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Conservation Group
Shirika la Kuhifadhi
Misititu ya Asili Tanzania

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DI SCIENZE NATURALI



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THE VERTEBRATE BIODIVERSITY AND FOREST CONDITION OF UDZUNGWA MOUNTAIN FORESTS IN MUFINDI DISTRICT

By N. Doggart, C. Leonard, A. Perkin, M. Menegon and F. Rovero

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CRITICAL ECOSYSTEM
PARTNERSHIP FUND

Cover photographs by Michele Menegon. From left to right. 1. Horned bush viper eating a reed frog. 2. View of Igoda Forest and adjacent tea fields. 3. Spiny flanked chameleon (*Chamaeleo laterispinis*)

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Whole report

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Sections with Report: (example using section 3)

Menegon, M., (2008). Reptiles and Amphibians. In: Doggart, N., C. Leonard, A. Perkin, M. Menegon and F. Rovero (2008). The Biodiversity and forest condition of Udzungwa Mountain forests in Mufindi District. TFCG Technical Paper No 18. DSM, Tz. 1 - 142 pp.

EXECUTIVE SUMMARY

Introduction

The Eastern Arc Mountain forests in Mufindi District lie at the south-western extreme of the Eastern Arc. The forests are found on the Mufindi plateau at the top of the Mufindi escarpment. The plateau includes a mosaic of forest, commercial tea cultivation, pine and eucalyptus plantation, coffee and subsistence agriculture. The forests of Mufindi are highly fragmented and many of them show high levels of disturbance some of which dates back over 50 years. Lovett & Pócs (1993) suggest that parts of the larger Mufindi forests such as Kigogo were cultivated in the mid 19th Century and cite the presence of agricultural ridges under the forest. Other parts of Mufindi Scarp East and West were inhabited at the time of gazettelement in the 1950s and 1960s. All of the forests have been affected by timber harvesting and the expansion of the tea estates.

Relative to some areas of the Eastern Arc, botanists have visited the Mufindi forests quite frequently. The Tea estates also attracted a number of biologists to the area including Colin Congdon, Ivan Bampton, Jon Lovett and Neil and Liz Baker. As a result there are several publications that describe the biodiversity and conservation of the area. Overall there has been more work on the plants than on the vertebrates with the exception of birds. As such the current survey focused on documenting the vertebrate fauna of the area.

This report documents the aims, methods, results and conclusions of biodiversity surveys carried out in the Eastern Arc Mountains of Mufindi District by a team from the Tanzania Forest Conservation Group and the Museo Tridentino di Scienze Naturali, Italy. The survey was financed by the Critical Ecosystem Partnership Fund as part of the partnership project 'Filling the Knowledge Gap: Surveys of Poorly Known Sites and Species in the Eastern Arc and Coastal Forests'.

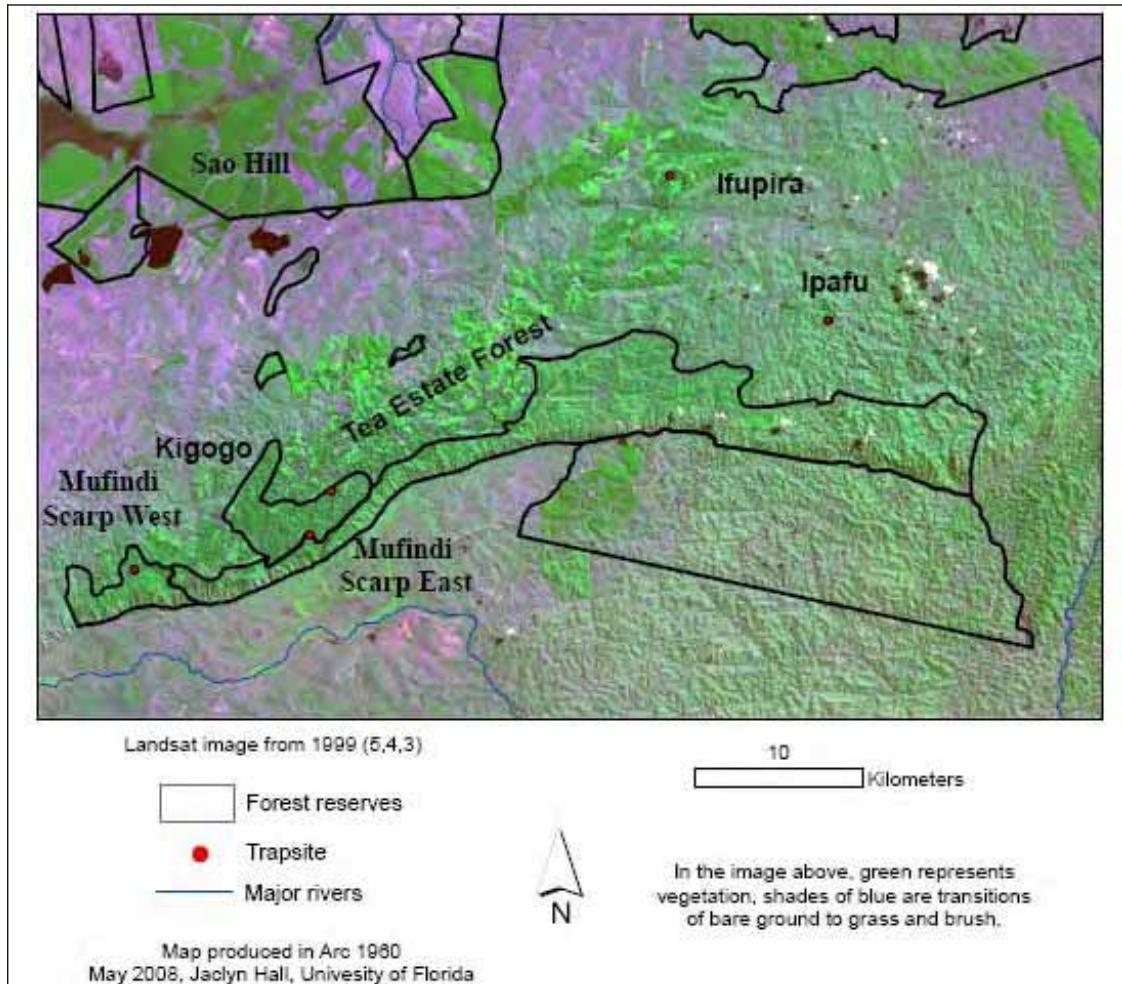
Methods and sampling localities

The surveys were conducted in two phases between February and August 2006 by a team of seven researchers visiting ten forests (Table 1). The surveys covered mammals, birds, reptiles and amphibians. The team used a combination of observations, sound recordings, mist-netting, pit fall traps and camera trapping in order to record vertebrate species. The condition of the forest was also assessed and interviews were conducted to document indigenous knowledge. The team carried out surveys in Lulanda, Ipafu, Igoda, Kigogo, Mufindi Scarp East, Mufindi Scarp West and Kidegemsitu Forest Reserves and two forest patches belonging to Unilever Tea Tanzania Limited (UTTLL): Ifupira, Livalonge forests and one owned by the Mufindi Tea Company: Lupeme. The forests range in altitude from 860 m to 2000 m asl. The forests contain a mosaic of forest, grassland, bamboo, woodland and thicket.

Table 1. Summary of area, altitudinal range and vegetation of forest reserves visited.

Forest	Area (ha)	Altitudinal range	Vegetation	Status
Ifupira	N/a	1900 - 2000	Montane forest	UTTLL
Igoda	80	1720 - 1820	Montane forest	LAFR
Ipafu	109	1700 - 1820	Montane forest	LAFR
Kidegemsitu	218	1840 - 1920	Montane forest	LAFR
Kigogo	2522	1770 - 1940	Montane forest and bamboo thicket	CFR
Livalonge	N/a	1880 - 1960	Montane forest	UTTLL
Lulanda	197	1480 - 1640	Montane forest	LAFR
Lupeme	N/a	1880 - 1920	Montane forest	MTC
Mufindi Scarp East	15183	860 - 1960	Montane forest, grassland	CFR
Mufindi Scarp West	1851	1300 - 1860	Montane forest, thicket and grassland	CFR

CFR = Catchment Forest Reserve; LAFR= Local Authority Forest Reserve; MTC = Mufindi Tea Company; UTTLL = Unilever Tea Tanzania Limited.



Map 1. Location of trap sites in the Mufindi landscape.

Species and species richness

Based on records from the scientific literature and from the results of the current survey, the survey team recorded 210 vertebrate species including 126 birds, 37 mammals, 27 reptiles and 20 amphibians. The overall species list from the survey is provided in Table 2.

Table 2. Vertebrate species recorded during the current survey in the North Pare Mountains.

Species	Common name	Forest Dependency	Range	Red list	Ifupira	Igoda	Ipafu	Lulanda	Lupeme	Mufindi Scarp East	Mufindi Scarp West	Kigogo	Kidegmsitu	Village belt and tea plantation
BIRDS														
<i>Accipiter melanoleucus</i>	Great Sparrowhawk	F	W					1			1			
<i>Accipiter minullus</i>	Little Sparrowhawk	F	W								1			
<i>Accipiter tachiro</i>	African Goshawk	F	W		1						1			
<i>Alethe fuelleborni</i>	White-chested Alethe	FF	W		1	1	1			1	1			
<i>Andropadus chlorigula</i>	Green-throated Greenbul	FF	W		1	1	1			1		1		
<i>Andropadus masukuensis</i>	Shelley's Greenbul	FF	W		1	1	1			1	1			
<i>Andropadus striifacies</i>	Stripe-faced Greenbul	FF	W				1			1				
<i>Andropadus virens</i>	Little Greenbul	F	W		1		1	1		1	1			
<i>Antheptes collaris</i>	Collared Sunbird	F	W		1		1	1		1	1			

Species	Common name	Forest Dependency	Range	Red list	Ifupira	Igoda	Ipafu	Lulanda	Lupeme	Mufindi Scarp East	Mufindi Scarp West	Kigogo	Kidegemisu	Village belt and tea plantation
<i>Anthus cinnamomeus</i>	African Pipit	O	W								1	1		
<i>Apalis alticola</i>	Brown-headed Apalis	F	W				1	1			1			
<i>Apalis chapini</i>	Chapin's Apalis	FF	EA N	LC	1			1				1	1	
<i>Apalis melanocephala</i>	Black-headed Apalis	FF	W					1						
<i>Apalis thoracica</i>	Bar-throated Apalis	FF	W		1		1	1			1	1		
<i>Aplopelia larvata</i>	Lemon Dove	F	W		1		1				1			
<i>Bathmocercus rufus</i>	Black-faced Rufous Warbler	F	W								1			
<i>Batis crypta</i>	Dark batis	FF	EA N	LC	1		1				1	1	1	
<i>Batis molitor</i>	Chin-spot Batis	O	W		1			1						
<i>Bradypterus cinnamomeus</i>	Cinnamon Bracken Warbler	F	W		1						1	1		
<i>Bradypterus lopezi</i>	Evergreen Forest Warbler	FF	W		1		1							
<i>Bubo africanus</i>	Spotted Eagle Owl	O	W					1						
<i>Buteo augur</i>	Augur Buzzard	F	W					1						
<i>Buteo oreophilus</i>	Mountain Buzzard	F	W		1		1				1	1		
<i>Kaupifalco monogrammicus</i>	Lizard buzzard	F	W											1
<i>Camaroptera brachyura</i>	Grey-backed Camaroptera	F	W				1	1			1			
<i>Campephaga flava</i>	Black Cuckoo Shrike	F	W				1							
<i>Caprimulgus poliocephalus</i>	Montane Nightjar	F	W		1			1			1			
<i>Centropus superciliosus</i>	White-browed Coucal	O	W					1						
<i>Ceratogymna brevis</i>	Silvery-cheeked Hornbill	F	W								1			
<i>Cercococcyx montanus</i>	Barred Long-tailed Cuckoo	F	W				1							
<i>Ceuthmochares aereus</i>	Eastern Yellowbill	F	W				1							
<i>Circaetus pectoralis</i>	Black-chested snake eagle	F	W		1									
<i>Cisticola erythrops</i>	Red-faced Cisticola	O	W				1				1			
<i>Cisticola nigriloris</i>	Black-lored Cisticola	F	EA N	LC			1	1			1		1	
<i>Cisticola njombe</i>	Churring Cisticola	O	EA N	LC			1						1	
<i>Colius striatus</i>	Speckled Mousebird	F	W		1						1			
<i>Columba arquatrix</i>	Olive Pigeon	F	W		1			1			1	1		
<i>Corvus albus</i>	Pied Crow	O	W		1		1	1			1	1		
<i>Cossypha anomala</i>	Olive-flanked Robin Chat	FF	W		1		1	1			1	1		
<i>Cossypha caffra</i>	Robin Chat	O	W		1		1	1			1			
<i>Cossypha heuglini</i>	White-browed Robin Chat	O	W		1		1							
<i>Cossypha natalensis</i>	Red-capped Robin Chat	F	W				1							
<i>Cryptospiza reichenovii</i>	Red-faced Crimsonwing	FF	W		1		1	1			1			
<i>Delichon urbica</i>	House Martin	O	W								1			
<i>Dendropicus fuscescens</i>	Cardinal Woodpecker	F	W		1		1	1						
<i>Dendropicus griseocephalus</i>	Olive Woodpecker	FF	W				1				1			
<i>Dicrurus ludwigii</i>	Square-tailed Drongo	FF	W					1			1	1		
<i>Dryoscopus cubla</i>	Black-backed Puffback	F	W		1		1	1			1	1		
<i>Elminia albonotata</i>	White-tailed Crested Flycatcher	FF	W		1		1	1			1	1		
<i>Estrilda astrild</i>	Common Waxbill	O	W		1		1	1						
<i>Estrilda paludicola</i>	Fawn-breasted Waxbill	O	W				1				1			
<i>Estrilda quartinia</i>	Yellow-bellied Waxbill	F	W				1	1			1			
<i>Euplectes ardens</i>	Red-naped Widowbird	O	W				1							
<i>Euplectes capensis</i>	Yellow Bishop	O	W				1	1						
<i>Falco biarmicus</i>	Lanner Falcon	O	W		1						1			
<i>Francolinus afer</i>	Red-necked Spurfowl	O	W					1						

Species	Common name	Forest Dependency	Range	Red list	Ifupira	Igoda	Ipafu	Lulanda	Lupeme	Mufindi Scarp East	Mufindi Scarp West	Kigogo	Kidegemitu	Village belt and tea plantation
<i>Fringilla levaillantii</i>	Red-winged Francolin	O	W								1			
<i>Fringilla squamatus udzungwensis</i>	Scaly Francolin	F	W									1		
<i>Gallinula chloropus</i>	Common moorhen	O	W		1									
<i>Hirundo abyssinica</i>	Striped Swallow	O	W								1			
<i>Hirundo angolensis</i>	Angola Swallow	O	W					1						
<i>Hirundo daurica</i>	red-rumped swallow	O	W		1									
<i>Hypargos niveoguttatus</i>	Peters' Twinspot	F	W				1							
<i>Indicator minor</i>	Lesser Honeyguide	F	W								1			
<i>Indicator indicator</i>	Greater Honeyguide	O	W											1
<i>Lagonosticta rhodopareia</i>	Jameson's Firefinch	O	W				1				1			
<i>Lagonosticta rubricata</i>	African Firefinch	O	W								1	1		
<i>Laniarius aethiopicus</i>	Tropical Boubou	O	W				1	1						
<i>Laniarius fuelleborni</i>	Fulleborn's Black Boubou	FF	EA N	LC	1		1	1			1	1	1	
<i>Lanius marwitzi</i>	Uhehe Fiscal	F	EA N	LC			1							
<i>Linurgus olivaceus</i>	Oriole Finch	FF	W		1			1						
<i>Lonchura cucullata</i>	Bronze Mannikin	O	W				1	1			1	1		
<i>Lonchura nigriceps</i>	Rufous-backed Mannikin	F	W					1						
<i>Lophaetus occipitalis</i>	Long-crested Eagle	O	W					1			1			
<i>Malaconotus nigrifrons</i>	Black-fronted Bush Shrike	F	W		1		1	1			1	1		
<i>Megaceryle maxima</i>	Giant kingfisher	F	W		1									
<i>Melaenornis fischeri</i>	White-eyed Slaty Flycatcher	F	W		1		1				1			
<i>Modulatrix stictigula</i>	Spot-throat	FF	EA N	LC	1		1	1			1	1		
<i>Motacilla aguimp</i>	African Pied Wagtail	O	W		1						1	1		
<i>Muscicapa adusta</i>	Dusky Flycatcher	O	W		1		1	1			1		1	
<i>Mysteria ibis</i>	Yellow-billed stork	O	W		1									
<i>Nectarinia amethystina</i>	Amethyst Sunbird	O	W					1			1			
<i>Nectarinia famosa</i>	Malachite Sunbird	O	W		1		1							
<i>Nectarinia mediocris</i>	Eastern Double-collared Sunbird	FF	W		1		1				1	1	1	
<i>Nectarinia olivacea</i>	Eastern Olive Sunbird	F	W		1		1	1				1	1	
<i>Nectarinia venusta</i>	Variable Sunbird	F	W				1	1			1			
<i>Onychognathus walleri</i>	Waller's Starling	FF	W				1	1			1			
<i>Oriolus larvatus</i>	Black-headed Oriole	F	W		1						1			
<i>Orthotomus metopias</i>	Red-capped Tailorbird	FF	W		1		1	1				1		
<i>Otus senegalensis</i>	African Scops Owl	O	W								1			
<i>Phyllastrephus flavostriatus</i>	Yellow-streaked Greenbul	FF	W					1						
<i>Phyllastrephus placidus</i>	Olive Mountain Greenbul	F	W		1		1	1			1	1		
<i>Platysteira peltata</i>	Black-throated Wattle-eye	F	W				1							
<i>Ploceus bertrandi</i>	Bertram's Weaver	O	W								1			
<i>Ploceus ocularis</i>	Spectacled Weaver	O	W				1	1						
<i>Ploceus xanthops</i>	Holub's Golden Weaver	O	W				1							
<i>Pogoniulus bilineatus</i>	Yellow-rumped Tinkerbird	F	W				1	1			1			
<i>Pogoniulus leucomystax</i>	Moustached Green Tinkerbird	FF	W		1		1	1			1	1		
<i>Pogonocichla stellata</i>	Starred Robin	F	W				1	1			1			
<i>Polemaetus bellicosus</i>	Martial eagle	O	W		1									
<i>Prinia subflava</i>	Tawny-flanked Prinia	O	W					1			1			

Species	Common name	Forest Dependency	Range	Red list	Ifupira	Igoda	Ipafu	Lulanda	Lupeme	Mufindi Scarp East	Mufindi Scarp West	Kigogo	Kidegemitu	Village belt and tea plantation
<i>Psalidoprocne orientalis</i>	Eastern Roughwing	F	W				1	1						
<i>Pseudoalcippe abyssinica</i>	African Hill Babbler	FF	W		1		1			1				
<i>Pycnonotus tricolor</i>	Yellow-vented Bulbul	F	W				1	1		1				
<i>Saxicola torquata</i>	Stonechat	O	W		1		1	1		1	1			
<i>Schoenicola brevirostris</i>	Broad-tailed warbler	O	W		1									
<i>Serinus canicollis</i>	Yellow-crowned Canary	O	W					1						
<i>Serinus hypostictus</i>	East African Citril	F	W		1		1	1		1				
<i>Serinus whytii</i>	Yellow-browed Seedeater	F	W		1		1	1		1				
<i>Serinus burtoni</i>	Thick-billed seedeater	F	W									1		
<i>Sheppardia lowei</i>	Iringa Akalat	FF	EA N	VU	1					1	1			
<i>Stactolaema olivacea</i>	Green Barbet	F	EA N	LC			1	1						
<i>Stephanoaetus coronatus</i>	Crowned Eagle	FF	W				1							
<i>Streptopelia semitorquata</i>	Red-eyed Dove	F	W		1		1	1		1	1	1		
<i>Strix woodfordii</i>	African Wood Owl	F	W		1			1		1				
<i>Tachybaptus ruficollis</i>	Little grebe	O	W		1									
<i>Tauraco livingstonii</i>	Livingstone's Turaco	FF	W		1		1	1		1	1	1		
<i>Tchagra minuta</i>	Marsh Tchagra	O	W				1							
<i>Terpsiphone viridis</i>	Paradise Flycatcher	F	W		1		1							
<i>Tockus alboterminatus</i>	Crowned Hornbill	F	W				1	1		1			1	
<i>Turdus olivaceus</i>	Olive Thrush	F	W		1		1							
<i>Turtur chalcospilos</i>	Emerald-spotted Wood Dove	O	W		1		1			1				
<i>Turtur tympanistria</i>	Tambourine Dove	F	W				1			1	1			
<i>Vidua macroura</i>	Pin-tailed Whydah	O	W					1						
<i>Zoothera gurneyi</i>	Orange Ground Thrush	FF	W					1						
<i>Zosterops senegalensis</i>	Yellow White-eye	F	W		1		1	1		1	1			
MAMMALS														
<i>Atilax paludinosus</i>	Marsh mongoose	F	W					1						
<i>Beamys hindei major</i>	Lesser pouched rat	F	EA N							1	1			
<i>Canis adustus</i> Sundevall, 1847	Side-striped jackal	O	W		1									
<i>Cephalophus harveyi</i>	Harvey's duiker	FF	W	LR/ cd	1		1	1		1	1	1		
<i>Cephalophus monticola</i>	Blue duiker	FF	W			1		1						
<i>Cercopithecus mitis moloneyi</i>	Gentle monkey	F	W		1	1	1	1	1	1	1	1		
<i>Chrysochloris stuhlmanni</i>	Golden mole		W									1		
<i>Civettictis civetta</i>	African civet	O	W					1	1	1				
<i>Colobus angolensis</i>	Angola pied colobus	F	W				1	1						
<i>Cricetomys gambianus</i>	Giant Pouched rat	F	W	LC				1	1	1	1			
<i>Crociodura sp A cf hildegardae</i>	White-toothed shrew		W				1			1				
<i>Crociodura sp B cf hildegardae</i>	White-toothed shrew		W							1		1		
<i>Crociodura sp C cf monax</i>	White-toothed shrew	FF	EA N	DD	1					1				
<i>Crociodura sp D</i>	White-toothed shrew											1		
<i>Dendromus sp.</i>	Climbing mouse										1			
<i>Galagoides cf orinus</i>	Mountain galago	FF	EA							1	1	1		
<i>Galagoides granti</i>	Grant's galago	FF	W					1						
<i>Genetta servalina lowei</i>	Lowe's servaline genet	FF	EA N								1	1		
<i>Grammomys dolichurus</i>	Narrow-footed thicket rat	F	W		1		1				1	1		

Species	Common name	Forest Dependency	Range	Red list	Ifupira	Igoda	Ipafu	Lulanda	Lupeme	Mufindi Scarp East	Mufindi Scarp West	Kigogo	Kidegemitsu	Village belt and tea plantation
<i>Graphiurus murinus</i>	African Dormouse	F	W							1				
<i>Heterohyrax brucei</i>	Bush hyrax	O	W							1		1		
<i>Hylomyscus arcimontensis</i>	Eastern Arc montane wood mouse	FF	EA N		1		1			1	1	1		
<i>Hystrix cristata</i> Linnaeus, 1758	Crested porcupine	F	W	LC							1			
<i>Lophuromys flavopunctatus</i>	Brush-furred rat	F	W		1		1				1			
<i>Mus minutoides</i>	Common mouse		W		1					1				
<i>Mus triton</i>	Common mouse		W							1		1		
<i>Myosorex kahaulei</i>	Mouse shrew	FF	E	EN	1		1			1		1		
<i>Nandinia binotata</i>	African palm civet	F	W					1	1		1			
<i>Neotragus moschatus</i>	Suni	F	W						1					
<i>Otolemur crassicaudatus</i>	Large-eared greater galago	O	W			1	1							
<i>Papio cynocephalus</i>	Yellow baboon	F	W						1	1		1		
<i>Paraxerus vexillarius byatti</i>	Swynnerton's bush squirrel	FF	EA N	VU	1		1		1	1	1	1		
<i>Potamochoerus larvatus</i>	Bush pig	F	W		1	1	1	1	1	1		1	1	
<i>Praomys delectorum</i>	Soft-furred rat	F	W		1		1			1	1	1		
<i>Rhynchocyon cirnei</i>	Chequered elephant shrew	FF	W		1		1	1	1	1		1		
<i>Suncus megalura</i>	Forest shrew	F	W									1		
<i>Tragelaphus scriptus</i>	Bushbuck	F	W									1		
REPTILES														
<i>Adenorhinus barbouri</i>		F	E						-					1
<i>Atheris ceratophorus</i>		FF	EA					1				1		-
<i>Bitis arietans</i>		O	W						-					1
<i>Causus rhombeatus</i>		O	W						-					1
<i>Chamaeleo dilepis</i>			W						-					1
<i>Chamaeleo laterispinis</i>		F	E						-			1		1
<i>Chamaeleo tempeli</i>		F	EA N					-	1			1		1
<i>Chamaeleo werneri</i>		F	EA					-				1		1
<i>Cordylus ukingensis</i>			W											
<i>Crotaphopeltis tornieri</i>		FF	EA N					-	1					1
<i>Dasypeltis scabra</i>		O	W					1						1
<i>Dispholidus typus</i>		O	W						-					1
<i>Duberria lutrix</i>		O	W					1	1					1
<i>Kinyongia cf. oxyrhina</i>		FF	EA					1						
<i>Kinyongia Sp. Nov.</i>		FF	E									1		-
<i>Lamphrophis fuliginosus</i>		O	W					1						1
<i>Lycodonomorphus whitey</i>		O	W					1						
<i>Lycophidion capense</i>		O	W						-	1				1
<i>Lycophidion uzungwense</i>		F	E						-					1
<i>Lygodactylus angularis.</i>		O	W	LC					-					1
<i>Melanoseps loveridgei</i>		F	W					-	1			1		1
<i>Melanoseps uzungwensis</i>		FF	E									1		
<i>Philothamnus ornatus</i>		O	W											1
<i>Psammophylax variabilis</i>		O	W						-					1
<i>Rhampholeon moyeri</i>		FF	EA									1		
<i>Rhinotyphlops nigrocandidus</i>		FF	EA					1						-
<i>Telescopus semiannulatus</i>		O	W						-					1

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<i>Thelotornis cf. mossambicanus</i>			W					1						
<i>Trachylepis varia</i>		O	W					-	1					1
AMPHIBIANS														
<i>Afrixalus sp.</i>								-						1
<i>Afrixalus sp. Nov.</i>		FF	E	Not listed				1				1		
<i>Amietia angolensis</i>		O	W	LC				-	1			1		1
<i>Amietophrynus gutturalis</i>		O	W	LC										1
<i>Arthroleptis cf. reichei</i>		FF	EA N	NT				1	1			1		
<i>Arthroleptis cf. xenodactyloides</i>		F	W	LC				1	1			1		1
<i>Arthroleptis sp.</i>		F						1				1		
<i>Hyperolius pictus</i>		O	EA N	LC				-						1
<i>Hyperolius pseudargus</i>		O	EA N	LC				-						1
<i>Hyperolius puncticulatus</i>		F	EA N	LC				1				1		1
<i>Leptopelis sp. Nov</i>		FF	E	Not listed				1	1			1		
<i>Nectophrynoides cf viviparus</i>		F	EA N	VU CIT ES I				-				1		-
<i>Phlyctymantis keithae</i>		O	E	VU				1						1
<i>Phrynobatrachus mababiensis</i>		O	W	LC				-	1					1
<i>Phrynobatrachus natalensis</i>		O	W	LC				-						1
<i>Probreviceps sp. Nov.</i>		FF	E	Not listed				-				1		
<i>Ptychadena uzungwensis</i>		O	W	LC				-						1
<i>Scolecophorus cf. kirkii</i>		FF	EA	VU				1				1		
<i>Strongylopus fuelleborni</i>		O	W	Not listed				-						1
<i>Xenopus cf. muelleri</i>		O	W	LC					1					1

The list of vertebrate species in Table 2 does not include any bat or fish species as such the total number of species in Mufindi's forests is greater than the 210 species that have been documented so far.

Table 3 summarises the species richness that was recorded in each of the forests visited by the survey team. These figures should be considered in the context of uneven sampling intensity. Thus whilst Lulanda, Mufindi Scarp West and Ipafu have the most species recorded, this partly reflects the more intensive survey effort in these forests, particularly in terms of the bird surveys.

Table 3. Summary of vertebrate species richness by taxa in nine Mufindi forests.

Forest	Amphibians	Reptiles	Mammals	Birds	Total
Ifupira	N/a	N/a	13	61	74
Igoda	N/a	N/a	4	N/a	4
Lupeme	6	6	9	N/a	21
Ipafu	N/a	N/a	13	74	87

Forest	Amphibians	Reptiles	Mammals	Birds	Total
Kidegemsitu	N/a	N/a	1	12	13
Kigogo	10	8	21	35	74
Mufindi Scarp East	N/a	N/a	18	N/a	18
Mufindi Scarp West	N/a	N/a	14	74	88
Lulanda	8	8	13	66	95

Endemism

In terms of endemic species, there are a total of 39 restricted range species found in Mufindi (Table 4). The reptilian fauna include the most restricted range species.

Table 4. Summary of the number of restricted range species in Mufindi.

Taxon	Udzungwa endemic (E)	Eastern Arc Endemic (EA)	Eastern Arc near-endemic (EA N)
Amphibians	4	1	5
Reptiles	5	5	3
Mammals	1	1	5
Birds	0	0	9
Total	10	7	22

The 39 restricted range species found in Mufindi are listed in Table 5.

Table 5. List of 39 restricted range vertebrate species found in Mufindi and their localities.

	Species	Common name	Forest Dependency	Range	Red list	Ifupira	Igoda	Ipafu	Lulanda	Lupeme	Mufindi Scarp East	Mufindi Scarp West	Kigogo	Kidegemsitu	Village belt and tea plantation
Species endemic to the Udzungwa Mountains found in Mufindi															
Amphibian	<i>Afrivalus Sp. Nov.</i>		FF	E					1				1		
Amphibian	<i>Leptopelis Sp. Nov</i>		FF	E					1				1		
Amphibian	<i>Phlyctymantis keithae</i>		O	E	VU				1						1
Amphibian	<i>Probreviceps Sp. Nov.</i>		FF	E					-				1		1
Mammal	<i>Myosorex kihalei</i>	Mouse shrew	FF	E	EN	1		1		1			1		
Reptile	<i>Adenorhinus barbouri</i>		F	E					-						1
Reptile	<i>Chamaeleo laterispinis</i>		F	E					-				1		1
Reptile	<i>Kinyongia Sp. Nov.</i>		FF	E									1		-
Reptile	<i>Lycophidion uzungwense</i>		F	E					-						1
Reptile	<i>Melanoseps uzungwensis</i>		FF	E											
Species endemic to the Eastern Arc Mountains found in Mufindi															
Amphibian	<i>Scolecophorus kirkii</i>		FF	EA	VU				1				1		
Mammal	<i>Galagoides cf. orinus</i>		FF	EA						1	1	1	1		
Reptile	<i>Atheris ceratophorus</i>		FF	EA					1				1		-
Reptile	<i>Chamaeleo werneri</i>		F	EA					-				1		1
Reptile	<i>Kinyongia cf. oxyrhina</i>		FF	EA					1						
Reptile	<i>Rhinotyphlops nigrocandidus</i>		F	EA											
Reptile	<i>Rhampholeon moyerii</i>		FF	EA					-				1		
Species near-endemic to the Eastern Arc Mountains found in Mufindi															
Amphibian	<i>Arthroleptis cf. reichei</i>		FF	EA N	NT				1				1		
Amphibian	<i>Hyperolius pictus</i>		O	EA N	LC				-						1
Amphibian	<i>Hyperolius pseudargus</i>		O	EA N	LC				-						1
Amphibian	<i>Hyperolius puncticulatus</i>		F	EA N	LC				1				1		1
Amphibian	<i>Nectophrynoides cf</i>		F	EA N	VU				-				1		-

	Species	Common name	Forest Dependency	Range	Red list	Ifupira	Igoda	Ipafu	Lulanda	Lupeme	Mufindi Scarp East	Mufindi Scarp West	Kigogo	Kidegemsitu	Village belt and tea plantation
	<i>viviparus</i>														
Bird	<i>Apalis chapini</i>	Chapin's Apalis	FF	EA N	LC	1			1				1	1	
Bird	<i>Batis crypta</i>	Dark batis	FF	EA N	LC	1		1				1	1	1	
Bird	<i>Cisticola nigriloris</i>	Black-lored Cisticola	F	EA N	LC			1	1			1		1	
Bird	<i>Cisticola njombe</i>	Churring Cisticola	O	EA N	LC			1						1	
Bird	<i>Laniarius fuelleborni</i>	Fulleborn's Black Boubou	FF	EA N	LC	1		1	1			1	1	1	
Bird	<i>Lanius marwizi</i>	Uhehe Fiscal	F	EA N	LC			1							
Bird	<i>Modulatrix stictigula</i>	Spot-throat	FF	EA N	LC	1		1	1			1	1		
Bird	<i>Sheppardia lowei</i>	Iringa Akalat	FF	EA N	VU	1						1	1		
Bird	<i>Stactolaema olivacea</i>	Green Barbet	F	EA N	LC			1	1						
Mammal	<i>Beamys hindei major</i>	Lesser pouched rat	F	EA N							1		1		
Mammal	<i>Crocidura sp C cf monax</i>	White-toothed shrew	FF	EA N	DD	1					1				
Mammal	<i>Genetta servalina lowei</i>	Lowe's servaline genet	FF	EA N								1	1		
Mammal	<i>Hylomyscus arcimontensis</i>	Eastern Arc montane wood mouse	FF	EA N		1		1			1	1	1		
Mammal	<i>Paraxerus vexillarius byatti</i>	Swynnerton's bush squirrel	FF	EA N	VU	1		1			1	1	1		
Reptile	<i>Chamaeleo tempeli</i>		F	EA N									1		1
Reptile	<i>Adenorhinos barbouri</i>		F	EA N											
Reptile	<i>Crotaphopeltis tornieri</i>		FF	EA N											1

It is interesting to note that 10 of the 39 restricted ranges species were recorded on village land of which four were not recorded in any of the forests. These species were mainly recorded in montane grassland on village land and reflects the importance of this habitat for the conservation of restricted range species.

The number of restricted range species varies considerably between reserves (Table 6) with Kigogo having the most Udzungwa and Eastern Arc endemics with a total of 27 restricted range species whilst no restricted range species were recorded in Igoda. Again these comparisons should be considered in the context of differences in sampling intensity however it does highlight the importance of both Kigogo (27 restricted range species) and Lulanda Forest Reserves (17 restricted range species).

The majority (20) of the species considered to be 'near-endemic' to the Eastern Arc Mountains have ranges that extend into the Southern Rift forests. Associations with Mount Kilimanjaro and the coastal forests are weaker with three and five species overlapping respectively. This reflects the proximity of the Mufindi forests with the Southern Rift forests.

Table 6. Number of restricted range species found in each forest.

Forest	Number of species endemic to the Udzungwa Mountains	Number of species endemic to the Eastern Arc Mountains	Number of species near-endemic to the Eastern Arc Mountains	Total
Ifupira	1	0	8	9
Igoda	0	0	0	0
Lupeme	1	0	5	6
Ipafu	1	0	9	10
Kidegemsitu	0	0	5	5
Kigogo	7	5	15	27
Mufindi Scarp East	1	0	4	5

Mufindi Scarp West	0	0	8	8
Lulanda	3	4	10	17
Village belt	4	1	5	10

Threatened taxa

In terms of globally threatened taxa, there are 26 species listed on the IUCN red list that are present in Mufindi. These are summarised in Table 7. It should be noted that most reptile species have not been assessed. Similarly the three new species of amphibian, the new chameleon species and the possible new galago taxon have not been assessed. However, given their restricted ranges and the rates of disturbance in Mufindi, it is likely that they will be considered vulnerable to extinction.

Table 7. Number of threatened species in Mufindi Forests.

Taxon	Endangered	Vulnerable	Near threatened	Least Concern
Amphibians	0	3	1	10
Reptiles			1	
Mammals	1	1		
Birds		1		8
Total	1	5	2	18

The species considered to be endangered is *Myosorex cf kahaulei*.

Species present in the Mufindi forest which are considered to be Vulnerable include:

Amphibians

Phlyctymantis keithae

Scolecophorus kirkii

Leptopelis barbouri

Nectophrynoides viviparus

Mammals

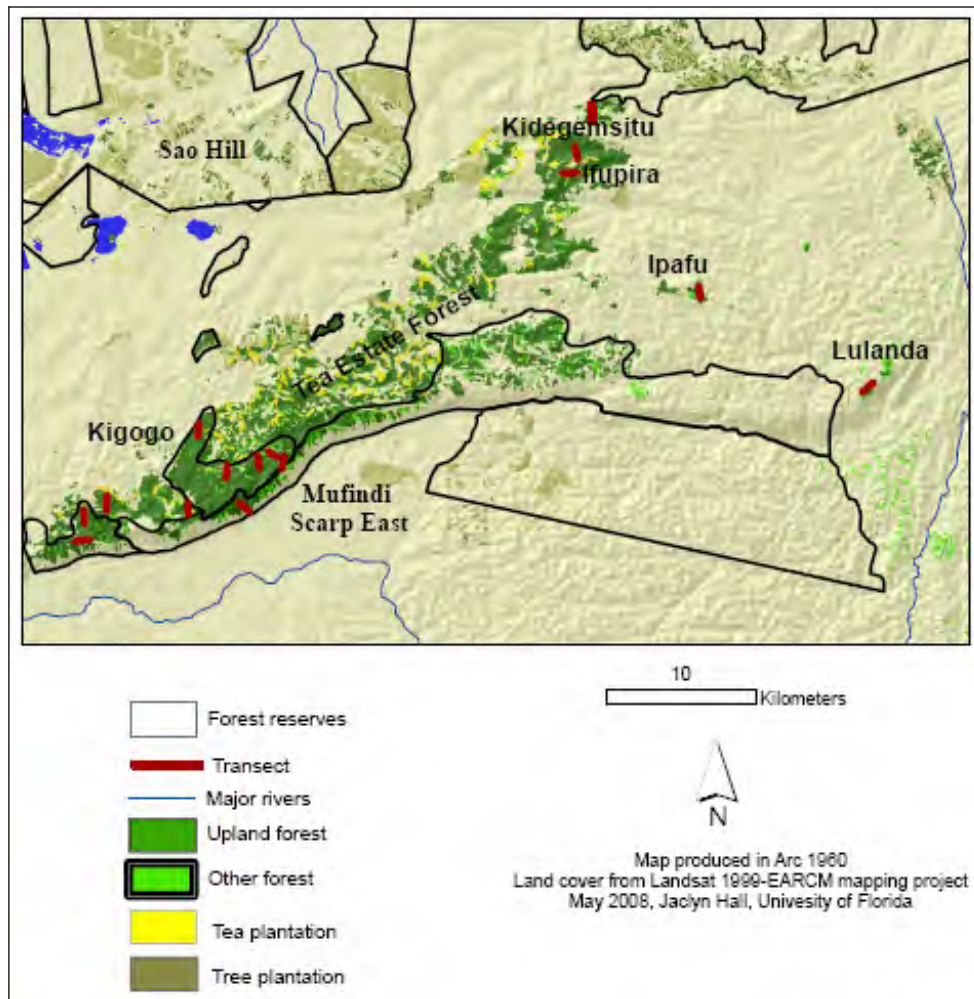
Paraxerus vexillarius byatti

Birds

Sheppardia lowei

Forest disturbance

The survey team assessed disturbance over 15 ha in eight of the forests.



Map 2. Location of disturbance transects in the Mufindi landscape.

The survey team recorded several different signs of resource use and disturbance within the forest reserves including pole and timber cutting, pitsawing (22 events), paths (14 events), fire (six events), cultivation (five events), traps (four events), abandoned settlement (one event) and bee hive (one hive). Of these, pole and timber cutting were the most prevalent and were recorded in all reserves. The highest rates of timber and pole cutting were in Kigogo and Lulanda Forest Reserves where there was more than twice as much cutting as in the other forests. In both reserves, most of the cutting was recorded as old cut, with the exception of some pole cutting in Kigogo Forest Reserve which appeared to be quite recent. The rate of timber cutting was lowest in Ifupira, Mufindi Scarp East and Ipafu forests. The results of the disturbance transects should be considered in light of signs of intensive logging in the past such that the edges of several of the tea estate forests are a tangled thicket of vines and scrubby vegetation with few large canopy trees.

Indigenous knowledge

In order to assess indigenous knowledge about the fauna of Mufindi's forests, 53 people (43 men, 10 women) were interviewed in eight groups from six villages between February and June 2006. Respondents mentioned ten primate, ungulate and sengi species. All but two of these species were also recorded by the survey team. The two species mentioned in the indigenous knowledge surveys but not recorded by the survey team are the tree hyrax and the rock hyrax. It is quite possible that both species are present but were not detected by the survey team. Further research is needed in order to confirm their presence. Respondents also confirmed that red colobus, mangabeys, black and rufous sengi and Abbott's duiker are not present in the Mufindi forests. The interviews also highlighted that in the forests of the Mufindi, there are some wildlife conflicts. Medium-sized wild animals such as vervet monkeys, Sykes monkeys, baboons and bushpigs were mentioned as causing damage to crops.

Conclusions

The surveys have shown that the forests are more important than was previously thought in terms of the concentration of restricted range species. With at least four strictly endemic vertebrate species, the Mufindi forests have comparable levels of endemism to other Eastern Arc mountain ranges. However these figures should be considered in light of the recent 'splitting' of several amphibian species thus raising documented rates of endemism across the Eastern Arc Mountains. Kigogo and Lulanda forests appear to be of particular importance in terms of endemic species and herpetofaunal species richness. The fauna show strong associations with the southern Rift forests reflecting the proximity of the Southern Highlands to the Mufindi forests. The surveys also recorded widespread disturbance and reflect the need for increased investment in protected area management in Mufindi.

