
08-Feb-03	PANDE	T32972	<i>P. bilineatus</i>	-	AD	-	10.5	51	12	19	28	-	0	NO
08-Feb-03	PANDE	A96517	<i>C. flaviventris</i>	-	AD	-	48	106	22.7	28	98	-	0	17
08-Feb-03	PANDE	T32973	<i>C. brevicauda</i>	-	AD	-	10	54	16.1	26.2	44	-	1	NO
09-Feb-03	PANDE	A96518	<i>P. fischeri</i>	-	AD	-	26	0	21.3	0	0	-	-	-
09-Feb-03	PANDE	X97023	<i>H. niveoguttatus</i>	.	AD	.	15	54	14.2	17	52	.	0	NO
09-Feb-03	PANDE	X97024	<i>H. niveoguttatus</i>	-	AD	M	17	57	14.5	19.9	51	-	0	NOF
09-Feb-03	PANDE	A96519	<i>N. gularis</i>	-	AD	-	48	109	25.8	35.1	115	-	3	NO
09-Feb-03	PANDE	T32974	<i>C. brevicauda</i>	-	AD	-	14	55	16	24.1	43	-	0	NOW
09-Feb-03	PANDE	T32975	<i>N. olivacea</i>	-	AD	M	11	55	21	15	45	-	0	NO
09-Feb-03	PANDE	X97025	<i>P. peltata</i>	-	IMM	M	12	64	15.5	19	52	-	0	NO
10-Feb-03	PANDE	A96520	<i>P. terrestris</i>	-	AD	-	28.5	84	0	22.6	22.8	-	0	NO
10-Feb-03	PANDE	X97026	<i>H. niveoguttatus</i>	-	AD	M	14	54	0	17.1	50	-	0	NOW
10-Feb-03	PANDE	T32976	<i>C. brevicauda</i>	-	AD	-	10	53	16.9	22.9	39	-	0	NO
10-Feb-03	PANDE	X97027	<i>H. niveoguttatus</i>	-	AD	F	13	54	14.2	16.7	52	-	0	NO
10-Feb-03	PANDE	X97028	<i>H. niveoguttatus</i>	-	AD	F	14	55	13.3	18	53	-	0	NO
10-Feb-03	PANDE	A96522	<i>C. flaviventris</i>	-	AD-	-	45	111	22.1	28.5	93	-	4	NO
10-Feb-03	PANDE	A96521	<i>C. natalensis</i>	-	AD	-	32.5	86	18.9	26.6	72	-	2	NO
11-Feb-03	PANDE	A96523	<i>C. quadrivirgata</i>	-	AD	-	26	86	16	26	77	-	0	18
11-Feb-03	PANDE	X97030	<i>H. niveoguttatus</i>	-	AD	M	13.5	54	14.6	16.8	50	-	0	NO
11-Feb-03	PANDE	T32977	<i>C. brevicauda</i>	-	AD	-	14.5	53	13.9	21	40	-	0	NO
11-Feb-03	PANDE	X97029	<i>H. niveoguttatus</i>	-	AD	F	37	56	13.1	19.5	13.4	-	0	NO
11-Feb-03	PANDE	X97031	<i>P. debilis</i>	-	AD	-	10	63	17	19	68	-	0	19
11-Feb-03	PANDE	E2054	<i>H. rustica</i>	-	imm	-	17	121	12.6	10.6	70	-	0	20
11-Feb-03	PANDE	X97032	<i>H. niveoguttatus</i>	-	AD	M	19.5	56	14.5	17.6	55	-	0	NO
11-Feb-03	PANDE	E2055	<i>H. rustica</i>	-	AD	-	21	121	12.4	11.5	55	-	0	NO
11-Feb-03	PANDE	T32978	<i>N. olivacea</i>	-	AD	F	18	52	22.3	14.8	41	-	0	NO
11-Feb-03	PANDE	A96524	<i>C. flaviventris</i>	-	AD	-	19	110	13.4	15.1	28	-	3	NO
11-Feb-03	PANDE	X97033	<i>H. niveoguttatus</i>	-	AD	F	14	55	14.2	20	50	-	0	NO