Recommendations

The recommendations arising from this study can be summarised as follows:

Conservation interventions

- Establish and implement equitable and effective joint forest management for Kigogo and Mufindi Scarp West and identify ways of restoring connectivity between the western forests.
- Continue to support joint forest management for Lulanda Forest Reserve given its exceptionally high concentration of restricted range species.
- Control hunting of forest mammals through awareness raising, joint forest management and coordination between stakeholders.
- Control illegal logging through joint forest management and awareness raising campaigns
- Implement awareness raising campaigns on the values, threats and conservation needs of the Mufindi Forests and strengthen environmental education in schools
- Identify and conserve critical montane grassland habitats in Mufindi.
- Support efforts to reduce local dependence on the unsustainable extraction of products from the forests particularly timber, poles and fuel wood.
- Develop and implement a strategy to tackle human – wildlife conflicts
- Develop and implement a strategy to address invasive alien species
- Develop and implement a strategy to prevent and tackle forest fires
- Improved coordination of conservation activities in Mufindi

Further research and monitoring

- Further research on taxonomy, distribution and conservation status of some of the possibly new, scarce and cryptic species including dwarf galagos, black and white colobus, squirrels, tree hyrax, Lowe's genet and blue duiker.
- Further analysis and description of the new amphibian and reptile species.
- Support for biodiversity and threat monitoring
- Further surveys to provide additional information on the distribution and status of threatened and restricted range species.
- Further research on the fauna of the montane grasslands with a view to identifying priority areas for conservation.
- Further research on optimal methods for restoring forest connectivity and in identifying priority areas in the western Mufindi forests.
- Research on control measures for invasive alien plant species.
- Conservation genetic studies on minimum viable populations sizes for species vulnerable to extinction, particularly the three new amphibian and one chameleon species.



Eastern double-collared sunbird. Photo by A. Perkin



African dormouse in Mufindi Scarp East. Photo by M. Menegon.



Uluguru one-horned chameleon (*Kinyongia cf. oxyrhina*). Photo by M. Menegon



Guttural toad *Amietophrynus gutturalis*. Photo by M. Menegon



Variable reed frog *Hyperolius pictus*. Photo by M. Menegon.



Lowe's servaline genet. Photo by F. Rovero



Galagoides cf orinus in Kigogo FR. Photo by A. Perkin



Harvey's duikers in Mufindi Scarp West. Photo by F. Rovero.



View of Mufindi Scarp. Photo by M. Menegon



Project team



Leonsi Mlawila with Eastern double-collared sunbird. Photo by A. Perkin



Waterfall in Kigogo Forest. Photo by M. Menegon.



Disturbed tea estate forest. Photo by A. Perkin.



Maneno Mbilinyi, Charles Leonard and Leonsi Mlawila measuring birds. Photo by A. Perkin.



Andrew Perkin conducting nocturnal surveys. Photo by C. Bracebridge



Michele Menegon releasing horned bush-viper in Kigogo. Photo by A. Perkin.

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Tanzania Forest Conservation Group

The Tanzania Forest Conservation Group (TFCG) is a Tanzanian non-governmental organisation that has been promoting the conservation of Tanzania's forests since 1985. TFCG's mission is to conserve and restore the biodiversity of globally important forests in Tanzania for the benefit of present and future generations. We achieve this through capacity building, advocacy, research, community development and protected area management, in ways that are sustainable and foster participation, cooperation and partnership.

TFCG supports field based projects promoting participatory forest management, environmental education, community development, advocacy and research in the Eastern Arc and Coastal Forests. TFCG also supports a community forest conservation network that facilitates linkages between communities involved in participatory forest management. To find out more about TFCG please visit our website www.tfcg.org

TFCG is a partner in the Filling the Knowledge Gap project.

Museo Tridentino di Scienze Naturali

The Museo Tridentino di Scienze Naturali (MTSN), founded in 1922, is an Italian institution dedicated to conservation, education and research in natural sciences. The mission of the MTSN is to promote knowledge and conservation of the mountainous environment through the transfer of up-dated information to a wide audience. The MTSN promotes both its own research activities and connections with national and international universities and research centres.

MTSN has been conducting research in the Eastern Arc Mountains of Tanzania since 1998. MTSN also supports community education and other conservation projects in the Udzungwa Mountains, and manages the [Udzungwa Ecological Monitoring Centre](#), a training and monitoring facility belonging to the Udzungwa Mountains National Park.

MTSN is a partner in the Filling the Knowledge Gap project.

Critical Ecosystem Partnership Fund

The [Critical Ecosystem Partnership Fund \(CEPF\)](#) is a joint initiative of Conservation International, the French Development Agency, the Global Environment Facility, the Government of Japan, the John D. and Catherine T. MacArthur Foundation and the World Bank. Conservation International administers the fund. CEPF provides strategic assistance to nongovernmental organizations, community groups and other civil society partners to help safeguard Earth's biodiversity hotspots. A fundamental goal is to ensure civil society is engaged in biodiversity conservation. The partnership invests in biodiversity hotspots, Earth's biologically richest and most threatened areas. CEPF focuses on hotspots in the developing world and strategically targets priority areas in the hotspots for maximum impact.

Between 2004 and 2008 the Critical Ecosystem Partnership Fund has invested US\$ 7 million in the Eastern Arc and Coastal Forests of Kenya and Tanzania.

CEPF has financed the Filling the Knowledge Gap project.

Contact details for project partners

Tanzania Forest Conservation Group, PO Box 23410, Dar es Salaam, Tanzania

E-mail: tfcg@tfcg.or.tz

Website: www.tfcg.org

Tel.: +255 (0)22 2669007

Museo Tridentino di Scienze Naturali, Via Calepina 14, I-38100 Trento, Italy

Website: www.mtsn.tn.it

Tel.: +39 0461 270311

Abbreviations and acronyms

AP	Andrew Perkin
a.s.l.	above sea level
CEPF	Critical Ecosystem Partnership Fund
CMEAMF	Conservation and Management of the Eastern Arc Mountain Forests
Dbh	Diameter at Breast Height
DNRO	District Natural Resources Office(r)
FBD	Forestry and Beekeeping Division
FR	Francesco Rovero
FTKG	Filling the Knowledge Gap
IUCN – SSC	International Union for the Conservation of Nature Species Survival Commission
MTSN	Museo Tridentino di Scienze Naturali
MW	Megawatts
TFCG	Tanzania Forest Conservation Group
UTTL	Unilever Tea Tanzania Limited

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Survey Team

Team Leader: Nike Doggart
Mammal specialists: Francesco Rovero and Claire Bracebridge
Primatologist: Andrew Perkin
Herpetologist: Michele Menegon
Ornithologists: Leonsi Mlawila and Maneno Mbilinyi
Research Officer: Charles Leonard
Field Assistants: Amani Maundu, Esi Mlawila, Costi Mbilinyi and Felista Mbilinyi.

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Report writing

The report has been written by Francesco Rovero, Michele Menegon, Andrew Perkin, Charles Leonard and Nike Doggart. Authors of the individual chapters are indicated in the text.

Editing

The overall editing of the report was carried out by Nike Doggart.

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1) Introduction

1.1 Background to the project

This report documents the results of biodiversity surveys carried out in the Udzungwa Mountain forests of Mufindi District through the 'Filling the Knowledge Gap' project. 'Filling the Knowledge Gap (FTKG): Surveys of Poorly Known Sites and Species in the Eastern Arc and Coastal Forests of Tanzania' is a partnership project between the Tanzania Forest Conservation Group (TFCG) and the Museo Tridentino di Scienze Naturali (MTSN). The project is financed by the Critical Ecosystem Partnership Fund, a joint initiative between Conservation International, the Global Environmental Facility, the World Bank, the Government of Japan and the MacArthur Foundation.

The purpose of the project is that:

Protected area authorities, conservation organizations and other stakeholders within the Eastern Arc and Coastal Forests are planning and implementing conservation activities using current, relevant and accurate information on the status of selected sites and species.

The project focuses on increasing the knowledge of the vertebrate biodiversity of the Tanzanian Eastern Arc Mountains with a particular focus on three isolated montane forest sites (the North Pare, Udzungwa (Mufindi side) and Rubeho (Mpwapwa side) Mountains) as well as selected coastal forests in Tanga, Coast and Lindi regions. The project team also visited the Nguu Mountains. The taxonomic focus of the project is on vertebrates, particularly primates, hyraxes, sengis, carnivores, forest antelopes, birds, amphibians and reptiles. The sites and taxa have been selected on the basis of gaps in our knowledge of the biodiversity of the hotspot, consultation with other researchers and also based on the strengths of TFCG and MTSN's research scientists.

The overall objectives of the surveys were:

1. To conduct field surveys of the vertebrate fauna and habitat condition for the Mufindi forests.
2. To address key gaps in our knowledge of the distribution and conservation status of diurnal primates, duikers, galagos, sengis, tree hyraxes, selected amphibians (bufonids and microhylids) and reptiles in the Mufindi forests.
3. To provide data on the distribution and relative abundance of duikers, galagos, diurnal primates, sengis, tree hyraxes, selected amphibians (bufonids and microhylids) and reptiles to the relevant IUCN-SSC Specialist Groups
4. To document indigenous knowledge of diurnal primates, duikers, galagos, sengis and tree hyrax.
5. To train protected area authority staff in monitoring and surveys techniques.
6. To train members of local communities in monitoring techniques.

The Mufindi forests are amongst the least surveyed forests in the Eastern Arc. In keeping with FTKG's objectives, biodiversity surveys were conducted in nine forests: Lulanda, Ipafu, Kigogo, Mufindi Scarp East, Mufindi Scarp West, Kidegemsitu and three forest patches belonging to Unilever Tea Tanzania Limited (UTTTL) forests in Ifupira, Lupeme and Livalonge tea estates. The surveys were carried out between February and August, 2006.

As part of the FTKG project, training was conducted in Mufindi forests to two district forest officers, two division forest officer and eight village environmental committee members. They were trained in forest disturbance survey techniques. The aim of the training was to provide capacity building to the protected area staff towards conserving and monitoring the Mufindi forests

1.2 Report structure

The report is organised in 11 sections. The report begins with an executive summary, which gives an outline of the overall findings of the Mufindi surveys.

The introduction contains an overview of the Filling the Knowledge Gap project and a description of the study area, including an overview of the location, geology, climate, hydrology, altitudinal range and

vegetation of the Mufindi forest in southern Udzungwa Mountains. This section also includes a history of biological research and conservation initiatives in the Mufindi.

Chapter 2 provides descriptions of each forest surveyed including general information about the forest such as location, map, soils, climate, vegetation, catchment and timber values.

The next five sections have information on the medium and large mammals, nocturnal mammals, small mammals, birds and herpetofauna of the Mufindi forests. Each section includes an introduction, aims, sampling intensity, results and discussion.

Section 8 outlines how the forests have been disturbed by human activities including timber extraction, pole cutting, wildlife trapping and fire.

Section 9 documents the indigenous knowledge of local people in the Mufindi forests. This includes information on sacred sites, traditions and observations of local wildlife including myths, behavioural observations, local names, hunting techniques and human – wildlife conflicts.

In the final sections, conclusions as well as conservation recommendations are made.

A detailed description of the methods used during these surveys is provided in Doggart *et al* 2006 c.

1.3 An overview of the Mufindi forests

1.3.1 Location

The Udzungwa Mountains are the largest of 13 mountain blocks that comprise the Eastern Arc in Tanzania. The Eastern Arc is a chain of block-faulted, crystalline mountains under the climatic influence of the Indian Ocean (Lovett 1985). The Udzungwa Mountains stretch across four districts in Tanzania. A small part is within Kilosa District and a strip of land is within Kilombero District (both Morogoro Region) and the rest is found in Kilolo and Mufindi Districts of Iringa Region. The Udzungwa Mountains extend over 1,613,140 ha (FBD, 2006 c) and are at the south-western end of the Eastern Arc Mountains. To the north lie the Rubeho Mountains while to the north-east lie the Uluguru and Malundwe Mountains.

The Udzungwa Mountains in Mufindi district represent the westernmost tip of the Eastern Arc. There are 12 Eastern Arc forest reserves in Mufindi District (based on FBD List of Forest Reserves in Tanzania). Of these four are Central Government protective Forest Reserves, that are managed as Catchment Forest Reserves (Uzungwa Scarp (extends west from Kilombero District), Mufindi Scarp East, Mufindi Scarp West and Kigogo) and eight are Local Authority Reserves (Lugoda Lutali (includes Luhunga, Igoda, Mkonge, Kitwite, Ipafu and Lugoda Lutali forests), Lulanda, Kidete, Mpanga, Kidegemitu, Kibao, Mpanga and Madisi). In addition there are some extensive areas of natural forest on private land including on the Malenda, Brooke Bond, Unilever (4106 ha) and Kyfulilo Farm. There is also a proposed village forest at Nandala Village.

The Catchment Forest Reserves are the most extensive category of protected area in Mufindi covering a total of 21,800 ha. Private forests are also extensive in this District, covering 13,450 ha. While Local Authority Forest Reserves cover 1,500 ha (Burgess *et al.* 2007).

1.3.2 Geology and soils

According to Lovett & Pócs (1993), generally Mufindi forests have well drained brown sandy loams developed over gneiss rocks. In some forests, for instance Kigogo and Mufindi Scarp East, the drained brown sandy loamy soils occur with outcrops of granite and clay stones.

1.3.3 Climate

According to Lovett & Pócs (1993), the climate in the Udzungwa Mountains of Mufindi is characterized by oceanic rainfall with oceanic/continental temperatures. The nearest rainfall stations are at Mufindi Forest Station (for Kigogo and Mufindi Scarp West), Kibwele Tea Factory (for Lulanda) and Kilima Tea Factory (for Mufindi Scarp East). Rainfall ranges between 600-2000 mm / year. The dry season extends between June - November. Temperatures vary from 20 °c max (December) to 15 °c min (July).

1.3.4 Hydrology

The Udzungwa Mountain forests in Mufindi district are part of the catchment area for the Rufiji River. The Rufiji River basin covers an area of 177,420 km² and has three major tributaries: the Great Ruaha River, the Kilombero River and the Luwegu River. The basin covers eight regions including Iringa region and 21 districts including Mufindi District. There are more than 30 rivers that contribute water to the Rufiji's major tributaries. In Mufindi District, the major rivers carrying water from the Udzungwa Mountain Forests into the Rufiji basin include the Kigogo River which flows from Kigogo Forest Reserve, the Little Ruaha flowing to the North of the Udzungwas, the Kihansi and Kilombero Rivers (www.rufijibasin.com).

Two biologically important areas that rely on water from Mufindi's catchment forests are the Kihansi Waterfalls and the Kilombero Valley. The Kihansi Falls are home to the critically endangered Kihansi Spray Toad *Nectophrynoides asperginis* and two endangered plant species including a wild coffee. The falls also support the Lower Kihansi Hydropower Project which contributes about 180 MW to the national grid.

The Kilombero Valley was declared a Ramsar site in 2002. The valley lies between the the Udzungwa Mountains at the northwestern side and the Mahenge Mountains on the southeastern side. Rivers flowing out of Mufindi District and into the Kilombero Valley include: the Kigogo, Kihansi, Ruhudji, Mnyera and Pitu Rivers. These rivers divide into a myriad of tributaries in the central part of the floodplain.

The Kilombero Valley is a key part of the Selous-Kilombero seasonal wildlife migrations. The valley contains almost 75 % of the world's population of the wetland dependent Puku antelope *Kobus vardonii*. The Crocodile population of the Kilombero and Selous is one of the most significant populations of *Crocodylus niloticus* in the world. The valley also provides an important dry season habitat for large mammals, particularly *Loxodonta africana*, *Hippopotamus amphibius* and *Syncerus caffer*. Three endemic birds are known; the weaverbird *Ploceus burnieri* and two undescribed species of Cisticola. In the wet season it is an essential spawning area for many fish species found in the Rufiji River system. Of these, two are endemic species *Citharinus congicus* and *Alestes stuhlmanni* (www.wetlands.org).

The Kilombero Valley also supports both subsistence and commercial agriculture including the Kilombero Valley Teak plantation. The river is also an important source of fish for fishing communities.

1.3.5 Altitudinal range

Mufindi's Eastern Arc forests extend along the main Mufindi plateau. The altitude of the plateau ranges from approximately 1500 m asl to the highest point at 2072 m asl at Sawala (Baker & Baker 2002). The southern extent of the plateau is covered with steep hills ranging in altitude from 1300 – 2000 m asl, while the topography further north is more gentle at around 1900 m asl. At the southern edge of the Mufindi plateau, the land drops steeply down an escarpment towards the Kilombero Valley at approximately 1000 m. It is this escarpment which lends its name to Mufindi Scarp East and West and to Uzungwa Scarp. At Uzungwa scarp, forest extends down this escarpment although further west there are only narrow stretches of forest from Kigogo Forest Reserve that descend down the escarpment. The remainder of the forest being confined to the plateau area with open woodland and thicket on the escarpment.

Overall, the altitudinal range of forests in the Udzungwa Mountains ranges from 300 to 2580 meters above sea level (Burgess *et al.*, 2007).

1.3.6 Forest change

A recent study by the Forestry and Beekeeping Division (FBD 2006 c) indicated that the area of forest in the Udzungwa Mountains has declined from 138,370 ha in 1979 to 135,280 ha by 2000. This represents a decline of 3,090 ha of forest over a period of 21 years, with most of the loss (2980 ha) occurring during the 1980s. Over the 21 years, the annual rate of forest loss has been 0.1 %. Newmark (1998) estimated that historically forest cover in the Udzungwa Mountains has extended up to 210,300 ha. Unfortunately it is not possible to clearly determine the rate of loss for the Mufindi forests specifically.

Woodcock (1998) documented forest decline in Lulanda where more than 60 % of the forest was cleared between 1945 and 1997.

1.3.7 Other research done in the area

Several studies have been carried out on the forest biodiversity of Mufindi District. Lovett & Pócs (1993) conducted an assessment of the condition of the catchment forest reserves in Iringa region including the catchment forests in Mufindi District. In Mufindi the study covered Idewa, Ihangana, Kibao, Kidete, Kigogo, Lugoda Lutali, Myangala, Mufindi Scarp East, Mufindi Scarp West and Lulanda Forests. The study provided an overview of the vegetation, biodiversity values, catchment values and conservation issues for each forest. Section 2 has more detailed information on the reserves which were covered by the Lovett & Pócs' study.

Lovett and Congdon also published three papers in the Journal of the East African Natural History Society about the Mufindi Forests based on their time in Mufindi associated with the tea estates (Lovett 1989, Lovett and Congdon 1989 and Lovett and Congdon 1990). The papers provide brief notes on the botanical composition of Luisenga stream, Lulanda and Kigogo forests with a particular focus on restricted range species.

With support from the Tanzania Forest Conservation Group, there have been three recent studies that have focused on Lulanda Forest.

Kerry Woodcock used Lulanda as one of her study sites for her doctoral thesis (Woodcock 2002). This research looked at the changing roles of different institutions in forest conservation over the 20th Century. In the case of Lulanda, using aerial photographs she documented that more than 60 % of the forest was cleared between 1945 and 1955, largely in response to directions from the British administration to clear the forest to make way for coffee plantations. Woodcock (1998) summarises how effective forest management has been under different scenarios in Lulanda, observing that the participatory approach promoted by TFCG from the mid- 1990s has at least halted further decline in the forest.

In 2001, the Tanzania Forest Conservation Group conducted research on the ecology of the Lulanda corridor with a view to improving the management and monitoring of the area (Doody 2002). The research documented the botanical composition of the three forest corridors (two in Lulanda and one in Luhunga) and made comparisons between the botanical composition of the corridors with that of the adjacent natural forests. The report concluded that while there are significant differences in the current botanical composition, there were signs of regeneration of species that dominate the natural forest.

In 2002, researchers from University of Newcastle UK together with Tanzanian researchers from Sokoine University and University of Dar es Salaam conducted an assessment of the Forest Corridor Programme in Lulanda forest (Hayhow *et al.* 2003). The team compared the biodiversity values of the forest corridor between Fufu and Mgwilwa and the forests themselves. The team focused on the vertebrate diversity of the two areas and found that there were still significant differences between the two areas but concluded that the corridor contributed positively to the conservation of the Lulanda Forest and that there were initial signs of some of the forest associated species using the corridor.

1.3.8 Conservation initiatives

The studies outlined in the previous section have all highlighted the threats facing the forests in Mufindi. Several conservation initiatives have attempted to address these threats. Some of the larger conservation initiatives in the Mufindi forests are described briefly in this section.

Mufindi Forest Conservation Project

This project is conducted by the Tanzania Forest Conservation Group (TFCG). TFCG has been providing support for forest conservation in the Southern Udzungwa Mountains in Mufindi district since 1995. The support has been focused on Participatory Forest Management for six forests covering 620 ha and working with six villages. The project has also been working with communities to increase household incomes through activities such as fish farms, improved fruit crops etc.

In addition TFCG has been reforesting areas of land that act as corridors between forest fragments. Through enrichment planting and fire protection, forest species are beginning to return to the corridors.

Detailed information on the project is available at www.tfcg.org

Hifadhi Ya Mazingira (HIMA) Programme (1998-2002).

This was a land use management and natural resource conservation programme established in Iringa region including Mufindi district. The programme covered Kifyoya, Masuni and Mandumbuli forests in Sadani division in Mufindi with the aims of improving the productivity and sustainability of agriculture and natural resources management, improving catchment protection, reducing soil erosion while improving moisture retention in priority catchments. HIMA also aimed at strengthening local institutions to enable them to support local communities in achieving viable and sustainable agricultural, natural resources management and catchment protection. Activities included training to farmers' extension staff, research, local institutional capacity building, awareness raising and support to villagers on natural forest management and appropriate land use.

UTTL Biodiversity Action Plan

Unilever Tea Tanzania (UTT) developed a Biodiversity Action Plan in 2003 in an effort to minimize the threats which face the natural forests that occupy more than 65 % of the land within UTT's Mufindi tea estates. Through this biodiversity action plan, the company has set guidelines to prevent agricultural encroachment into the high biodiversity forests and felling of indigenous trees. Furthermore, in ensuring that threats are avoided the company provides alternative sources of firewood to its employees.

Lower Kihansi Environmental Management Project (LKEMP).

The project was established in order to reduce the downstream threat of habitat loss as a result of the Kihansi Hydropower project in the Kihansi Gorge. The LKEMP is implemented by the Government of Tanzania through the Environment Division under the Vice President's Office together with the Ministry of Natural Resources and Tourism and Tanzania's National Environmental Management Council. The objective of this project is to put in place a series of measures for the long term conservation of the Kihansi Gorge ecosystem and upstream catchment areas. At the national level, the project has the objective of supporting the development of a coordinated and consistent legal and constitutional framework for environmental and water resources management and strengthening of ecosystem monitoring and assessment functions of environmental institutions.

Mufindi Environmental Trust

Other conservation initiatives in Mufindi include conservation activities carried out by Mufindi Environmental Trust (MUET). This is a non-government organisation which supports afforestation and environmental awareness raising in villages in Mufindi district.

Socio-economic context and history

Historically there is some evidence to suggest that significant parts of the land now forested, were once agricultural land. Lovett (unpubl.) quotes Greenway (1973) who observed that forests at Mufindi and nearby Dabaga (08° 05' S 35° 56' E) showed "... almost everywhere, past cultivation in the form of crop ridges and furrows when the forest floor herbage is removed". Lovett poses the hypothesis that small pox decimated the population in this area during the 18th Century. Congdon (pers. Comm.) noted that when the tea estates were recruiting workers in the 1950s there were few people living in the area and so workers were recruited at Ukinga with lorries transporting workers on a weekly basis between Ukinga and Mufindi. Lovett attributes the botanical paucity of several of the Mufindi forests to forest clearance over the last few centuries which has left a forest dominated by more widespread Afrmontane species in contrast to other Eastern Arc Mountain forests at comparable altitude such as West Kilombero Scarp which include more restricted range tree species.

2) Forest Reserve descriptions

This section provides detailed descriptions of Ifupira, Igoda, Ipafu, Kidegemsitu, Kigogo, Livalonge Lulanda, Lupeme, Mufindi Scarp East and Mufindi Scarp West.

2.1 Ifupira Forest

Iringa Region, Mufindi District

Altitudinal range: 1900 – 2000 m asl

Access

From the Mafinga – Sawala Road turn left before Sawala towards Ifupira Village. Immediately after Ifupira Village turn right towards Mdabulo. The road cuts through the forest.

Description

The forest belongs to Unilever Tea Tanzania Limited. It is part of a mosaic of forest, tea and traditional agriculture that extends over 15 km in a north east / south west direction on the Mufindi plateau. The area visited by the survey team was centred around 9061500 and 768200. It is part of the same mosaic as Lupeme Forest.

Topography and Hydrology

The forest extends around two river valleys, the southernmost is the Lilasi River valley. There is a UTTL dam close to the road within the forest which is where the team established their camp site.

2.2 Igoda Forest

Originally part of the Lugoda-Lutali Local Authority Forest Reserve

Iringa Region, Mufindi District

Year of establishment: unknown

Declaration: unknown

Border map: The Igoda forest was surveyed by Mufindi District Council Surveys Office in July – August 2000 with support from the Tanzania Forest Conservation Group. The map does not have a JB number. We were unable to trace the original map for the Lugoda Lutali reserve.

Topographic maps: 248 / 2 – 249 / 1

Gazetted area: 80.3 ha

Gazetted boundary length: unknown

Location: 9053200 - 9054500

774300 - 776000

Altitude: 1720 – 1820 m asl

Access

The forest is located on the Eastern edge of Igoda Village. The Sawala – Lulanda road cuts through the forest.

Description

Igoda is part of the fragmented Lugoda-Lutali Local Authority Forest Reserve which also includes Kitwite, Igoda, Mholomelwa, Lugodalutali, Ipafu and Mkonge forests. Although this forest does not appear in the list of Tanzanian Forest Reserves nor on the 1959 map of Tanzanian Forest Reserves, it is listed in the List of Mufindi Forest Reserves (Mufindi District Council 2006)

Climate (from Lovett & Pócs 1993)

Oceanic rainfall with oceanic/continental temperatures. Rainfall: 1400 mm/year (Kilima Tea Factory). Dry season: June - November. Temperatures: 19° C max. (November), 14° C min. (July).

Vegetation (based on research carried out in 2000 by Moses Mwangoka, TFCG Botanical Collector)

Montane forest dominated by *Parinari excelsa*, *Macaranga kilimandscharica* and *Bersama abyssinica*. Other common tree species found within the forest include *Bridelia micrantha*, *Albizia gummifera* and *Aphloia theiformis*. Occasional trees include: *Kiggelaria africana* and *Xymalos monospora*. Common

shrubs include *Tecoma nyassae*, *Erthyrococca* sp., *Clutia abyssinica*, *Solanum* sp. and *Psychotria goetzi*. Other shrubs include: *Triumfetta* sp., *Rhus longipes*, *Ipomaea involucrata* and *Rauvolfia* sp..

Common herbs include *Bidens* sp., *Vernonia* sp., *Rubus* sp., *Isoglossa lactea* and *Mimulopsis solmsii*.

Climbers include *Clematis simensis*, *Tarenna roseicosta*, *Rutidea orientalis* and *Asparagus setaceus*.

Topography and hydrology

The forest extends over a gently undulating part of the Mufindi plateau. The Fyogo river skirts the northern tip of the forest. A stream flows from east to west through the middle of the forest which joins the Mpanga River further south-east.

2.3 Ipafu Forest

Originally part of Lugoda-Lutali Forest Reserve.

Iringa Region, Mufindi District

Year of establishment: unknown

Declaration: unknown

Border map: The Ipafu forest was surveyed by Mufindi District Council Surveys Office in July – August 2000 with support from the Tanzania Forest Conservation Group.

Topographic maps: 249 / 1

Gazetted area: 109 ha

Altitude: 1700 - 1820 m asl

Location: 9052755 to 9054375
776550 to 777875

Access

The forest is adjacent to Ikaning'ombe Village. The Sawala – Lulanda road cuts through the northern end of the forest. Ipafu forest is 500 m east of the Igoda forest.

Description

Igoda is part of the fragmented Lugoda-Lutali Local Authority Forest Reserve which also includes Kitwite, Igoda, Mholomelwa, Lugodalutali, Ipafu and Mkonge forests. Although this forest does not appear in the list of Tanzanian Forest Reserves nor on the 1959 map of Tanzanian Forest Reserves, it is listed in the List of Mufindi Forest Reserves (Mufindi District Council 2006)

Climate (from Lovett & Pócs 1993)

Oceanic rainfall with oceanic / continental temperatures. Rainfall: 1400 mm / year (Kilima Tea Factory).

Dry season: June - November. Temperatures: 19° C max. (November), 14° C min. (July).

Vegetation (based on research carried out in 2000 by Moses Mwangoka, TFCG Botanical Collector)

Montane forest dominated by *Parinari excelsa*, *Xymalos monospora*, *Ochna holstii*, *Millettia dura* and *Albizia gummifera*. Other tree species include *Vepris* sp., *Rytigynia lichenoxenos* and *Eugenia* sp. Dominant shrubs include *Chassalia subochreatea*, *Psychotria* sp., and *Maytenus* sp. Other shrubs include *Dalbergia lacta*, *Dracaena laxissima*, *Pavetta lynesii*, *Allophyllus ferrugineus*, *Helixanthera* sp., *Coffea mufindiensis* and *Clutia* sp. Climbers include *Artobotrys* sp..

Topography

The reserve extends over two east – west oriented valleys. There is a steep slope from the valley below the reserve, rising up to 1820 m at the top of the forest. The streams are tributaries to the Mpanga River.

2.4 Kidegemsitu Forest

Iringa Region, Mufindi District

Year of establishment: 1945

Declaration: Local Authority Forest Reserve

JB Map: 82 (1945)
Topographic maps: 232 / 4
Forest area: 218 ha
Altitude: 1840 - 1920 m asl
Location: 9064800 - 9065700
7769500 – 771500

Access

The closest village to Kidegemsitu Forest is Ludilo Village. From the Mafinga - Sawala road turn left towards Ifupira village. Immediately after Ifupira Village take the left hand fork towards Ludilo Village. Alternatively turn right at Itulavanu from the Mafinga – Sawala road towards Ifwagi. From there head south via Ikonongo to Ludilo. From Ludilo it is a 1 km walk in a northwesterly direction.

Description

Kidegemsitu is not cited in the list of Tanzanian Forest Reserves but is included as a Local Authority Reserve in the Mufindi District list of reserves. We were unable to trace any information about the gazettelement notice.

On the topographic map a second part of the forest is shown to the north of the patch visited by the survey team. The northerly forest patch appears to have been entirely cleared.

Vegetation

Disturbed montane forest. The least disturbed forest is on the western edge of the forest patch.

Topography and hydrology

The reserve extends up a gentle slope on the side of a small valley. The stream in the valley flows into the Mafindasa River.

2.5 Kigogo Catchment Forest Reserve

Mufindi District, Iringa Region

Year of establishment: 1952
Declaration: GN 131 of 1952
Border map: JB 120 (1:10,000) of 23/1/52
Topographic maps: 248/1, 248/2
Gazetted area: 6232 acres (2522 ha)
Gazetted boundary length: 97,430 feet (29.7 km)
Location: 08°37'40" - 08°41'40"S; 35°11'45" - 35°16'30"E
Altitude: 1770 - 1940 m.



Map 3. Kigogo Forest Reserve JB Map

Access (from Lovett & Pócs 1993)

About 55 km from Mafinga. Access to the northern boundary is 6 km South of Mninga Village and 1 km South of Mkalala Village. The beginning of the forest road to the view point on the escarpment is 7 km from the head office of Unilever Tea (T) Ltd., at Lugoda on Kivere Estate. The reserve covers the Mufindi escarpment and Kigogo and Ngalawa valleys. It is contiguous with and lies north-east of Mufindi Scarp West Forest Reserve, and is west of Mufindi Scarp East FR.

Soils (from Lovett & Pócs 1993)

Under forest: Well drained brown sandy loams over gneiss. Outcrops of clay with stones occur.

Climate (from Lovett & Pócs 1993)

Oceanic rainfall with oceanic/continental temperatures. Nearest rainfall station: Mufindi Forest Station. Estimated rainfall: 2000 mm/year. Dry season: June - November. Temperatures: 20° C max. (Dec.), 15° C min. (Jul.).

Vegetation (from Lovett & Pócs 1993)

Kigogo Forest Reserve is montane forest with extensive areas of bamboo, both in single-species stands and in forest understory. Parts of the reserve are secondary over old cultivation.

Montane forest: Canopy to 20 m. Trees include: *Albizia gummifera*, *Aphloia theiformis*, *Bersama abyssinica*, *Bridelia brideliifolia*, *Cassipourea gummiflua*, *Cryptocarya liebertiana*, *Ilex mitis*, *Macaranga kilimandscharica*, *Maytenus acuminata*, *Nuxia congesta*, *Ochna holstii*, *Parinari excelsa*, *Phoenix reclinata*, *Pittosporum viridiflorum*, *Podocarpus*, *Rapanea melanophloeos*, *Rytigynia lichenoxenos*, *Rytigynia uhligii*, *Schrebera alata*, *Sinarundinaria alpina*, *Syzygium guineense* subsp. *afromontanum*, *Vepris stolzii*, *Xymalos monospora*. In lower parts of the forest, where it is adjacent to Mufindi Scarp East FR, trees may include: *Allanblackia stuhlmannii*, *Cylicomorpha parviflora*, *Chrysophyllum gorungosanum*, *Garcinia volkensii*, *Galiniera saxifraga*, *Myrianthus holstii*, *Neoboutonia macrocalyx*, *Polyscias fulva*, and *Strombosia scheffleri*.

Topography and hydrology (from Lovett & Pócs 1993)

The Kigogo River flows down the escarpment and is an important source of water for the Mufindi Paper Mills on the Mgololo plain below the escarpment. There are many other small streams flowing to the East and West down the escarpment. Water from these is used for small scale irrigation of vegetable plots and general use by the local people.

Timber values (from Lovett & Pócs 1993)

Ocotea and *Khaya nyasica* formerly occurred, but stocks are now exhausted. Lower grade timber includes: *Albizia gummifera*, *Bridelia brideliifolia* and *Chrysophyllum gorungosanum*. *Podocarpus* also occurs, though no large trees were seen.

Biodiversity (from Lovett & Pócs 1993)

The reserve contains quite a number of Eastern Arc endemics. Animals include: Red Duiker, Livingstone's Suni, Bushbuck, Blue Monkey, Bushpig, Red-legged Sun Squirrel. Birds include: Mountain Greenbul, White-chested Alethe, Olive-flanked Ground Robin, Iringa Ground Robin, Spot-throat, Red-capped Forest Warbler, Chapin's Apalis, and Njombe Thick-billed Seed-eater. Kigogo is the type locality of the bird *Francolinus squamatus uzungwensis*. Before 1960 buffalo were common, though none exist there today. Similarly Harvey's red duiker, Livingstone's Suni and leopard were once common but are rare now due to extensive hunting and trapping. Blue monkeys occur, but Black and White, and Red Colobus have never been seen. Butterflies include: *Acraea vuillotii*, *Chondrolepis obscuriora*, *Chondrolepis similisa* and a new species of *Anthene*. Rare and interesting plants include: *Aframomum laxiflorum*, *Afrothismia insignis*, *Allanblackia stuhlmannii*, *Bersama rosea*, *Coffea mufindensis*, *Oxyanthus lepidus* subsp. *kigogoensis*, *Psychotria megalopus*, *Stolzia christopherii*, *Stolzia leedalii*, and a tree *Annonaceae* that has yet to be placed to genus.

Human impacts (from Lovett & Pócs 1993)

Paths crossing the reserve are used by people who live on the plateau, but cultivate on the fertile land below the escarpment. The main path through the reserve is also quite important for trade during the Ulanzi (bamboo wine) season. The Ulanzi season on the escarpment and in the valley are slightly out-of-phase giving rise to a brisk trade. In the northern part of the reserve a road has been placed along the trace of a traditional footpath in order to reach a view point. There is also a path along the Kigogo river which was used by fishermen. The river itself was stocked with trout. An arboretum and forest station were established some time ago, but are now abandoned.

Parts of the forest currently under closed canopy cover were formerly cultivated as indicated by cultivation ridges. The cultivation and subsequent regeneration are probably at least 150 years old. There are many areas of cultural importance within the reserve which are related to former inhabited

sites. More recent disturbance comes from logging for *Ocotea* and *Khaya nyasica*. There are many old buffalo traps, and hunting for smaller animals is still practised. Fuelwood, building poles and bamboo for basket making are extracted on a small scale.

2.6 Livalonge forest

Iringa Region, Mufindi District

Topographic map: 248/1

Altitude: 1880 – 1960

Access

Livalonge forest can be accessed by road from Mafinga (via Nyololo and Igowole divisions) through Ithomasa village to UTTL's Livalonge tea estate. The forest is adjacent to the tea estate. Alternatively, the forest can be accessed from Mafinga to Livalonge tea estates through roads which cut across the tea estates including the UTTL's Lugoda and Kivere tea estates. Livalonge forest is contiguous with Mufindi Scarp West on its south/south-eastern side.

Description

The forest belongs to the UTTL and is centred on 737520 / 9039314. The forest range extends for about 3 km in the north-west / south-east orientation. Tea, cinchona and subsistence crops surround the forest on its north / north-west, south and western sides. Much of the forest interior is occupied by high canopy trees while most of the forest edge especially on the southern edge is dominated by smaller trees and a shrubby tangle of vines and *Rubus* sp..

2.7 Lulanda Forest Reserve

Iringa Region, Mufindi District although on map sheet 249/1 Lulanda is placed in Iringa District.

Declaration : Not known to be officially declared

Topographic map : 249/1

Measured area : 196.7 ha (three patches 89.3, 24.8, 82.6 ha) Lulanda Forest was surveyed by Mufindi District Council Surveys Office in July – August 2000 with support from the Tanzania Forest Conservation Group.

Measured boundary length : 1310 m (13.1 km)

Location: 08°35'15" - 08°17'07"S; 35°36'50" - 35°38'15"E

Altitude: 1480 - 1640 m asl.

Access

About 75 km from southeast of Mafinga. Access is from the road through Mdabulo mission, Ihanu and Ibwanzi villages to Lulanda village. The forest is located in the southern Udzungwa Mountains, (5 km East of Mufindi Scarp East Forest Reserve) in two valleys on the edge of the east facing escarpment from 1480 - 1640 m.

Soils (from Lovett & Pócs 1993)

Under forest: Well drained brown sandy loams over gneiss.

Climate (from Lovett & Pócs 1993)

Oceanic rainfall with oceanic/continental temperatures. Nearest rainfall station: Kibwele Tea Factory.

Estimated rainfall: 1600 - 2000 mm / year with a mist effect. Dry season: June - November.

Temperatures: 19° C max. (November), 14° C min. (July).

Vegetation (from Lovett & Pócs 1993)

The three forest patches are montane forest with swampy open areas in valley bottoms.

Montane forest: Canopy to 30 m, intact in parts but generally much disturbed following extraction of timber species. Larger trees include: *Alangium chinense*, *Albizia gummifera*, *Allanblackia stuhlmannii*, *Apholia theiformis*, *Bersama abyssinica*, *Bridelia brideliifolia*, *Caloncoba welwitschii*, *Canthium oligocarpum*, *Cassipourea gummiflua*, *Chrysophyllum gorungosanum*, *Cola greenwayi*, *Cryptocarya liebertiana*, *Cylicomorpha parviflora*, *Drypetes gerrardii*, *Drypetes usambarica*, *Garcinia volkensii*, *Isolona hexaloba*, *Ixora scheffleri*, *Maytenus acuminata*, *Myrianthus holstii*, *Myrica salicifolia* (on the edges), *Pancovia golungensis*, *Parinari excelsa*, *Polyceratocarpus scheffleri*, *Polyscias fulva*, *Rauvolfia*

caffra, *Rawsonia reticulata*, *Schefflera goetziana*, *Schrebera alata*, *Strombosia scheffleri*, *Trichocladus ellipticus*, *Trilepisium madagascariense*, *Vitex amaniensis* and *Xymalos monospora*.

Swamps: Thick herbaceous cover to 3 m tall with *Mimulopsis* and *Cyathea*. Trees include: *Anthocleista grandiflora* and *Hallea rubrostipulata*.

Topography and Hydrology Values (from Lovett & Pócs 1993)

The forest protects a small catchment with year round stream flow. The water is used for domestic consumption and small scale irrigation.

Biodiversity (from Lovett & Pócs 1993)

For such a small forest Lulanda contains a remarkable number of interesting species, and with nearly forty large tree species recorded it has a high diversity. Mammals include: Black-and-White Colobus, and formerly Red Duiker and Livingstone's Suni. Birds include: Buff-spotted Pygmy Crake, Mountain Greenbul, Little Greenbul, Shelley's Greenbul, Yellow-streaked Greenbul, Olive Mountain Greenbul, Chapin's Apalis, Black-headed Apalis, Brown-headed (Grey) Apalis, Bar-throated Apalis, Red-capped Forest Warbler, White-chested Alethe, Spot-throat, and Olive-flanked Ground Robin. New or interesting trees and shrubs include: *Berteria pauloi*, *Canthium* sp. nov., *Coffea* sp. nov., *Cola* sp. nov., *Drypetes gerrardinioides*, *Drypetes usambarica* var. *rugulosa*, *Lasianthus peduncularis*, *Lasiodiscus* sp. aff. *mildbraedii*, *Psychotria megalopus*, *Trichilia lovetii* and *Zimmermaniopsis uzungwae*.

Human Impacts (from Lovett & Pócs 1993)

Recent timber extraction has heavily disturbed the forest, opening the canopy in many areas. There is encroachment for cultivation along the edges of the forest. Building poles, firewood and medicines are taken. There is a footpath through the forest linking the village with cultivated areas below the reserve.

2.8 Lupeme Forest

Iringa Region, Mufindi District

Topographic maps: 248 /2
Altitude : 1820 – 1990 m asl.

Access

From the Mafinga – Sawala road, turn left in Sawala towards the Lupeme Tea estate (and the Fox Highland Lodge). The road cuts through the forest in several places including close to the location where the surveys were undertaken.

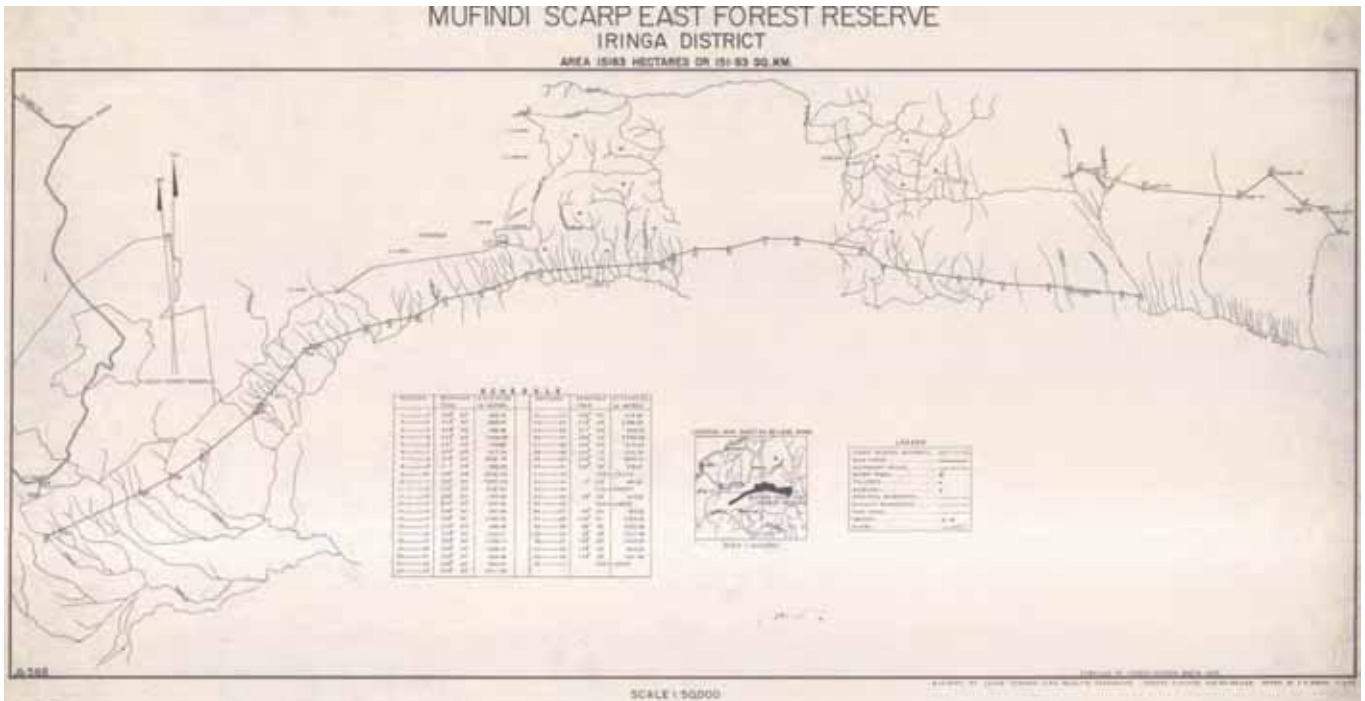
Description

The forest belongs to the Mufindi Tea Company. It is part of a mosaic of forest, tea, cinchona and traditional agriculture that extends over 15 km in a north –east / south west orientation. The area visited by the survey team was centred around 764220 / 9057436.

2.9 Mufindi Scarp East Catchment Forest Reserve

Iringa Region; Mufindi District

Year of establishment: 1954
Declaration : GN 450 of 1954
Variation Order : There must be one relating to putting the main and alternate route to Southern Paper Mills through the reserve.
Border map: JB 588 (1963)
Topographic maps : 248/1, 248/2, 249/1
Gazetted area : 15,183 ha
Gazetted boundary length : 51,736.31 m (rest curvilinear)
Location: 8°34'05"S - 08°42'40"S; 35°11'55"E - 35°36'05"E
Altitude: 860 m – 1960 m



Map 4. Mufindi Scarp East JB Map

Access (from Lovett & Pócs 1993)

40 km south of Mafinga, 3 km South of Sawala, on the Mufindi loop road. Access is from the road from Sawala to Mgololo which bisects the reserve (not shown on topographical sheet 248/2), from the road along Mpanga ridge and at many places on the escarpment from the Brooke Bond Tea Estates. The south-western limb of the reserve is bordered by Kigogo Forest Reserve to the northwest. The reserve covers a 45 km long strip of the Mufindi escarpment from southwest of Livalonga to 4.5 km southwest of Lulanda village, and the Mpanga ridge east of Kibwele Tea Estate and south of Lugoda Lutali villages from an elevation of 860 to 1960 m. It is mislabelled as Mufindi Scarp West Forest Reserve on map sheet 248/1, and as Mufindi Scarp Forest Reserve on map sheet 248/2.

Soils (from Lovett & Pócs 1993)

Under forest: Well drained brown sandy loams over gneiss or clay with stones, with small areas of granitic outcrops on the escarpment.

Climate (from Lovett & Pócs 1993)

Oceanic rainfall with oceanic/continental temperatures. Rainfall: 1450 mm/year (Kilima Tea Factory). Dry season: June - November. Temperatures: 19° C max. (November), 14° C min. (July).

Vegetation (from Lovett & Pócs 1993)

The escarpment is covered by grassland with scattered *Protea* but extends into montane forest on the lower south eastern part of the Kigogo FR. The Mpanga ridge is covered by scrubby to secondary upper montane forest on infertile clay with stones soils.

Montane forest: Canopy to 20 m. Trees include: *Allanblackia stuhlmannii*, *Cylicomorpha parviflora*, *Chrysophyllum gorungosanum*, *Garcinia volkensii*, *Galiniera saxifraga*, *Myrianthus holstii*, *Neoboutonia macrocalyx*, *Polyscias fulva*, and *Strombosia scheffleri*.

Upper montane forest: Secondary in nature on poor soils of the Mpanga ridge, with patches of wattle. The canopy is very open, but trees to 20 m occur. Trees include: *Albizia gummifera*, *Bersama abyssinica*, *Cussonia spicata*, *Dombeya torrida*, *Macaranga kilimandscharica*, *Maesa lanceolata*, *Polyscias fulva*, *Rapanea melanophloeos*. Shrubs include: *Buddleja salviifolia*, *Dodonea viscosa*, *Tecomaria*. Climbers include: *Urera*. Herbs include: *Ensete*, *Lobelia gibberroa*.

Catchment Values (from Lovett & Pócs 1993)

The Kigogo River flows through the reserve and there are numerous other small streams flowing to the East and West down the escarpment. Water from these streams is used for small scale irrigation of

vegetable plots and general use by the local people living below the escarpment, and by Southern Paper Mills for pulp processing. The escarpment is susceptible to erosion, and so the reserve protects it.

Timber Values:

Some timber species occur in the montane forest where the reserve is continuous with Kigogo FR. Stocks of Mkangazi (*Khaya nyasica*) are exhausted, but some Mlembelembe (*Chrysophyllum gorungosanum*) and other less valuable species remain.

Biodiversity (from Lovett & Pócs 1993)

The montane forest continuous with the Kigogo FR is of the Eastern Arc type and contains a number of species of restricted distribution including: *Allanblackia stuhlmannii* and *Psychotria megalopus*. On the Mpanga ridge the forest is secondary and contains few species of restricted distribution. Birds include: *Buteo oreophilus*, *Cossypha anomala*, *Sheppardia lowei*, *Orthotomus metopias*, *Andropadus tephrolaemus* and *Alcippe abyssinica*.

Human Impacts (from Lovett & Pócs 1993)

Areas of thicket on the Mpanga ridge were under cultivation prior to gazettelement. The reserve is traversed by traditional footpaths in a number of places. Fire occurs in the escarpment grassland most years. Fuel wood, poles, and other forest products are used by the villages on the northern boundary. A road 40 m wide and about 13 km long (about 52 ha) has been cleared along the Mpanga ridge. The main road from Sawala to the Mufindi Paper Mills at Mgololo traverses the escarpment. A small road south of the Luisenga river traverses the escarpment, but is very eroded at the bottom.

2.10 Mufindi Scarp West Forest Reserve

Iringa Region; Mufindi District

Declaration:	Not seen
Border map :	JB 587 1963 (1:50,000)
Topographic map :	248/1
Gazetted area :	4576 acres (1851.8 ha)
Gazetted boundary length :	8607 m (28,239 ft.) rest curvilinear
Location:	08°41'15"S - 08°43'50"S; 35°07'40"E - 35°10'50"E.
Altitude:	1300 – 1860 m asl

Access

140 km from Mafinga (via Ngwazi), 12 km from Igowole. Access is from Udumka or Ihomasa village. The road from Kifyulilo Tea Research Station to Ihomasa passes through the northern edge of the reserve for a short distance, and Malenda Farm borders the reserve. The reserve covers part of the Mufindi escarpment south of Ihomasa together with hills and valleys behind the escarpment with an elevational range of 1300 m to 1860 m. The area marked Mufindi West Scarp FR on map sheet 248/1 includes part of Mufindi Scarp East FR to the east, and extends west of the actual boundary.

Soils (from Lovett & Pócs 1993)

Under forest: well drained brown sandy loams over gneiss.

Climate (from Lovett & Pócs 1993)

Oceanic rainfall with oceanic/continental temperatures. Rainfall: 2000 mm/year (Mufindi Forest Station).

Dry season: June - November. Temperatures:

20_C max. (Dec.), 15_C min. (Jul.).

Vegetation (from Lovett & Pócs 1993)

The steep escarpment is covered by grassland with scattered *Protea* sp., with montane forest in the northern and central part of the reserve, edged by scrubby thicket. The montane forest is probably secondary as the reserve was formerly inhabited.

Montane forest: Canopy to 15 - 20 m. Trees include: *Albizia gummifera*, *Allophylus africanus*, *Apholia theiformis*, *Bersama abyssinica*, *Bridelia bridelliodes*, *Canthium oligocarpum*, *Catha edulis*, *Chrysophyllum gorungosanum*, *Croton sylvaticus*, *Cussonia spicata*, *Diospyros whyteana*, *Macaranga kilimandscharica*, *Maesa lanceolata*, *Neoboutonia macrocalyx*, *Nuxia congesta*, *Oxyanthus speciosus*, *Pittosporum viridiflorum*, *Polyscias fulva*, *Psychotria mahonii*, *Rapanea melanophloeos*, *Strychnos mitis*,

Syzygium guineense subsp. *afromontanum*, *Syzygium masukuense*, *Vepris stolzii*, *Xymalos monospora*. Trees at the forest edge include: *Buddleja salviifolia*, *Dombeya torrida*, *Flacourtia indica*, *Heteromorpha*, *Myrica salicifolia*, *Osyris lanceolata*. Shrubs include: *Clausena anisata*, *Clusia abyssinica*, *Dodonea viscosa*, *Kiggelaria africana*, *Kotschya*, *Lippia*, *Lobelia gibberroa*, *Maytenus mossambicensis*, *Pavetta*, *Rhus longipes*, *Rytigynia*, *Solanum schumannianum*, *Tecomaria capensis*, *Triumfetta*, *Vernonia*.

Catchment Values (from Lovett & Pócs 1993)

There are numerous other small streams flowing to the East and West down the escarpment. Water from these streams is used for irrigation of tea, for small scale irrigation of vegetable plots and general use by the local people, and by Southern Paper Mills in pulp processing. The escarpment is very susceptible to erosion, and so this is protected by the reserve.

Timber Values (from Lovett & Pócs 1993)

The valuable species such as Muheti (*Ocotea usambarensis*) are exhausted, but less valuable species such as Mtanga (*Albizia gummifera*) and Muhapi (*Bridelia bridellifolia*) occur.

Biodiversity (from Lovett & Pócs 1993)

This reserve contains the southernmost forest in the Eastern Arc, and although areas of the forest are secondary, there is likely to be remnants of Eastern Arc forests in the river valleys.

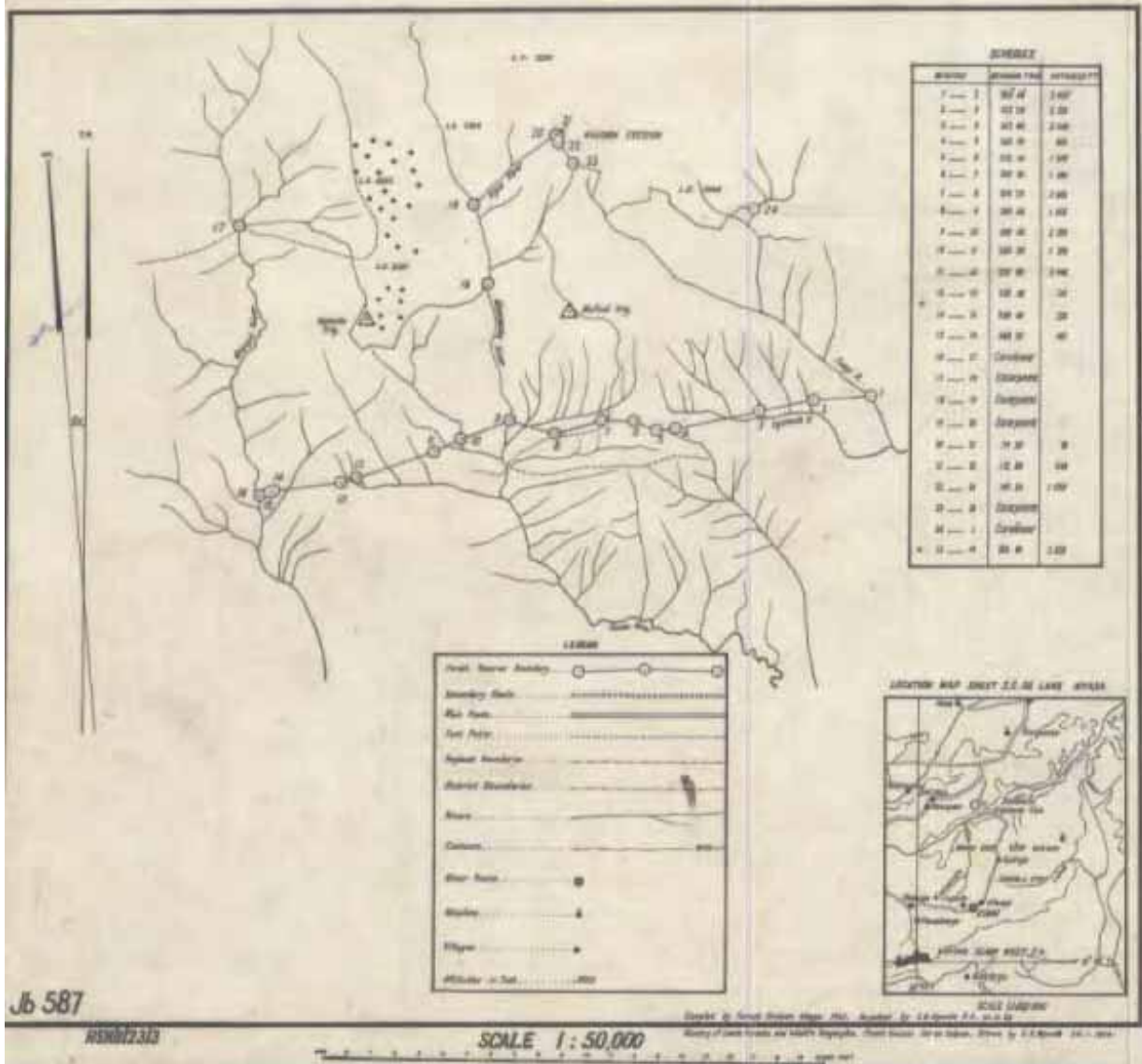
Human Impacts (from Lovett & Pócs 1993)

Formerly there was a mission within the reserve near Malenda Farm. Much of the forested area north of the escarpment was inhabited prior to gazettement of the reserve so many places in Mufindi West Scarp Forest Reserve have cultural importance. Examples of areas of importance are: Ikemesa, Malenda, Kipugu and Itendega. In the north and north east the reserve is bordered by Kifyulilo, Malenda and Livalonge tea estates which protect it from encroachment. On map sheet 248/1, which is drawn from 1978 aerial photography, habitation is shown in the north western part of the reserve. Timber was formerly extracted and small animals hunted. Fire occurs in the escarpment grasslands almost annually.

MUFINDI SCARP WEST FOREST RESERVE

RINCA DISTRICT

AREA 4536 ACRES OR 7.15 SQUARE MILES



Map 5. Mufindi Scarp West JB Map

3) Medium and large mammals

By Francesco Rovero and Andrew Perkin

3.1 Literature review

While the northern Udzungwa forests have been the subject of several studies on mammals (review in Rovero & De Luca, submitted), there is little information on mammals from the southern, Mufindi forests. A review of records of primates and duikers appears in Dinesen *et al.* (2001); the areas covered include "Mufindi" (presumably Mufindi Scarp West Forest Reserve) and "Kigogo" (presumably Kigogo Forest Reserve). Out of the nine Udzungwa species considered in the review, they report the occurrence (with abundance indicated as rare) of only Sykes' monkey and Harvey's duiker in both Mufindi forests.

3.2 Objectives

The objectives of the mammal research conducted during this study were:

1. To increase our understanding of the biogeography, taxonomy and ecology of large forest mammals, especially the primates and forest antelopes in the Mufindi forests.
2. To contribute data and information to the Red List process and to conservation organisations for improved management of study taxa.
3. To provide training in the survey techniques and monitoring of study taxa, especially transect census and camera-trapping techniques.
4. To increase awareness at the local and national level on the conservation of study taxa.

3.3 Methods

We define medium to large mammals as all those mammal species that are usually not recorded using standard trapping methods for small mammals such as Sherman's and pitfall traps and are instead recorded by the model of camera-traps used in these surveys. Thus, we included mammals from the size of a squirrel from the genus *Paraxerus* and elephant shrew from the genus *Petrodromus* and above.

A detailed account of the methods is provided in Rovero (2006). The following methods were deployed:

Census walks to count primates and forest antelopes

Application of this method in Mufindi forests was constrained in terms of length of transects conducted and efficiency by the severe degradation of most forests resulting in vegetation thickness and thus difficulties to walk straight and at a reasonable pace. Moreover, some of the forest patches are small, in the order of 1 km² (e.g. Lulanda and Ipafu) which limited the length of the transects.

Camera-trapping to detect presence of medium to large mammals

Camera-traps (Deercam DC 300) were set to take photos 24-h per day and mounted with 36 exposure, Kodak 200 ISO films. The minimum delay between consecutive photos was set at 1 minute. We retrieved cameras after approximately 30 - 45 days. Trap-days were computed as the number of 24-h periods cameras were operating, i.e. until they were retrieved or the film was full (and thus it can be less than 30 days). For each camera-trapped species, we computed the number of events as the number of photos, not considering photos of the same species or individual taken within the same hour. Trap-rate was computed as the number of events divided by trapping effort (in days) and multiplied by 100. For each species, we pooled data from different cameras by computing total number of events, number of successful cameras and mean trap-rate for successful cameras. We present results for each forest site, as well as for all sites.

Other observations of wildlife and human disturbance were recorded opportunistically.

Nocturnal transects

See Section 4 for more details on this. Records from the nocturnal transects have been included in this section for the purposes of estimating species richness however more details and discussions are provided in the next section.

3.4 Sampling intensity

We deployed camera-traps at a total of 32 camera-trap sites in five areas, as follows:

1. Lupeme forest (small forest belonging to UTT near the lake adjacent to Foxes' lodge)
2. Kigogo forest (both in Kigogo Forest Reserve and contiguous forest areas that belong to UTT)
3. Mufindi Scarp West (both in the Forest Reserve a contiguous forest area that belongs to UTT)
4. Lulanda (Fufu forest patch)
5. Ipafu Forest

One camera-trap was stolen while installed in the forest (at the edge of Kigogo forest near tea plantations) and three cameras did not produce photographs. The remaining 27 cameras operated for a total of 802 trap-days (Table 8).

F. Rovero and one assistant conducted 10 census walks (Table 8), for a mean distance of 1.6 km walked per census, as estimated by GPS. Ground distance is greater, however these walks were kept straight as much as possible and the altitudinal range covered by each walk was small (mean altitude range of 90 m). Average census duration was 2.5 hours, beginning at about 7:30 h.

Sampling intensity for census walks and camera-trapping is summarized in Table 8, more details on each census walk and camera-trap site are reported in Appendices 1 and 2 respectively.

Table 8. Summary of sampling intensity for camera-trapping and census walks.

Forest site	Number of camera-traps (total trap-effort)	Number of census walks (mean distance)	Altitude range of the transects and camera-traps	Period
Lupeme + "lake forest" (at Foxes' lodge)	4 (116 days)	-	1745-1900	Feb-March 2006
Kigogo	8 (257 days)	4 (1.84 km)	1800-1900	Feb-March 2006
Fufu (Lulanda) + Mgwilwa	7 (206 days)	2* (1.43 km)	1530-1750	May-Aug 2006
Mufindi Scarp West	8 (223 days)	4 (1.53 km)	1800-1920	May-Aug 2006
All sites	27 (802 days)	10 (1.60 km)	1530-1920	Feb-Aug 2006

* Census walks conducted in Fufu forest patch (Lulanda) only.

Records from Ipafu, Igoda, Kidegamsitu and Mufindi Scarp East are based on records made by other members of the survey team. Systematic diurnal transects and camera trapping were not carried out in these forests.

3.5 Results

A total of 21 species of medium to large mammals from 13 families were recorded by the survey team (Table 9). Two other species may be present in these forests: the squirrel, *Heliosciurus undulatus* and the tree hyrax, *Dendrohyrax validus* however we were not able to confirm the presence of these species and further field work is necessary to assess their presence or absence (see section 4 for further discussion on *D. validus*). Eleven species were detected through camera-trapping and sightings or signs, while nine species were recorded through observations of by hearing their vocalisations. Only the African civet was recorded on the basis of signs alone. Because of high sensitivity settings, camera-traps also took several photographs of one or more species of small rodents that could not be identified and therefore are not considered in this section.

Table 9. Checklist of medium to large mammals recorded in Mufindi forests.

Species	Common name	Forest Dependency	Range	Red list	ifupira	Igoda	Lupeme	Ipafu	Kidegamsitu	Kigogo general	Mufindi Scarp East	Mufindi Scarp West	Lulanda	Detection

Species	Common name	Forest Dependency	Range	Red list	Ifupira	Igoda	Lupeme	Ipafu	Kidegmsitu	Kigogo general	Mufindi Scarp East	Mufindi Scarp West	Lulanda	Detection
COLOBIDAE														
<i>Colobus angolensis palliatus</i> Sclater, 1860	Angola pied colobus	F	W					1					1	Ob
CERCOPITHECIDAE														
<i>Papio cynocephalus</i> Desmarest, 1820	Yellow baboon	F	W				1			1	1			Ob
<i>Cercopithecus mitis moloneyi</i> Wolf, 1822	Gentle monkey	F	W		1	1	1	1		1	1	1	1	CT, Ob, VH
GALAGONIDAE														
<i>Otolemur crassicaudatus</i> (É. Geoffroy 1812)	Large-eared greater galago	O	W			1		1						
<i>Galagoides granti</i> Thomas and Wroughton, 1907	Grant's galago	FF	W										1	T
<i>Galagoides cf orinus</i>	Mountain galago									1	1	1		VH
MACROSCOLIDIDAE														
<i>Rhynchocyon cirnei</i> Peters, 1847	Chequered elephant shrew	FF	W		1		1	1		1	1		1	CT, Ob
SCIURIDAE														
<i>Paraxerus vexillarius byatti</i> Kershaw, 1923	Swynnerton's bush squirrel	FF	EA N	VU	1		1	1		1	1	1	1	CT, Ob
MURIDAE														
<i>Cricetomys gambianus</i> Waterhouse, 1840	Giant Pouched rat	F	W	LC			1			1		1	1	CT
HERPESTIDAE														
<i>Atilax paludinosus</i> Cuvier, 1829	Marsh mongoose	F	W										1	CT
HYSTRICIDAE														
<i>Hystrix cristata</i> Linnaeus, 1758	Crested porcupine	F	W	LC								1		CT
VIVERRIDAE														
<i>Genetta servalina lowei</i> Pucheran, 1855	Lowe's servaline genet	FF	EA N							1		1	1	CT
<i>Civettictis civetta</i> Schreber, 1776	African civet	O	W				1					1	1	D
<i>Nandinia binotata</i> Gray, 1830	African palm civet	F	W				1					1	1	CT
CANIDAE														
<i>Canis adustus</i> Sundevall, 1847	Side-striped jackal	O	W		1									Ob
PROCAVIDAE														
<i>Heterohyrax brucei</i> (Gray, 1868)	Bush hyrax	O	W							1	1			VH
SUIDAE														
<i>Potamochoerus larvatus</i> Cuvier, 1822	Bush pig	F	W		1	1	1	1	1	1	1		1	CT, D
BOVIDAE														
<i>Tragelaphus scriptus</i> Pallas, 1766	Bushbuck	F	W							1				CT
<i>Philantomba monticola</i> Thunberg, 1789	Blue duiker	FF	W			1							1	Ob
<i>Cephalophus harveyi</i> Thomas, 1893	Harvey's duiker	FF	W	LR/cd	1			1		1	1	1	1	CT, Ob, D
<i>Neotragus moschatus</i> Von Dueben, 1846	Suni	F	W				1							CT

Key to Table 9

Red List

EN = Endangered, VU Vulnerable, LR/cd = Lower Risk/conservation dependent, DD = Data Deficient, LC = Least Concern

Range

W = Widespread, EA N = Near-endemic to the Eastern Arc Mountains

Forest dependency

FF = strictly confined to forest, F = mainly forest, but also found outside, O = non-forest species

Detection method

CT = Camera Trap, D = Dung, Ob = Observation, VH = Vocalisation heard

Taxonomy follows Wilson and Reeder (2005)

The number of medium and large mammal species recorded from each reserve is given in Table 10.

Table 10. Medium to large mammal species richness by forest.

Forest	Number of medium and large mammal species
Ifupira	6
Igoda	4
Lupeme	9
Ipafu	7
Kidegemsitu	1
Kigogo	11
Mufindi Scarp East	8
Mufindi Scarp West	9
Lulanda	13

3.5.1 Census walks for primates and forest antelopes.

Sighting rates (number of groups / dung piles per km) are presented in Table 11, primate records being divided into sightings and the sum of sightings and auditory records. Because males of Sykes' monkeys are usually more visible than females and juveniles and because males often move at the edge of the rest of the social group, sightings of and vocalizations / alarm calls of single individuals were considered as a sighting of a group, for the purpose of computing the encounter rate.

Sykes' monkey and Angolan colobus were the only diurnal primates seen during census walks. Sykes' monkey appeared to be relatively common and it was recorded at all sites, with a maximum of two groups seen during each walk. Group size ranged from 5 to 8. In contrast, Angolan colobus was only recorded in Lulanda forest patches. In "Fufu" patch, which is mature forest dominated by *Parinari excelsa*, the population is probably down to 3 - 4 groups. In the adjacent, but separated "Mgwilwa" patch, only one group of three individuals was sighted.

Two groups of Angolan colobus that were counted in Fufu had 5 and 4 individuals, respectively, with the following composition:

- 1 adult male, 1 adult female, 1 adult (sex not determined), 1 sub-adult
- 1 adult male, 1 adult female, 1 large juvenile/sub-adult, 1 adult.

Only one duiker was seen during systematic walks, while camera-trapping provided more information on forest antelopes. The only record of a blue duiker in the area was from an opportunistic sighting in Mgwilwa forest patch, at Lulanda.

Table 11. Summary of primate and forest antelope census walk results from Mufindi surveys.

Site	Observation Rate ¹			
	Sykes' seen	Sykes' seen+heard	Angolan colobus	Duiker seen
Kigogo	0,73	0,95	-	-
Mufindi Scarp W	0,70	0,56	-	0,56
Lulanda	1,05	1,40	1,05	-
All sites	0,83	0,97	1,05	0,56

¹ The number of times per kilometre an individual or group of primates or an individual antelope was observed.

3.5.2. Camera-trapping

Table 12 summarizes results in terms of number of events (independent photographs) and species recorded. Overall, a total of 202 events were recorded over 802 trapping-days. The number of mammal species recorded per forest site ranged from 5 to 10. In addition, three species of birds were recorded. Trapping effort per camera ranged from 23 to 44 days, with a mean of 29.7 days.

Table 12. Summary of camera-trapping sampling effort and results obtained.

Forest Site	Number of events	Number of mammal species
Lupeme	10	5
Kigogo	37	6
Lulanda and Ipafu	99	9
Mufindi Scarp West	56	10
All sites	202	14

The following tables (Table 13 - 17) present, for each site, as well as for the four sites combined, the list of species camera-trapped; the number of independent photos (events); the number of cameras where a species was photo-trapped and the trap-rate. The trap-rate is the mean trap-rate across all of the camera-sites where the species was trapped. Details of trap-sites are presented in the Appendix 2.

Table 13. Camera-trapping results for Lupeme Forest.

Species	Events	Trap-rate	Successful cameras
Swynnerton's bush squirrel	1	3.45	1
Giant-pouched rat	1	3.45	1
Chequered sengi	4	6.9	2
African palm civet	1	3.45	1
Suni	3	10.34	1

In Lupeme Forest the four cameras recorded a total of 10 events of 5 mammal species over 116 trap-days.

Table 14. Camera-trapping results for Kigogo forest.

Species	Events	Trap-rate	Successful cameras
Sykes' monkey	5	8.51	2
Swynnerton's bush squirrel	22	18.62	4
Giant-pouched rat	1	3.33	1
Lowe's genet	4	6.72	2
Harvey's duiker	4	3.87	3
Bushbuck	1	3.33	1

In Kigogo Forest the eight cameras recorded 37 events of six mammal species during 257 trap-days

Table 15. Camera-trapping results for Lulanda and Ipafu forests.

Species	Events	Trap-rate	Successful cameras
Swynnerton's bush squirrel	14	26.52	3
Lesser pouched rat	19	22.14	3
Giant-pouched rat	38	25.84	5
Chequered sengi	17	14.45	5
African palm civet	3	5.85	2

Lowe's genet	1	4.35	1
Marsh mongoose	1	2.38	1
Suni	3	4.50	2
Harvey's duiker	3	3.46	3
Birds:			
Lemon dove	22	45.91	2
Orange ground thrush	25	25.46	4
Great Sparrowhawk	1	2.38	1

In Lulanda and Ipafu Forests, the seven cameras recorded 99 events of nine mammal species and 48 events of three bird species during 206 trap-days

Table 16. Camera-trapping results for Mufindi Scarp West forest.

Species	Events	Trap-rate	Successful cameras
Swynnerton's bush squirrel	13	11.94	4
Lesser pouched rat	1	3.23	1
Giant-pouched rat	4	9.09	1
Chequered sengi	13	9.66	5
Porcupine	1	4.35	1
African palm civet	8	5.06	5
African civet	2	3.67	2
Lowe's genet	8	11.67	3
Harvey's duiker	2	3.67	2
Bush pig	1	4.00	1
Birds:			
Lemon dove	25	21.77	4
Orange ground thrush	4	4.36	3

The eight cameras recorded 53 events of 10 mammal species and 29 events of two bird species during 223 trap-days.

Table 17. Camera-trapping results for the four forest areas combined.

Species ¹	Events	Trap-rate	Number of successful cameras ²	Number of forests
Swynnerton's bush squirrel	50	15.13	12	4
Lesser pouched rat	20	12.68	4	2
Giant-pouched rat	44	10.43	8	4
Chequered sengi	34	10.33	12	3
Sykes' monkey	5	8.51	2	1
Lowe's genet	13	7.58	6	3
Suni	6	7.42	3	2
African palm civet	12	4.79	8	3
Porcupine	1	4.35	1	1
Bush pig	1	4.00	1	1
African civet	2	3.67	2	1
Harvey's duiker	9	3.66	8	3
Bushbuck	1	3.33	1	1
Marsh mongoose	1	2.38	1	1
Birds:				
Lemon dove	47	33.84	6	2
Orange ground thrush	29	14.91	7	2

Great Sparrowhawk	1	2.38	1	1
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¹ Species are ranked by mean trap-rate, which is an index of relative abundance. The mean trap-rate is calculated across all of the camera-sites where the species was trapped.

² The number of cameras that recorded this species.

3.5.3 Notes on opportunistic observations

Details on the galagos and hyrax are provided in Section 4.

Baboon were heard by A. Perkin close to Kigogo Forest Reserve.

Side-striped jackal was observed by A. Perkin at night on the road near to the Ifupira Forest.

Blue duiker was observed by F. Rovero in Mgwilwa Forest patch in Lulanda.

3.6 Discussion

3.6.1 Species richness, diversity and abundance

With 21 species of medium to large mammal, the Mufindi forests are comparable to other Eastern Arc mountain forests in terms of their species richness. For example, we recorded 19 medium to large mammal species in three small forests in the North Pare Mountains (total area 48 km²) using the same methods and comparable sampling effort (Doggart *et al.* 2008). Despite the small size and high levels of disturbance of the Mufindi forests, they are also comparable with some much larger forest areas including Kanga Forest Reserve in the South Nguru where we recorded 14 species (area 67 km², Rovero *et al.* 2007) and Uluguru North FR (85 km², F. Rovero & A. Bowkett, unpubl. data) where only eight species were recorded.

However, a comparison with species' richness of some forests in the northern parts of Udzungwa (see Rovero & De Luca submitted), especially those within the well-protected National Park, shows that the mammal community in Mufindi is impoverished, and composed mainly of small-bodied species. This could be an effect of hunting and habitat degradation acting over a considerable length of time. Thus, we did not record some of the larger, widespread mammals found in northern forests, such as leopard and buffalo, although Colin Congdon (pers. comm.), a former employee of the Mufindi estate, recalls that in the 1970s leopard and buffalo were present in the forests. The absence or scarcity of these large mammals is likely to reflect hunting and habitat degradation. This possibility is further substantiated by our observation that species that are normally hunted such as Harvey's duiker and blue duiker, bushpig, and bushbuck appear to be present at very low densities, as estimated by camera-trapping rates.

Similarly, we did not record some of the more restricted range, and forest-dependent species found in the Northern Udzungwas including Udzungwa red colobus, Abbott's duiker or the Sanje mangabey (closest populations are in the Uzungwa Scarp Forest Reserve, ca. 50 km to the north-east of Mufindi forests). Moreover, we did not record the recently discovered Kipunji (*Rungwecebus kipunji*) although Mufindi lies directly between the two known populations of this recently described primate species. The absence of these restricted-ranges species may be due to biogeographic reasons such as the isolation of the southern forests over time which has prevented colonisation from the northern forests.

Species' richness in Mufindi did not appear to be correlated with forest area, since the highest richness was found in the three Lulanda forests, which altogether do not exceed 5 km² and single patches are in the range of 1 - 2 km². Interestingly, in Lulanda we recorded three species that were not found in the other forests: Angolan colobus, marsh mongoose and blue duiker. The exclusive presence of Angolan colobus in Lulanda forests is especially puzzling, since this species is very common in the northern Udzungwa forests and there are other areas of good canopy forest, especially in Kigogo, that could support a healthy population of this primate. In contrast, that blue duiker was recorded in only one site may reflect both the elusiveness of this species (which applies to marsh mongoose as well) and its disappearance from other forests because of hunting pressure.

Other species that were found at only one site are bushbuck and tree hyrax (possible record only) which were recorded in Kigogo only. In general, abundance of ungulates seems especially low. The diversity of species recorded was otherwise quite similar among the forests surveyed. That only one species was recorded in Kidegemitu reflects the low sampling intensity in this forest.

In terms of abundance, among the primates, Sykes' monkey was found to be relatively common throughout the forests, which is not surprising as this species often occurs in areas with secondary and regenerating vegetation and forest edges (Rovero *et al.* 2006 b). The encounter rate of about 0.8 groups per km (by GPS) from census walks is very similar to that recorded in North Pare Mountains with the same method. The low abundance, and especially small range of Angolan colobus in Lulanda forest patches is reason for concern for the long-term viability of this population that is completely isolated. It is also concerning that no infants or juveniles were seen in the groups sighted.

Among the camera-trapped species, smaller mammals such as Swynnerton's bush squirrel, both lesser and giant-pouched rat, and chequered sengi appear to be the commonest species as derived from both camera-trap rates and number of successful camera-traps. Among the carnivores, Lowe's genet and palm civet were captured at several sites and with relatively higher trap-rates. In contrast, duikers and other ungulates were trapped with the lowest rates and number of sites. It should be noted, however, that conclusions on abundance from our rapid assessment methods are always indicative and need to be considered with caution.

3.6.2 Threatened and endemic species

The only globally threatened species according to IUCN (2007) that we recorded in the Mufindi forests is the Swynnerton's bush squirrel *Paraxerus vexillarius*. This species is listed as Vulnerable, and it is also endemic to the Eastern Arc and Southern Rift (Burgess *et al.* 2007). There is very little information on this species, and on *Paraxerus* in general. There is also some taxonomic confusion over *Paraxerus*, with contrasting names being used in the literature (Wilson & Reeder 2005 and Kingdon 1997).

Although servaline genets *Genetta servalina* are widespread in equatorial Africa, the subspecies *G. s. lowei* is very localised and only found in three blocks in the Eastern Arc Mountains (Rovero *et al.* 2006 a).

It is also worth mentioning the status of Harvey's duiker *Cephalophus harveyi*, which is classified as Lower Risk - Conservation Dependent (IUCN 2007). While it is relatively widespread, this duiker is increasingly threatened from hunting and habitat degradation throughout its range (Kingdon & Rovero in press).

In terms of diversity and biogeography, Mufindi forests seem generally less important than northern Udzungwa forests, which could be due to a combination of larger size, wider altitude range of forest cover, and better protection of some of the northern forests (e.g. Mwanihana and Ndundulu/Luhomero). Moreover, Mufindi forests are relatively more scattered and isolated than most of the northern Udzungwa forests, that are closer together and might have been connected until more recently. This could explain why large endemic species such as Sanje mangabey and Udzungwa red colobus were not recorded in Mufindi forests. Nevertheless, some of the Mufindi forests hold an interesting mammal community with some Eastern Arc endemic and near-endemic taxa that need focal research and conservation attention.

3.7 Conservation

The predominance of secondary and regenerating canopy in Mufindi forests indicates that there has been heavy disturbance in the past. Such habitat degradation is likely to have negatively affected the forest dependent small and large mammal species and their prey. Hunting must also have occurred at high levels, as shown by restricted presence and low abundance of duikers and other species that are usually hunted. During the surveys reported in this chapter, we only found one active nylon snare (in "Fufu" forest). This may indicate that hunting is not practised anymore to a large extent. Possibly because the target species are now so rare that hunting is no longer worthwhile.

In general, the forests of Mufindi are being poorly conserved, with the exception of "Fufu" forest in Lulanda, where TFCG has been running a community conservation project since 1993, and some areas within Mufindi Scarp West that are managed by Unilever. Nevertheless, Mufindi forests extend over a considerable area and some parts, such as the lower parts of Kigogo Forest Reserve are still in good shape. Albeit in low numbers and fragmented, there are populations of medium to large forest mammals that would certainly recover if they were properly protected.

4) Nocturnal mammals

By Andrew Perkin

4.1 Introduction

This section of the report documents the findings from the nocturnal surveys for galagos and hyrax in the southern Udzungwa forests of Mufindi district.

There are few published accounts of galago research in the Udzungwa Mountains. Honess (1996) worked in the lowland Matundu FR where he recorded '*Galagoides udzungwensis*' (now called *Galagoides zanzibaricus*). Bayes (1998) conducted a galago genetics study and sequenced a sample collected by J. Fjeldsa (sample number: JFM710B held at the Copenhagen Zoological Museum) that was provisionally identified as *Galagoides orinus*. This sequence indicated that *G. orinus* is distinct from other *Galagoides* species such as *G. zanzibaricus* and *G. granti*.

Butynski *et al* (1998) conducted galago surveys in the eastern and south central Udzungwa mountains (Mang'ula, Matundu, Sanje falls, Kihansi river and Udzungwa scarp). They recorded *Galagoides zanzibaricus* in all sites except in Uzungwa Scarp Forest Reserve where *Galagoides orinus* was recorded at a site ca. 65 km east of our first sampling site (Site 1) in Mufindi Scarp West Forest Reserve. The author conducted galago surveys in the Eastern Udzungwas in Ndundulu and Nyumbanitu Mountains as part of the Frontier-Tanzania surveys of West Kilombero FR (Perkin 2001 a). *G. orinus* was recorded in the submontane and montane forest areas and one record of *G. zanzibaricus* was recorded in a riverine forest at 1000 m, an unusually high altitude for this species. *Otolemur crassicaudatus* was reported by local people to be present in the surrounding woodlands. Frontier also collected one *G. orinus* from New Dabaga FR in the central Udzungwas (Perkin 2001 b).

Only one survey for galagos had previously been conducted in the South Western Udzungwa forests in Lulanda forest where, one species, Grant's galago *G. granti* was found (Perkin unpub. data, Hayhow *et al.* 2003). Further East by 40 km, at Kihansi, *G. zanzibaricus* was found from 400 – 1,070 m (Honess 1996, Butynski *et al* 1998, Cordeiro pers comm..)

Biogeographically the western Udzungwa forests of Mufindi district are an interesting area since they represent the known and probable species limits for several galago species. Lulanda represents the known north western limit for *Galagoides granti* and Kihansi represents the known south western limit for *G. zanzibaricus*. Surprisingly *G. orinus* was not found in Lulanda (Hayhow *et al.* 2003) thus Udzungwa Scarp FR represented the known south western limit for *G. orinus* prior to the this survey (Butynski *et al* 1998). The few tape recordings of *G. orinus* from the Udzungwas have indicated some qualitative differences from the type form in Uluguru mountains (Lawrence & Washburn 1936). More recordings are needed to investigate these differences further. The *Otolemur* species are unusually distributed in the Udzungwas. The expected forest form Garnett's galago *O. garnettii* is known only from one locality in the north west Udzungwas at Mbatwa (A. Perkin, unpubl. data) and *O. crassicaudatus* occurs in several areas in the woodlands and plantation forests of the Udzungwas (Perkin 2001 a & b, Perkin unpub data, Moyer pers. com).

One species of tree hyrax *Dendrohyrax validus* occurs in Tanzania's Eastern Arc and Coastal forests. Various surveys have shown that the distribution of *D. validus* is very patchy within its known range. In the Udzungwas they are known from the Forests of the Eastern part of the Udzungwa Mountains in the Udzungwa Mountains National Park (Perkin unpub data), West Kilombero, New Dabaga and Uzungwa Scarp Forest Reserve (Topp-Jorgensen 2001a & b). *Dendrohyrax validus* like other *Dendrohyrax* species are highly vocal and use vocalisations to maintain territories and social cohesion whilst leading a largely solitary and arboreal lifestyle. As such, vocalisation studies can indicate their presence in an area however preliminary vocalisation studies indicate differences in the vocal repertoires between populations (Roberts 2001). It is thought that this may have taxonomic implications given the long periods of isolation of the region as a whole and of individual populations. Tree hyrax are commonly

hunted and monitoring rates of hyrax vocalisations can give an indication of hunting pressure (Topp-Jørgensen & Pedersen 2001).

Other hyrax species that occur in other parts of the Eastern Arc Mountains and coastal zone are the rock hyrax *Procavia capensis* and the bush hyrax *Heterohyrax brucei*. *P. capensis* which occurs in the northern parts of the Eastern Arc Mountains and Coastal Forests (Kingdon 1997) has been recorded in the North Pare Mountains while the bush hyrax *H. brucei* is considered to occur throughout the range of Eastern Arc Mountains and Coastal Forests but in bushed and rocky areas and not in forest (Kingdon 1997). Thus, in Mufindi, areas of rocky forest edge may also contain bush hyrax. There are few published records of hyrax from the western Udzungwas but a few studies imply that *Dendrohyrax validus* and *Heterohyrax* occur in the area (Kingdon 1997).

4.2 Objectives

The objectives of the nocturnal primate and hyrax surveys were:

1. To increase our understanding of the biogeography, taxonomy and ecology of galagos and hyraxes.
2. To contribute data and information to the Red List process and to conservation organisations for improved management of study taxa.
3. To increase awareness at the local and national level on the conservation of study taxa.