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11-Feb-03	PANDE	A96525	<i>C. flaviventris</i>	-	AD	-	41	110	24	23.3	100	-	2	NO
11-Feb-03	PANDE	T32979	<i>P. bilineatus</i>	-	AD	-	19	53	13.4	15.1	28	-	3	NO
11-Feb-03	PANDE	T32980	<i>C. brevicauda</i>	-	AD	-	10	52	15	20	40	-	0	NO
11-Feb-03	PANDE	A96526	<i>C. flaviventris</i>	-	AD	-	41	105	24.7	23	100	-	0	21
11-Feb-03	PANDE	A96527	<i>L. aethiopicus</i>	-	AD	-	49	87	23.8	32	91	-	3	NO
11-Feb-03	PANDE	A96528	<i>N. rufus</i>	-	AD	-	46	121	22.1	33.9	105	-	4	NO
11-Feb-03	PANDE	A96529	<i>N. gularis</i>	-	AD	-	38	95	22.6	26.5	100	-	3	NO
11-Feb-03	PANDE	A96530	<i>C. flaviventris</i>	-	AD	-	46	95	21	23	96	-	3	NO
11-Feb-03	PANDE	A96531	<i>L. aethiopicus</i>	-	AD	-	42	88	25	35	99	-	0	NO
11-Feb-03	PANDE	T32981	<i>C. bravicaudata</i>	-	AD	-	12	55	14.1	23.8	44	-	0	NO
11-Feb-03	PANDE	A96532	<i>P. terrestris</i>	-	AD	-	20	80	19.4	21.9	91	-	3	NO
11-Feb-03	PANDE	X97034	<i>H. niveoguttatus</i>	-	AD	M	16	56	14.6	19.6	54	-	0	NO
11-Feb-03	PANDE	X97035	<i>H. niveoguttatus</i>	-	AD	-	14	55	15.6	16	51	0	2	NO
12-Feb-03	PANDE	A96533	<i>P. terrestris</i>	-	AD	-	43	92	22	24.1	94	-	0	23
12-Feb-03	PANDE	A96534	<i>C. natalensis</i>	-	AD	-	33	91	18.5	27	76	-	0	NO
12-Feb-03	PANDE	A96535	<i>P. fischeri</i>	-	AD	-	39	101	25.4	27	109	-	0	24
12-Feb-03	PANDE	B39401	<i>C. striatus</i>	-	AD	-	56	95	15.3	25.7	18.5	-	0	25
12-Feb-03	PANDE	B39402	<i>T. tympanistria</i>	-	AD	-	55	101	16	23	87	-	0	NO
12-Feb-03	PANDE	A96536	<i>P. terrestris</i>	-	AD	-	35	84	21	23.2	87	-	4	NO
12-Feb-03	PANDE	X.97036	<i>H. niveoguttatus</i>	-	AD	M	15	55	14.6	19	50	-	0	NO
12-Feb-03	PANDE	X97037	<i>H. niveoguttatus</i>	-	AD	F	16	54	14.5	16	51	-	0	NO
12-Feb-03	PANDE	X97038	<i>C. chiniana</i>	-	AD	-	20	60	16.5	2404	53	-	0	26
12-Feb-03	PANDE	T32982	<i>C. brevicauda</i>	-	AD	-	11	54	14.4	23.9	40	-	1	NO
12-Feb-03	PANDE	A96537	<i>N. gularis</i>	-	IMM	-	58	110	23.6	31	105	-	3	NO
12-Feb-03	PANDE	X97039	<i>P. bilineatus</i>	-	AD	-	12	52	13.4	17.7	37	-	0	NO
12-Feb-03	PANDE	X97040	<i>S. borin</i>	-	AD	-	18	80	16	23.3	62	1	0	27
12-Feb-03	PANDE	E2056	<i>H. albventris</i>	-	AD	-	43	96	45	18	95	-	0	NO
12-Feb-03	PANDE	A96539	<i>C. flaviventris</i>	-	AD	-	41	94	20.9	22.8	86	-	0	28
12-Feb-03	PANDE	T32983	<i>N. olivacea</i>	-	AD	-	8	58	24.1	17.1	50	-	0	NO
12-Feb-03	PANDE	A96538	<i>P. terrestris</i>	-	AD	-	23	72	18.5	25	89	-	0	NO
12-Feb-03	PANDE	A96540	<i>C. flaviventris</i>	-	AD	-	46	110	23.7	22.7	102	-	0	NO
12-Feb-03	PANDE	A96541	<i>C. flaviventris</i>	-	AD	-	43	105	22	23	97	0	4	NO
12-Feb-03	PANDE	A96542	<i>N. gularis</i>	-	AD	-	59	110	23.7	30.1	104	0	3	NOF
12-Feb-03	PANDE	T32984	<i>P. bilineatus</i>	-	AD	-	12	54	12.4	14	34	0	2	NOF

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12-Feb-03	PANDE	A96543	<i>C. fossii</i>	-	AD	-	37	115	16.6	22.7	120	-	0	NO
13-Feb-03	PANDE	A96544	<i>P. cucullatus</i>	-	AD	-	33	83	20.4	23	49	-	0	NOW
13-Feb-03	PANDE	X97041	<i>H. niveoguttatus</i>	-	AD	M	13	54	14.7	16	51	-	0	NO
13-Feb-03	PANDE	X97042	<i>H. niveoguttatus</i>	R	AD	F	14	0	0	0	0	0	0	0
13-Feb-03	PANDE	A96545	<i>C. quadrivirgata</i>	-	AD	-	24.5	75	16	24.6	70	-	0	29
13-Feb-03	PANDE	X97043	<i>H. niveoguttatus</i>	-	AD	F	13.5	55	13.2	16.7	51	-	0	NO
13-Feb-03	PANDE	A96546	<i>C. flaviventris</i>	-	AD	-	39	100	22	21	90	-	3	NO
13-Feb-03	PANDE	T32985	<i>C. brevicauda</i>	-	AD	-	10.5	51	15.7	21.5	40	-	0	NO
13-Feb-03	PANDE	A96547	<i>L. aethiopicus</i>	-	AD	-	51	86	25.4	35.6	88	-	0	30
13-Feb-03	PANDE	A96548	<i>A. albifrons</i>	-	AD	F	20.5	82	22	20.3	60	-	0	NO
13-Feb-03	PANDE	A96549	<i>A. albifrons</i>	-	AD	F	30	80	21	22	66	-	0	NO
13-Feb-03	PANDE	A96550	<i>A. albifrons</i>	-	AD	F	29.5	79	17.3	20.3	56	-	0	No
13-Feb-03	PANDE	B39403	<i>T. tympanistria</i>	-	AD	F	67	114	18.9	21	92	-	0	NO
13-Feb-03	PANDE	X97044	<i>S. borin</i>	-	AD	-	19	80	14.7	21.2	55	-	0	NO
13-Feb-03	PANDE	A96551	<i>C. natalensis</i>	-	AD	-	28	90	19	35	71	-	4	NO
13-Feb-03	PANDE	A96552	<i>N. gularis</i>	-	AD	-	47	101	24.4	34.3	101	-	3	NO
13-Feb-03	PANDE	X97045	<i>P. bilineatus</i>	-	AD	-	125	51	13.2	18.9	30	-	0	NO
13-Feb-03	PANDE	T32986	<i>A. collaris</i>	-	IMM	-	7	50	15.6	14.8	31	-	0	NO
13-Feb-03	PANDE	X97046	<i>H. niveoguttatus</i>	-	AD	-	19	58	13.8	20.2	54	-	0	NO
13-Feb-03	PANDE	X97047	<i>H. niveoguttatus</i>	-	AD	-	19.5	54	14	21.2	51	-	0	NO
13-Feb-03	PANDE	T32987	<i>A. collaris</i>	-	IMM	-	7	51	15	14.8	30	0	0	NO
13-Feb-03	PANDE	X97042	<i>H. niveoguttatus</i>	-	AD	-	17	56	14.9	20.2	55	-	1	NO
14-Feb-03	PANDE	A96553	<i>P. bicolor</i>	-	AD	-	40	87	19.3	24.8	56	-	0	NO
14-Feb-03	PANDE	T32988	<i>C. brevicauda</i>	-	AD	-	11	52	15.3	24	41	-	0	NO
14-Feb-03	PANDE	A96554	<i>P. terrestris</i>	-	AD	-	28	85	21.7	26.2	83	-	0	NO
14-Feb-03	PANDE	A96555	<i>C. flaviventris</i>	-	AD	-	47	105	23.7	22.9	105	-	0	NO
14-Feb-03	PANDE	T32989	<i>C. brevicauda</i>	-	AD	-	10	55	15.4	24.6	41	-	0	NO
14-Feb-03	PANDE	X97049	<i>P. peltata</i>	-	AD	-	13.5	62	15	18.4	51	-	0	31
14-Feb-03	PANDE	X97050	<i>H. niveoguttatus</i>	-	AD	F	13.5	53	12	16	50	-	0	NO
14-Feb-03	PANDE	T32990	<i>C. brevicauda</i>	-	AD	-	10.5	51	14.3	23.3	35	-	4	NO
14-Feb-03	PANDE	A96556	<i>N. gularis</i>	-	AD	-	36	91	21.4	31.4	97	-	0	NO
14-Feb-03	PANDE	X97051	<i>H. niveoguttatus</i>	-	AD	M	10	54	12.8	17	50	-	0	NO
14-Feb-03	PANDE	T32991	<i>M. nitidula</i>	-	AD	M	10	50	11.6	14	34	-	0	NO
14-Feb-03	PANDE	X97052	<i>H. niveoguttatus</i>	-	AD	-	16	56	12	22	51	-	0	NO