4.3 Methods

Three methods were used to determine the presence of galagos and hyrax: nocturnal transect surveys, vocalisation analysis and trapping. A summary of these methods is provided below. For more details please refer to Perkin (2006) in the methods manual of the Filling the Knowledge Gap project.

4.3.1 Nocturnal transect surveys

Night walks were conducted along pre-existing paths or cut transects to reduce noise and disturbance. Galagos were detected visually by their eyeshine using head torches. Morphological details were noted with the aid of a spotting torch and binoculars. Photographs were also taken where possible. Visual descriptions were compared with published and unpublished descriptions and photographs. Hyrax are typically very hard to observe, thus recording their vocalizations is the most reliable method to detect their presence and identify them. During the nocturnal census walks, galago and hyrax vocalizations were tape-recorded and used for species identification. An analogue Marantz PMD-222 audiocassette recorder and a Sennheiser K6-ME66 directional microphone were used.

Night walks started just before dusk and continued between 18:45 and 22:00, then in the mornings from 05:00 – sunrise. A 15 minute point survey was conducted at 19:00, to estimate relative densities of galagos within a 50 meter radius. During the night, data was also taken advantageously around camp. Walks were conducted slowly at 0.5 km / hr pausing to observe any galagos and other target species when animals were seen and to record vocalizations. Start and finish times were noted as well as time taken to record and / or observe animals. The times at which animals were detected and any behavioural observations were also recorded (Perkin 2006).

4.3.2 Vocalization analysis

Vocalizations were imported into a computer and digitized using Avisoft-Sonapro (R. Spect, Berlin) software to generate sonograms, and spectrograms that graphically illustrate sound patterns. These can then be used to identify calls, make qualitative comparisons and descriptions and quantitative measurements. Galagos are identified mainly from their species specific advertising call and to a lesser extent their alarm calls (due to their complexity and variety).

4.3.2 Trapping

Trapping galagos is difficult and capture rates are highly variable depending on the species, weather and locality. Live box traps of the Chardonneret design were used to attempt to live-trap galagos. Banana and peanut butter bait in varying combinations were used. Galagos once caught are carefully handled with gloves, measured and photographed before release during the night at the point of original capture.

4.4 Sampling intensity

Night walks were conducted in four sites for a total of 76 hrs and 30 min (Table 18). Trapping for galagos was attempted in all reserves for a total of 15 trap nights.

Table 18. Summary of sampling intensity for trapping intensity for galagos.

Forest Reserve	Night walk survey intensity (hrs)	Trapping intensity for galagos. Number of trap nights	Altitude range (meters)
Kigogo	24	15	1630 - 1730
Mufindi East	25	0	1570 - 1800
Mufindi West*		0	
Ifupira Division, Unilever forest	23	0	
Igoda	4hr 30 min	0	1700 - 2030
All sites	76 hrs and 30 min	15	

*Mufindi West was surveyed opportunistically for galagos by C. Leonard and C. Bracebridge.

4.5 Results

4.5.1 Species

Two species of galago and two species of hyrax were recorded in the Southern Udzungwa forests. A third species of galago, the Thick tailed greater galago *Otolemur crassicaudatus* (Congdon pers. Comm.) was reported to occur but was not detected during the nocturnal field surveys. One of the dwarf galagos is provisionally identified as the Mountain galago *Galagoides cf. orinus* and the second was Grant's galago *Galagoides granti*.

The Mountain galago *Galagoides cf. orinus* was found to be very similar in appearance and size to other populations in the main forest blocks in the eastern parts of the Udzungwas. This population was also similar in appearance and size to other populations within the Eastern Arc Mountains. This similarity identifies the southern Udzungwa population within the genus *Galagoides*, and then in the species clade of *G. orinus* and not either the Zanzibar galago *G. zanzibaricus* (found in the lowland Udzungwas east of the Kihansi river) or Grant's galago *G. granti* (found in Lulanda forest). Both *G. granti* and *G. zanzibaricus* are approximately 50 % larger than *G. orinus*.

One species of hyrax was heard faintly from the lower slopes of the escarpment. The calls indicated the presence of bush hyrax *Heterohyrax*. Droppings and other signs found on the edge of the escarpment in Kigogo FR at about 1500 m a.s.l. also indicate the presence of hyrax. This part of the forest is steep and remote and holds good canopy forest dominated by *Parinari excelsa* indicating suitable habitat for tree hyrax *Dendrohyrax*.

Table 19. Checklist of galago and hyrax species recorded in Mufindi forests.

Species	Scientific name	Kigogo	Mufindi Scarp East	Mufindi scarp West	Livalonge	Ifupira	Kidegamsitu	Igoda	Ipafu	Lulanda
Galagos										
Dwarf galago	<i>Galagoides cf. orinus</i>	Ob, Vh	Ob	Vh						
Grant's galago	<i>Galagoides granti</i>									Litt*
Hyrax										
Bush hyrax	<i>Heterohyrax brucei</i>		Vh							
Tree hyrax	<i>Dendrohyrax validus</i>	? D							VH	

* Recorded in Hayhow *et al.* 2003

Detection method

Ob = Observation, VH = Vocalisation heard, Litt = record from the literature

4.5.2 Galago vocalisation

The galago recorded in Kigogo, Mufindi Scarp East and Mufindi Scarp West is provisionally identified as the mountain galago, largely based on the vocalizations recorded. During this survey five call types were recorded for *G. cf. orinus*. These recorded calls are compared with the call repertoire for *G. orinus* at the type locality in the Uluguru Mountains and with the population of Mountain galago in the Taita population which differs significantly from the Uluguru population.

Table 20. A comparison between the main call types uttered by three populations of 'Mountain Galagos' *Galagoides orinus*.

Species	Udzungwa population	Uluguru population (Type locality)	Taita population
Double unit croak call or scaling call		x	
Squeak and repetitive call	x		
Incipient repetitive call	x		
Yaps and screeches and	x	X	x
'pissst' contact call	x	X	
Yaps and rapid yaps		X	
Grunt shrieks	x	X	x

A total of 64 calls were sound recorded. Surprisingly few alarm calls were recorded with the majority being advertising or contact calls. The majority of the calls were composed of 'incipient repetitive calls' (see chart below) followed by the 'psst repetitive call' (Figure 1).

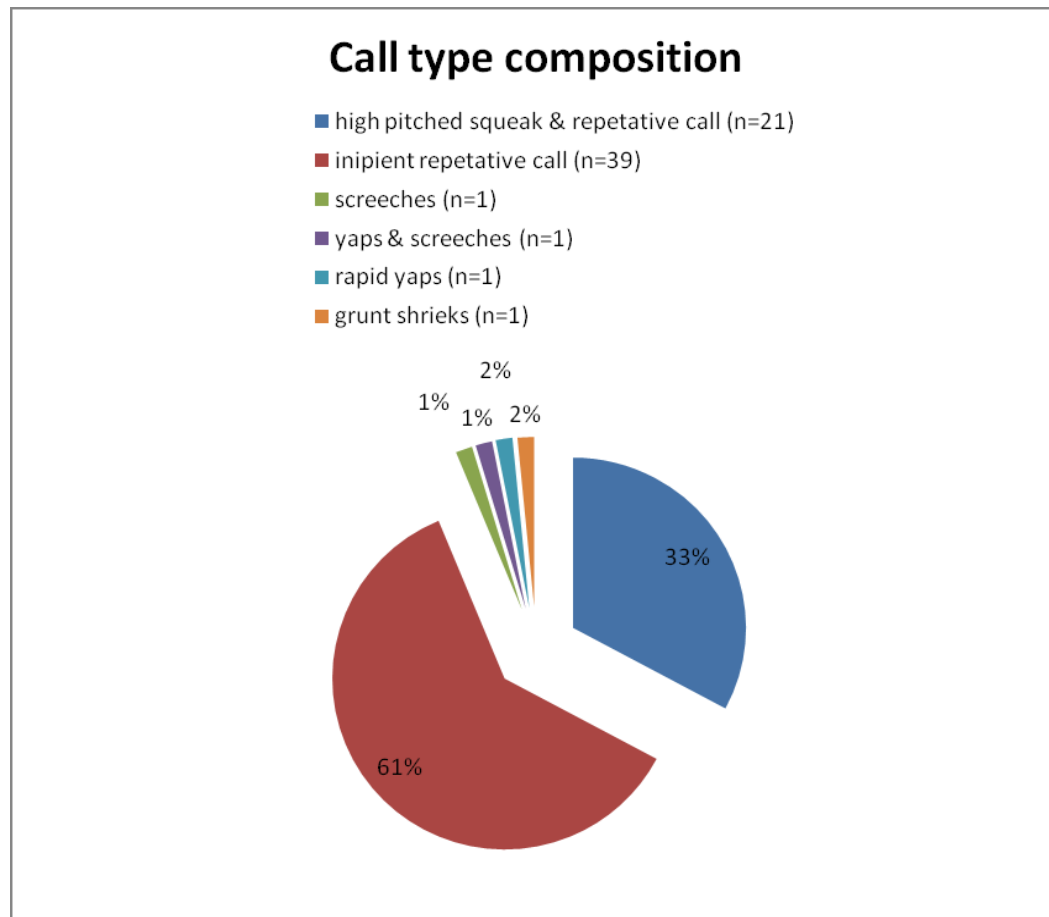


Figure 1. Chart showing percentage of galago calls of different call types.

High pitched squeak and repetitive call

The high pitched squeak and repetitive call was identified as the species' typical advertising call. This call was the most frequently recorded call (61 %, n = 21). Advertising calls are typically heard in the evenings when animals wake up and leave their sleeping sites. The galagos call out to their family members as well as others in the vicinity in order to advertise their presence and maintain contact in the dark. Galagos are territorial and vocal behaviour is very important in maintaining their territories. This call is also species specific and is thus important in identifying galagos during field surveys. When this call is compared to other populations of mountain galagos in the Eastern Arc Mountains especially the type population in the Uluguru Mountains significant differences were noted (see xxx).

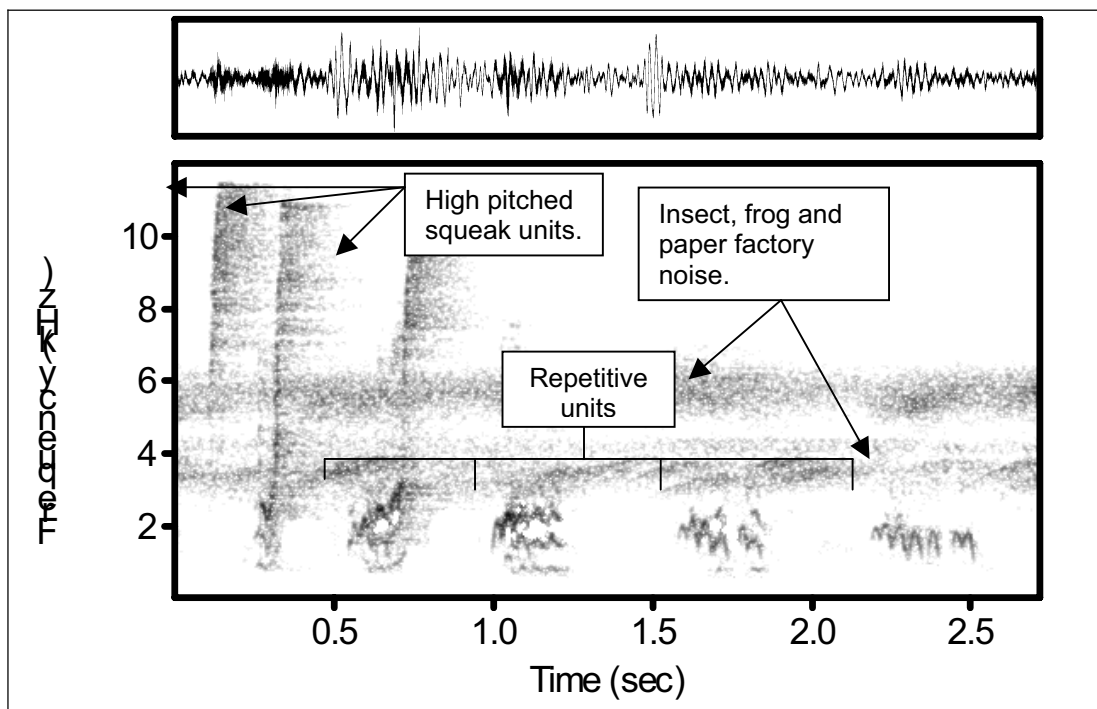


Figure 2. Annotated advertising call of *G. cf. orinus* from Kigogo Forest Reserve.

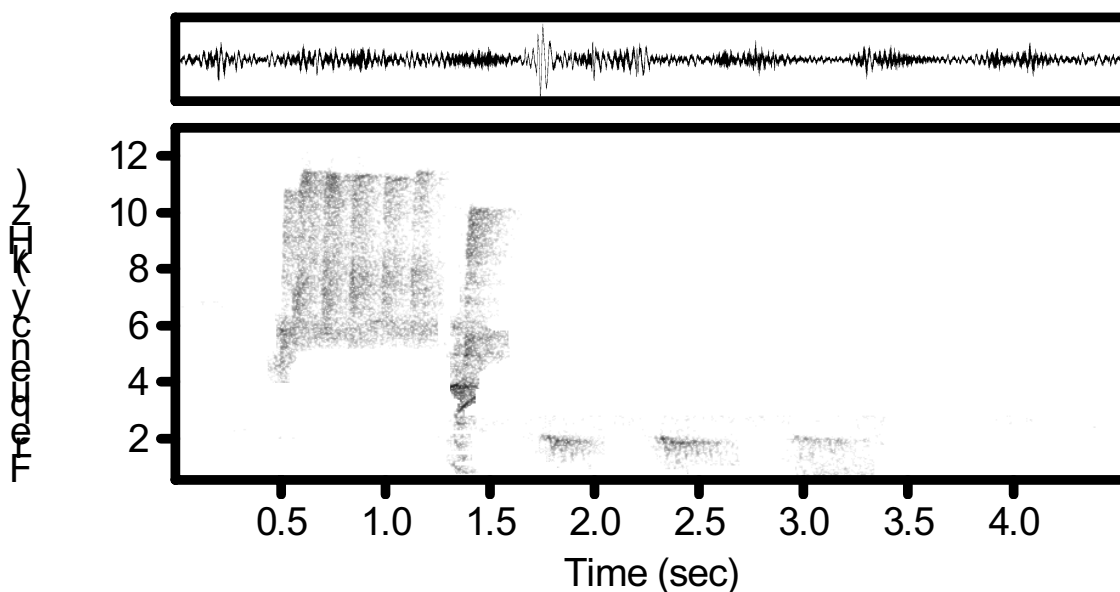


Figure 3. Sonogram of the species specific advertisement call the 'psst and repetitive call' for *G. cf. orinus* recorded in Kigogo FR.

Figures 2 and 3 show the species specific advertisement call of the *G cf. orinus* from Kigogo Forest Reserve. 'The squeak and repetitive call' of the mountain galago recorded in Kigogo Forest Reserve, which reliably indicates the presence of this species. There are 3 - 6 high pitched (approx 3 – 10 kHz) squeak introductory units. Starting before the end of the last squeak unit the low pitched (0.65 - 2.6 kHz) single and sometimes double unit repetitive units are uttered.

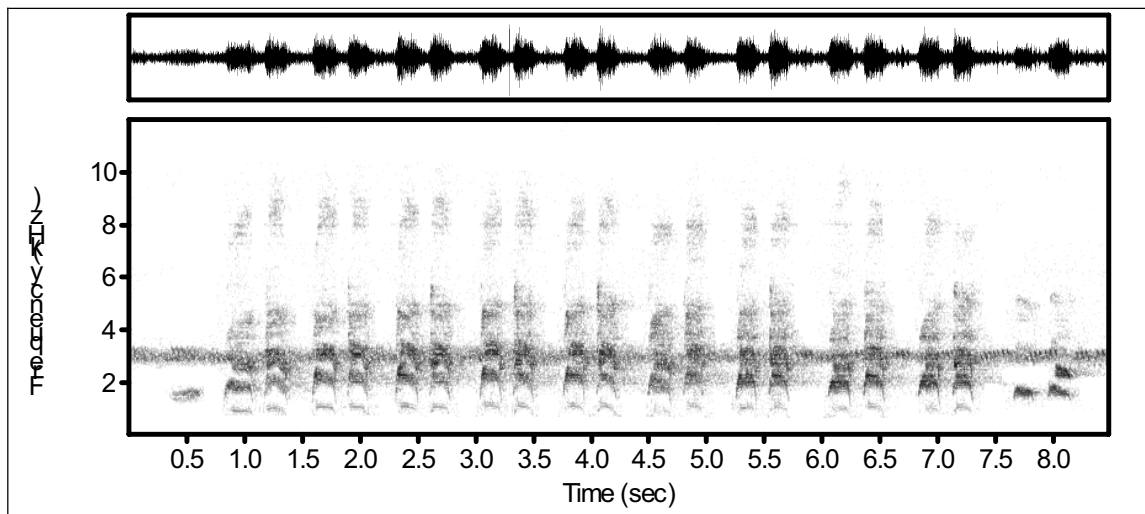


Figure 4. The double unit repetitive or scaling call of *G. orinus* from the type locality in the Uluguru Mountains.

Figure 4 shows the double unit call from animals at the type locality in the Ulugurus. By comparing Figure 4 with Figures 2 and 3 it is evident that there are clear spectrographical differences between the Udzungwa *G. cf. orinus* population and the Uluguru population.

Incipient repetitive call

The incipient repetitive call is similar to the high pitched squeak and repetitive call but without the 'squeak' element (see figures below). I have named this as 'incipient' to refer to the possibility that this is an incomplete 'high pitched squeak and repetitive call' without the squeak elements. Thirty nine of these calls were recorded which formed the majority of the calls recorded (69%) (see Fig. 1). Often a second sub unit can be detected which indicates affinities with the double unit rolling call of the Rondo galago *G. rondoensis*. This call has also never been heard in the Uluguru *G. orinus* population.

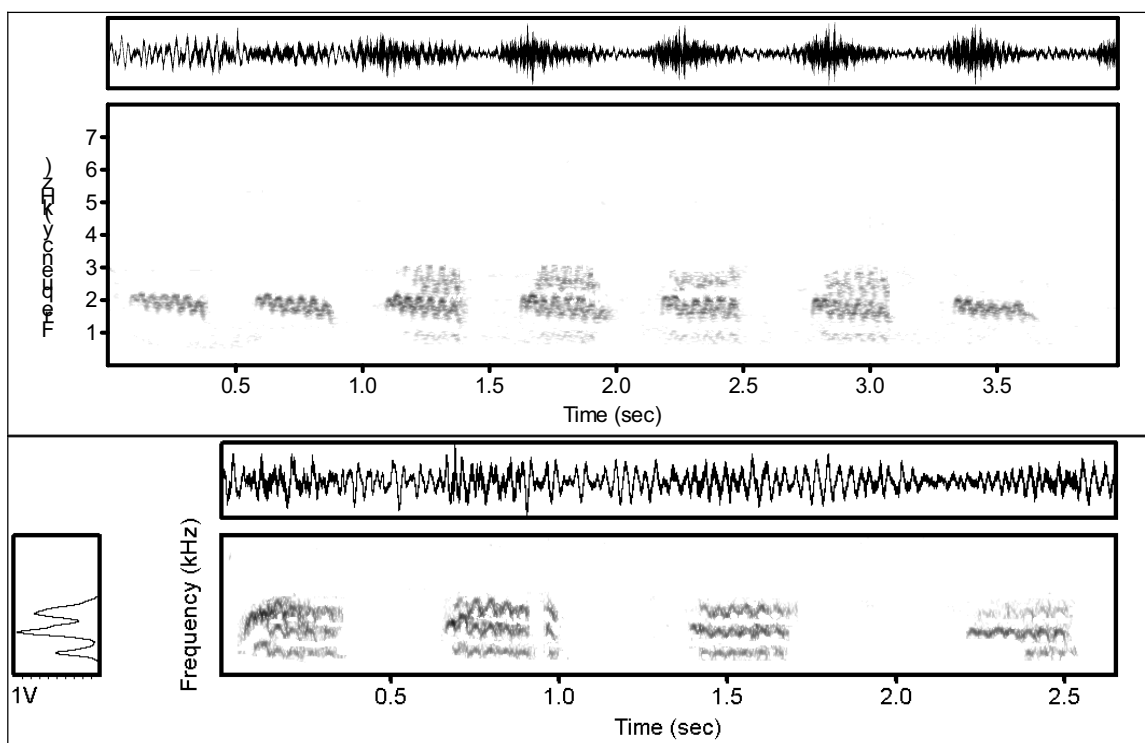


Figure 5. Sonograms of the incipient double unit repetitive call of *G cf. orinus* in Kigogo Forest Reserve.

Figures 5 show an ‘incipient double unit repetitive call’ of the *G. cf. Orinus* from Kigogo Forest S. Udzungwa Mts. The squeak units are absent, a second subunit can be seen.

Grunt shrieks

This call is uttered when the galago is in heightened state of excitement and is probably an alarm call to indicate a source of danger such as a predator. This loud urgent call serves both to warn others and to warn the predator that it has been detected.

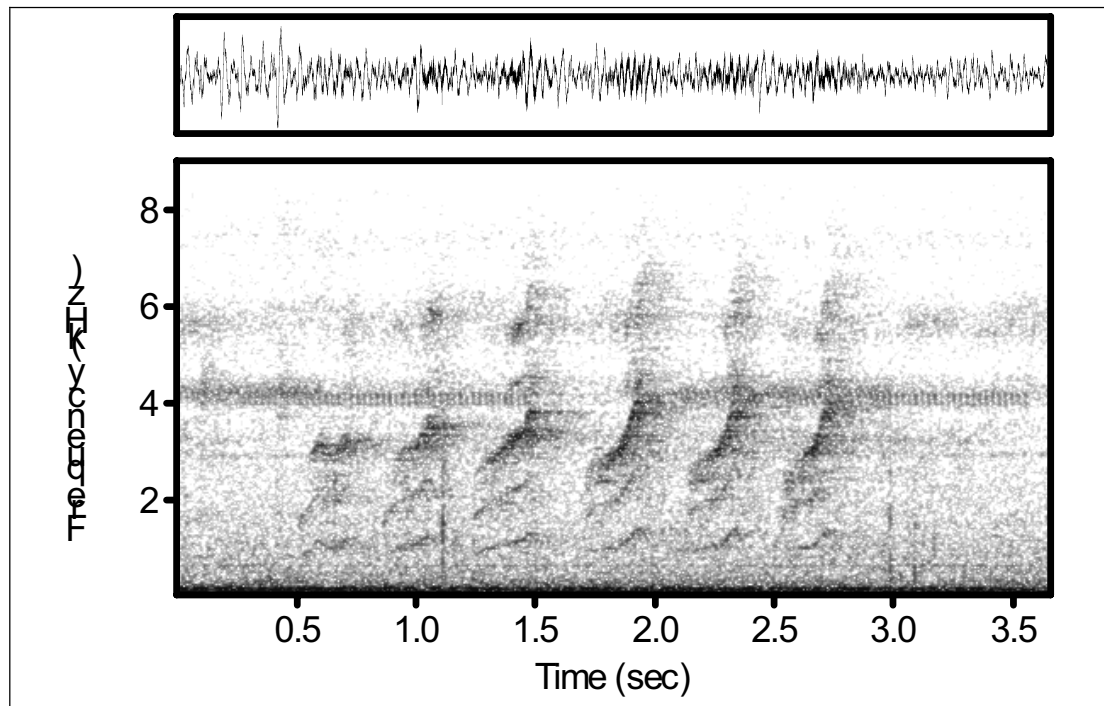


Figure 6. Sonogram of a grunt shriek call.

Figure 6 shows a section of the grunt shriek call. The total call length was over 3 min, 55 sec. The call is highly variable and uttered by only one galago while others maybe in the proximity. The amount of shriek units in each phrase varies from 1 - 12 as does the time interval between phrases (0.5 – 22 sec).

4.6 Discussion

4.6.1 Species richness, diversity and abundance

Galagos

The Mountain galago *Galagoideus. orinus*, is an Eastern Arc endemic species. The dwarf galago populations encountered during this survey appear to be most similar to *G. orinus* but are distinct on the basis of vocalizations. Provisionally the species is therefore identified as the Udzungwa mountain galago *G. cf. orinus* however the *G. cf. orinus* in Mufindi appear to be different to the population at the type locality in the Uluguru mountains. This suggests that the Mufindi populations may be taxonomically different and may be a sister species. To the west *G. cf. orinus* is also vocally different from the southern highlands dwarf galago, the Ukinga galago *Galagoideus sp. nov.* Ukinga (Groves 2001). The taxon in the Mufindi forests, is also known to occur only along the Mufindi Scarp East and Kigogo escarpment forests. Elsewhere in the Udzungwas *G. cf. orinus* is present in the Uzungwa Scarp, Kilanze Kitungulu, New Dabaga, Nyumabnito, Ndundulu, Luhomero and the Mwanihana forests (Perkin a & b 2001, Butynski *et al* 1998).

That no *Galagoideus* were detected at Igoda, Ipafu and Ifupira is surprising since these dwarf galagos are known to tolerate secondary forest. The forests of Ifupira would have been continuous until recently with the Mufindi escarpment forests. The forest fragments of Igoda and Ipafu seem to be ecologically suitable and the fact that *G. granti* (see below) occurs in the nearby Lulanda forest fragment make the absence of any *Galagoideus* in these forests strange.

The record of Grant's galago occurring only in Lulanda forest (Hayhow *et al.* 2003) is unusual as Grant's galago is normally found south of the Rufiji River. North of the Rufiji, Grant's galago is usually replaced by *G. zanzibaricus* and *G. orinus*.

No *Otolemur* species were positively confirmed to occur although local people indicate that *O. crassicaudatus* occurs in the forest edge farmland habitat mosaic of Ipafu, Igoda and Lulanda. The absence of the forest *Otolemur* Garnett's galago *O. garnettii* reflect this species general absence from the Udzungwa mountains apart from a small riverine forest at Mbatwa in the north of the Udzungwa Mountains National Park (Rovero *et al* 2007).

Hyrax

Further research is required in order to confirm the identification of the hyrax species along the Mufindi escarpment. Whilst, bush hyrax and tree hyrax can be sympatric (Topp-Jorgensen *et al.* 2001 b, Owen & Perkin 2007), further research is required to confirm these. That no vocalizations were recorded indicates that hyrax are occurring in low densities are confined to the most remote rocky areas to avoid hunting pressure. Colin Congdon (pers. com.) a resident in the Mufindi area for over 50 years reports that hyrax were common in the forests and local people were often seen carrying hyrax carcasses that they had trapped. Given the lack of clear evidence of the presence of hyrax, this indicates that hyrax have been intensively hunted almost to the point of localised extinction.

4.6.2 Threatened and endemic species

Galagos

The large eared greater galago is not threatened, the Mountain galago is listed as Data Deficient by IUCN.

Hyrax

Both bush hyrax *Heterohyrax* and tree hyrax *Dendrohyrax validus* are not listed as threatened (IUCN 2008). The taxonomic authority that the IUCN redlist assessors use recognise *Dendrohyrax validus* as a subspecies; *Dendrohyrax arboreous validus*. For this report I recognise *D. validus* as a species following Walker 1995 and Kingdon 1997.

4.6.3 Conservation

G. cf. orinus within the Mufindi forests was found to be restricted to the escarpment forests of Mufindi East, Mufindi West and Kigogo Forest Reserve. The main threat to this galago species is habitat clearance. As such local Mufindi based conservation efforts should focus on these areas for this taxon. Wider afield this taxon is found in other much larger forests of the Udzungwa Mtns. and is quite abundant in the montane and submontane forests of these areas and as such, is of no imminent conservation concern providing these forests are not threatened with clearance.

The identity of the hyrax species in the Mufindi forests is still in question. However Hyrax appear to be highly threatened by hunting and indeed are likely to be locally extinct in all but a few remote parts of the Mufindi escarpment edge in Kigogo forest. A cessation of hunting is vital for hyrax to recover as well as protecting their habitat since they require large old trees to inhabit.

5) Small Mammals

By Claire Bracebridge, Nike Doggart and Charles Leonard

5.1 Literature review

Small mammals constitute a highly successful group adapted to a wide array of niches both in natural environments and in human dominated landscapes. In tropical forests small mammals play an important role as dispersal agents and pollinators, and their impact on seed and seedling survivorship through predation is thought to play a major role in forest dynamics (Fleming, 1975; and various citations in Struhsaker, 1998). They are also important prey for many medium-sized carnivores and raptors (Chandrasekar-Rao & Sunquist, 1996), and therefore play an important ecological role in natural forest ecosystems.

The Eastern Arc Mountains are home to seven endemic and five near-endemic shrews and rodents (Burgess *et al.* 2007). The rodent fauna is widely distributed throughout the Eastern Arc although many species are restricted to montane or sub-montane habitats, while shrew species are more patchily distributed indicating a higher level of speciation in the individual Eastern Arc mountain regions (Stanley *et al.*, 1998).

Little work had been carried out previously on the small mammal fauna of the Mufindi area. In 2002, an expedition from the University of Newcastle conducted small mammal surveys in Lulanda Forest Reserve where they recorded seven rodent species and at least one shrew species (Hayhow *et al.* 2003). Although none of their specimens have been identified to species level, we have included their results up to the level of genus.

5.2 Objectives

The objectives of the small mammal research conducted during this study were:

- To document the presence of Eastern Arc endemic and near endemic rodent and shrew species in Mufindi forests
- To document the species richness of selected forests in Mufindi forests.

5.3 Methods

The small mammal fauna of Mufindi forests was surveyed by combining bucket pitfall traps with drift fencing and Sherman traps. Such methods have been shown to capture most of the small mammal fauna effectively (Stanley *et al.*, 1998). A summary of the methods used is provided below with more details provided in Perkin (2006).

For the purposes of this study we define “small mammals” as including shrews from the families Soricidae and Chrysochloridae and rodents from the family Muridae excluding the Giant pouched rat which was included as a medium-sized mammal in Section 3.

5.3.1 Bucket Pitfall Trapping

Shrews and rodents were sampled using bucket pitfall lines. Three 50 m linear transects were created at each survey site. Each transect had eleven 20 litre plastic buckets which were sunk into the ground with their rims flush to ground level. The buckets contained small holes to allow rainwater to drain from them and each bucket was positioned 5 m apart. A line of vertical plastic sheeting (approximately 0.5 m high) ran along the bucket line crossing the centre of each bucket to form a ‘drift fence’. The plastic fencing was supported by stakes tied to the plastic sheeting using sisal string. Small holes were pierced into the plastic using a twig through which the string was threaded. A 10 – 15 cm lip of plastic sheeting was left on the ground onto which soil and leaf litter was placed to prevent any gap in the drift fence at ground level. The lip was oriented so that it faced up the slope. Two slits were made in the ‘lip’ above each bucket to avoid animals using the ‘lip’ as a bridge over the bucket. Habitat details were recorded on a standard form for each bucket pitfall trap so that consistent habitat details were recorded on individual specimen forms.

Each line was placed no more than 50 m apart. Traps were checked early each morning and evening. For those individuals where it was not possible to provide a reliable identification in the field, the animal

was taken as a specimen. All shrews were also taken as specimens because of the difficulties of identifying shrews in the field. Other individuals were marked and released. The animals were marked by clipping a small area of fur above the left hind foot and were released close to the trap where they were caught.

5.3.2 Sherman Traps

Medium to large-sized rodents were sampled using 45 medium Sherman traps (23 cm x 8 cm x 9 cm) and five large Sherman traps (38 cm x 12 cm x 10 cm) baited with toasted coconut and peanut butter.

Traps were set in two groups of 17 and one group of 16 (with at least one large trap in each group) in different micro-habitat types and set at least 2 m apart in clusters of two or three. Numbered tags were tied to vegetation at eye height above each trap in order to ensure that the traps were successfully relocated. Traps were wedged into tree roots or between stakes to prevent a trapped animal from endangering itself by 'rolling' the trap. Traps were located in areas likely to be frequented by rodents such as in dense tangles of vegetation; at the base of fruiting trees and close to rodent holes. Ten traps were set along low level branches in Mufindi Scarp West Forest Reserve, nine in Ifupira forest, five in Ipafu, ten in Mufindi Scarp East and nine in Kigogo Forest Reserves. These traps were secured by wedging the trap between branches or by using vines. All larger Sherman traps were set on the ground. Habitat details were recorded on a standard form for each bucket pitfall so that the consistent details were recorded on individual specimen forms.

Traps were baited each evening (1600 hrs or later) for five nights and checked early the following morning (0630 hrs). Traps were closed during the day. When checking the traps, the status of each trap was recorded on a standard form to record whether the trap had caught an animal or was touched, snapped, not working or the bait was missing. These data was summarized on a separate form to provide overall trapping rates for each site.

5.3.3 Identification

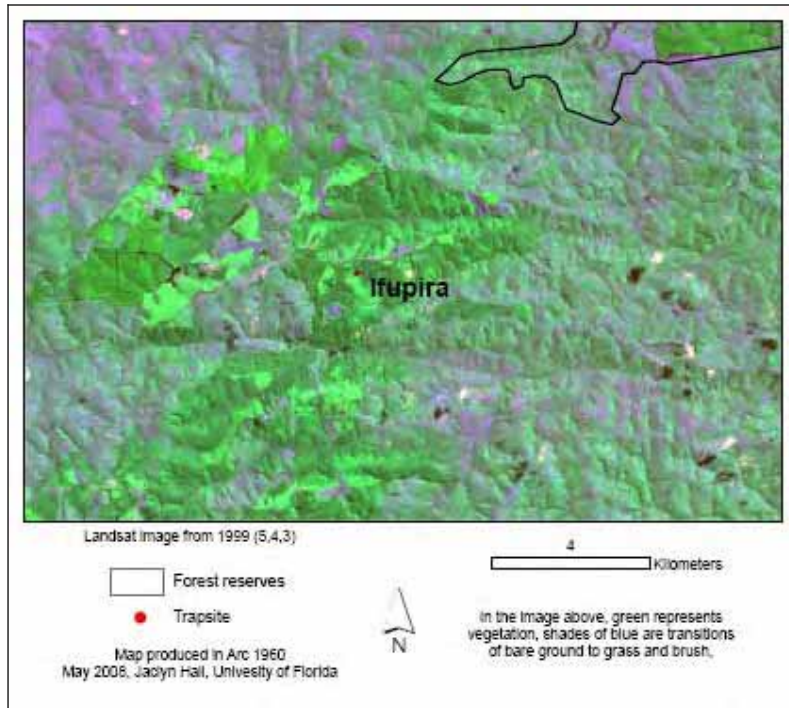
Animals were identified in the field using a combination of Kingdon (1997) and the Tanzanian mammal key together with the lead author's experience from previous small mammal surveys. The specimens were then looked through by Professor K. M. Howell of the University of Dar es Salaam to confirm or correct the identifications. Although, we had planned to send the specimens to W. Stanley at the Field Museum, Chicago, changes in US postal regulations prevented us from doing this. However W. Stanley kindly provided some comments on the identifications. The specimens are currently (March 2008) stored at the University of Dar es Salaam.

5.4 Sampling intensity

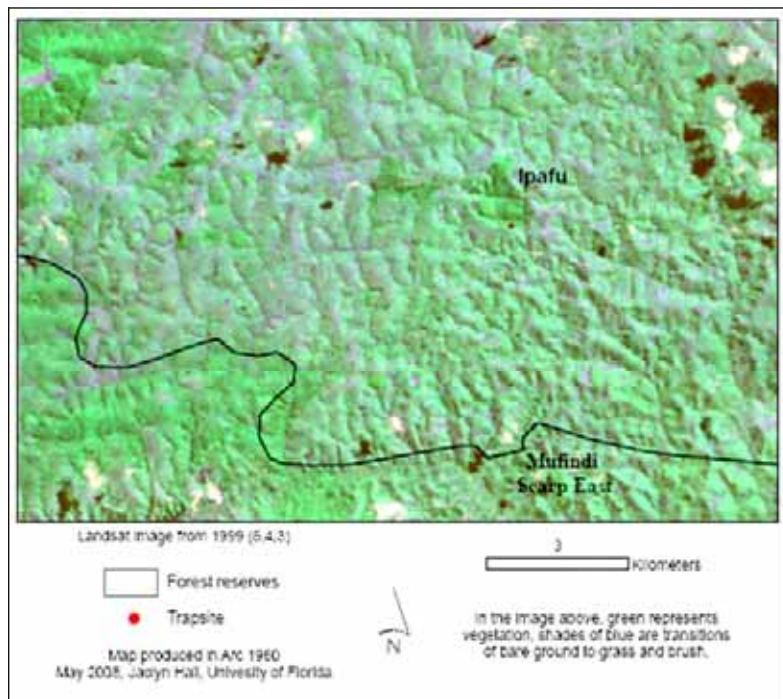
Small mammals were trapped during February, June and July 2006 at five trapsites: four trapsites inside forest reserves (Kigogo, Mufindi Scarp West, Mufindi Scarp East and Lugoda-Lutali (Ipafu Forest)) and one in Ifupira forest for five nights at each site. A total of 1248 trap nights were carried out using Sherman traps and 874 trap nights using bucket pitfall traps. The sampling intensity for each of the five forests is summarised in Table 21.

Table 21. Summary of sampling intensity for small mammals.

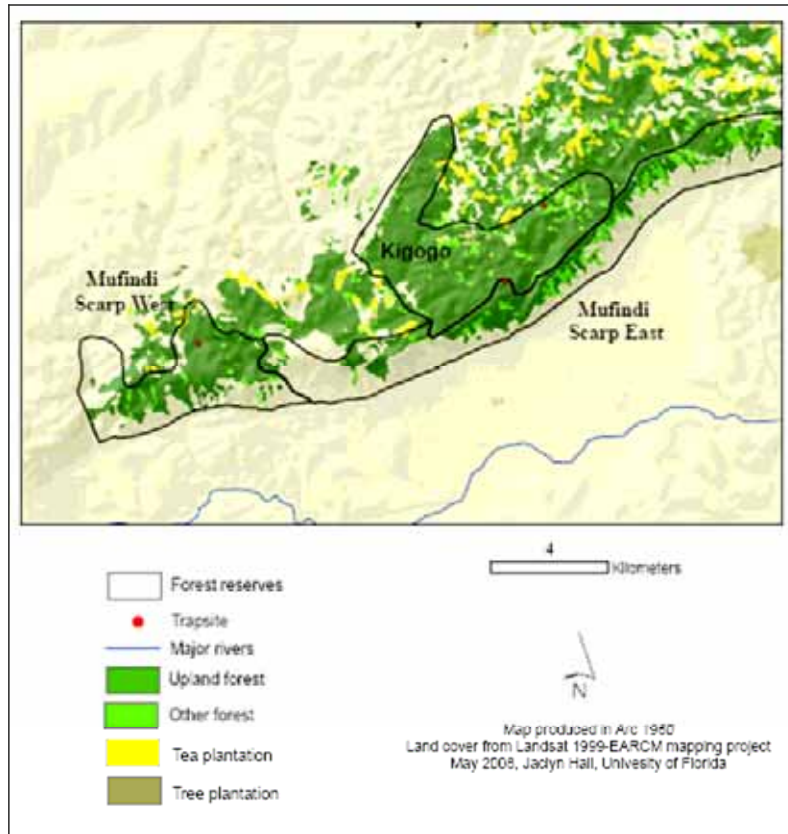
Zoo site	Dates	Location	Habitat	Altitude (m asl)	Grid ref (E)	Grid ref (N)	Sherman trap nights	Bucket pitfall trap nights
1	18/02/06-22/02/06	Mufindi Scarp East FR	Montane forest	1800	746579	9040100	250	175
2	26/02/06-03/02/06	Kigogo FR	Montane forest	1850	747899	9042693	250	175
3	14/06/06-18/06/06	Ifupira	Montane forest	1920	768086	9061476	249	175
4	20/06/06-24/06/06	Ipafu Forest	Submontane forest	1734	777533	9052839	249	174
5	27/06/06-01/07/06	Mufindi Scarp West FR	Submontane / montane forest	1790-1815	736120	9037989	250	175



Map 6. Location of trap site in Ifupira Forest.



Map 7. Location of trap site in Ipafu forest.



Map 8. Location of trap sites in Kigogo and Mufindi Scarp West.

5.5 Results

A total of 16 small mammal species from three families were recorded at the five trap sites. These species are listed in Table 22.

Table 22. Checklist of small mammal species from five Mufindi Forests.

Species	Common name	Distribution	Ecol. Type	IUCN status	No. of individuals per zoo site (recaptures)				
					Mufindi Scarp East	Kigogo	Ifupira	Ipafu	Mufindi Scarp West
CHRYSOCHLORIDAE									
<i>Chrysochloris stuhlmanni</i>	Golden mole	W			0	1	0	0	0
MURIDAE									
<i>Beamys hindei major</i>	Lesser pouched rat	EA N	F		2	4	0	0	0
<i>Dendromus sp.</i>	Climbing mouse				0	0	0	0	1
<i>Grammomys dolichurus</i>	Narrow-footed thicket rat	W	F		0	1	1	3	3
<i>Graphiurus murinus</i>	African Dormouse	W	F		2	0	0	0	0
<i>Hylomyscus arcimontensis</i>	Eastern Arc montane wood mouse	EA N	FF		8 (2)	13 (6)	7	1	9 (1)
<i>Lophuromys flavopunctatus</i>	Brush-furred rat	W	F		0	0	1	1	1
<i>Mus minutoides</i>	Common mouse	W			3 (1)	0	1	0	0
<i>Mus triton</i>	Common mouse	W			13	3	0	0	0
<i>Praomys delectorum</i>	Soft-furred rat	W	F		16 (2)	32 (8)	6 (1)	12 (11)	10 (8)
SORICIDAE									
<i>Crociodura sp A cf hildegardeae</i>	White-toothed shrew	W			4	0	0	1	0

<i>Crocidura sp B cf hildegardae</i>	White-toothed shrew	W			6	1	0	0	0
<i>Crocidura sp C cf monax</i>	White-toothed shrew	EA N	FF	DD	1	0	1	0	0
<i>Crocidura sp D</i>	White-toothed shrew				0	2	0	0	0
<i>Myosorex kihaulei</i>	Mouse shrew	E	FF	EN	1	1	1	1	0
<i>Suncus megalura</i>	Forest shrew	W	F		0	1	0	0	0
					56 (5)	59 (14)	18 (1)	19 (11)	24 (9)

Similar species were recorded by Hayhow *et al.* (2003) in Lulanda including the genera: *Praomys*, *Lophuromys*, *Hylomyscus*, *Grammomys*, *Dendromus*, *Mus* and *Beamys hindei* (family Muridae). At least one species from the genus *Crocidura* (family Soricidae) was also recorded.