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14-Feb-03	PANDE	X97053	<i>H. niveoguttatus</i>	-	AD	M	16	54	12	17.5	50	-	0	NO
14-Feb-03	PANDE	X97054	<i>H. niveoguttatus</i>	-	AD	M	19	55	12.6	17.7	53	-	0	NO
15-Feb-03	PANDE	B39404	<i>T. tympanistria</i>	-	AD	-	70	110	17.1	21.4	90	-	3	NO
15-Feb-03	PANDE	X97055	<i>H. niveoguttatus</i>	-	AD	F	16	56	12	17	53	-	0	NO
15-Feb-03	PANDE	X97056	<i>H. niveoguttatus</i>	-	AD	-	15	55	12.5	17	54	-	0	NO
15-Feb-03	PANDE	T32992	<i>P. bilineatus</i>	-	AD	-	14.5	54	12	15	30	-	0	NO
15-Feb-03	PANDE	A96557	<i>L. aethiopicus</i>	-	AD	-	43	83	22.6	30.2	84	2	0	32
16-Feb-03	PANDE	X97057	<i>T. viridis</i>	-	AD	M	12	80	18.5	15.8	93	-	0	NO
16-Feb-03	PANDE	A96558	<i>C. flaviventris</i>	-	AD	-	50	105	23.6	28	93	-	0	33
16-Feb-03	PANDE	A96560	<i>P. terrestris</i>	-	AD	-	40	84	22.2	23.4	97	-	0	NO
16-Feb-03	PANDE	A96559	<i>P. terrestris</i>	-	AD	-	35	85	22.6	27	95	-	3	NO
16-Feb-03	PANDE	A96561	<i>P. terrestris</i>	-	IMM	-	30	85	21.5	26	84	-	3	NO
16-Feb-03	PANDE	A96562	<i>P. terrestris</i>	-	AD	-	32	80	20	21.7	83	-	0	34
16-Feb-03	PANDE	X97058	<i>S. borin</i>	-	AD	-	22	84	14.8	21.1	57	2	0	NO
17-Feb-03	PANDE	C7406	<i>C. superciliosus</i>	-	AD	-	140	150	30.5	42.7	187	-	0	35
17-Feb-03	PANDE	C7407	<i>C. superciliosus</i>	-	AD	-	135	150	33.5	42.4	200	-	0	

Key to Appendix 8

Ring # - Ring numbers are allocated by the Tanzania Bird Ringing Scheme???

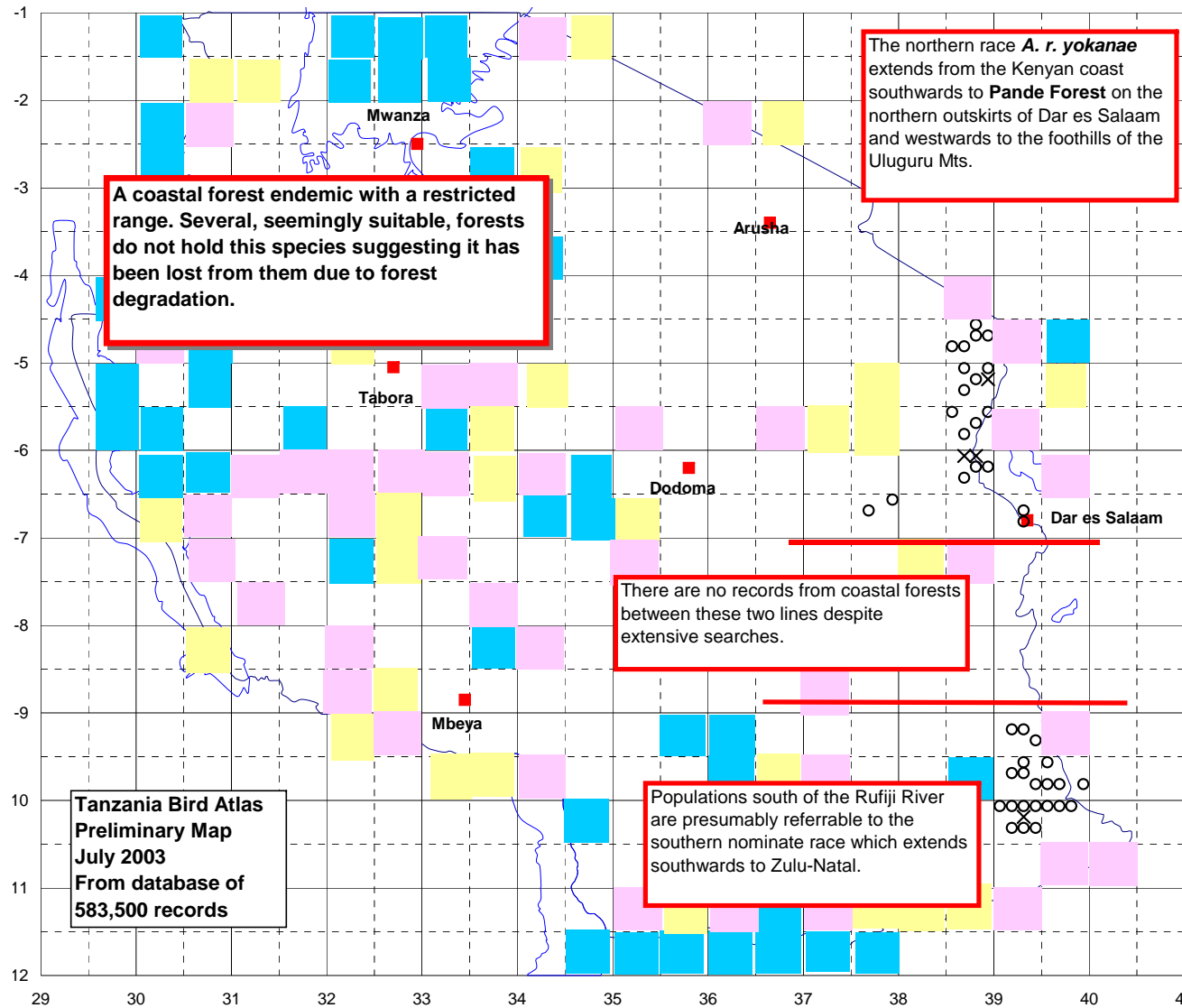
Re -

Age

AD - Adults

Imm - Immature

Appendix 8. Distribution and seasonality of the plain backed sunbird. From Baker and Baker in prep.