Details of the specimen identification numbers recorded for each species from each reserve are provided in Appendices 3, 4, 5, 6 and 7. These Appendices also provide a breakdown of how many animals of each species were recorded in bucket pitfalls vs Sherman traps.

5.6 Discussion

5.6.1 Species richness

With nine species from the family Muridae and six species from the Soricidae family, the Mufindi forests have comparable species richness in terms of small mammals to other parts of the Eastern Arc Mountains. For example in Uluguru North Forest Reserve 10 species from the family Muridae and 7 species from the family Soricidae were recorded by Frontier Tanzania (Bracebridge, 2005). Similarly in West Kilombero Scarp Forest Reserve, 10 species from the family Muridae and 5 species from the family Soricidae were recorded (Topp-Jorgensen *et al.*, 2001 b).

In comparing the species richness of the six forests from which data is available it appears that the most diverse small mammal fauna are found in Mufindi Scarp East and Kigogo forests (Table 23). Lulanda also exhibits relatively high species richness. Mufindi Scarp West appears to contain the fewest species.

Table 23. Number of small mammal species recorded in six Mufindi forests.

Forest	Number of small mammal species recorded
Ifupira	7
Ipafu	6
Kigogo	10
Mufindi Scarp East	10
Mufindi Scarp West	5
Lulanda (Newcastle data)	8

5.6.2 Abundance

Praomys delectorum was the species of rodent recorded most frequently with a total 76 animals trapped in the five trap sites. This species is abundant throughout the Eastern Arc Mountains and is also present on Mount Rungwe, Mount Meru and Mount Kilimanjaro. It was particularly abundant in the montane forests in Kigogo and Ifupira (7.5 individuals captured per 100 trap nights).

Mus triton was almost as abundant as *Praomys* in Mufindi Scarp East (3 individuals versus 3.75 individuals per 100 trap nights), where the trap site was located on a ridge top with a track and grassy areas suitable for this species.

Hylomyscus arcimontensis was captured at every zoo site but in lower overall numbers. This is a recently described species limited to the Eastern Arc Mountains and Mt Rungwe. It was particularly abundant in Kigogo (3 individuals per 100 trap nights).

Other rodent species captured in low numbers were *Beamys hindei* (Kigogo and Mufindi Scarp East), *Grammomys dolichurus* (Kigogo and Mufindi Scarp West), *Graphiurus murinus* (Mufindi Scarp East) and *Dendromus* sp which was only recorded in Mufindi Scarp West.

Chrysochloris stuhlmanni, the Golden mole was found in a bucket in Kigogo after heavy rain. This is one of the few areas where it has been captured during trapping (B. Stanley, pers. comm.).

In terms of shrew captures, all species were collected in low numbers (between 0.25 and 0.5 individual per 100 trap nights).

Crocidura hildegardeae was found in three of the forests, whilst the Mouse shrew (*Myosorex kahaulei*), an Eastern Arc endemic and endangered, was found in all of the forests, except Mufindi Scarp West. *Crocidura monax*, a vulnerable, near endemic species to the Eastern Arc, was captured in Mufindi Scarp East and Ifupira only. In Kigogo Forest an unidentified *Crocidura* species was also captured and awaits taxonomic identification.

5.6.3 Endemism

There are four species of shrew and rodent with restricted ranges that occur in the Mufindi forests. Of these one species is endemic to the Udzungwa Mountains (*Myosorex kahaulei*) and three species are near endemic to the Eastern Arc Mountains (*Beamys hindei major*, *Hylomyscus arcimontensis* and *Crocidura monax*).

Table 24. Number of Eastern Arc endemic and near endemic species.

Forest	Number of Udzungwa endemic species	Number of Eastern Arc near endemic species
Mufindi Scarp East	1	3
Kigogo	1	2
Ifupira	1	2
Ipafu	1	1
Mufindi Scarp West	0	1

5.6.4 Habitat dependence

The surveys recorded three species that are considered to be forest dependent: *Crocidura monax*, *Hylomyscus arcimontensis* and *Myosorex kahaulei*. The presence of *H. arcimontensis* in all of the forests indicates that at least some of the forest remaining is of sufficiently good quality to support this forest dependent species. Mufindi Scarp East, Ipafu and Ifupira forest all contain three forest dependent small mammal species while Kigogo, has only two such species. In terms of forest dependent species, only the mouse *H. arcimontensis* was recorded Mufindi Scarp West which may reflect the drier characteristics of this forest.

5.6.5 Threatened species

Only one species that is listed as threatened by IUCN was recorded from the Mufindi forests, the shrew *Myosorex kahaulei*. This species was recorded in Mufindi Scarp East, Kigogo, Ifupira and Ipafu forests but was not recorded from Mufindi Scarp West Forest. The species is endemic to the Udzungwa Mountains and is thought to be threatened by habitat clearance.

6) Birds

By Leonsi Mlawila, Maneno Mbilinyi, Liz Baker and Nike Doggart

6.1 Introduction

The Udzungwa Mountains as a whole are home to seven of the 19 Eastern Arc endemic bird species and 23 of the 26 near endemic species (Burgess *et al.* 2007). Of these nine of the Eastern Arc near-endemic bird species are known from the Mufindi area. No Eastern Arc endemic bird species are confirmed from the Mufindi area.

The Mufindi forests visited during this survey are part of the 'Udzungwa Mountains' important bird area (Baker & Baker 2002).

Other bird surveys that have been carried out in this area include Hayhow *et al.* (2003) who recorded 26 bird species from Lulanda forest including the African tailorbird *Orthotomus metopias*, the spot-throat *Modulatrix stictigula* and Fulleborn's black boubou *Laniarius fuelleborni*. They also recorded the presence of Moreau's sunbird, *Nectarinia moreaui* in the Lulanda corridor, although this record has not been confirmed by the present study.

In Kigogo, Lovett & Pócs (1993) recorded the presence of Mountain Greenbul, White-chested Alethe, Olive-flanked Ground Robin, Iringa Ground Robin, Spot-throat, Red-capped Forest Warbler, Chapin's Apalis, and Njombe Thick-billed Seed-eater in Kigogo and noted that Kigogo is the type locality of *Francolinus squamatus udzungwensis*.

In Lugoda-Lutali Lovett & Pócs (1993) recorded the presence of: Mountain buzzard, Chapin's apalis, African Hill-babbler, Olive-flanked Robin Chat, Speckled Mousebird, Spot-throat, Eastern Double-Collared sunbird, Moustached Green Tinkerbird and Yellow White-eye.

In Lulanda Lovett & Pócs (1993) recorded Buff-spotted Pygmy Crake, Mountain Greenbul, Little Greenbul, Shelley's Greenbul, Yellow-streaked Greenbul, Olive Mountain Greenbul, Chapin's Apalis, Black-headed Apalis, Brown-headed (Grey) Apalis, Bar-throated Apalis, Red-capped Forest Warbler, White-chested Alethe, Spot-throat and Olive-flanked Robin Chat.

In Mufindi Scarp East, Lovett & Pócs (1993) recorded: Mountain buzzard, Olive-flanked Robin Chat, Iringa Akalat, Red-capped Tailorbird and African Hill-babbler.

6.2 Objectives

The objectives of the bird research conducted during this study were:

- To document the presence of Eastern Arc endemic and near endemic bird species in the Eastern Arc Mountain forests of Mufindi District.
- To document the bird species richness of selected Eastern Arc Mountain forests in Mufindi District.

6.3 Methods

Two methods were used to assess the bird fauna of the Mufindi forests: mist netting and observations. A summary of these methods is provided below. For more details on the methods used, please refer to Doggart (2006 a).

6.3.1 Mist netting

Nets were opened at first light on each day, checked frequently throughout the day and closed at dusk. Captured birds were placed in clean cloth bags and taken to the ringing station for processing.

The netting sites embraced a good variety of vegetation structures as indicated by the good numbers of forest-dwelling species captured (7 Iringa Akalat *Sheppardia loweii* and 14 Spot-throat *Modulatrix stictigula*). In addition to mist netting, observations were recorded at each site and one day was dedicated to observing by walking through the different parts of the forest as far as the forest edge.

Measurements

All birds were fitted with East African Natural History Society rings and standard weights and measurements were taken. These are wing, bill, tarsus and tail. Birds were also weighed using Pesola balances at 50 g, 100 g and 300 g. Where possible, age and sex were noted and the time of day of the capture recorded. Birds were also checked for breeding status by noting the size of the brood patch on a scale from 1 – 5 and birds were examined for the presence of fat. No birds were retrapped.

Moult

Every individual was checked for moult and only two birds were found to be moulting: a Little Greenbul *Andropadus virens* at Ipafu and the single Evergreen Forest Warbler *Bradypterus mariae* captured at Ifupira. See Appendix 9 for measurements and moult details. Forest birds would be expected to moult towards the end of, or immediately after breeding allowing for low energy expenditure during the cold season.

6.3.2 Observations

Two days were devoted to surveying a wider area of forest to compile a species list for each forest. Both members of the team walked in the same direction, usually as far as the forest edge recording birds as they went. Species known by their voice were also recorded.

6.4 Sampling intensity

Bird survey work and mist netting were carried out by Leons Mlawila and Maneno Mbilinyi in four forests in Mufindi District, namely Ifupira Forest -8.488557, 35.43582 alt 1929 m., Ipafu Forest, -8.56235, 35.52331 alt 1949 m., and Mufindi Scarp West Forest Reserve, -8.4153, 35.0848 alt 1791 m and Lulanda Forest -8.60749, 35.62351 alt 1681 m between 13th and 28th June 2006 (Table 25). This survey work was carried out in conjunction with surveys for galagos, small mammals, reptiles and frogs. Additional records were made opportunistically by Andrew Perkin in Kigogo and Kidegemsitu. Other records from the literature are included in Table 26.

Twenty, 6 m mist nets were placed in good forest in Ipafu, Ifupira and Mufindi Scarp West giving an average of 1440 net meter hours per full day of mist netting. A total of six full days of mist netting and three half days (when nets were being moved) were carried out.

Table 25. Summary of sampling intensity for bird surveys.

Forest site	Net meter hours	Number of observation days	Altitudinal range of mist nets	Period
Ifupira	1440 (2.5 days)	2	1929	13 th – 15 th June 2006
Ipafu	1440 (2.5 days)	2	1949	20 th – 22 nd June 2006
Mufindi Scarp West	1440 (2.5days)	2	1791	26 th – 28 th June 2006
Lulanda	0 (0 days)	2	N / a	June 2006
Kigogo*	0	10	N / a	February 2006
Kidegemsitu*	0	1	N / a	June 2006

* Bird records from Kigogo and Kidegemsitu were made opportunistically by Andrew Perkin.

6.5 Results

A total of 126 species of bird were recorded through observations and mist netting in six forests in Mufindi District. These species are listed in Table 26

Table 26. Checklist of bird species from six Mufindi Forests

Species	Common name	Forest Dependency	Range	Red list	Ifupira	Ipafu	Lulanda	Mufindi Scarp West	Kigogo	Kidegemsitu	Other	Data Source
<i>Accipiter melanoleucus</i>	Great Sparrowhawk	F	W				1	1				MM
<i>Accipiter minullus</i>	Little Sparrowhawk	F	W					1				MM
<i>Accipiter tachiro</i>	African Goshawk	F	W		1			1				MM

Species	Common name	Forest Dependency	Range	Red list	Ifupira	Ipafu	Lulanda	Mufindi Scarp West	Kigogo	Kidegmsitu	Other	Data Source
<i>Alethe fuelleborni</i>	White-chested Alethe	FF	W		1	1	1	1	1			MM, Litt
<i>Andropadus chlorigula</i>	Green-throated Greenbul	FF	W		1	1	1	1		1		MM, AP
<i>Andropadus masukuensis</i>	Shelley's Greenbul	FF	W		1	1	1	1	1			MM, AP
<i>Andropadus striifacies</i>	Stripe-faced Greenbul	FF	W			1		1				MM
<i>Andropadus virens</i>	Little Greenbul	F	W		1	1	1	1	1			MM, AP
<i>Anthreptes collaris</i>	Collared Sunbird	F	W		1	1	1	1	1			MM, AP
<i>Anthus cinnamomeus</i>	African Pipit	O	W					1	1			MM, AP
<i>Apalis alticola</i>	Brown-headed Apalis	F	W			1	1	1				MM
<i>Apalis chapini</i>	Chapin's Apalis	FF	EA N	LC	1		1		1	1		MM, AP
<i>Apalis melanocephala</i>	Black-headed Apalis	FF	W				1					MM
<i>Apalis thoracica</i>	Bar-throated Apalis	FF	W		1	1	1	1	1			MM
<i>Aplopelia larvata</i>	Lemon Dove	F	W		1	1		1				MM
<i>Bathmocercus rufus</i>	Black-faced Rufous Warbler	F	W					1				MM
<i>Batis crypta</i>	Dark batis	FF	EA N	LC	1	1		1	1	1		MM, AP
<i>Batis molitor</i>	Chin-spot Batis	O	W		1		1					MM
<i>Bradypterus cinnamomeus</i>	Cinnamon Bracken Warbler	F	W		1			1	1			MM
<i>Bradypterus lopezi</i>	Evergreen Forest Warbler	FF	W		1	1						MM
<i>Bubo africanus</i>	Spotted Eagle Owl	O	W				1					MM
<i>Buteo augur</i>	Augur Buzzard	F	W				1					MM
<i>Buteo oreophilus</i>	Mountain Buzzard	F	W		1	1		1	1			MM, AP
<i>Kaupifalco monogrammicus</i>	Lizard buzzard	F	W								1	MM
<i>Camaroptera brachyura</i>	Grey-backed Camaroptera	F	W			1	1	1				MM
<i>Campephaga flava</i>	Black Cuckoo Shrike	F	W			1						MM
<i>Caprimulgus poliocephalus</i>	Montane Nightjar	F	W		1		1	1				MM
<i>Centropus superciliosus</i>	White-browed Coucal	O	W				1					MM
<i>Ceratogymna brevis</i>	Silvery-cheeked Hornbill	F	W					1				MM
<i>Cercococcyx montanus</i>	Barred Long-tailed Cuckoo	F	W			1						MM
<i>Ceuthmochares aereus</i>	Eastern Yellowbill	F	W			1						MM
<i>Circaetus pectoralis</i>	Black-chested snake eagle	F	W		1							MM
<i>Cisticola erythrops</i>	Red-faced Cisticola	O	W			1		1				MM
<i>Cisticola nigriloris</i>	Black-lored Cisticola	F	EA N	LC		1	1	1		1		MM, AP
<i>Cisticola njombe</i>	Churring Cisticola	O	EA N	LC		1				1		MM, AP
<i>Colius striatus</i>	Speckled Mousebird	F	W		1			1				MM
<i>Columba arquatrix</i>	Olive Pigeon	F	W		1		1	1	1			MM, AP
<i>Corvus albus</i>	Pied Crow	O	W		1	1	1	1	1			MM, AP
<i>Cossypha anomala</i>	Olive-flanked Robin Chat	FF	W		1	1	1	1	1			MM, Litt
<i>Cossypha caffra</i>	Robin Chat	O	W		1	1	1	1				MM
<i>Cossypha heuglini</i>	White-browed Robin Chat	O	W		1	1						MM
<i>Cossypha natalensis</i>	Red-capped Robin Chat	F	W			1						MM
<i>Cryptospiza reichenovii</i>	Red-faced Crimsonwing	FF	W		1	1	1	1				MM
<i>Delichon urbica</i>	House Martin	O	W					1				MM
<i>Dendropicos fuscescens</i>	Cardinal Woodpecker	F	W		1	1	1					MM
<i>Dendropicus griseocephalus</i>	Olive Woodpecker	FF	W			1		1				MM
<i>Dicrurus ludwigii</i>	Square-tailed Drongo	FF	W				1	1	1			MM, AP
<i>Dryoscopus cubla</i>	Black-backed Puffback	F	W		1	1	1	1	1			MM, AP
<i>Elminia albonotata</i>	White-tailed Crested Flycatcher	FF	W		1	1	1	1	1			MM, AP
<i>Estrilda astrild</i>	Common Waxbill	O	W		1	1	1					MM
<i>Estrilda paludicola</i>	Fawn-breasted Waxbill	O	W			1		1				MM

Species	Common name	Forest Dependency	Range	Red list	Ifupira	Ipafu	Lulanda	Mufindi Scarp West	Kigogo	Kidegmsitu	Other	Data Source
<i>Estrilda quartinia</i>	Yellow-bellied Waxbill	F	W			1	1	1				MM
<i>Euplectes ardens</i>	Red-naped Widowbird	O	W			1						MM
<i>Euplectes capensis</i>	Yellow Bishop	O	W			1	1					MM
<i>Falco biarmicus</i>	Lanner Falcon	O	W		1			1				MM
<i>Francolinus afer</i>	Red-necked Spurfowl	O	W				1					MM
<i>Francolinus levaillantii</i>	Red-winged Francolin	O	W					1				MM
<i>Francolinus squamatus udzungwensis</i>	Scaly Francolin	F	W						1			Litt
<i>Gallinula chloropus</i>	common moorhen	O	W		1							MM
<i>Hirundo abyssinica</i>	Striped Swallow	O	W					1				MM
<i>Hirundo angolensis</i>	Angola Swallow	O	W				1					MM
<i>Hirundo daurica</i>	red-rumped swallow	O	W		1							MM
<i>Hypargos niveoguttatus</i>	Peters' Twin-spot	F	W			1						MM
<i>Indicator minor</i>	Lesser Honeyguide	F	W					1				MM
<i>Indicator indicator</i>	Greater Honeyguide	O	W								1	MM
<i>Lagonosticta rhodopareia</i>	Jameson's Firefinch	O	W			1		1				MM
<i>Lagonosticta rubricata</i>	African Firefinch	O	W					1	1			MM, AP
<i>Laniarius aethiopicus</i>	Tropical Boubou	O	W			1	1					MM
<i>Laniarius fuelleborni</i>	Fulleborn's Black Boubou	FF	EA N	LC	1	1	1	1	1	1		MM, AP
<i>Lanius marwizi</i>	Uhehe Fiscal	F	EA N	LC		1						MM
<i>Linurgus olivaceus</i>	Oriole Finch	FF	W		1		1					MM
<i>Lonchura cucullata</i>	Bronze Mannikin	O	W			1	1	1	1			MM, AP
<i>Lonchura nigriceps</i>	Rufous-backed Mannikin	F	W				1					MM
<i>Lophaetus occipitalis</i>	Long-crested Eagle	O	W				1	1				MM
<i>Malaconotus nigrifrons</i>	Black-fronted Bush Shrike	F	W		1	1	1	1	1			MM, AP
<i>Megaceryle maxima</i>	Giant kingfisher	F	W		1							MM
<i>Melaenornis fischeri</i>	White-eyed Slaty Flycatcher	F	W		1	1		1				MM
<i>Modulatrix stictigula</i>	Spot-throat	FF	EA N	LC	1	1	1	1	1			MM, AP
<i>Motacilla aguimp</i>	African Pied Wagtail	O	W		1			1	1			MM, AP
<i>Muscicapa adusta</i>	Dusky Flycatcher	O	W		1	1	1	1		1		MM, AP
<i>Mysteria ibis</i>	Yellow-billed stork	O	W		1							MM
<i>Nectarinia amethystina</i>	Amethyst Sunbird	O	W				1	1				MM
<i>Nectarinia famosa</i>	Malachite Sunbird	O	W		1	1						MM
<i>Nectarinia mediocris</i>	Eastern Double-collared Sunbird	FF	W		1	1		1	1	1		MM, AP
<i>Nectarinia olivacea</i>	Eastern Olive Sunbird	F	W		1	1	1		1	1		MM, AP
<i>Nectarinia venusta</i>	Variable Sunbird	F	W			1	1	1				MM
<i>Onychognathus walleri</i>	Waller's Starling	FF	W			1	1	1				MM
<i>Oriolus larvatus</i>	Black-headed Oriole	F	W		1			1				MM
<i>Orthotomus metopias</i>	Red-capped Tailorbird	FF	W		1	1	1		1			MM, Litt
<i>Otus senegalensis</i>	African Scops Owl	O	W					1				MM
<i>Phyllastrephus flavostriatus</i>	Yellow-streaked Greenbul	FF	W				1					MM
<i>Phyllastrephus placidus</i>	Olive Mountain Greenbul	F	W		1	1	1	1	1			MM, Litt
<i>Platysteira peltata</i>	Black-throated Wattle-eye	F	W			1						MM
<i>Ploceus bertrandi</i>	Bertram's Weaver	O	W					1				MM
<i>Ploceus ocularis</i>	Spectacled Weaver	O	W			1	1					MM
<i>Ploceus xanthops</i>	Holub's Golden Weaver	O	W			1						MM
<i>Pogoniulus bilineatus</i>	Yellow-rumped Tinkerbird	F	W			1	1	1				MM
<i>Pogoniulus leucomystax</i>	Moustached Green Tinkerbird	FF	W		1	1	1	1	1			MM, AP

Species	Common name	Forest Dependency	Range	Red list	Ifupira	Ipafu	Lulanda	Mufindi Scarp West	Kigogo	Kidegmsitu	Other	Data Source
<i>Pogonocichla stellata</i>	Starred Robin	F	W			1	1	1				MM
<i>Polemaetus bellicosus</i>	Martial eagle	O	W		1							MM
<i>Prinia subflava</i>	Tawny-flanked Prinia	O	W				1	1				MM
<i>Psalidoprocne orientalis</i>	Eastern Roughwing	F	W			1	1					MM
<i>Pseudoalcippe abyssinica</i>	African Hill Babbler	FF	W		1	1		1				MM
<i>Pycnonotus tricolor</i>	Yellow-vented Bulbul	F	W			1	1	1				MM
<i>Saxicola torquata</i>	Stonechat	O	W		1	1	1	1	1			MM
<i>Schoenicola brevirostris</i>	Broad-tailed warbler	O	W		1							MM
<i>Serinus canicollis</i>	Yellow-crowned Canary	O	W				1					MM
<i>Serinus hypostictus</i>	East African Citril	F	W		1	1	1	1				MM
<i>Serinus whytii</i>	Yellow-browed Seedeater	F	W		1	1	1	1				MM
<i>Serinus burtoni</i>	Thick-billed seedeater	F	W						1			MM, Litt
<i>Sheppardia lowei</i>	Iringa Akalat	FF	EA N	VU	1			1	1			MM, Litt
<i>Stactolaema olivacea</i>	Green Barbet	F	EA N	LC		1	1					MM
<i>Stephanoaetus coronatus</i>	Crowned Eagle	FF	W			1						MM
<i>Streptopelia semitorquata</i>	Red-eyed Dove	F	W		1	1	1	1	1	1		MM, AP
<i>Strix woodfordii</i>	African Wood Owl	F	W		1		1	1				MM
<i>Tachybaptus ruficollis</i>	Little grebe	O	W		1							MM
<i>Tauraco livingstonii</i>	Livingstone's Turaco	FF	W		1	1	1	1	1	1		MM, AP
<i>Tchagra minuta</i>	Marsh Tchagra	O	W			1						MM
<i>Terpsiphone viridis</i>	Paradise Flycatcher	F	W		1	1						MM
<i>Tockus alboterminatus</i>	Crowned Hornbill	F	W			1	1	1		1		MM, AP
<i>Turdus olivaceus</i>	Olive Thrush	F	W		1	1						MM
<i>Turtur chalcospilos</i>	Emerald-spotted Wood Dove	O	W		1	1		1				MM
<i>Turtur tympanistria</i>	Tambourine Dove	F	W			1		1	1			MM, AP
<i>Vidua macroura</i>	Pin-tailed Whydah	O	W				1					MM
<i>Zoothera gurneyi</i>	Orange Ground Thrush	FF	W				1					MM
<i>Zosterops senegalensis</i>	Yellow White-eye	F	W		1	1	1	1	1			MM

Key to Table 26

Red List

EN = Endangered, VU Vulnerable, LR/cd = Lower Risk/conservation dependent, DD = Data Deficient, LC = Least Concern

Range

W = Widespread, EA N = Near-endemic to the Eastern Arc Mountains

Forest Dependency

FF = strictly confined to forest, F = mainly forest, but also found outside, O = non-forest species

Data Source

MM = Maneno Mbilinyi, AP = Andrew Perkin, Litt = Record from the literature (Lovett & Pócs 1993).

In total, 42 birds were ringed comprising 25 species. Sight records were also noted in each of the forests and 124 species were recorded from 444 observations. All of the species that were recorded through the mist netting were also recorded from observations. Observation data for the four forests is listed in Appendix 8 and data from the mist netting exercises in three of the four forests are attached as Appendix 9.

As is usually the case in mist netting exercises, ground dwelling and understorey birds dominated the catch. However, numbers of sunbirds and white-eyes captured were lower than expected with only

three sunbirds and one white-eye being caught overall although more birds were observed feeding above mist net height and at the forest edge. Catch rates tailed off significantly after 9 am, demonstrating that the cold season at higher altitudes is indeed a low activity period for birds.

A single Starred Robin, *Pogonocichla stellata* was caught and only two were seen. This is probably indicative of male birds remaining on territory while other members of the population move to lower altitudes at the cold time of year. The species is a known altitudinal migrant in Zambia and Malawi (Britton 1980) and in Tanzania (Baker 1993), (Baker & Baker *in prep.*).

15 of the 25 species captured and 24 of the 124 species observed belong to the Important Bird Areas Afro-tropical Highlands biome which includes 91 species for Tanzania (Baker & Baker 2002.).

Seven individuals of the Tanzanian endemic species Iringa Akalat *Sheppardia lowei* were captured and a further three individuals seen. It is a resident forest-dwelling species known to occur at varying densities above 1450 m in the larger patches of forest in the Udzungwa Mountains from Dabaga and Mufindi south to the Njombe area (Fry *et al.* 198*). It forages on the forest floor and is often difficult to detect although it is fairly easy to capture in mist nets. This survey confirms that the Iringa Akalat still occurs in relatively small forest and isolated patches such as Ipafu 109 hectares. Also among the forest floor dwelling species are Spot-throat *Modulatrix stictigula* (14 captures), Olive-flanked Robin Chat *Cossypha anomala* (5 captures) and the White-chested Alethe *Alethe fuelleborni* (3 captures).

Greenbuls dominated the catch and 46 of the 142 birds ringed (32 %) comprising five species were ringed. They can be a difficult group to identify and two birds with ring numbers A65446 and A65447 were thought to be different. Further checking through books not available in the field using photographs taken in the hand indicate that these two individuals are most likely to be Grey Olive Greenbul *Phyllastrephus placidus* as originally thought.

In terms of observations, due to the time of year, few birds were calling and activity levels were low. The greatest level of activity was found at the forest edge and in sunny glades. A few interesting species were added to those that were mist netted and these were, Crowned Eagle *Stephanoaetus coronatus*, Mountain Buzzard *Buteo oreophilus*, Red-winged Francolin *Francolinus levaillantii*, Olive Woodpecker *Dendropicos griseocephalus* - a female, entering a nest hole, Uhehe Fiscal *Lanius marwizi* (a Tanzanian endemic, there is anecdotal evidence of a decline in Mufindi area), Orange Ground Thrush *Zoothera gurneyi* (there are only 21 records for this species from the Mufindi area in Tanzania Bird Atlas database) and Red-capped Robin Chat *Cossypha natalensis* (9 Tanzania Bird Atlas records for Mufindi for this known altitudinal migrant).

6.6 Discussion

6.5.1 Species of special interest

Spot-throat *Modulatrix stictigula*. This genus has uncertain affinities and is sometimes grouped with babblers although it looks like a small thrush. It is a shy resident of montane forest undergrowth above 900m from NE Tanzania to N Malawi where it keeps close to the forest floor. Its presence is often given away by the series of loud clear whistles which vary regionally. Near-endemic to the Eastern Arc Mountains, it is a locally common species. During this survey 14 birds were ringed and all were captured within the forest. Eight at Ifupira, four at Ipafu and two at Mufindi Scarp Forest West. None were caught or seen at the forest edge.

Iringa Akalat *Sheppardia lowei*. Endemic to Tanzania. Listed as 'vulnerable' in Threatened Birds of the World (2000), it is considered threatened in the Southern Highlands where forest patches are smaller and under greater pressure. However, the range includes the Udzungwa Mountains National Park where the species receives the highest level of protection available in Tanzania. Seven birds were caught: four in Ifupira and three in Mufindi Scarp West. All birds were captured deep in the forest and not at the edge or on roads which bisect the forest.

Olive-flanked Robin Chat *Cossypha anomala*. This species occurs at low densities in the Ukaguru, Uluguru and in forests of the Southern Highlands, extending southwards into the Nyika National Parks of

Malawi and Zambia and in northern Moçambique. There is an isolated population in the Mbulu highlands. Five birds were caught: two in Ifupira, two in Ipafu and one in Mufindi Scarp West.

Green-throated Greenbul *Andropadus chlorigula*. Endemic to Tanzania, it is a common resident in montane forest and at the forest edge, occurring in the Nguru, Ukaguru and Udzungwa mountain blocks. The species arises from study into the Montane Greenbul *Andropadus tephrolaemus* complex which has resulted in a number of races being elevated to full species. Four were ringed: three at Ifupira and one at Ipafu.

Stripe-faced Greenbul. Molecular study by Roy (1997) proposes that the three races of Stripe-cheeked Greenbul be elevated to full species level. Two of these occur in Tanzania. The former race *striifacies* (Stripe-faced Greenbul) is fairly common in montane forests from the Chyulu and Taita Hills of southern Kenya to the Udzungwa Mountains. Four individuals were captured, 2 in Ipafu and 2 in Mufindi Scarp Forest West. Olive-headed Greenbul (formerly the race *olivaceiceps*) occurs in SW Tanzania from Mt Rungwe and the Poroto Mountains to northern Moçambique and Malawi. Nominate *milanjensis* is endemic to eastern Zimbabwe and south Malawi (Mt Mulanje). 4 were ringed, 2 at Ipafu and 2 at Mufindi Scarp Forest West.

Chapin's Apalis *Apalis chapini*. Endemic to the forests of SW Tanzania, Malawi and E. Zambia the species was split from Chestnut-throated Apalis *A. porphyrolaema* by Dowsett and Dowsett-Lemaire 1980. The species was seen and heard during survey walks but as it is largely a canopy species, none were captured.

Churring Cisticola *Cisticola njombe*. The species is endemic to the Southern Highlands and Nyika National Park in Malawi. This is fairly common in upland grasslands and forest edge. It was seen and heard mostly in pairs in bush and scrub adjacent to all 4 forested areas.

Uhehe Fiscal *Lanius marwitzii*. Endemic to Tanzania, it is uncommon in the southern Eastern Arc Mountains. Only two were seen at the forest edge underlining the suggestion that the species may be declining in the area in recent years.

Bertram's Weaver *Ploceus bertrandi*. Although this species has a fairly wide distribution in Tanzania from the Ulugurus to the Southern Highlands, it is nowhere common in the Southern Highlands, 2 females were seen. Both at Ipafu feeding at the forest edge. The species is also known from northern Malawi and Zambia.

Kipengere Seedeater *Serinus melanochrous*. Although not recorded during this survey, this species is known to occur in the Mufindi area (Tanzania Bird Atlas). It is listed as Near-threatened in Threatened Birds of the World (2000) and is a species which further survey teams should be aware of.

Cryptospiza spp. Ring number K41684. A bird showing neither of the characteristics for a male or a female Red-faced Crimsonwing was caught. This individual showed a distinctive red eye ring and the colour around the eye was uniform with the rest of the face. Further captures would be needed to draw any conclusions from this.

6.5.2 Species richness

In terms of overall species richness, 126 species have been recorded in the Eastern Arc forests of Mufindi. This is more than the species richness recorded for forests in the South Nguru Mountains (115 species) (Kiure & Doggart 2007) and the Rubeho Mountains (106 species) (Doggart *et al.* 2006) but less than the total recorded in the Uluguru Mountains (Doggart *et al.* 2004).

Table 27. Bird species richness in six reserves.

Forest	Number of species
Ifupira	61
Ipafu	74
Kidegemsitu	12
Kigogo	35

Forest	Number of species
Mufindi Scarp West	74
Lulanda	66

Mufindi Scarp West and Ipafu forests had the highest species richness with 74 species recorded from each forest. The lowest species richness was recorded in Kidegemsitu. These figures should however be compared in the context of the relative survey effort whereby the forests that were most intensively studied were those visited by Mbilinyi and his team i.e. Ipafu, Ifupira, Lulanda and Mufindi Scarp West. It is no coincidence more species were recorded in these forests than in Kigogo or Kidegemsitu which were not surveyed systematically. It is likely that Kigogo forest, in particular, has a significantly higher species richness than was recorded by the survey team given the pattern revealed by the surveys of the other taxa.

6.5.3 Endemism

Nine bird species that are near-endemic to the Eastern Arc Mountains were recorded during the current survey however no Eastern Arc endemic bird species were recorded from the Mufindi forests (Table 28). All of the restricted range species found in Mufindi also have populations in the Southern rift forests highlighting the strong biological affinities between the Southern Udzungwas and Southern Rift forests. There are no known bird species endemic to the Mufindi forests. The ranges used in this report are based on Burgess *et al.* (2007).

Table 28. Eastern Arc endemic and near-endemic birds found in the South Nguru Mountains and their ranges.

Species	Common name	Forests in which recorded	Range (based on Burgess <i>et al.</i> 2007)
<i>Apalis chapini</i>	Chapin's apalis	Ifupira, Lulanda, Kigogo and Kidegemsitu	Nguru, Uluguru, Ukaguru, Rubeho, Udzungwa and Southern Rift forests
<i>Batis crypta</i>	Dark batis	Ifupira, Ipafu, Mufindi Scarp West, Kigogo and Kidegemsitu	Ukaguru, Uluguru, Kiboriani and Wota Mts, Rubeho and Iringa highlands (Iringa), Southern Highlands
<i>Cisticola nigriloris</i>	Black-lored cisticola	Ipafu, Lulanda, Mufindi Scarp West and Kidegemsitu	Rubeho, Udzungwa and Southern Rift
<i>Cisticola njombe</i>	Churring cisticola	Ipafu and Kidegemsitu	Rubeho, Udzungwa and Southern Rift
<i>Laniarius fuelleborni</i>	Fulleborn's Black Boubou	Ifupira, Ipafu, Lulanda, Mufindi Scarp West, Kigogo and Kidegemsitu	West Usambara, Uluguru, Nguru, Ukaguru, Rubeho, Udzungwa and Southern Rift forests.
<i>Lanius marwizi</i>	Uhehe Fiscal	Ipafu	Ukaguru, Rubeho, Udzungwa and Southern Rift forests
<i>Modulatrix stictigula</i>	Spot-throat	Ifupira, Ipafu, Lulanda, Mufindi Scarp West and Kigogo	E & W Usambara, Nguru, Uluguru, Ukaguru, Rubeho, Udzungwa and Southern Rift forests
<i>Sheppardia lowei</i>	Iringa Akalat	Ifupira, Mufindi Scarp West and Kigogo	Udzungwa and Southern Rift forests
<i>Stactolaema olivacea</i>	Green Barbet	Ipafu and Lulanda	E & W Usambara, Nguu Nguru, Uluguru, Ukaguru, Rubeho, Udzungwa, Coastal Forests, and Southern Rift*

Table 29 indicates that there is little difference between the forests in terms of the number of near-endemic bird species. With seven near-endemic bird species, it appears that Ipafu is particularly important for birds and was the only forest in which the Uhehe fiscal was recorded.

Table 29. Number of Eastern Arc near-endemic bird species recorded in six forests.

Forest	Number of bird species near-endemic to the Eastern Arc
Ifupira	5
Ipafu	7
Kidegemsitu	5
Kigogo	6
Mufindi Scarp West	5
Lulanda	5

7) Reptiles and amphibians

Michele Menegon

7.1 Literature review

Forest reserves and synantropic habitats in Mufindi area have been randomly sampled in the past by amateurs and researchers and several Eastern Arc endemic and near endemic species have been recorded for the area. Scattered information are present in scientific publications, unpublished reports and in the herpetological collection of the University of Dar es Salaam. The Udzungwa endemic skink *Melanoseps uzungwensis* was recorded in Kigogo Forest Reserve by Broadley *et al.* (2006) and Salvidio *et al.* (2004). A specimen of the Eastern Arc endemic snake *Rhinotyphlops nigrocandidus* was collected in Lulanda Forest by the botanist J. Lovett on 14 December 1988 and is now one of the paratypes of the species (Broadley & Van Wallach, 2000). The Udzungwa and Southern Highlands endemic lizard *Cordylus ukingensis* has been collected 10 km SE of Igeleke village, Mufindi District (Menegon *et al.* In print). The Udzungwa endemic chameleon *Chamaeleo laterispinis* has been described by Arthur Loveridge on the basis of a series collected in Kigogo Forest (Loveridge, 1932). The Eastern Arc and Southern Highlands endemic toad *Nectophrynoides viviparus* has been reported for Kigogo Forest Reserve by Menegon *et al.* (2004). However until now, there has not been a systematic review of the area's herpetofauna.

7.2 Objectives

The objectives of the herpetofaunal research conducted during this study were:

1. To assess the species richness and endemism ratio of the herpetofauna in some of the forest reserves in Mufindi.
2. To collect further information in order to improve the understanding of the biogeography and taxonomy of the herpetofauna of the Eastern Arc Mountains.
3. To contribute data and information to the Red List process and to conservation organisations for improved management of study taxa.
4. To increase awareness at the local and national level on the conservation of the studied taxa.

7.3 Methods

Four survey methods were used to sample the herpetofauna of the Mufindi area Forests. These were:

- Visual encounter surveys (day and night);
- Opportunistic acoustic surveys (day and night);
- Opportunistic digging to sample cryptic assemblages (day only);
- Pit fall trapping.

For details of the survey methods, please refer to Menegon (2006).

Kigogo Forest Reserve has been sampled by opportunistic VES and acoustic survey both during the day and night, in two different sites for 4 and 6 days respectively. Lulanda forest and Lupeme Forest have been briefly visited for two days each. Farmland, tea plantations and open grassland areas have been visited mainly in order to find suitable sites for more extensive herpetofauna surveys in the near future. Specimens have also been sampled opportunistically during forest walks. Searches were conducted both during the day and by night to sample the highest number of species. Further records of snakes and chameleons were obtained from local people living in the villages at the forest edge and from the herpetological collection of the University of Dar es Salaam. Individual abundances have been recorded. Voucher specimens have been collected and, when possible, frog calls were recorded by means of a Sony TCM directional microphone and a Sony Minidisc. Specimens, photographs and sound recordings will be deposited in the Museo Tridentino di Scienze Naturali, Trento, Italy. Amphibians taxonomy follows Frost *et al.* 2006.

The Kigogo forest (8° 40' S 35° 15' E) is an extensive area of escarpment edge forest ranging in altitude from 1,800 m to below 1,500 m and covering the Kigogo and Nyarua Kiseu river catchments in the southern Udzungwa Mountains. Lulanda and Lupeme Forests, Farmland and Grasslands have also been visited.

Table 30. Summary of sampling sites for herpetofauna.

Collecting site	UTM co-ordinates	Elevation range m asl	Main vegetation Type	Main habitats investigated
Kigogo Site 1	36L074889 / 9041146	1700 - 1800	Montane forest	Open canopy forest, Closed canopy forest
Kigogo Site 2	36L746579 / 9040348	1700 - 1800	Montane forest	Open canopy forest, Closed canopy forest
Lupeme Forest	36L0764780 / 9057392	1883	Montane forest	Open canopy, disturbed
Lulanda Forest	36L0788226 / 9046728	1430	Montane forest	Closed canopy forest
Village belt and tea plantations	Various	1700 – 1800	Farmland, tea plantations	Synantropic habitats

7.4 Results

7.4.1 Species composition and richness

A total of 29 species have been recorded, of these 15 are Amphibians and 14 are Reptiles. 20 additional records have been found in the scientific literature and in the herpetological collection of the University of Dar es Salaam, giving a total of 49 species recorded for the area (a total of 20 species of Amphibians in 10 families and 29 species of Reptiles in 6 families) (Table 31). The present study recorded 3 amphibian taxa and one reptile taxon that are sufficiently distinct from other taxa that they may be considered new species based upon the available data. The assessment of new species has been done on the basis of morphological, genetic and bioacoustic analysis. The descriptions for these species are being prepared.

Table 31. Check List of Amphibians and Reptiles of Mufindi area Forests.

Taxa	Habitat	Endemism	IUCN status	KI 1	KI 2	LU	LP	VI	Recording method
AMPHIBIANS									
Arthroleptidae									
<i>Arthroleptis cf. reichei</i>	FF	N	NT	+	+	+	+	-	Coll.
<i>Arthroleptis sp.</i>	F	-	-	+	+	+	-	-	Coll.
<i>Arthroleptis cf. xenodactyloides</i>	F	W	LC	+	+	+	+	+	Coll.
<i>Leptopelis Sp. Nov.</i>	FF	E	Not listed	+	+	+	+	-	Coll.
Bufoidea									
<i>Amietophrynus gutturalis</i>	O	W	LC	-	-	-	-	+	Coll.
<i>Nectophrynoides cf. viviparus</i>	F	EA N	VU – CITES I	-	+	-	-	-	Coll.
Brevicipitidae									
<i>Probreviceps Sp. Nov.</i>	FF	E	Not listed	+	+	-	-	-	Coll.
Hyperoliidae									
<i>Afraxalus Sp. Nov.</i>	FF	E	Not listed	+	+	+	-	-	Coll.
<i>Afraxalus sp.</i>	O	-	-	-	-	-	-	+	Obs.
<i>Hyperolius puncticulatus</i>	F	EA N	LC	+	+	+	-	+	Coll.
<i>Hyperolius pictus</i>	O	EA N	LC	-	-	-	-	+	Coll.
<i>Hyperolius pseudargus</i>	O	EA N	LC	-	-	-	-	+	Coll.
<i>Phlyctymantis keithae</i>	O	E	VU	-	-	+	-	+	UDSM
Pipidae									
<i>Xenopus cf. muelleri</i>	O	W	LC	-	-	-	+	+	UDSM
Pyxicephalidae									
<i>Amietia angolensis</i>	O	W	LC	-	+	-	+	+	Coll.
Ranidae									
<i>Strongylopus fuelleborni</i>	O	W	Not listed	-	-	-	-	+	UDSM

Taxa	Habitat	Endemism	IUCN status	KI 1	KI 2	LU	LP	VI	Recording method
Ptychadenidae									
<i>Ptychadena uzungwensis</i>	O	W	LC	-	-	-	-	+	UDSM
Petropedetidae									
<i>Phrynobatrachus mababiensis</i>	O	W	LC	-	-	-	+	+	UDSM
<i>Phrynobatrachus natalensis</i>	O	W	LC	-	-	-	-	+	Coll.
Scolecormorphidae									
<i>Scolecormorphus cf. kirkii</i>	FF	EA	-	+	+	+	-	-	Coll.
REPTILES									
Gekkonidae									
<i>Lygodactylus angularis</i>	O	W		-	-	-	-	+	Coll.
Chamaeleonidae									
<i>Kinyongia Sp. Nov.</i>	FF	E	CITES II	+	-	-	-	-	Coll.
<i>Kinyongia cf. oxyrhina</i>	FF	EA	CITES II	-	-	+	-	-	TFCG
<i>Chamaeleo dilepis</i>	O	W	CITES II	-	-	-	-	+	Obs.
<i>Chamaeleo laterispinis</i>	F	E	CITES II	-	+	-	-	+	Coll.
<i>Chamaeleo tempeli</i>	F	EA N	CITES II	-	+	-	+	+	Coll.
<i>Chamaeleo werneri</i>	F	EA	CITES II	+	+	-	-	+	Coll.
<i>Rhampholeon moyeri</i>	FF	EA		+	+	-	+		Coll.
Cordylidae									
<i>Cordylus ukingensis</i>		W	CITES II						LIT.
Scincidae									
<i>Melanoseps loveridgei</i>	F	W		-	+	-	-	+	Coll.
<i>Melanoseps uzungwensis</i>	FF	E		+	-	-	-	-	LIT.
<i>Trachylepis varia</i>	O	W		-	-	-	+	+	Obs.
Typhlopidae									
<i>Rhinotyphlops nigrocandidus</i>	FF	EA		-	-	+	-	-	LIT.
Colubridae									
<i>Duberria lutrix</i>	O	W		-	-	+	+	+	Coll.
<i>Lycodonomorphus whitey</i>	O	W		-	-	+	-	-	UDSM
<i>Dasypeltis scabra</i>	O	W		-	-	+	-	+	UDSM
<i>Dispholidus typus</i>	O	W		-	-	-	-	+	Coll.
<i>Crotaphopeltis tornieri</i>	FF	EA N		-	-	-	+	-	Coll.
<i>Lycophidion capense</i>	O	W		-	-	-	+	+	UDSM
<i>Lycophidion uzungwense</i>	O	E		-	-	-	-	+	Coll.
<i>Lamphrophis fuliginosus</i>	O	W		-	-	+	-	+	UDSM
<i>Telescopus semiannulatus</i>	O	W		-	-	-	-	+	UDSM
<i>Thelotornis cf. mossambicanus</i>		W		-	-	+	-	-	Coll.
<i>Psammophylax variabilis</i>	O	W		-	-	-	-	+	UDSM
<i>Philothamnus ornatus</i>	O	W		-	-	-	-	+	Coll.
Viperidae									
<i>Adenorhinos barbouri</i>	F	EA N		-	-	-		+	UDSM
<i>Atheris ceratophorus</i>	FF	EA		+	+	+	-	+	Coll.
<i>Bitis arietans</i>	O	W		-	-	-	-	+	Coll.
<i>Causus rhombeatus</i>	O	W		-	-	-	-	+	UDSM

Key to Table 31

Locality

KI 1 = Kigogo Forest Reserve Site 1; KI 2 = Kigogo Forest Reserve Site 2 LU = Lulanda Forest Reserve

LP = Lupeme Forest; VI = Village belt and plantations

Red List

EN = Endangered, VU Vulnerable, LR/cd = Lower Risk/conservation dependent, DD = Data Deficient, LC = Least Concern

Range

E = Endemic to the Udzungwa Mountains; EA = Eastern Arc Endemic, EA N = Near-endemic to the Eastern Arc Mountains, W = Widespread,

Forest Dependency

FF = strictly confined to forest, F = mainly forest, but also found outside, O = non-forest species

Recording Method

Coll. = Collected during the current survey

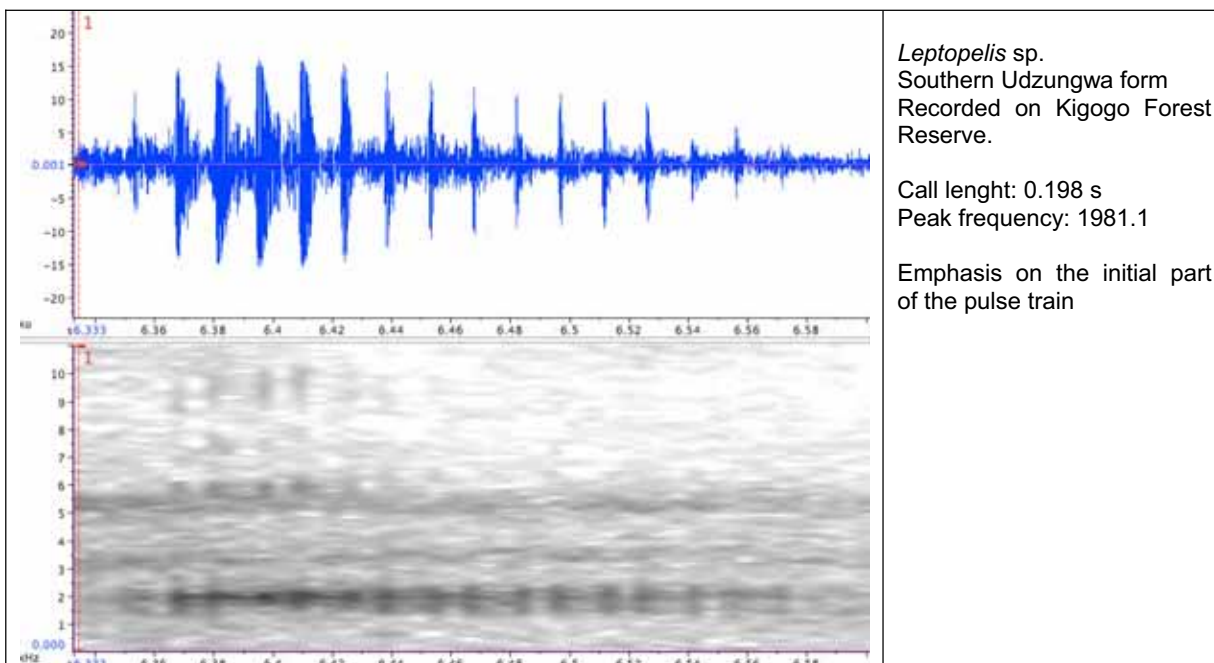
LIT = Record taken from the literature

UDSM = In the herpetological collection of the University of Dar es Salaam

7.4.2 New species

The present study recorded three amphibian taxa and one reptile taxon that are sufficiently distinct from other taxa that they may be considered new species based upon the available data. The assessment of the taxonomic status of the species collected during the surveys was done in the context of a more extensive work on the genera, involving molecular, osteological, bioacoustic and morphological analysis conducted between 2005 and 2008 (Loader *et al.* unpublished, Poynton *et al.* unpublished, Menegon *et al.* unpublished). Formal description of some of the species is in progress.

Leptopelis Sp. Nov. A medium sized forest *Leptopelis* in the Udzungwa range was considered belonging to the species *L. barbouri* by several authors. Recent bioacoustical analysis (Michele Menegon unpublished data) and genetic analysis (Simon Loader unpublished data) show that *Leptopelis barbouri* is actually a complex of different species (type locality in Usambara Mountains). The species collected in the study sites shows bioacoustic and genetic differences and is likely to be endemic to the Udzungwa Range. See below a comparison between the call recorded in Kigogo and a *Leptopelis cf. barbouri* call recorded in Kanga Forest Reserve, further north. Further analysis is needed in order to assess the taxonomy of the *Leptopelis barbouri* complex.



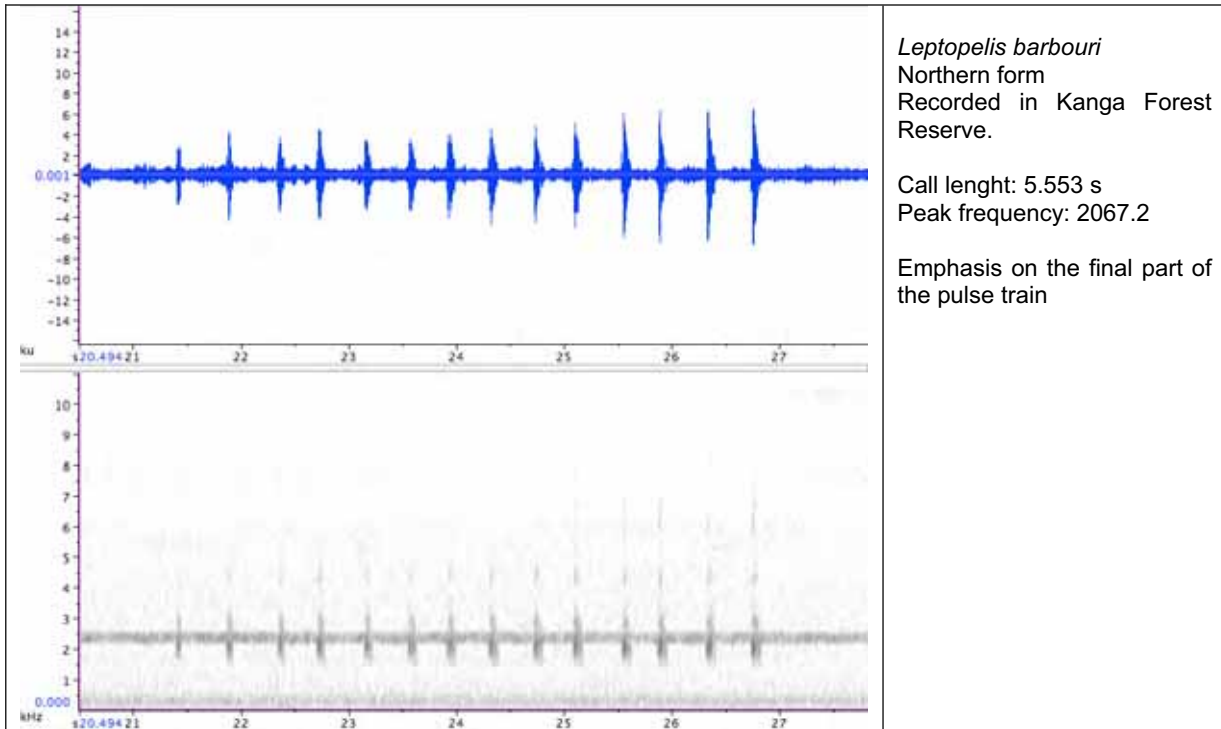
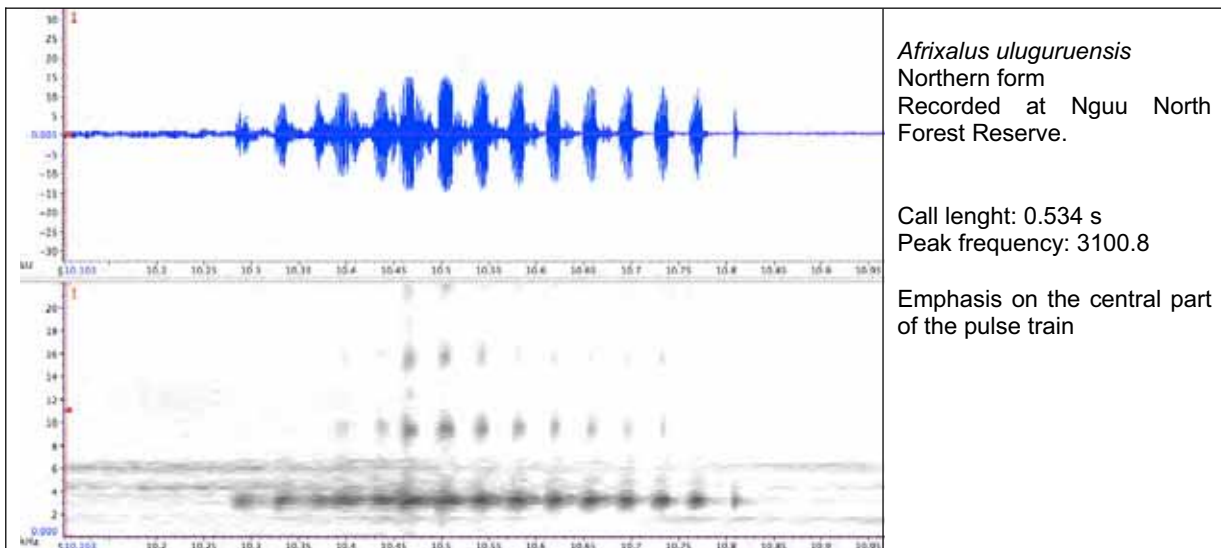


Figure 7. Comparisons of sonograms for *Leptopelis* sp.

***Afrivalus* Sp. Nov.** was considered to belong to the species *A. uluguruensis* by Schiötz (1999). Further analysis based on acoustical data (Menegon unpublished), Barry Clarke unpublished morphological data and Loader unpublished genetic data, show that *A. uluguruensis* is actually a complex of different species (type locality in the Uluguru Mountains). The species recorded for the study site seems to be endemic of the southern Udzungwa Mountains from the Uzungwa Scarp Forest Reserve in the north to the Forest patches in Mufindi area in the south. See below (Figure 8) a preliminary comparison between the call recorded in Kigogo and an *Afrivalus* cf. *uluguruensis* call recorded in Nguu North Forest Reserve. Further analysis is needed in order to assess the species composition of the *Afrivalus* cf. *uluguruensis* complex



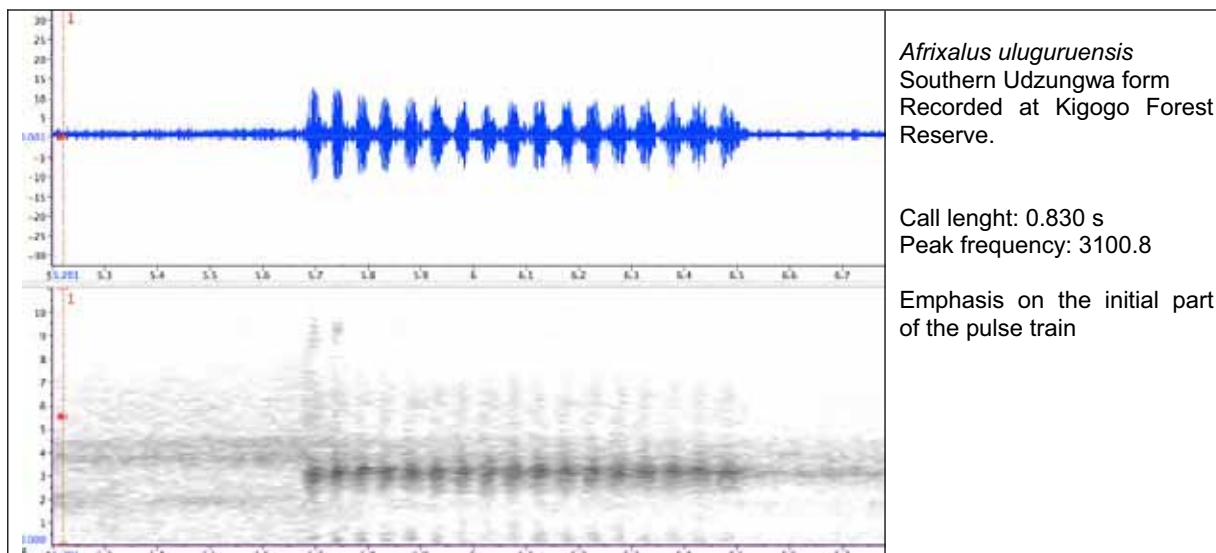


Figure 8. Comparisons of sonograms for *Afrixalus* sp.

***Probreviceps* Sp. Nov.** has been reported as *Probreviceps macrodactylus rungwensis* by Loader *et al.* (2006). In that paper the phylogenetic assessment of the genus shows that the species have two divergent lineages, which each correspond to distinct areas, the Udzungwa and Southern Highlands. Since the Mount Rungwe represents the type locality for *Probreviceps macrodactylus rungwensis*, the populations of the Udzungwa Mountains belong to a phylogenetic distinct taxon that deserve taxonomic assessment. For further details of the analysis of species and intrageneric relationships in Brevicipitidae, see Loader *et al.* (2004).

***Kinyongia* Sp. Nov.** Among reptiles, the *Kinyongia* species collected in Kigogo Forest Reserve – site 1 – does not fit the description of any known species and it has a peculiar rostral appendage formed by two short converging horns, quite unique among the currently known *Kinyongia* species. From a morphological point of view it belongs to the *K. fischeri* complex *sensu* Tilbury *et al.* 2007. A further specimen of this species, collected in the northern part of the Udzungwa mountains and originally misidentified as *Bradypodion tenue* (now *K. tenuis*), has been found in the herpetological Collection of University of Dar es Salaam. A molecular assessment of the taxon is currently on going.

7.4.3 Endemism

The proportion of amphibian and reptile species from the Mufindi area that are endemic or near-endemic to the area is high. Based on the results of this study, 6 species that represent 12.7 % of the herpetofauna species recorded are strictly endemic to the Udzungwa Mountains and a further 21 species representing 44.6 % of the recorded species, have ranges restricted to the Eastern Arc Mountains or Southern Highlands (Tables 32 and 33).

Table 32. Number of endemic amphibian species recorded Mufindi area.

Forest reserve	Udzungwa endemic	Eastern Arc Endemic	Eastern Arc near-endemic	Widespread
Kigogo	3	1	3	2
Lulanda	3	1	2	2
Lupeme	1	0	1	7
Village belt	1	0	3	9
Total species	4	1	5	10

Table 33. Number of endemic reptile species recorded in Mufindi area.

Forest reserve	Udzungwa endemic	Eastern Arc Endemic	Eastern Arc near-endemic	Widespread
Kigogo	3	3	2	0
Lulanda	0	3	0	5
Lupeme	0	1	2	3
Village belt	2	2	3	13
Total species	4	5	4	14

7.4.4 Zoogeography

Within the Eastern Afromontane endemic species, the Mufindi area shows slightly more overlap in terms of species with the Southern Highlands than with the northern part of the Eastern Arc Mountains. This supports the assumption of some authors that, at least from an herpetological point of view, there is no faunal gap between the Eastern Arc Mountains and the Southern Highlands (Menegon and Davenport in print). Specifically, two species are shared with the Southern Highlands and the northern Eastern Arc mountain blocks; four (maybe five) species are shared with the Southern Highlands only and three are shared with the northern blocks of Eastern Arc Mountains only.

7.4.5 Threatened species

The surveys recorded two species listed as being vulnerable to extinction according to IUCN criteria and one species considered near-threatened. A provisional assessment of the three new species suggests that these species are all vulnerable to extinction on the basis of their small and fragmented populations.

Table 34. List of threatened and CITES-listed amphibian and reptile species.

Scientific name	Threatened status	CITES
Arthroleptidae		
<i>Arthroleptis reichei</i>	NT	-
<i>Leptopelis sp. nov.</i>	VU - Need to be assessed*	
Bufonidae		
<i>Nectophrynoides cf. viviparus</i>	VU	CITES I
Brevicipitidae		
<i>Probreviceps sp. nov.</i>	VU - Need to be assessed*	
Hyperolidae		
<i>Afrixalus sp. nov.</i>	VU - Need to be assessed*	
<i>Phlyctymantis keithae</i>	VU	
Chamaelonidae		
<i>Kinyongia sp.</i>		CITES II
<i>Kinyongia cf. oxyrhina</i>		CITES II
<i>Chamaeleo dilepis</i>		CITES II
<i>Chamaeleo laterispinis</i>		CITES II
<i>Chamaeleo tempeli</i>		CITES II
<i>Chamaeleo werneri</i>		CITES II
<i>Rhampholeon moyeri</i>		CITES II
Cordylidae		
<i>Cordylus ukingensis</i>		CITES II

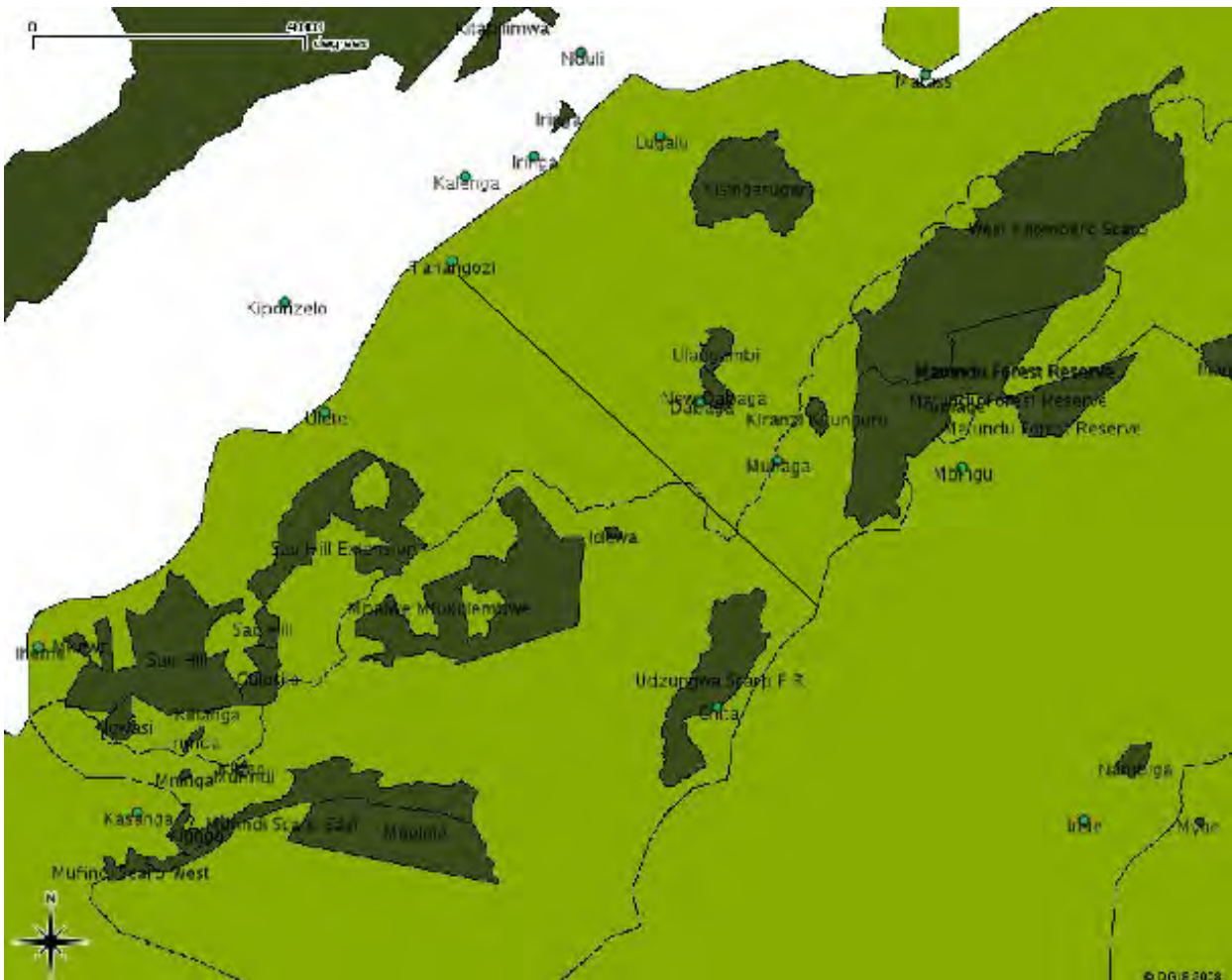
7.5 Discussion

Although the herpetofauna of the Mufindi area has been randomly collected for many years, several unrecorded or undescribed species were found during our study. The herpetological survey, combined with previous data, revealed nearly 50 species including three species new to science in an area highly modified by man. The species composition reflects the geographic position of the area that, rather than a gap, seems to represent a bridge between the Eastern Arc Mountains and the Southern Highlands.

Populations with small effective sizes (< 100) are prone to rapid divergence, loss of heterozygosity, inbreeding and random fixation of mutations (Driscoll, 1999). Mufindi, with its artificial archipelago of small forest patches, is an interesting natural laboratory to study the minimum viable population size of species. Such research could contribute to our understanding of the size at which a population is at risk

of local extinction (Gilpin and Soulé, 1986 and Soulé, 1987). Such research could also contribute to our understanding of genetic bottlenecks, the founder effect and the ability of some endemic or near endemic species to disperse in altered habitats.

The southern Udzungwa Mountains, more specifically the mosaic of forest and grasslands included in the area south west of a line, cutting the so called ‘Mgeta corridor’ and linking the villages of Tanangozi in the north west and Mngeta in the south east (see Map xx), shows certain differences relative to the herpetofaunal composition of the more northerly Eastern Arc Mountains (although further research is needed to assess whether Kisinga-Rugaro, New Dabaga-Ulongambi and Kiranzi-Kitunguru forest reserves fall to the north or south of the line). Two of the genera endemic to the Eastern Arc Mountains, *Callulina* and *Hoplophryne*, occur in the northern part of the Udzungwa Mountains and throughout the rest of the Eastern Arc Mountains, but are absent south of this line. Similarly the genus *Boulengerula* is absent from the entire Udzungwa mountain block while it is widely distributed, with several species, in the northern part of the Eastern Arc Mountains. The population of the *Probreviceps* cf. *rungwensis* occurring in the southern Udzungwa, is genetically more closely related to the Southern Highlands taxon rather than to the northern Udzungwa one (Simon Loader pers. com.). Several so-called “Eastern Arc Mountain near endemic species” are shared between the southern Udzungwas only and the Southern Highlands, among them *Chamaeleo tempeli*, *Cordylus ukingensis* and *Adenorhinos barbouri*.



Map 9. The Mngeta divide.

Other southern African species that reach the Southern Udzungwas but not the rest of the Eastern Arc Mountains include the grass dwelling lizards of the genus *Tetradactylus*. The *Tetradactylus* lizards are widespread, with several species, in southern Africa. Only two of them are recorded at northern latitudes, one is the recently described *Tetradactylus udzungwensis*, endemic to southern Udzungwa only, the other one is *T. ellenbergeri* that also reaches the montane grasslands in Southern Udzungwa and occurs in syntopy with the former species in the vicinity of Bomalong’ombe Village, west of Uzungwa Scarp Forest Reserve. The survey team have searched for both of these species in the Mufindi area but have not yet recorded them. This could be due to local extinction or biases in research

effort against open areas). The range of the *Tetradactylus* lizard species further highlights the peculiarity of the southern Udzungwa herpetofauna and stresses the need for more phylogeographic investigation in order to understand the relationship between the faunal assemblages of the southern part of the Eastern Arc Mountains and the Southern Highlands.

8) Forest use

By Charles Leonard and Nike Doggart

8.1 Introduction

The forests of the Eastern Arc Mountains are gradually being cleared (Forestry and Beekeeping Division, 2006c) and there is an urgent need for the problem to be documented if changes are to be made to reverse or slow the degradation process (Madoffe *et al.*, 2000). These forests have been under continuous exploitative human pressure for at least 2,000 years (Schmidt, 1989). The growing human population in the area has placed greater demand on the resources of the ecosystem to provide food, fuelwood, hydropower, clean water, land and other forest products.

8.2 Objectives

The major objectives of the forest use survey were:

- To assess the intensity and distribution of human disturbance within the Eastern Arc Mountain forests of Mufindi District.
- To record the types of human disturbance affecting the Eastern Arc Mountain forests of Mufindi District.

8.3 Methods

Disturbance transects were used to provide information on rates of timber extraction and pole cutting and other disturbances within the forests. Disturbance was assessed within fifteen 10 m wide transects in Ifupira (2), Livalonge (1), Mufindi Scarp West (2), Kigogo (5), Mufindi Scarp East (2), Ipafu (1), Kidegemsitu (1) and Lulanda Forests (1). Each transect was 1 km in length. Transects were placed starting at the forest boundary and following a constant bearing. The bearing depended on the orientation of the forest. The location of the start and end points were recorded using a GPS. The distance between transects varied between forests and depended on the area of the forest. The location of the transects in each of the eight forests is shown in Maps xx and the coordinates for each transect are provided in Appendix 11.

Disturbance rates were recorded for each 50 m section along the transect lines. The level of disturbance was assessed in terms of the number of poles and timbers which were cut relative to the number of live or naturally dead trees in a 10 m strip (5 m either side of the transect line). Poles were defined as those trees with straight stems at least 2 m in length and with 5 - 15 cm dbh. Timber trees were defined as all trees with straight stems at least 3 m in length and exceeding 15 cm dbh.

Every cut tree stump and cut pole was measured within the transect. The diameter at breast height (dbh) was measured at the standard height of 1.3 m above the ground using a calibrated tape. The diameter of cut trees and poles were measured at the point of cut. Fallen tree trunks or branches were not counted, only stumps.

Other forms of human disturbance were also recorded systematically in each of the forests. These disturbances include fire, pitsawing, timber / planks, trapping, cultivation, grazing, paths, charcoal burning or clearings.

A more detailed account of the methods used for assessing disturbance is provided in Doggart (2006 b).

8.4 Sampling intensity

Forest use was assessed over a total of 15 ha (Table 35).

Table 35. Number of disturbance transects assessed in each reserve.

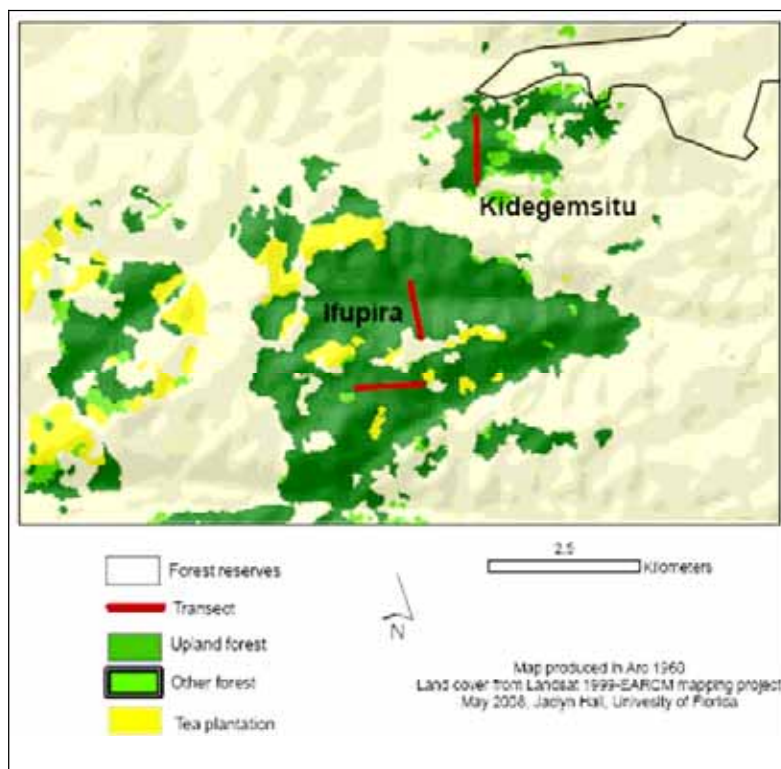
Forest	Number of transects	Area of transect (ha)
Ifupira	2	2
Livalonge	1	1
Mufindi Scarp West	2	2
Mufindi Scarp East	2	2

Forest	Number of transects	Area of transect (ha)
Kigogo	5	5
Ipafu	1	1
Kidegemsitu	1	1
Lulanda	1	1
TOTAL	15	15

8.5 Results

8.4.1 Ifupira forest

Ifupira Forest is managed by UTTL. The only recent signs of disturbance recorded in Ifupira were old cut poles. However the broken canopy and prevalence of the invasive alien species *Rubus* sp. and *Lantana camara*, indicates that this forest has been logged intensively in the past. A dam has been constructed inside the forest to supply water to the tea fields. The construction of the dam also involved the construction of a road and water channels which have contributed to the degradation of the forest. The road to Mdadulo from Ifupira traverses the forest on the south-eastern side.



Map 10. Location of disturbance transects in Ifupira and Kidegemsitu Forests.

Pole extraction

A total of 831 poles were recorded in Ifupira forest. Of these, 89 % of the poles were alive, 10 % were naturally dead, 1 % were old cut poles and 0 % were freshly cut. The number of poles recorded in each transect are summarized in Table 36 below.

Table 36. Numbers of live, dead, and cut poles recorded in Ifupira forest.

Transect number	Transect area (ha)	Total number poles sampled	Average live poles per ha (% of total)	Average dead poles per ha (% of total)	Average old cut poles per ha (% of total)	Average fresh cut poles per ha (% of total)
IF1	1	313	265 (85)	48 (15)	0 (0)	0 (0)
IF2	1	518	474 (92)	38 (7)	6 (1)	0 (0)
Total	2	831	369.5 (89)	43 (10)	3 (1)	0 (0)

Note: Values in brackets are percentages of total poles recorded, to nearest whole number.

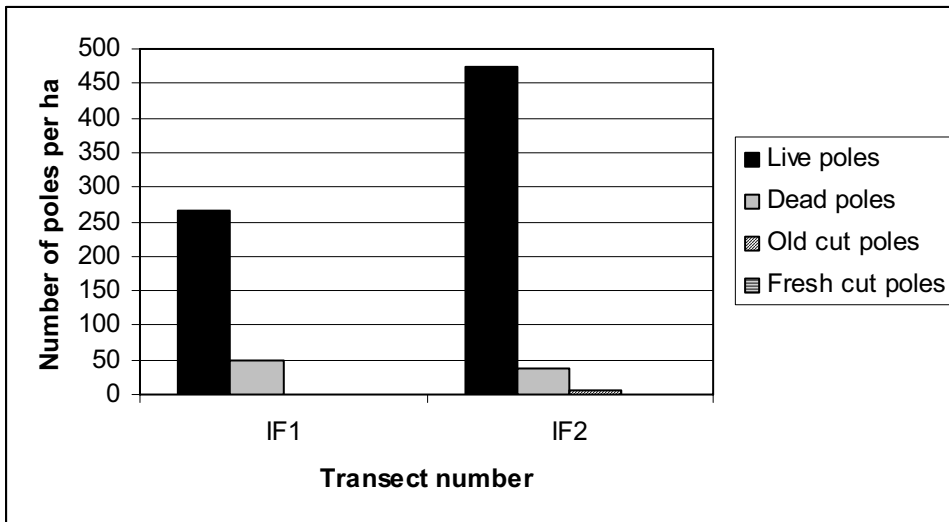


Figure 9. Abundance of live, naturally dead, old and fresh cut poles along disturbance transects in Ifupira forest.

Timber extraction

A total of 498 timber-sized trees were recorded in Ifupira forest. On average, 85 % were live, 15 % were naturally dead, 0 % were old cut and 0 % were freshly cut timber trees. Table 37 below summarizes numbers of timbers recorded in each transect.

Table 37. Numbers of live, dead, and cut timbers recorded in Ifupira forest.

Transect number	Transect area (ha)	Total number timbers sampled	Average live timbers per ha (% of total)	Average dead timbers per ha (% of total)	Average old cut timbers per ha (% of total)	Average fresh cut timbers per ha (% of total)
IF1	1	304	251 (83)	53 (17)	0 (0)	0 (0)
IF2	1	194	174 (90)	20 (10)	0 (0)	0 (0)
Total	2	498	212.5 (85)	36.5 (15)	0 (0)	0 (0)

Note: values in brackets are percentages of total timbers recorded, to nearest whole number.

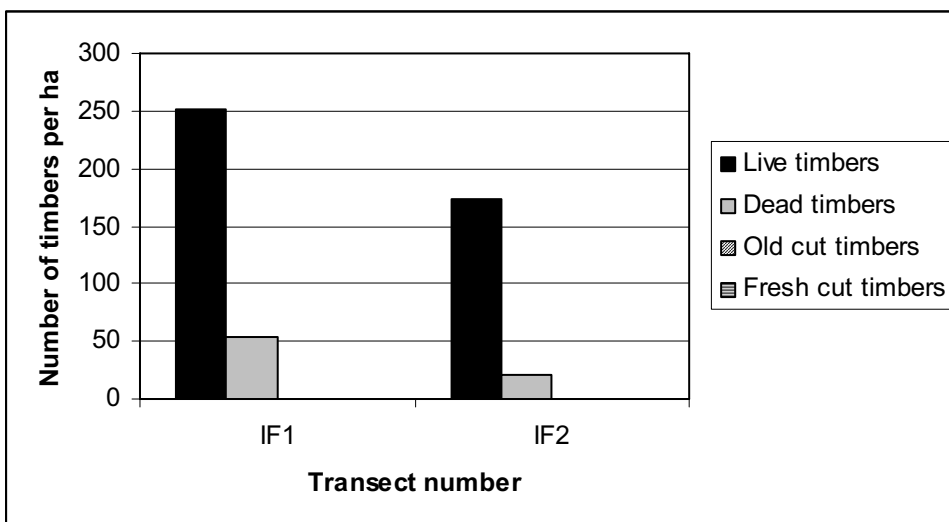


Figure 10. Abundance of live, naturally dead, old and fresh cut timbers along disturbance transects in Ifupira forest.

8.5.2 Livalonge forest

Livalonge forest is contiguous with Mufindi Scarp West Forest Reserve along its southern / south-eastern border. The forest is managed by Unilever Tea Tanzania Limited (UTTL). The forest vegetation at the forest edge, especially where it forms a boundary with Mufindi Scarp West, consists of a low

canopy with vine tangles and *Rubus* sp.. In contrast, the forest interior is characterised by the presence of a high canopy with emergents up to 30 m. Signs of forest duikers and bush pigs were prevalent in the forest interior indicating low levels of disturbance. The northern and western edge of the forest is surrounded by agricultural land, both subsistence agriculture and tea fields. Overall, in terms of the canopy structure and prevalence of invasive alien species, the forest is less disturbed than Ifupira forest which is also managed by UTTL. Signs of disturbance recorded during the surveys included old cut poles and timber, an old pitsaw site, a rope snare and a path.

Pole extraction

A total of 436 poles were recorded in Livalonge forest. On average, 84% of recorded poles along the transect were alive, 15% were naturally dead, 1% were old cut poles and 0% fresh cut. Numbers of poles recorded along the transect are summarized in Table 38 below.

Table 38. Numbers of live, dead, and cut poles recorded in Livalonge forest.

Transect number	Transect area (ha)	Total number poles sampled	Average live poles per ha (% of total)	Average dead poles per ha (% of total)	Average old cut poles per ha (% of total)	Average fresh cut poles per ha (% of total)
LIV1	1	436	368 (84)	66 (15)	2 (1)	0 (0)

Note: Values in brackets are percentages of total poles recorded, to nearest whole number.

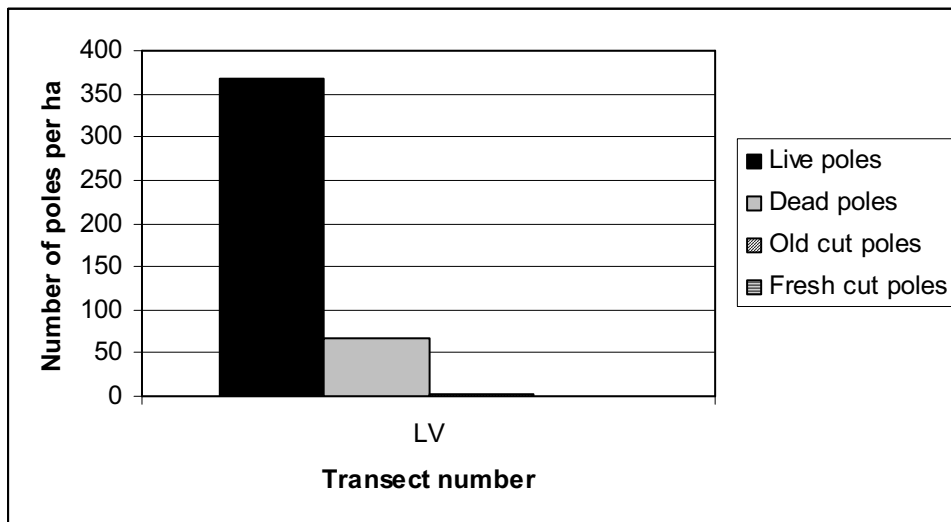


Figure 11. Abundance of live, naturally dead, old and fresh cut poles along disturbance transects in Livalonge forest.

Timber extraction

A total of 236 timbers were recorded in Livalonge forest. On average, 79% of recorded timbers along the transect were live, 20% were naturally dead, 1% were old cut timbers and 0% fresh cut. Numbers of timbers recorded along the transect are summarized in Table 39 below.

Table 39. Numbers of live, dead, and cut timbers recorded in Livalonge forest.

Transect number	Transect area (ha)	Total number timbers sampled	Average live timbers per ha (% of total)	Average dead timbers per ha (% of total)	Average old cut timbers per ha (% of total)	Average fresh cut timbers per ha (% of total)
LIV1	1	236	187 (79)	46 (20)	3 (1)	0 (0)

Note: values in brackets are percentages of total timbers recorded, to nearest whole number.

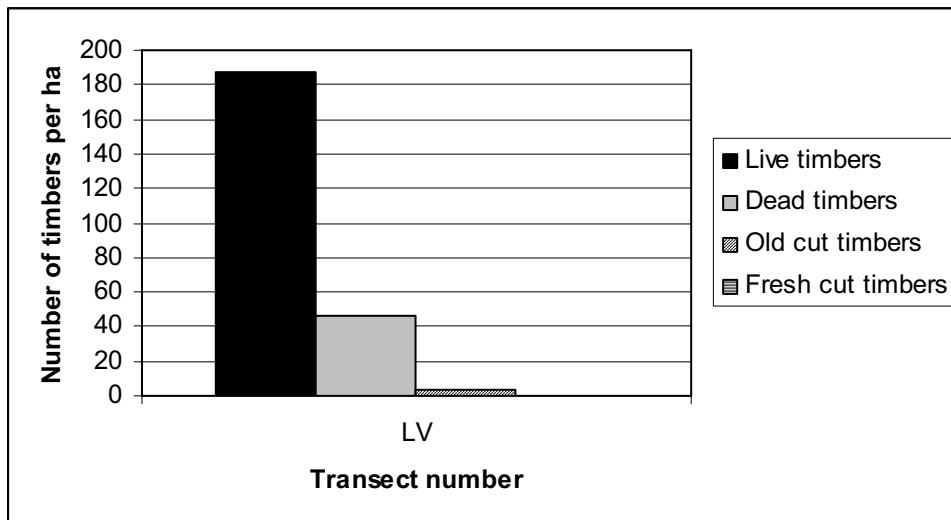


Figure 12. Abundance of live, naturally dead, old and fresh cut timbers along disturbance transect in Livalonge forest.

8.4.3 Mufindi Scarp West

Historically, parts of Mufindi Scarp West were inhabited by local people and Germans (see Indigenous Knowledge Survey section of this report). As a result the reserve is dominated by secondary growth vegetation. The ridge tops in the forest interior have a high canopy while the valleys have a scrubby tangle dominated by *Rubus* sp.. There is an old track crossing the forest that was formerly used to transport logs to the Mgololo’s Southern Paper Mills (now called Mufindi Paper Mills).