**Plain-backed Sunbird
*Anthreptes reichenowi***

47 plots from
133 records

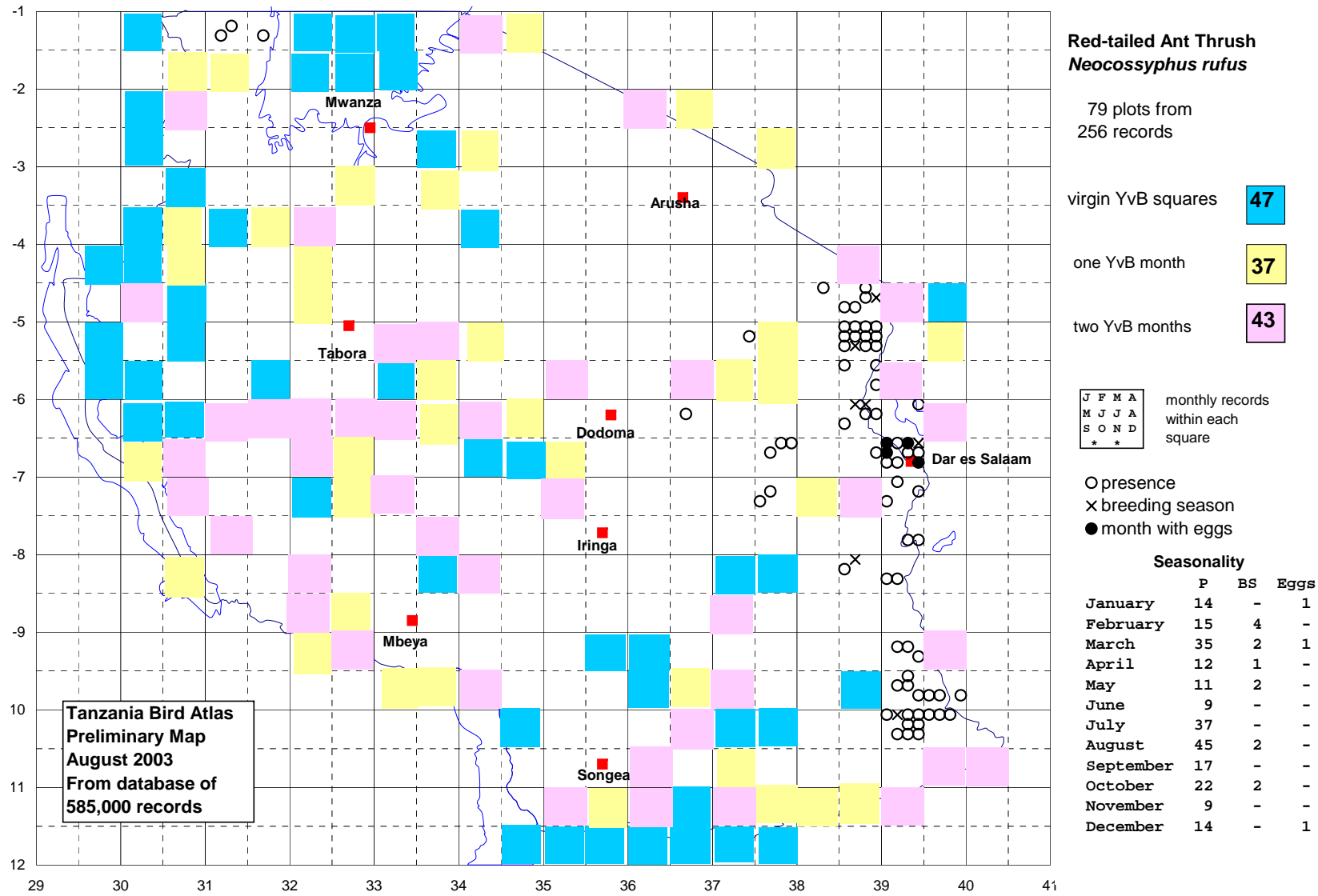
- virgin YvB squares 48
- one YvB month 35
- two YvB months 43

J F M A M J J A S O N D
* *
monthly records
within each
square

- O presence
- X breeding season
- month with eggs

	Seasonality		
	P	BS	Eggs
January	13	-	-
February	13	1	-
March	20	1	-
April	6	-	-
May	-	-	-
June	3	-	-
July	14	1	-
August	18	2	-
September	7	-	-
October	14	-	-
November	15	-	-
December	5	-	-

Appendix 9. Distribution and seasonality of the Red-tailed Ant Thrush. From Baker and Baker in prep.