Types of disturbance that were recorded by the survey team in Mufindi Scarp West Forest Reserve include cut poles and timber; cultivation, paths, pitsawing and old settlements. One path was recorded on each of the transects whilst pitwasing was recorded five times. Signs of an old settlement were visible along Transect MW 2. These were the remains of a German settlement from the 1920s. There is a belief held by some local people that the Germans left rupees and gold behind. This belief has led to various attempts to excavate pits where the gold is said to have been hidden. More detailed information about this is found in Indigenous Knowledge Survey Section 9 of this report.

Approximately 600 m along Transect MW 1 the team recorded a four acre field where beans were being cultivated. Similarly along the forest boundary close to Transect MW 1, five acres have been cleared for the cultivation of wheat and beans. The cultivation is taking place at the source of the Kitendega River. There is an abrupt transition from forest to tea where the forest reserve adjoins the Malenda Tea Farms Ltd. No reserve demarcation was visible in this area.

Pole extraction

A total of 803 poles were recorded in Mufindi Scarp West FR. On average, 86 % of poles recorded along the disturbance transects were live, 13 % were naturally dead, 1 % were old cut poles and 0 % were freshly cut. Numbers of poles recorded along the disturbance transects are summarized in Table 40 below.

Table 40. Numbers of live, dead, and cut poles recorded in Mufindi Scarp West FR.

Transect number	Transect area (ha)	Total number poles sampled	Average live poles per ha (% of total)	Average dead poles per ha (% of total)	Average old cut poles per ha (% of total)	Average fresh cut poles per ha (% of total)
MW1	1	423	361 (85)	60 (14)	2 (1)	0 (0)
MW2	1	380	332 (87)	47 (12)	1 (1)	0 (0)
Total	2	803	346.5 (86)	53.5 (13)	1.5 (1)	0(0)

Note: Values in brackets are percentages of total poles recorded, to nearest whole number.

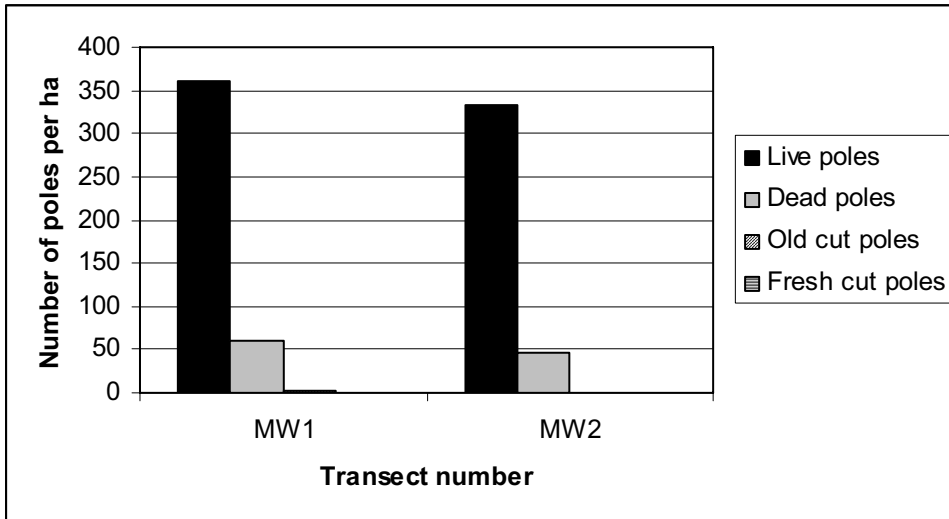


Figure 13. Abundance of live, naturally dead, old and fresh cut poles along disturbance transects in Mufindi Scarp West FR.

Timber extraction

A total of 508 timbers were recorded along the transects in Mufindi Scarp West FR. On average, 85 % of recorded timbers along the disturbance transects were live, 15 % were naturally dead, 0 % were old cut timbers and 0 % fresh cut. Numbers of timbers recorded along the disturbance transects are summarized in Table 41 below.

Table 41. Numbers of live, dead, and cut timbers recorded in Mufindi Scarp West FR.

Transect number	Transect area (ha)	Total number timbers sampled	Average live timbers per ha (% of total)	Average dead timbers per ha (% of total)	Average old cut timbers per ha (% of total)	Average fresh cut timbers per ha (% of total)
MW1	1	274	236 (86)	38 (14)	0 (0)	0 (0)
MW2	1	234	194 (83)	38 (16)	2 (1)	0 (0)
Total	2	508	215 (85)	38 (15)	1 (0)	0(0)

Note: values in brackets are percentages of total timbers recorded, to nearest whole number.

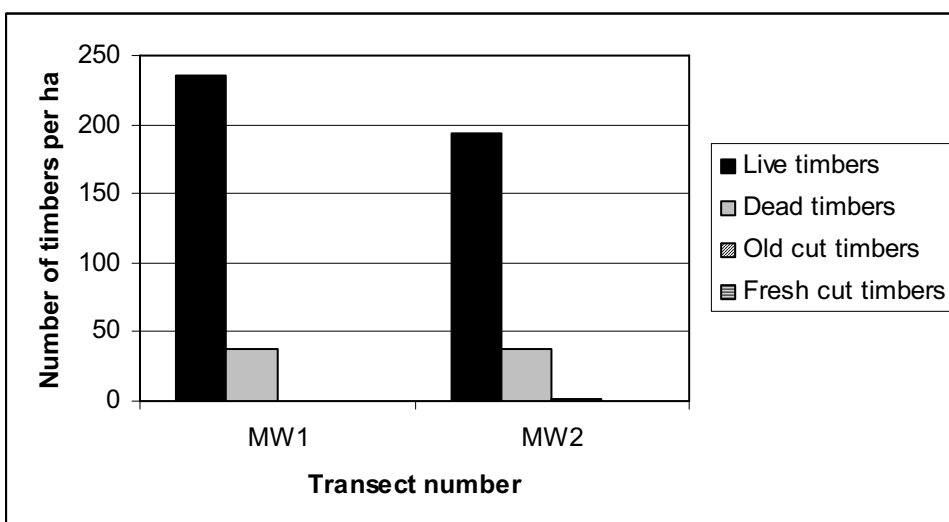


Figure 14. Abundance of live, naturally dead, old and fresh cut timbers along disturbance transects in Mufindi Scarp West FR.

8.5.4 Kigogo Forest Reserve

Kigogo Forest Reserve contains some of the least disturbed forest in Mufindi District. The forest interior is characterised by a high canopy interspersed by occasional patches of riverine forest, shrubs, tree ferns and bamboo. Forest in the vicinity of the Kigogo River showed few signs of disturbance. In

contrast the forest edge, especially on the western and northern sides appears to be highly disturbed and is dominated by *Rubus* sp. and other shrubs.

Types of disturbance that were recorded in Kigogo Forest Reserve include: cut poles and timber, pitsawing, paths, fire, cultivation, forest soil collection and wildlife trapping. Pitsawing along transect KG 1 was recorded six times whilst paths were recorded twice. Along transect KG 2 cultivation was recorded three times while pitsawing was recorded only once. In transect KG 3 two paths were recorded, while fire was recorded once. In transect KG 4, paths were recorded four times whereas fire, cultivation, cutting of planks and a cleared forest area were recorded only once. The area that had been cleared was being used as a source of forest soil for tea seedlings. Along transect KG 5, wildlife trapping was recorded three times while pitsawing was recorded only once.

The cultivation recorded along Transect KG 2 from 100 m to 200 m from the forest boundary was tea belonging to UTTL while the cultivation recorded on Transect KG 4 was a vegetable field of about two acres. This field was found at about 300 m from the forest boundary. The tea field was more than 300 m wide and 150 m in length.

Extraction of bamboo stems for commercial basket making is another disturbance in Kigogo which if continued unchecked could result in the depletion of the bamboo. There were signs that workers from the tea estate are harvesting bamboo from the forest reserve to weave baskets for tea collection. This was particularly evident along the path up to the Kigogo View Point. Several paths cross the reserve which are used by tea workers to access fields on the escarpment. In the northern part of the forest, a track has been established to reach the viewpoint.

Pole extraction

A total of 3215 poles were recorded in Kigogo FR. On average, 79 % of recorded poles along the disturbance transects were live, 13 % were naturally dead, 7 % were old cut poles and 1 % fresh cut. Numbers of poles recorded along the disturbance transects are summarized in Table 42 below.

Table 42. Numbers of live, dead, and cut poles recorded in Kigogo FR.

Transect number	Transect area (ha)	Total number poles sampled	Average live poles per ha (% of total)	Average dead poles per ha (% of total)	Average old cut poles per ha (% of total)	Average fresh cut poles per ha (% of total)
KG1	1	285	238 (84)	43 (15)	4 (1)	0 (0)
KG2	1	437	395 (90)	42 (10)	0 (0)	0 (0)
KG3	1	839	678 (81)	160 (19)	1 (0)	0 (0)
KG4	1	963	650 (68)	82 (9)	206 (21)	25 (3)
KG5	1	691	582 (84)	103 (15)	6 (1)	0 (0)
Total	5	3215	508.6 (79)	86 (13)	43.4 (7)	5 (1)

Note: Values in brackets are percentages of total poles recorded, to nearest whole number.

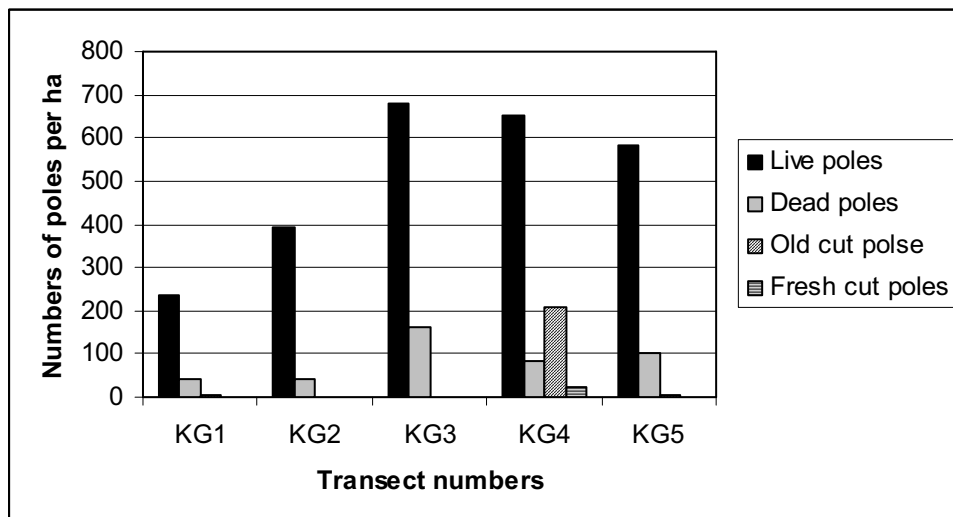


Figure 15. Abundance of live, naturally dead, old and fresh cut poles along disturbance transects in Kigogo FR.

Timber extraction

A total of 1372 timbers were recorded in Kigogo FR. On average, 82 % of recorded timbers along the disturbance transects were live, 15 % were naturally dead, 3 % were old cut timbers and 0 % fresh cut. Numbers of timbers recorded along the disturbance transects are summarized in Table 43 below.

Table 43. Numbers of live, dead, and cut timbers recorded in Kigogo FR.

Transect number	Transect area (ha)	Total number timbers sampled	Average live timbers per ha (% of total)	Average dead timbers per ha (% of total)	Average old cut timbers per ha (% of total)	Average fresh cut timbers per ha (% of total)
KG1	1	338	279 (83)	54 (16)	5 (1)	0 (0)
KG2	1	217	198 (91)	19 (9)	0 (0)	0 (0)
KG3	1	272	231 (85)	39 (14)	2 (1)	0 (0)
KG4	1	285	202 (71)	53 (19)	30 (10)	0 (0)
KG5	1	260	221 (85)	39 (15)	0 (0)	0 (0)
Total	5	1372	226.2 (82)	40.8 (15)	7.4 (3)	0 (0)

Note: values in brackets are percentages of total timbers recorded, to nearest whole number.

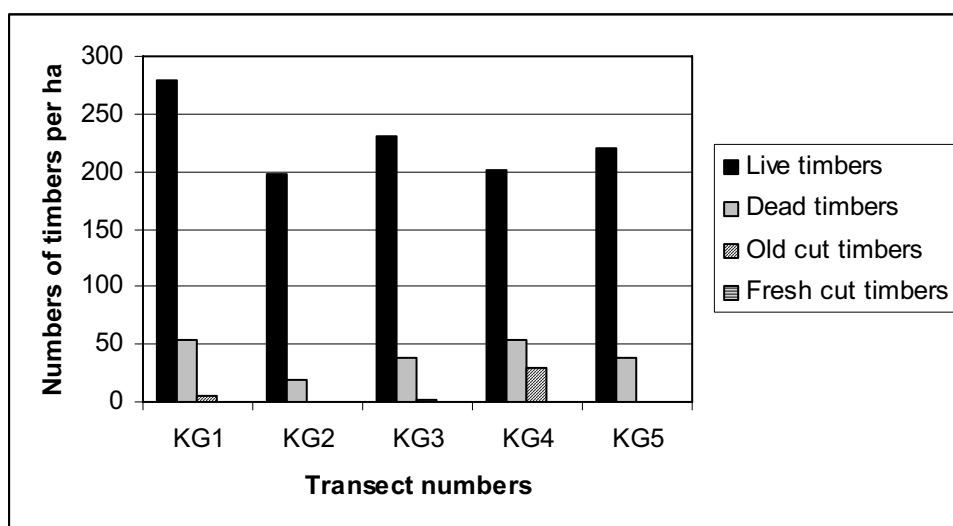


Figure 16. Abundance of live, naturally dead, old and fresh cut timbers along disturbance transects in Kigogo FR.

8.5.5 Mufindi Scarp East

The reserve has two distinct vegetation types: wooded grassland and montane forest. Wooded grassland dominates most of the escarpment. There is a gradation of vegetation between the wooded grassland and montane forest in the western side of the reserve where it adjoins Kigogo Forest Reserve. Although the upper montane part of the reserve contains trees with a high canopy, the canopy on the lower parts of the reserve is open.

Types of disturbance that have been recorded in Mufindi Scarp East Forest Reserve include cut poles and timber, fire, pitsawing and trapping. In transect ME 1 pitsawing was recorded twice while wildlife trapping and a path were recorded once. In transect ME 2, the only recorded disturbance was fire which was recorded four times.

Overall, fire has affected much of the reserve. The fires that spread into the reserve usually originate in farms at the base of the escarpment. The fires frequently sweep across the reserve’s woodland and damage the forest edge. There are also numerous paths which cross the escarpment.

Pole extraction

A total of 1243 poles were recorded in Mufindi Scarp East FR. On average, 88 % of recorded poles along the disturbance transects were live, 12 % were naturally dead, 0 % were old cut poles and 0 %

fresh cut. Numbers of poles recorded along the disturbance transects are summarized in Table 44 below.

Table 44. Numbers of live, dead, and cut poles recorded in Mufindi Scarp East FR.

Transect number	Transect area (ha)	Total number poles sampled	Average live poles per ha (% of total)	Average dead poles per ha (% of total)	Average old cut poles per ha (% of total)	Average fresh cut poles per ha (% of total)
ME1	1	545	489 (90)	56 (10)	0 (0)	0 (0)
ME2	1	698	602 (86)	96 (14)	0 (0)	0 (0)
Total	2	1243	545.5 (88)	76 (12)	0 (0)	0 (0)

Note: Values in brackets are percentages of total poles recorded, to nearest whole number.

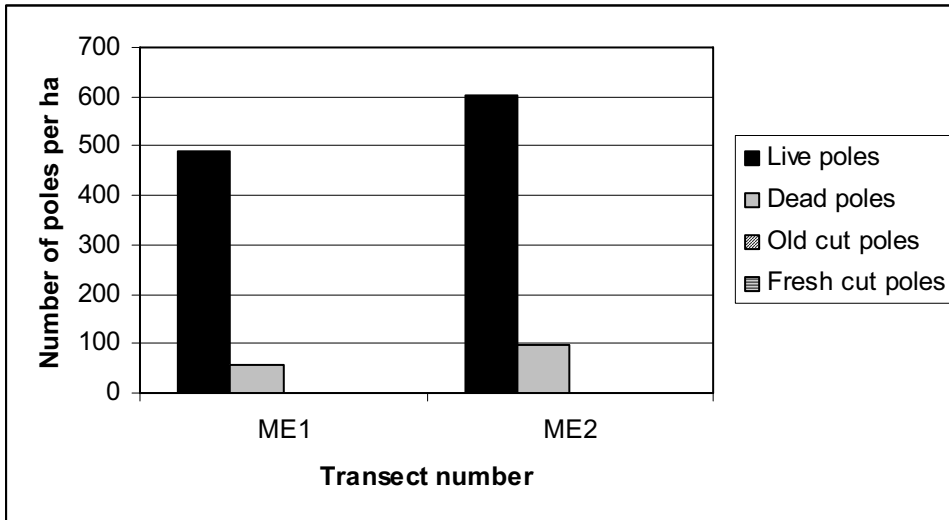


Figure 17. Abundance of live, naturally dead, old and fresh cut poles along disturbance transects in Mufindi Scarp East FR.

Timber extraction

A total of 683 timbers were recorded in Mufindi Scarp East FR. On average, 87 % of recorded timbers along the disturbance transects were alive, 13 % were naturally dead, 0 % were old cut timbers and 0 % fresh cut. Numbers of timbers recorded along the disturbance transects are summarized in Table 45 below.

Table 45. Numbers of live, dead, and cut timbers recorded in Mufindi Scarp East FR.

Transect number	Transect area (ha)	Total number timbers sampled	Average live timbers per ha (% of total)	Average dead timbers per ha (% of total)	Average old cut timbers per ha (% of total)	Average fresh cut timbers per ha (% of total)
ME1	1	328	268 (82)	58 (18)	2 (0)	0 (0)
ME2	1	325	298 (92)	27 (8)	0 (0)	0 (0)
Total	2	653	283 (87)	42.5 (13)	1 (0)	0 (0)

Note: values in brackets are percentages of total timbers recorded, to nearest whole number.

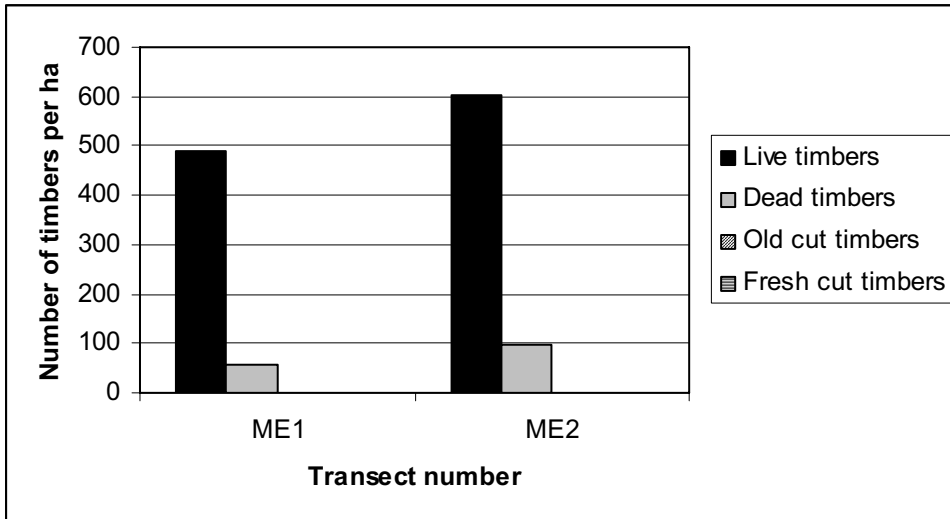
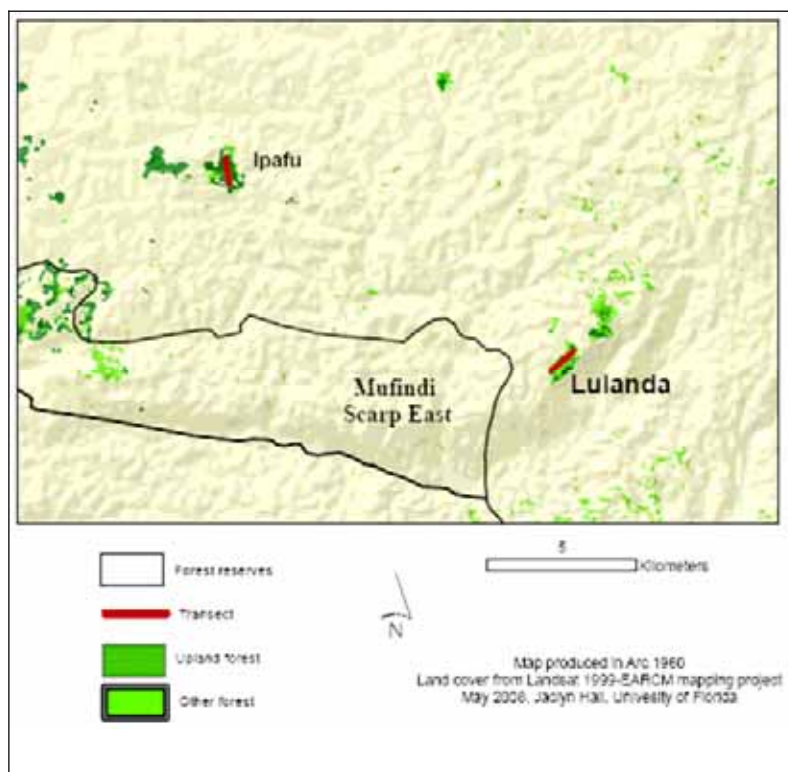


Figure 18. Abundance of live, naturally dead, old and fresh cut timbers along disturbance transects in Mufindi Scarp East FR.

8.5.6 Ipafu forest

The eastern and southern-eastern part of Ipafu forest is dominated by montane forest with a high canopy. The area consists of ridges and valleys with streams that flow towards the Mpanga River. The road to Lulanda crosses the forest on its northern side. The forest strip on the northern / north-western edge of the forest is dominated by rubus and vine tangles with a few scattered trees. The cause of this disturbance was not clear.



Map 11. Location of disturbance transects in Lulanda and Ipafu forests.

Types of disturbance that were recorded in Ipafu forest include cut poles and timber, a path and pitsawing.

Pole extraction

A total of 536 poles were recorded in Ipafu forest . On average, 88 % of the poles recorded along the disturbance transect were alive, 11 % were naturally dead, 1 % were old cut poles and 0% were fresh cut. Numbers of poles recorded along the disturbance transects are summarized in Table 46 below.

Table 46. Numbers of live, dead, and cut poles recorded in Ipafu.

Transect number	Transect area (ha)	Total number poles sampled	Average live poles per ha (% of total)	Average dead poles per ha (% of total)	Average old cut poles per ha (% of total)	Average fresh cut poles per ha (% of total)
IP1	1	536	473 (88)	61 (11)	2 (1)	0 (0)

Note: Values in brackets are percentages of total poles recorded, to nearest whole number.

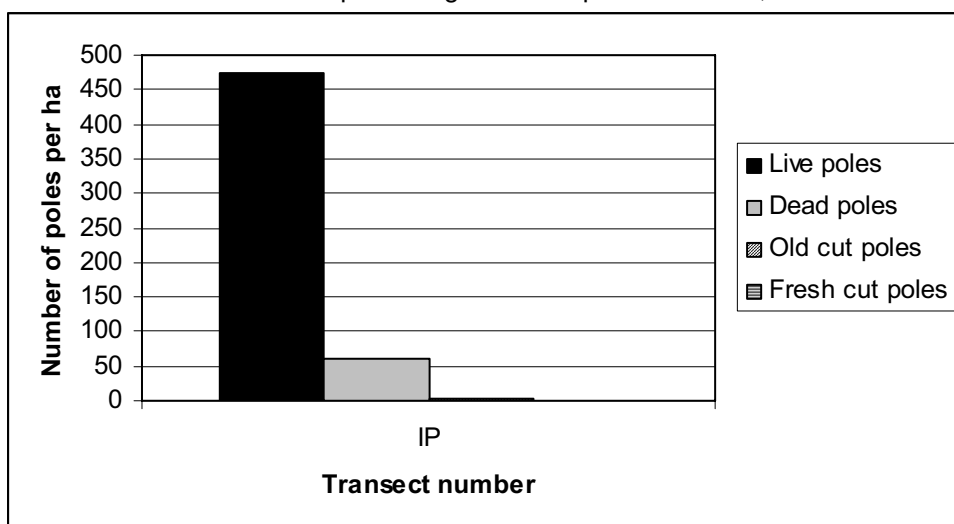


Figure 19. Abundance of live, naturally dead, old and fresh cut poles along disturbance transect in Ipafu forest.

Timber extraction

A total of 181 timbers were recorded along the transects in Ipafu forest. On average, 81 % of recorded timbers along the disturbance transect were live, 18 % were naturally dead, 1 % were old cut timbers and 0 % fresh cut. Numbers of timbers recorded along the disturbance transect are summarized in Table 47 below.

Table 47. Numbers of live, dead, and cut timbers recorded in Ipafu forest.

Transect number	Transect area (ha)	Total number timbers sampled	Average live timbers per ha (% of total)	Average dead timbers per ha (% of total)	Average old cut timbers per ha (% of total)	Average fresh cut timbers per ha (% of total)
IP1	1	181	147 (81)	33 (18)	1 (1)	0 (0)

Note: values in brackets are percentages of total timbers recorded, to nearest whole number.

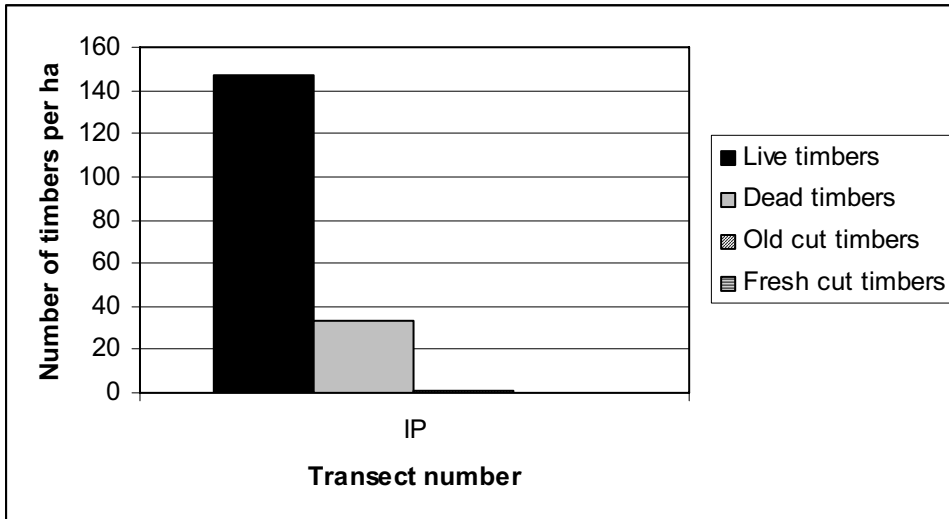


Figure 20. Abundance of live, naturally dead, old and fresh cut timbers along disturbance transect in Ipafu forest.

8.5.7 Kidegemsitu forest

The topographic map indicates that Kidegemsitu forest originally extended over two forest patches. However, during the surveys, the team found only one patch. The other patch appears to have been cleared. According to the Mufindi District Forest Officer, Mr Jeswald Ubisimbali, part of the other patch (more than 60 ha) was cleared several years ago by an individual farmer in order to plant tea. The case is said to be at the High Court in Dar es Salaam. The remaining patch is disturbed with a broken canopy and appears to be secondary in nature. The Kidegemsitu forest is under intense pressure from attempts to clear the forest for tea, pine and other crops. Types of disturbance and forest use that were recorded in Kidegemsitu forest include cut timber and poles, paths (1), a bee hive (1) and pitsaw sites (3).

Pole extraction

A total of 854 poles were recorded in Kidegemsitu forest. On average, 85 % of recorded poles along the disturbance transect were live, 15 % were naturally dead, 0 % were old cut poles and 0 % were fresh cut. Numbers of poles recorded along the disturbance transects are summarized in Table 48 below.

Table 48. Numbers of live, dead, and cut poles recorded in Kidegemsitu forest.

Transect number	Transect area (ha)	Total number poles sampled	Average live poles per ha (% of total)	Average dead poles per ha (% of total)	Average old cut poles per ha (% of total)	Average fresh cut poles per ha (% of total)
KD1	1	854	725 (85)	127 (15)	2 (0)	0 (0)

Note: Values in brackets are percentages of total poles recorded, to nearest whole number.

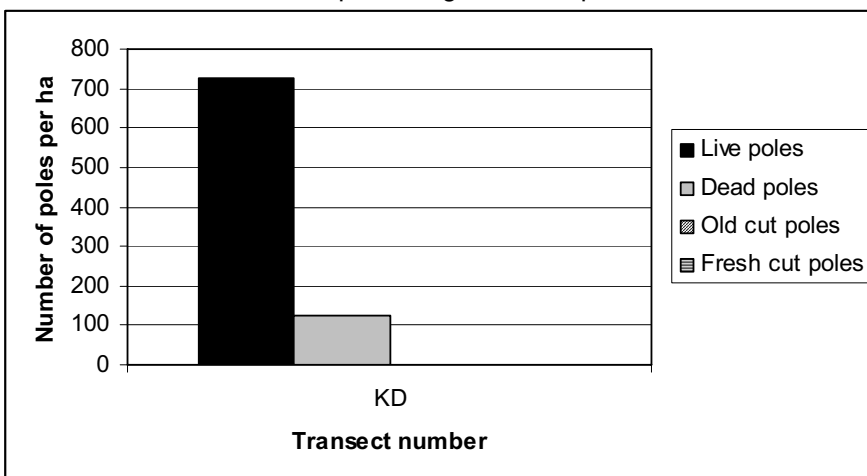


Figure 21. Abundance of live, naturally dead, old and fresh cut poles along disturbance transect in Kidegemsitu forest.

Timber extraction

A total of 206 timbers were recorded in Kidegemsitu forest. On average, 71 % of recorded timbers along the disturbance transect were alive, 28 % were naturally dead, 1 % were old cut timbers and 0 % fresh cut. Numbers of timbers recorded along the disturbance transect are summarized in Table 49 below.

Table 49. Numbers of live, dead, and cut timbers recorded in Kidegemsitu forest.

Transect number	Transect area (ha)	Total number timbers sampled	Average live timbers per ha (% of total)	Average dead timbers ha (% of total)	Average old cut timbers per ha (% of total)	Average fresh cut timbers per ha (% of total)
KD1	1	206	146 (71)	57 (28)	3 (1)	0 (0)

Note: values in brackets are percentages of total timbers recorded, to nearest whole number.

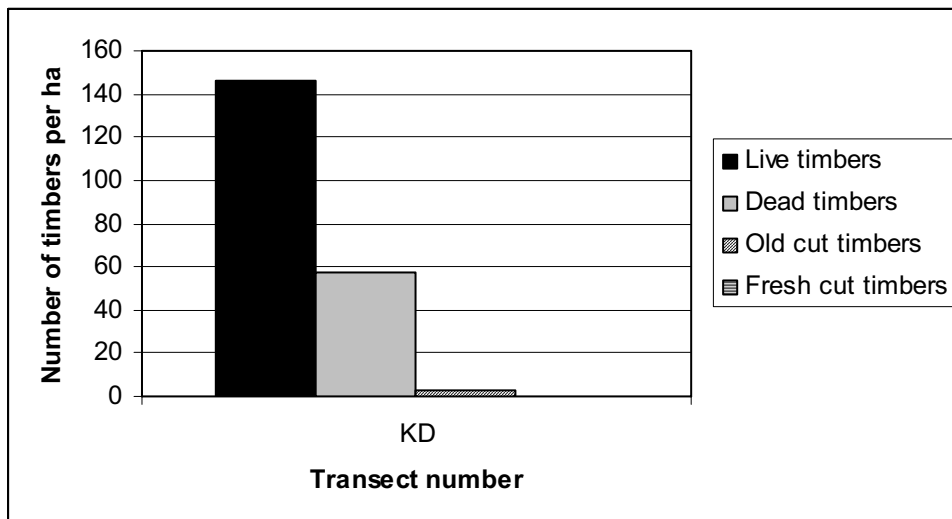
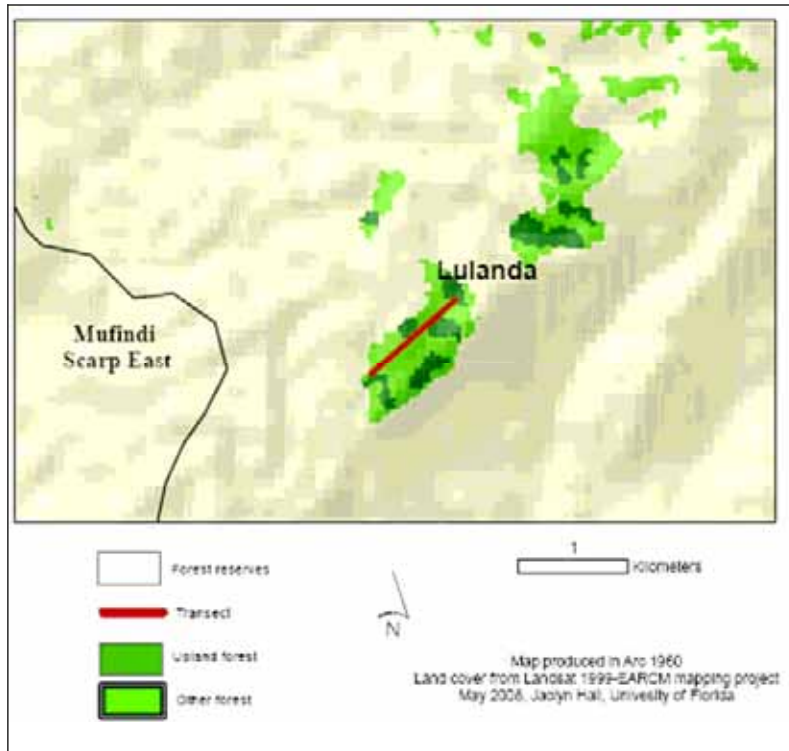


Figure 22. Abundance of live, naturally dead, old and fresh cut timbers along disturbance transect in Kidegemsitu forest.

8.5.8 Lulanda forest

The three patches of forest at Lulanda are characterized by the presence of montane forest with a high canopy. Disturbance in Lulanda has decreased significantly over the last decade. Woodcock (1998) in her doctoral study demonstrated the fragmentation of Lulanda from a single forest in the early 1900s to the current situation where only three forest fragments remain. In the past fire, logging and clearance for agricultural land have posed a significant threat to the forest. The most intense disturbance took place in the 1950s when local people were encouraged to clear parts of the forest for coffee cultivation.

In the 1990s, several biologists highlighted the exceptional biodiversity value of Lulanda Forest and the threats that it was facing (Lovett & Pócs 1993 and Woodcock, 2002). For example Lovett & Pócs noted that the stocks of some valuable timber species such as *Khaya nyasica* and *Vitex amaniensis* had been exhausted as a result of excessive harvesting. This resulted in the establishment of the Lulanda Forest Conservation Project by the Tanzania Forest Conservation Group in 1993. Improved forest management with the involvement of the local community and local government has significantly reduced forest disturbance in Lulanda.



Map 12. Location of the disturbance transect in Lulanda Forest.

The only types of disturbance recorded during the current surveys were old cut poles and timber and three old pitsaw sites. No recent signs of disturbance were recorded.

Pole extraction

A total of 433 poles were recorded along the transects in Lulanda forest. On average, 89 % of recorded poles along the disturbance transect were live, 9 % were naturally dead, 2 % were old cut poles and 0 % fresh cut. Numbers of poles recorded along the disturbance transects are summarized in Table 50 below.

Table 50. Numbers of live, dead, and cut poles recorded in Lulanda forest.

Transect number	Transect area (ha)	Total number poles sampled	Average live poles per ha (% of total)	Average dead poles per ha (% of total)	Average old cut poles per ha (% of total)	Average fresh cut poles per ha (% of total)
LU1	1	433	385 (89)	39 (9)	8 (2)	1 (0)

Note: Values in brackets are percentages of total poles recorded, to nearest whole number.

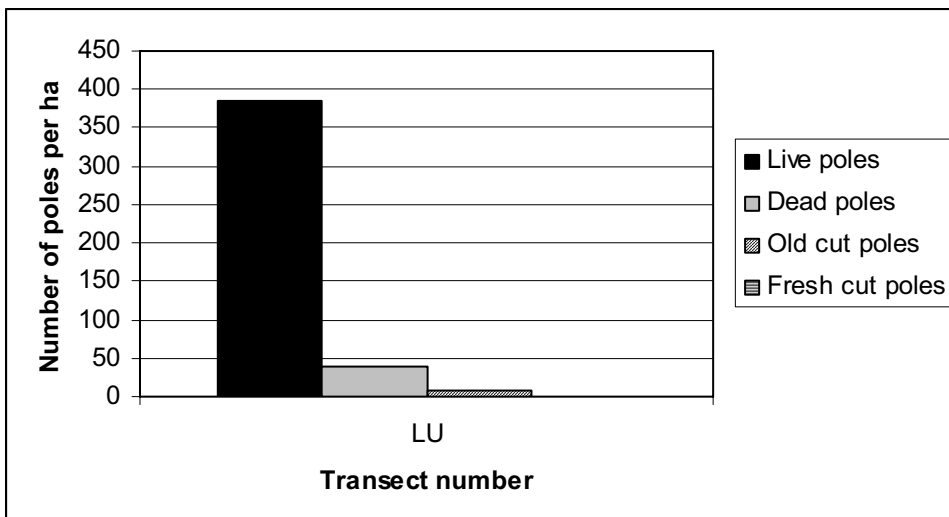


Figure 23. Abundance of live, naturally dead, old and fresh cut poles along disturbance transect in Lulanda forest.

Timber extraction

A total of 227 timbers were recorded along the transects in Lulanda forest. On average, 81 % of recorded timbers along the disturbance transect were live, 12 % were naturally dead, 7 % were old cut timbers and 0 % fresh cut. Numbers of timbers recorded along the disturbance transect are summarized in Table 51 below.

Table 51. Numbers of live, dead, and cut timbers recorded in Lulanda forest.

Transect number	Transect area (ha)	Total number timbers sampled	Average live timbers per ha (% of total)	Average dead timbers per ha (% of total)	Average old cut timbers per ha (% of total)	Average fresh cut timbers per ha (% of total)
LU 1	1	227	184 (81)	27 (12)	16 (7)	0 (0)

Note: values in brackets are percentages of total timbers recorded, to nearest whole number.

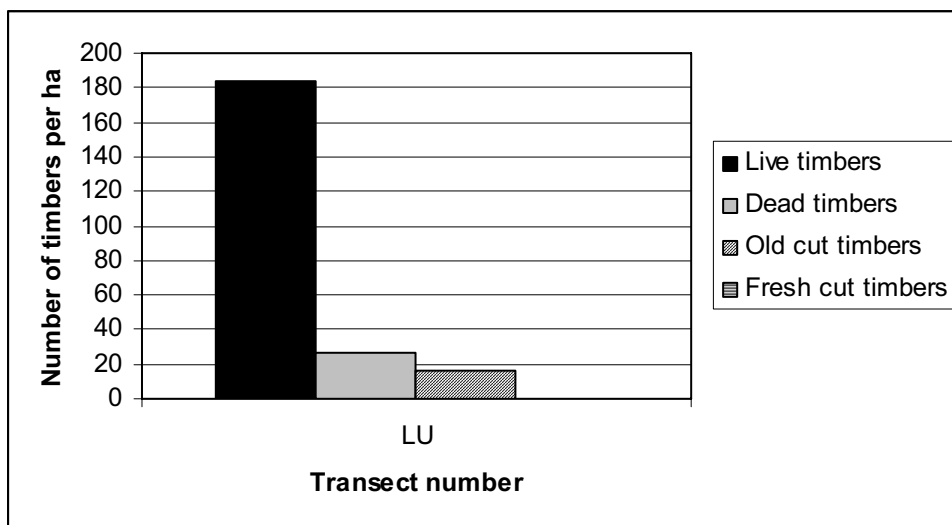


Figure 24. Abundance of live, naturally dead, old and fresh cut timbers along disturbance transect in Lulanda forest.

8.5.9 Other Human Disturbances

In addition to the signs of timber and pole cutting that are outlined in detail above, six other types of disturbance were recorded in the forests of Mufindi District: cultivation, pitsawing, fire, paths, wildlife trapping, forest clearance and old settlements. These are summarised in Table 52.

Table 52. Summary of other disturbances recorded in the Mufindi Forests.

Forest	Number of events									Total
	Pitsaw	Cultivation	Fire	Paths	Traps	Planks	Forest soil collection	Settlement	Other	
Ifupira										0
Livalonge	1			1	1					3
Mufindi Scarp West	5	1		2				1	1*	10
Kigogo	7	4	2	8	3	1	1			26
Mufindi Scarp East	2		4	1	1					8
Ipafu	1			1						2
Kidegemsitu	3			1					1**	5
Lulanda	3									3

* Old settlements/remains of bricks

** Beehive

8.6 Discussion

Relative to other parts of the Udzungwa Mountains such as the Udzungwa Mountain National Park and the Kilombero Nature reserve, the forests of Mufindi district have been heavily disturbed. Human disturbance was recorded in all of the eight forests included in this study. The most frequently recorded types of disturbance were timber cutting followed by pole cutting, pitsawing sites, paths and wildlife trapping.

The highest rates of timber and pole cutting were in Kigogo and Lulanda Forest Reserves where there was more than twice as much cutting as in the other forests. In both reserves, most of the cutting was recorded as old cut, with the exception of some pole cutting in Kigogo Forest Reserve which appeared to be quite recent. The rate of timber cutting was lowest in Ifupira, Mufindi Scarp East and Ipafu forests. That Lulanda and Kigogo also contain some of the best forest in terms of having an intact forest canopy and an absence of invasive alien species seems paradoxical. One hypothesis is that historically logging and forest clearance in the other forest patches removed most of the harvestable timber but that this was sufficiently long enough ago for all of the tree stumps to have rotted. Another hypothesis is that there is more effective forest management in the other reserves. Further research is needed in order to understand better the links between the disturbance rates recorded during these surveys and their current management.

The highest rates of pole cutting were in Kigogo FR, where approximately 24 % of all poles have been cut, with 3 % freshly cut. High rates of pole cutting in Kigogo correspond with the presence of many paths in this forest (eight paths recorded during the surveys). People use the paths to harvest poles, travelling to other villages along the escarpment as well as accessing their farms below the escarpment.

Based on the results from the transects, Kigogo has the most disturbance events per hectare while Ifupira forest has the least.