Appendix 10. Bucket pitfall trapping locations and daily detailed trapping effort at Pande Game Reserve

Bucket Pitfall Trap line 1:

Location: S. 06° 41.919' E. 39° 04.694'

Habitat: Secondary evergreen coastal forest

Date:		4-Feb	5-Feb	6-Feb	7-Feb	8-Feb	9-Feb	10-Feb		Total
Trapping effort (No. of Buckets)		11	11	11	11	11	11	11		77
Species:										
<i>Mabuya maculilabris</i>		0	0	0	0	0	0	1		1
<i>Gerrhosaurus flavigularis</i>		0	0	0	0	1	0	0		1
<i>Crocidura sp</i>		0	1	0	0	0	0	0		1

Bucket Pitfall Trap line 2:

Location: S. 06° 41.966' E. 39° 04.670'

Habitat: Secondary evergreen coastal forest

Date:		4-Feb	5-Feb	6-Feb	7-Feb	8-Feb	9-Feb	10-Feb		
Trapping effort (No. Of Buckets)		11	11	11	11	11	11	11		77
Species:										
<i>Mabuya maculilabris</i>		0	1	0	0	0	0	1		2
<i>Cordylus tropidosternum</i>		0	0	0	0	1	0	0		1
<i>Crocidura sp</i>		1	0	0	0	0	0	0		1
<i>Mus sp</i>		0	0	0	1	0	0	0		1

Bucket Pitfall Trap line 3:

Location: S. 06° 41.186' E. 39° 04.844'

Habitat: Edge of a pond

Date:		4-Feb	5-Feb	6-Feb	7-Feb	8-Feb	9-Feb	10-Feb		
Trapping effort (No. Of Buckets)		11	11	11	11	11	11	11		77
Species:										
<i>Phrynobatrachus mababiensis</i>		100	40	5	28	88	13	22		296

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<i>Hemisus marmoratum</i>	1	0	0	3	0	0		4
<i>Xenopus muelleri</i>	0	0	0	0	0	1	0	1
<i>Ptychadena anchietae</i>	0	0	0	0	0	2	0	2
<i>Mabuya maculilabris</i>	0	1	0	0	0	0	1	2
<i>Crocidura sp</i>	0	0	0	0	1	0	1	2

Bucket Pitfall Trap line 4:

Location: S. 06° 41.236' E. 39° 04.839'

Habitat: Wooded grassland close to a pond

Date:		4-Feb	5-Feb	6-Feb	7-Feb	8-Feb	9-Feb	10-Feb	
Trapping effort (No. Of Buckets)		11	11	11	11	11	11	11	77
Species:									
<i>Xenopus muelleri</i>		0	0	0	3	1	2	0	6
<i>Arthroleptis stenodactylus</i>		0	0	0	1	0	0	1	2
<i>Schoutedenella xenodactyloides</i>		0	0	0	1	3	0	0	4
<i>Phrynobatrachus acridoides</i>		0	0	0	0	2	0	0	2
<i>Phrynobatrachus mababiensis</i>		0	0	0	0	3	0	0	3
<i>Gerrhosaurus flavigularis</i>		0	0	0	0	0	0	1	1
<i>Lygodactylus capensis</i>		0	0	0	0	0	0	1	1
<i>Mabuya maculilabris</i>		0	0	0	0	0	0	0	0
<i>Mabuya varia</i>		0	0	0	0	0	0	1	1
<i>Crocidura sp</i>		0	0	0	0	0	2	0	2

Bucket Pitfall Trap line 5:

Location: S. 06° 41.677' E. 39° 04.798'

Habitat: Fire induced wooded grassland

Date:		4-Feb	5-Feb	6-Feb	7-Feb	8-Feb	9-Feb	10-Feb	
Trapping effort (No. of Buckets)		0	0	0	11	11	11	11	44
Species:									
<i>Arthroleptis stenodactylus</i>		0	0	0	0	0	1	0	1
<i>Lygodactylus capensis</i>		0	0	0	0	1	0	0	1

<i>Mabuya varia</i>	0	0	0	0	1	0	0		1
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Bucket Pitfall Trap line 6:

Location: S. 06° 41.641' E. 39° 04.758'

Habitat: Fire induced wooded grassland

Date:	4-Feb	5-Feb	6-Feb	7-Feb	8-Feb	9-Feb	10-Feb		
Trapping effort (No. of Buckets)	0	0	0	11	11	11	11		44
Species:									
<i>Arthroleptis stenodactylus</i>	0	0	0	0	0	1	0		1
<i>Bufo gutturalis</i>	0	0	0	0	1	1	0		2
<i>Mabuya varia</i>	0	0	0	0	0	2	0		2
<i>Crocidura sp</i>	0	0	0	0	0	1	0		1

Bucket Pitfall Trap line 7:

Location: S. 06° 43.396' E. 39° 05.233'

Habitat: Forest and fire induced grassland edge.

Date:	12-Feb	13-Feb	14-Feb	15-Feb	16-Feb	17-Feb			Total
Trapping effort (No. of Buckets)	11	11	11	11	11	11			66
Species:									
<i>Mertensophryne micranotis</i>	1	1	0	0	1	0			3
<i>Lygodactylus capensis</i>	0	0	0	0	0	2			2
<i>Crocidura sp</i>	1	0	1	0	0	1			3

Bucket Pitfall Trap line 8:

Location: S. 06° 43.474' E. 39° 05.234'

Habitat: Closed regenerating forest and fire induced grassland edge.

Date:	12-Feb	13-Feb	14-Feb	15-Feb	16-Feb	17-Feb			
Trapping effort (No. of Buckets)	11	11	11	11	11	11			66
Species									

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<i>Phrynobatrachus acridoides</i>	2	0	0	0	0	0			2
<i>P. mababiensis</i>	2	4	0	0	0	0			6
<i>Kassina senegalensis</i>	0	0	0	0	0	1			1
<i>Mabuya maculilabris</i>	1	0	0	0	1	0			2
<i>Crocidura sp</i>	2	2	0	2	0	0			6

Bucket Pitfall Trap line 9:

Location: S. 06° 43.500' E. 39° 05.304'

Habitat: Closed regenerating forest.

Date:		12-Feb	13-Feb	14-Feb	15-Feb	16-Feb	17-Feb			
Trapping effort (No. of Buckets)		11	11	11	11	11	11			66
Species										
<i>Crocidura sp</i>		1	1	0	0	0	0			2
<i>Beamys sp</i>		0	1	0	0	0	0			1

Bucket Pitfall Trap line 10:

Location: S. 06° 43.370' E. 39° 05.257'

Habitat: Closed regenerating forest.

Date:		12-Feb	13-Feb	14-Feb	15-Feb	16-Feb	17-Feb			
Trapping effort (No. of Buckets)		11	11	11	11	11	11			66
Species										
<i>Phrynobatrachus mababiensis</i>		1	0	0	0	0	0			1
<i>Mertensophryne micranotis</i>		0	1	2	2	0	0			5
<i>Crocidura sp</i>		0	0	1	1	2	0			4

Bucket Pitfall Trap line 11:

Location: S. 06° 44.044' E. 39° 05.408'

Habitat: Wooded grassland

Date:		12-Feb	13-Feb	14-Feb	15-Feb	16-Feb	17-Feb			
Trapping effort (No. of Buckets)		0	11	11	11	11	11			55

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Species									
<i>Arthroleptis stenodactylus</i>		0	0	0	1	0	0		1
<i>Gerrhosaurus flavigularis</i>		0	0	1	0	0	0		1
<i>Crocidura sp</i>		0	0	2	1	0	0		3

Bucket Pitfall Trap line 12:

Location: S. 06° 43.436' E. 39° 05.186'

Habitat: Wooded grassland

Date:		12-Feb	13-Feb	14-Feb	15-Feb	16-Feb	17-Feb		
Trapping effort (No. of Buckets)		0	11	11	11	11	11		55
Species									
<i>Phrynobatrachus mababiensis</i>		0	0	0	1	0	0		1
<i>Mabuya striata</i>		0	0	0	0	0	1		1
<i>Crocidura sp</i>		0	4	0	1	0	2		7
<i>Dendromus sp</i>		0	0	0	0	0	1		1