Low rates of disturbances in Ifupira forest may reflect careful management by Unilever Tea Tanzania Ltd (UTTL) in managing the forest patches between the tea fields. But interestingly in Livalonge forest which is also managed by UTTL, rates of recent disturbance were considerably higher. Furthermore, as with Lulanda and Kigogo, the overall appearance of Livalonge Forest is that of a less disturbed forest relative to Ifupira where the canopy is broken and there is an abundance of *Rubus* sp. and *Lantana camara*.

The distribution of disturbances within the eight forests was more-or-less similar. Most cultivation and fire was recorded within 500 m of the reserve boundary. In contrast, pitsawing sites and snares were most frequently recorded further from the reserve boundary. Most paths were randomly distributed in most of the forests. Apart from being used by villagers to access other villages and their farms, the random distribution of the paths reflects the use of the paths to do illegal activities in the forests both at the forest edge and in the forest interior including accessing the pitsawing and wildlife trapping sites.

The proximity of fire to the forest edge reflects the use of fire in clearing fields close to the forest boundary. When these fires get out of control they can quickly spread into the forest reserves. To some extent cultivation within the forests reflects the ambiguity of the forest boundaries which have not been clearly demarcated in most places.

Kidegemsitu forest is one of the forests in which participatory forest management has recently been established. Absence of fresh timber cutting may be evidence that illegal cutting has decreased in the forest as a result of improved forest management.

9) Indigenous knowledge survey

By Charles Leonard

9.1 Introduction

People living close to forests often have an extensive knowledge of the wildlife found within the forests. Levels of knowledge are likely to vary depending on the frequency with which a person visits the forest, the activities that they are conducting in the forest and the degree to which they have received information on the forest from their parents and other elders. Such information can be valuable in detecting cryptic species that might otherwise be missed during a biodiversity survey as well as providing information relevant for the design of conservation initiatives.

According to Woodcock (2002), the types of local knowledge also vary according to gender. Woodcock mentioned that activities such as wildlife hunting in the East Usambaras are conducted solely by men. In contrast, activities such as collection of edible wild plants and firewood from the forests are usually carried out by women. This suggests that women may have more botanical knowledge whilst men may be more knowledgeable about the forests animals. Woodcock (and also Ylhaisi (2000)) highlighted that the younger generation are now less eager to learn about the forests from their elders and that this may be a significant potential threat in passing environmental knowledge down to future generations.

9.2 Methods

Semi-structured interviews were conducted with a fairly open framework that allowed for focused, conversational and two way communication. At the start of the interview, the facilitator explained the purpose of the interview, which was to understand better the relationship between people in the local area and the animals of interest. The interviewees included at least three people per group. Groups were separated according to gender and age categories.

The facilitator recorded names, gender, tribe, profession, length of residency in the area and age group of the person(s) interviewed. Then questions about animal groups were asked based on the following groups: forest duikers, diurnal primates, galagos, hyraxes and sengis. The discussion focused on:

- Uses e.g. hunting for meat, skins;
- Local names
- Trapping methods;
- Any stories of traditions about the animals;
- Perceptions of changing populations / status;
- Behavioural or ecological observations e.g. feeding, predation, breeding.

The process was repeated for each taxon. During the interview, a few notes were made and immediately after the interview, detailed notes were recorded into data sheets. A detailed description of the methods and sample data sheets are provided in Doggart (2006 c).

9.3 Sampling intensity

In the Udzungwa Mountains in Mufindi district, interviews were conducted with 53 people (43 men, 10 women) in eight groups from six villages between February and June 2006. Details of these groups are outlined in Table 53.

Table 53. Sampling intensity for indigenous knowledge survey.

Village	Number of interviewees / age group		Length of residency		Educational level		Economic activity	Gender	Tribe	Adjacent forest
	20 - 40	> 40	Whole life	> 5	< / = Std7	=/ < Form 4 and > Std 7				
Ludilo	4	4	8		8		Agric	M	Hehe	Kidegemsitu

Village	Number of interviewees /age group		Length of residency		Educational level		Economic activity	Gender	Tribe	Adjacent forest
	20 - 40	> 40	Whole life	> 5	< / = Std7	=/<Form 4 and >Std 7				
Ikaning'ombe	2	2	4		3	1	3 Agric, 1 Agric + Traditional healing	M	Hehe	Ipafu
Ifupira	2	3	5		5		Agric	M	Hehe	Kidegemsitu and UTTL's forest in Ifupira Division
Lulanda		3	3		3		2 Agric, 1 Traditional healing	F	Hehe	Lulanda
Lulanda		7	7		6	1	Agric	M	Hehe	
Ihomasa	3	7	10		10		Agric	F	Hehe	MSW and UTTL's forest around Livalonge Division
Ihomasa	2	7	9		9		Agric	M	Hehe	
Ikwega	3		3		3		Agric	M	Hehe	Kigogo, MSE and UTTL's forests around Kivere tea estate.

9.4 Results

9.4.1 Sacred forests

The forests of Mufindi Scarp West and Livalonge were the only forests mentioned as still having sites with sacred values. Lulanda and Ipafu forests were mentioned as having had sacred values in the past. As sacred sites, ordinary people were not allowed to enter into the sites, only the village leaders. Some of the activities that were carried out in these sites included making offerings and conducting rituals either to please the gods so that the rains would come or to resolve problems or to thank the gods after harvesting crops. In Ipafu, local people mentioned that witch doctors used waters from the forest to treat sick people. In Fufu Forest, Lulanda, local respondents mentioned that there is a large tree inside the forest where it is believed that the famous Hehe leader, Chief Mkwawa used to rest under its shade on his way back from the war. The local people respect this site, although no spiritual activity is carried out there.

Other sites with cultural or spiritual values that were mentioned include some grave sites in Ihomasa village where members of a particular clan go to say prayers and to make offerings. No sacred values were mentioned for Kigogo, Mufindi Scarp East, Ifupira or Kidegemsitu Forests.

In the early of 1900s, Germans settled in a part of Mufindi Scarp West. Before they arrived, local people were living in the forest. The Germans moved the local people from the forest to land adjacent to the forest. The locals in Ihomasa village believe that the Germans buried gold and rubies somewhere in Mufindi Scarp West forest. As a result several attempts have been made by some of the locals to dig up the hidden jewels from within the reserve. In addition, the locals believe that if someone visits one of these sites without consulting the witchdoctors beforehand, they will ultimately die either by being bitten by large venomous snakes or by being killed by thunderstorms in the caves. Some elders from Ihomasa village showed the survey team one of the areas which was settled by the Germans in Mufindi Scarp West Forest Reserve. The area is known locally as Mufindi and they mentioned that this is where Mufindi District got its name.

9.4.2 Mufindi Scarp West Forest Reserve

Adjacent village: Ihomasa

Introduction

Of the 19 people from Ihomasa who were interviewed, nine were men and ten were women. All of them had lived in the area for their whole lives.

How frequently do people see the focal taxa

In Ihomasa, all of the men stated that they were familiar with red duiker, chequered sengi, greater galago, rock hyrax and Sykes monkey. In contrast only four men stated that they were familiar with dwarf galago and bushbuck.

All of the women stated that they were familiar with red duiker, bushbuck, chequered sengi, rock hyrax and Sykes monkey. Of the ten women interviewed, only one woman stated that she had seen a dwarf galago while eight were familiar with greater galago. No-one said that they had observed Abbott's duiker, black and white colobus, red colobus, mangabey or tree hyrax in the forest suggesting that none of these species are present in Mufindi Scarp West or the Unilever forest.

Table 54. Frequency with which focal taxa were sighted by villagers in Ihomasa Village.

Species' name	Percentage of men and women who stated that they have ever seen the species		Most frequently stated frequency of sighting
	Men	Women	
Red duiker	100	100	Once per year
Abbott's duiker	0	0	Never
Bushbuck	67	100	Less than once per year
Blue duiker	0	0	Never
Black and rufous sengi	0	0	Never
Chequered sengi	100	100	Once per week
Dwarf galago	22	10	Once per month
Greater galago	100	80	Once per month
Tree hyrax	0	0	Never
Rock hyrax	100	100	Once per year
Sykes monkey	100	100	Once per month
Black and white colobus	0	0	Never
Red colobus	0	0	Never
Mangabey	0	0	Never

In Ihomasa Village most species were cited as being seen both inside and outside of the forest. Only red duiker, bushbuck and dwarf galago were cited as only being found inside the forest whilst the rock hyrax and greater galago were only observed outside of the forest (Table 55)

Table 55. Location of sightings in Ihomasa Village.

Species	Site where species is seen		
	Inside the forest	Outside the forest	Both
Red duiker	√ (100%)		
Bushbuck	√ (74%)		
Chequered sengi	√ (47%)		√ (53)
Dwarf galago	√ (26%)		
Greater galago		√ (58%)	√ (32%)
Rock hyrax		√ (16%)	√ (84)
Sykes monkey	√ (37)		√ (63%)

In Ihomasa Village, the populations of only three species were thought to be increasing (Table 56). For the remaining five species most people considered that their populations were declining.

Table 56. Interviewee responses on abundance of focal taxa in Ihomasa Village.

Species	% of interviewees responded on abundance (number out of the total who have observed that species)		
	Increasing	Decreasing	Don't know
Red duiker		100 (19)	
Bushbuck		58 (11)	
Chequered sengi	21 (4)		79 (15)
Dwarf galago			26 (5)
Greater galago		37 (7)	53 (10)
Rock hyrax	21 (4)	37 (7)	42 (8)
Sykes monkey	26 (5)	21 (4)	53 (10)

Reasons for changes in the abundance of focal taxa

Respondents stated that red duiker and bushbuck populations were declining because they are being hunted for their meat and skin. Habitat loss due to encroachment of agricultural land was also cited as a cause for the decline in the populations of these species.

Populations of Sykes monkeys and rock hyrax were thought to have increased due to the abundance of their preferred food and high fecundity. Amongst those who noted a decline in populations of Sykes monkeys, they attributed this to hunting for meat and to protect crops. Those who noted a decline in populations of rock hyrax attributed it to hunting for meat and skins.

The abundance of chequered sengis was reported to be increasing due to abundance of their preferred food and habitat while that of greater galagos was stated to decrease due to habitat loss and because they are hunted for meat (Table 57).

Table 57. Traditional uses for focal taxa in Ihomasa Village.

Species	Use				% of interviewees mentioned (in brackets, their number out of total ie 19)
	Meat	Medicine	Skin	Trade	
Red duiker	√	√	√		100% (19) meat, 84% (16) skin, 11% (4) medicine
Bushbuck	√	√	√		58% (11) both meat and skin, 11% (4) medicine
Chequered sengi	√				11% (4) meat
Greater galago	√				42% (8) meat
Rock hyrax	√				100% (19)
Sykes	√	√			37% (7) meat, 11% (4) medicine
Dwarf galago					None

The Hehe names for seven mammal species were recorded (Table xx).

Table 58. Local names of focal taxa in Ihomasa Village.

Species	Language	Name
Red duiker	Hehe	Funo
Bushbuck	Hehe	Mato
Chequered sengi	Hehe	Kimsangi
Dwarf galago	Hehe	Kipwege
Greater galago	Hehe	Pwege
Rock hyrax	Hehe	Miimbi
Sykes monkey	Hehe	Indumbili

Traditions and stories

Red duiker: Horns and hooves are used by traditional healers to treat people with bad omens. The traditional healers burn the horns and hooves and use the smoke to treat the sick people. It is also believed that if the animal runs into someone's house when chased by a predator, the dwellers of that house will experience trouble.

Bushbuck: The tail is used by traditional healers to cure sick people especially those suffering from 'evil spirits'. The healer fans the sick person with the tail.

Sykes monkey: It is believed that bones of Sykes monkeys can be used to treat a human bone disease known locally as *Kichaganza*.

Chameleons: People practising witchcraft use horned chameleons in their activities.

9.4.3 Lulanda Forest

Adjacent village: Lulanda

Of the 10 people from Lulanda who were interviewed, seven were men and three were women. All of them had lived in the area for their whole lives.

How frequently do people see the focal taxa

In Lulanda, all of the men stated that they were familiar with red duiker, bushbuck, chequered sengi, greater galago, rock hyrax and black and white colobus monkey (Table 59). Of the seven men who were interviewed, six were familiar with both blue duiker and dwarf galago while four men were familiar with Sykes monkeys. All of the women were familiar with bushbuck, chequered sengi, galagos, and black and white colobus. Out of the three women interviewed, only two were familiar with red duiker and only one was familiar with blue duiker. Chequered sengi, greater galago, rock hyrax and black and white colobus were seen the most regularly whilst bushbuck and blue duiker were rarely seen. Neither the men nor the women said that they had observed Abbott's duiker, red colobus, black and rufous sengi, mangabey or tree hyrax in the forest suggesting that none of these species are present in the reserve.

Table 59. Frequency with which focal taxa were sighted by villagers in Lulanda Village.

Species' name	Percentage of men and women who stated that they have ever seen the species		Most frequently stated frequency of sighting
	Men	Women	
Red duiker	100	67	Once per month
Abbott's duiker	0	0	Never
Bushbuck	100	100	Less than once per year
Blue duiker	86	33	Once per year
Chequered sengi	100	100	Once per week
Black and rufous sengi	0	0	Never
Dwarf galago	86	100	Once per month
Greater galago	100	100	Once per week
Tree hyrax	0	0	Never
Rock hyrax	100	100	Once per week
Sykes monkey	57	0	Once per month
Black and white colobus	100	100	Once per week
Red colobus	0	0	Never
Mangabey	0	0	Never

In Lulanda Village most species were cited as being seen only inside the forest with the exception of the red duiker, blue duiker and black and white colobus which were observed both inside and outside of the forest and the rock hyrax and greater galago which were only observed outside of the forest (Table 60)

Table 60. Location of sightings in Lulanda Village.

Species	Site where species is seen		
	Inside the forest	Outside the forest	Both
Red duiker	√ (50%)		√ (40%)
Bushbuck	√ (100%)		
Blue duiker	√ (60%)		√ (10%)
Chequered sengi	√ (100%)		
Dwarf galago	√ (90%)		
Greater galago		√ (100%)	
Rock hyrax		√ (100%)	
Sykes monkey	√ (40%)		
Black and white colobus	√ (30%)		√ (70%)

Reasons for changes in the abundance of focal taxa

There was some uncertainty as to whether populations of the focal taxa were increasing or decreasing with most respondents stating that they did not know (Table 61). In contrast to other forests, four species were cited as having populations that were increasing: red duiker, bushbuck, Sykes monkey and black and white colobus monkey. Only rock hyrax was considered to be declining. The perception that

most animal populations are stable or increasing probably relates to the careful management of this forest and the banning of hunting within the forest for several years.

This observation was confirmed by the respondents who noted that the red duiker populations have increased due to a reduction in illegal subsistence hunting as a result of increased awareness of the importance of natural resources. It was also thought that their preferred food species were more abundant, again due to improved forest management.

The respondents were not aware of changes in the abundance of sengis, galagos and blue duiker. Furthermore, only three respondents mentioned that the population of bushbuck is increasing whilst the others were unsure. Again the reason given for the increased abundance of bushbuck was reduced illegal subsistence hunting. Increased availability of food and less predation were the main factors mentioned in relation to the increase in the abundance of black and white colobus and Sykes monkeys. Declining rock hyrax populations were attributed to subsistence hunting for meat, although most of the respondents were not aware of changes in their abundance.

Table 61. Interviewee responses on abundance of focal taxa in Lulanda Village.

Species	% of interviewees who responded on abundance (number of people who responded)		
	Increasing	Decreasing	Don't know
Red duiker	100 (10)		
Bushbuck	30 (3)		70 (7)
Blue duiker			100 (10)
Chequered sengi			100 (10)
Dwarf galago			100 (10)
Greater galago			100 (10)
Rock hyrax		40 (4)	50 (5)
Sykes monkey	40 (4)		
Black and white colobus	70 (7)		30 (3)

Respondents mentioned that red duiker, bushbuck, blue duiker and rock hyrax are hunted for meat (Table 62). Interestingly none of the primates were mentioned as being hunted for meat. The skins of bushbuck and red duiker are also used.

Table 62. Traditional uses for focal taxa in Lulanda Village.

Species	Use				% of respondents mentioning each use (number of respondents)
	Meat	Medicine	Skin	Trade	
Red duiker	√		√		90% (9) both meat and skin
Bushbuck	√		√		100% (10) both meat and skin
Blue duiker	√				70% (7) meat
Chequered sengi					None
Dwarf galago					None
Greater galago					None
Rock hyrax	√				90% (9) meat
Sykes monkey					None

Respondents provided the Hehe names for nine mammal species (Table 63).

Table 63. Local names of focal taxa in Lulanda Village.

Species	Language	Name
Red duiker	Hehe	Funo
Bushbuck	Hehe	Mato
Blue duiker	Hehe	Kiharusi
Chequered sengi	Hehe	Kisangi
Dwarf galago	Hehe	Kipwege
Greater galago	Hehe	Pwege
Rock hyrax	Hehe	Miimbi
Sykes monkey	Hehe	Indumbili
Black and white colobus	Hehe	Mbega

Traditions and stories

Bushbuck: It is believed that the traditional healers use femur and tibia bones of the animal to create a water reservoir for irrigation for people who do not eat bushbuck meat.

Behaviour observations:

Black and white colobus: It was stated that these animals act as *shamba* guards against intrusion by vervet monkeys and baboons.

Chequered sengi: It was also mentioned that chequered sengi are often preyed upon by jackals outside of the forest.

9.4.4 Ifupira Forest

Adjacent village: Ifupira

Five people from Ifupira were interviewed, all of them were men. They had lived in the area for their whole lives. It was difficult to get women respondents as the time at which the survey was conducted was not convenient for them and unfortunately the survey team were unable to return at a more convenient time.

How frequently do people see the focal taxa

In Ifupira, all of the respondents stated that they were familiar with red duiker, bushbuck, chequered sengi, greater galago, rock hyrax and Sykes monkey (Table 64). Chequered sengi were mentioned as being seen the most regularly whilst red duiker were rarely seen. They did not mention the presence of black and white colobus, red colobus, tree hyrax, black and rufous sengi and mangabeys in the forest suggesting that none of these species are present in Ifupira Forest.

Table 64. Frequency with which focal taxa were sighted by villagers in Ifupira Village.

Species' name	Percentage of men who stated that they have ever seen the species	Most frequently stated frequency of sighting
Abbott's duiker	0	Never
Red duiker	100	Once per year
Bushbuck	100	Once per month
Blue duiker	0	Never
Chequered sengi	100	Once per day
Black and rufous sengi	0	Never
Dwarf galago	0	Never
Greater galago	100	Once per month
Tree hyrax	0	Never
Rock hyrax	100	Once per month
Sykes monkey	100	Once per month
Black and white colobus	0	Never
Red colobus	0	Never
Mangabey	0	Never

Red duiker and bushbuck were cited as only being present in the forest whilst chequered sengi and Sykes monkey were observed both inside and outside of the forest. Greater galago and rock hyrax were only observed outside of the forest (Table 65).

Table 65. Location of sightings in Ifupira Village.

Species	Site where species is seen		
	Inside the forest	Outside the forest	Both
Red duiker	√ (100%)		
Bushbuck	√ (100%)		
Chequered sengi			√ (100%)
Greater galago		√ (100%)	
Rock hyrax		√ (100%)	
Sykes monkey			√ (100%)

There was some uncertainty regarding population trends for most of the focal taxa. Only in the case of red duiker and bushbuck was there agreement that the populations of these species were declining (Table 66).

Table 66. Interviewee responses on abundance of focal taxa in Ifupira Village.

Species	% of interviewees responded on abundance (Number of interviewees = 5)		
	Increasing	Decreasing	Don't know
Red duiker		100	
Bushbuck		100	
Chequered sengi			100
Greater galago			100
Rock hyrax			100
Sykes			100

Reasons for changes in the abundance of focal taxa

The respondents mentioned that the abundance of red duiker and bushbuck was declining because of excessive illegal subsistence hunting. It was also noted that the populations of bushbuck and red duiker in Ifupira are now very low relative to their abundance in the past. However respondents stated that red duiker and bushbuck are more abundant in other habitats such as in the Lupeme and Itona forests.

Traditional uses of focal taxa

Red duiker and bushbuck are used for both meat and their skins whilst rock hyrax are hunted for their meat only (Table 67). Interestingly no primates were mentioned as being hunted for their meat or skins.

Table 67. Traditional uses for focal taxa in Ifupira Village.

Species	Use			
	Meat	Medicine	Skin	Trade
Red duiker	√		√	
Bushbuck	√		√	
Chequered sengi				
Greater galago				
Rock hyrax	√			
Sykes monkey				

Note: Uses were mentioned by all the interviewees i.e. 100%

Respondents mentioned Hehe names for six mammal species (Table 68).

Table 68. Local names of focal taxa in Ifupira Village.

Species	Language	Name
Red duiker	Hehe	Funo
Bushbuck	Hehe	Mato
Chequered sengi	Hehe	Kisangi
Greater galago	Hehe	Pwege
Rock hyrax	Hehe	Miimbi
Sykes monkey	Hehe	Ndumbili

9.4.5 Ipafu Forest

Adjacent village: Ikaning'ombe

Four people from Ikaning'ombe were interviewed, all of them were men. They had lived in the area for their whole lives. It was difficult to get women respondents as the time at which the survey was conducted was not convenient for them and unfortunately the survey team were unable to return at a more convenient time.

How frequently do people see the focal taxa

In Ikaning'ombe, all of the respondents stated that they were familiar with red duiker, bushbuck, chequered sengi, greater galago, rock hyrax, black and white colobus and Sykes monkey. Sykes monkeys were seen the most frequently. Relative to other villages, bushbuck and red duiker were also observed quite frequently. They did not mention the presence of Abbott's duiker, blue duiker, red

colobus, tree hyrax, black and rufous sengi and mangabey in the forest suggesting that none of these species are present in the reserve.

Table 69. Frequency with which focal taxa were sighted by villagers in Ikaning'ombe Village.

Species' name	Percentage of men who stated that they have ever seen the species	Most frequently stated frequency of sighting
Abbott's duiker	0	Never
Red duiker	100	Once per month
Bushbuck	100	Once per month
Blue duiker	0	Never
Chequered sengi	75	Once per month
Black and rufous sengi	0	Never
Dwarf galago	0	Never
Greater galago	100	Once per month
Tree hyrax	0	Never
Rock hyrax	100	Once per month
Sykes monkey	100	Once per day
Black and white colobus	100	Once per week
Red colobus	0	Never
Mangabey	0	Never

Most species were observed both inside and outside of the forest (Table 70). Only bushbuck was seen exclusively within the forest and only rock hyrax were observed exclusively outside of the forest.

Table 70. Location of sightings in Ikaning'ombe Village.

Species	Site where species is seen		
	Inside the forest	Outside the forest	Both
Red duiker			√ (100)
Bushbuck	√ (100)		
Chequered sengi			√ (75)
Greater galago			√(100)
Rock hyrax		√ (100)	
Sykes monkey			√ (100)
Black and white colobus			√ (100)

In terms of perceptions of changes in the abundance of the focal taxa there was some discrepancy in the responses. The majority of respondents cited an increase in the populations of red duiker, bushbuck, greater galago, rock hyrax, Sykes monkey and black and white colobus (Table 71). However one interviewee was uncertain of changes in any of the populations.

Table 71. Interviewee responses on changes in the abundance of focal taxa in Ikaning'ombe Village.

Species	% of interviewees responded on abundance (Number of interviewees = 4)		
	Increasing	Decreasing	Don't know
Red duiker	75		25
Bushbuck	75		25
Chequered sengi			75
Greater galago	75		25
Rock hyrax	75		25
Sykes monkey	75		25
Black and white colobus	75		25

Reasons for changes in the abundance of focal taxa

Most respondents mentioned that increases in the populations of red duiker, bushbuck, greater galago, rock hyrax, Sykes monkey and black and white colobus monkey were due to enhanced conservation strategies in the area. Reduced subsistence hunting for antelopes, which was very common in the past, was another reason given for the population increases. The respondents stated the population size of animals like red duiker and bushbuck during the 1980s was very low but that at present the population is

higher. None of the respondents commented on the abundance of chequered sengi, this is an indication that the respondents had very little knowledge on the abundance of chequered sengi.

Traditional uses of focal taxa

Red duiker and bushbuck are used for both meat and their skins whilst rock hyrax are hunted for their meat only (Table 72). Interestingly sengis and primates were not mentioned as being hunted for their meat or skins.

Table 72. Traditional uses for focal taxa in Ikaning’ombe Village.

Species	Use			
	Meat	Medicine	Skin	Trade
Red duiker	√		√	
Bushbuck	√		√	
Chequered sengi				
Greater galago				
Rock hyrax	√			
Sykes monkey				
Black and white colobus				

Note: Uses were mentioned by all the interviewees i.e. 100%

Respondents provided Hehe names for six of the mammal species (Table 73). In some cases two names were provided.

Table 73. Local names of focal taxa in Ikaning’ombe Village.

Species	Language	Name
Red duiker	Hehe	Funo
Bushbuck	Hehe	Mato
Chequered sengi	Hehe	Kisangi
Greater galago	Hehe	Pwege, Kimng’etu,
Rock hyrax	Hehe	Miimbi, Kipimbi
Sykes monkey	Hehe	Ndumbili, Ngedenge

Behavioural observations

It was said that red duiker and bushbuck migrate to Ipafu from the lowland Mpanga forest during the dry season. During this period, fire incidences are common in Mpanga forest and many animals move to other places.

9.4.6 Kigogo Forest Reserve

Adjacent village: Ikwega

Three people from Ikwega were interviewed, all of them were men. They had lived in the area for their whole lives. It was difficult to get women respondents as the time at which the survey was conducted was not convenient for them and unfortunately the survey team were unable to return at a more convenient time.

How frequently do people see the focal taxa

In Ikwega, all of the respondents stated that they were familiar with red duiker, bushbuck, chequered sengi, dwarf galago, tree hyrax and Sykes monkey (Table 74). Sykes monkeys, dwarf galagos and chequered sengi were observed most frequently whilst red duiker appear to be the least abundant. They did not mention the presence of Abbott’s duiker, blue duiker, black and white colobus, red colobus, rock hyrax, black and rufous sengi and mangabey in the forest suggesting that none of these species are present in the reserve.

Table 74. Frequency with which focal taxa were sighted by villagers in Ikwega Village.

Species’ name	Percentage of men who stated that they have ever seen the species	Most frequently stated frequency of sighting
Abbott’s duiker	0	Never
Red duiker	100	Less than once per year

Species' name	Percentage of men who stated that they have ever seen the species	Most frequently stated frequency of sighting
Bushbuck	100	Once per month
Blue duiker	0	Never
Chequered sengi	100	Once per week
Black and rufous sengi	0	Never
Dwarf galago	100	Once per week
Greater galago	0	Never
Tree hyrax	100	Once per year
Rock hyrax	0	Never
Sykes monkey	100	Once per week
Black and white colobus	0	Never
Red colobus	0	Never
Mangabey	0	Never

Red duiker, bushbuck and tree hyrax are observed exclusively within the forest whereas chequered sengis, dwarf galagos and Sykes monkeys were cited as being present both inside and outside the forest (Table 75).

Table 75. Location of sightings in Ikwega Village.

Species	Site where species is seen		
	Inside the forest	Outside the forest	Both
Red duiker	√ (100%)		
Bushbuck	√ (100%)		
Chequered sengi			√ (100%)
Dwarf galago			√ (100%)
Tree hyrax	√ (100%)		
Sykes monkey			√ (100%)

Respondents noted that most species were declining (Table 76). Only the populations of the chequered sengi and Sykes monkey were thought to be increasing.

Table 76. Interviewee responses on abundance of focal taxa in Ikwega Village.

Species	% of interviewees responded on abundance (Number of interviewees = 3)		
	Increasing	Decreasing	Don't know
Red duiker		100	
Bushbuck		100	
Chequered sengi	100	.	
Dwarf galago		100	
Tree hyrax		100	
Sykes monkey	100		

Reasons for changes in the abundance of focal taxa

The respondents mentioned that the abundance of red duiker, bushbuck and tree hyrax was declining because of excessive illegal subsistence hunting. It was also added that, the population of these species is now very low compared with the past. Populations of these species are patchy in Kigogo forest with most restricted to a few areas of riverine habitat such as along the Kigogo River. Loss of habitat due to agricultural encroachment was the factor stated as being the cause of the decline in the population of dwarf galagos. Although Sykes monkey is consumed as meat by some of the villagers in Ikwega, the respondents stated that the abundance of Sykes monkeys is increasing mainly due to the high fecundity and availability of their preferred food including cereals like maize. It was suggested that the increased abundance of chequered sengis was due to less predation. All of the respondents seemed to be knowledgeable about changes in the abundance of the species mentioned above.

A wider range of animals were listed as being hunted for meat in Ikwega relative to other villages (Table 77). This included Sykes monkey, tree hyrax and chequered sengi. Sykes monkeys were also cited as being used for medicinal purposes.

Table 77. Traditional uses for focal taxa in Ikwega Village.

Species	Use			
	Meat	Medicine	Skin	Trade
Red duiker	√			
Bushbuck	√		√	
Chequered sengi	√			
Dwarf galago				
Tree hyrax	√			
Sykes monkey	√	√		

Note: Uses were mentioned by all the interviewees i.e. 100% Respondents mentioned the Hehe names for four species (Table 78).

Table 78. Local names of focal taxa in Ikwega Village.

Species	Language	Name
Red duiker	Hehe	Funo
Bushbuck	Hehe	Mato
Chequered sengi	Hehe	Kisangi
Sykes monkey	Hehe	Ndumbili

Traditions and stories

It is believed that if pregnant women or their husbands hear the calls of dwarf galagos they will have babies who cry throughout the night.

Behavioural observations

Respondents mentioned that they like Sykes monkeys because they chase away vervet monkeys from their maize farms. They stated that Sykes monkeys are less destructive than vervets.

9.4.7 Kidegamsitu Local Authority Forest Reserve

Adjacent village: Ludilo

Eight people from Ludilo were interviewed, all of them were men. They had lived in the area for their whole lives. It was difficult to get women respondents as the time at which the survey was conducted was not convenient for them and unfortunately the survey team were unable to return at a more convenient time.

How frequently do people see the focal taxa

In Ludilo, all of the respondents stated that they were familiar with red duiker, bushbuck, chequered sengi, greater galago, rock hyrax and Sykes monkey (Table 79). The most frequently observed animal was the chequered sengi whilst Sykes monkeys were rarely seen. They did not mention the presence of black and white colobus, red colobus, tree hyrax, black and rufous sengi and mangabey in the forest suggesting that none of these species are present in the reserve.

Table 79. Frequency with which focal taxa were sighted by villagers in Ludilo Village.

Species' name	Percentage of men who stated that they have ever seen the species	Most frequently stated frequency of sighting
Abbott's duiker	0	Never
Red duiker	100	Once per month
Bushbuck	100	Once per month
Blue duiker	0	Never
Chequered sengi	100	Once per week
Black and rufous sengi	0	Never
Dwarf galago	0	Never
Greater galago	87.5	Once per week (37.5%), per month (37.5%), less than once

Species' name	Percentage of men who stated that they have ever seen the species	Most frequently stated frequency of sighting
		per year (25%)
Tree hyrax	0	Never
Rock hyrax	0	Never
Sykes monkey	25	Less than once per year
Black and white colobus	0	Never
Red colobus	0	Never
Mangabey	0	Never

Only red duiker and bushbuck were cited as being present only within the forest (Table 80). Other species were mentioned by at least some of the respondents as being present both inside and outside of the forest.

Table 80. Location of sightings in Ludilo Village.

Species	Site where species is seen		
	Inside the forest	Outside the forest	Both
Red duiker	√ (100%)		
Bushbuck	√ (100%)		
Chequered sengi	√ (25%)	√ (37.5%)	√ (37.5%)
Greater galago		√ (62.5%)	√ (25%)
Sykes monkey			√ (25%)

In Ludilo none of the respondents mentioned any animal populations that were increasing. Instead, many were uncertain of the status of the populations of the focal taxa or thought that they were declining (Table 81).

Table 81. Interviewee responses on abundance of focal taxa in Ludilo Village.

Species	% of interviewees responded on abundance (Number of interviewees = 8)		
	Increasing	Decreasing	Don't know
Red duiker		62.5	37.5
Bushbuck		25	75
Chequered sengi			100
Greater galago			100
Sykes		25	

Reasons for changes in the abundance of focal taxa

Illegal hunting for meat and skins was the major cause of the reduced abundance of red duiker and bushbuck (Table 82). The respondents also mentioned that Sykes monkeys are a problematic animal in their area and that they therefore hunt them in order to protect their crops. This factor has contributed to a decline in the Sykes monkey populations in the area.

Table 82. Traditional uses for focal taxa in Ludilo Village.

Species	Use			
	Meat	Medicine	Skin	Trade
Red duiker	√		√	
Bushbuck	√		√	
Chequered sengi				
Greater galago				
Sykes monkey				

Note: Uses were mentioned by all the interviewees i.e. 100%

Respondents provided Hehe names for five mammal species (Table 83).

Table 83. Local names of focal taxa in Ludilo Village.

Species	Language	Name
Red duiker	Hehe	Funo

Species	Language	Name
Bushbuck	Hehe	Mato
Chequered sengi	Hehe	Kisangi
Greater galago	Hehe	Pwege
Sykes monkey	Hehe	Ndumbili

9.4.8 Traditional hunting techniques

Across all the forests, the hunting techniques are more or less similar. Animals such as antelopes and monkeys are hunted using guns (muzzle loaders), dogs, snares, *pangas* or spears. Dogs are often used to flush the animals from their hiding places after which they can easily be shot, snared or killed by *pangas* and spears.

Alternatively, for animals such as galagos they use *ulanzi* as bait and when the animal gets drunk they catch them by hand. Also they opportunistically catch them on the brewing sites when they are drunk. For other primates such as Sykes and vervet monkeys many people surround them and then they kill them using *pangas* or spears.

9.5 Discussion

9.5.1 Species

Overall, local people mentioned the presence of ten primate, ungulate and sengi species. The results were different across the six surveyed forests with the exception of red duiker, bushbuck, chequered sengi and Sykes monkey which were mentioned as being present in all of the forests surveyed (Table 84).

Blue duiker was only mentioned as being present in Lulanda forest whilst black and white colobus monkey was only mentioned as being present in Lulanda and Ipafu forests.

Galagos were mentioned as being present in all the forests with the exception to Ifupira, Ipafu and Kidegemsitu forests for which there was no mention of dwarf galagos and Kigogo forest in which the respondents did not mention the presence of greater galago.

Tree hyrax was only mentioned as being present in Kigogo forest whilst rock hyrax was mentioned as being present outside all of the forests with the exception of Kigogo and Kidegemsitu forests.

Respondents were also consistent in not mentioning Abbott's duiker, red colobus, mangabey and black and rufous sengi suggesting that these species are not present in the Mufindi forests.

Table 84. Summary of species mentioned during the indigenous knowledge surveys.

Species	Forest
Red duiker	Kigogo, Mufindi Scarp West (including Livalonge forest), Ifupira, Kidegemsitu, Ipafu and Lulanda.
Bushbuck	Kigogo, Mufindi Scarp West (including Livalonge forest), Ifupira, Kidegemsitu, Ipafu and Lulanda.
Chequered sengi	Kigogo, Mufindi Scarp West (including Livalonge forest), Ifupira, Kidegemsitu, Ipafu and Lulanda.
Dwarf Galago	Kigogo, Mufindi Scarp West (including Livalonge forest) and Lulanda.
Greater Galago	Mufindi Scarp West (including Livalonge forest), Ifupira, Kidegemsitu, Ipafu and Lulanda.
Sykes monkey	Kigogo, Mufindi Scarp West (including Livalonge forest), Ifupira, Kidegemsitu, Ipafu and Lulanda.
Rock hyrax	Mufindi Scarp West (including Livalonge forest), Ifupira, Ipafu and Lulanda.
Black and white colobus monkey	Lulanda and Ipafu
Tree hyrax	Kigogo
Blue duiker	Lulanda
Abbott's duiker	None
Red Colobus	None
Mangabey	None
Black and rufous sengi	None

There is more variability with regard to whether animals are seen only inside or outside of the forest, or in both areas (Table 85). All the species mentioned spend some time in either habitat with the exception of bushbuck and tree hyrax which were mentioned to be found only inside the forests. The variability in responses may reflect differences in how familiar the respondents were with the species.

Table 85. Summary of whether animals were seen only inside or outside of forests or both.

Species	% of respondents in all villages		
	Inside forest only	Outside forest only	Both inside and outside the forest
Red duiker	77%	0%	15%
Bushbuck	78%	0%	0%
Blue duiker	13%	0%	2%
Chequered sengi	27%	13%	54%
Dwarf galago	27%	0%	6%
Greater galago	27%	23%	15%
Tree hyrax	6%	0%	0%
Sykes monkey	21%	0%	50%
Rocky hyrax	0%	40%	31%
Black and white colobus	13%	0%	13%

In some cases, interviewees found it difficult to clearly distinguish between some of the animal species. For example, some of the respondents confused galagos with bush squirrels (taxa not included in the study) and were also confused on the differences between some antelopes such as blue duiker, common duiker and suni. Some of the respondents confused the Greater and Dwarf galagos, with most respondents being more familiar with the Greater galago. This shows that some local people are not familiar with some of the species present in forests adjacent to them, particularly cryptic animals such as the dwarf galago. Comparing awareness of forest species between those people who regularly enter the forest and those who do not, the answer is predictably that those who spend more time in the forest are more familiar with the forest species.

9.5.2 Threats to forest wildlife and traditional uses

In the forests of Mufindi district, illegal subsistence hunting for meat and habitat loss due to encroachment for agriculture were the main reasons given for the decrease in the abundance of duikers. For hyraxes and Sykes monkeys hunting for meat and for bushbuck hunting for both meat and skin were the major reasons. Details on the motivation for hunting are provided in Table 86. Sykes monkeys were hunted mainly for food and medicinal purposes. Less predation and high availability of food were the main reasons mentioned for changes in abundance of galagos and sengis.

Table 86. Uses of mammals hunted in the Udzungwa Mountains forest of Mufindi district

Species	Use			
	Meat	Medicine	Skin	Trade
Red duiker	83%	8%	63%	0%
Bushbuck	80%	8%	75%	0%
Blue duiker	13%	0%	0%	0%
Chequered sengi	13%	0%	0%	0%
Dwarf galago	0%	6%	0%	0%
Greater galago	15%	0%	0%	0%
Tree hyrax	6%	0%	0%	0%
Rock hyrax	71%	0%	58%	0%
Sykes monkey	29%	13%	0%	0%
Black and white colobus	8%	0%	0%	0%

Tree hyrax, bushbuck and Sykes monkey were reported to be sold as meat by local hunters. Prices varied and the meat was either sold in pieces or as the whole animal. Sykes monkey were sold at TSh 1000 – 2000 per animal (approximately US\$ 1 – 2), bushbuck Tshs 1000 per animal (approximately US\$ 1) and tree hyrax 700 per animal (approximately US\$ 0.70).

The skin of Sykes monkey is used by witch doctors to treat sick people. In addition, bones of Sykes monkey are used to treat a human bone disease 'kichaganza' whereby the bones of the Sykes monkey are boiled into a broth which is drunk by the patient.

Of all the species, Sykes monkeys was mentioned the most frequently as having a medicinal value in the forests of Mufindi.

9.5.3 Wildlife conflicts

Local people in Tanzania who live adjacent to boundaries of protected areas often experience problems from wildlife. Wildlife knows no boundaries and roams freely in and out of the protected areas. When outside a protected area, wildlife can compete with crops and livestock for land and water. The wild animals can cause damage to crops, livestock and poultry or inflict injuries to people. Normally, the animals concerned are large animals such as elephants, buffalo, lions and crocodiles. However even animals such as baboons, bush pigs and monkeys can cause significant damage. Small animals such as some rodents and small carnivores such as mongooses can also cause damage. These are regarded as pests. This causes conflicts between the people, the wild animals and the wildlife departments.

In the forests of the Mufindi, there are some wildlife conflicts. Medium-sized wild animals such as vervet monkeys, Sykes monkeys, baboons and bushpigs were mentioned as causing damage to crops (Tables 87 – 92).

Table 87. Crop damage caused by different animals as reported by respondents around Mufindi Scarp West.

Animal	Main crops said to be targeted.	% of respondents mentioning the animal as a pest
Baboons	Maize and beans	15
Vervet monkeys	Maize, beans, and mangoes.	23
Sykes monkeys	Maize, beans, and mangoes.	74
Bush pigs	Maize, beans and cabbage	17
Galagos	Banana, pawpaw, mangoes and <i>ulanzi</i>	6

Table 88. Crop damage caused by different animals as reported by respondents around Lulanda forest.

Animal	Main crops said to be targeted	% of respondents mentioning the animal as a pest
Baboons	Maize and beans	100
Vervet monkeys	Maize and beans	100
Sykes monkeys	Maize, beans, and mangoes.	40

Table 89. Crop damage caused by different animals as reported by respondents around Ifupira forest.

Animal	Main crops said to be targeted	% of respondents mentioning the animal as a pest
Vervet monkeys	Maize.	100
Bush pigs	Maize, beans and potatoes	100

Table 90. Crop damage caused by different animals as reported by respondents in Ipafu forest

Animal	Main crops said to be targeted	% of respondents mentioning the animal as a pest
Baboons	Maize and beans	100
Vervet monkeys	Maize	75
Sykes monkeys	Maize	75
Bush pigs	Maize and beans	75
Galagos	Banana and <i>ulanzi</i>	75
Black and white colobus	Maize	75

Table 91. Crop damage caused by different animals as reported by respondents in Kigogo Forest Reserve

Animal	Main crops said to be targeted	% of respondents mentioning the animal as a pest
Baboons	Maize and beans	100
Vervet monkeys	Maize, beans, and mangoes.	100
Sykes monkeys	Maize, beans, and mangoes.	100
Bush pigs	Maize, beans and cabbage	100

Galagos	Banana, mangoes and <i>ulanzi</i> .	33
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It was reported that galagos break the bamboo containers used to tap the *ulanzi* from the bamboo stem.

Table 92. Crop damage caused by different animals as reported by respondents in Kidegemsitu forest

Animal	Main crops said to be targeted	% of respondents mentioning the animal as a pest
Baboons	Maize and beans	100
Vervet monkeys	Maize	100

Baboons and vervet monkeys were mentioned consistently in all the villages. In contrast Sykes monkey is not mentioned around Ifupira and Kidegemsitu forests, suggesting that the species is either absent or is not problematic in these areas.

10) Conclusions

The surveys have shown that despite the fragmentation and disturbance visible in the Mufindi forests, they continue to provide habitat to at least 38 restricted range vertebrate species of which at least five species appear to be found in the Mufindi forests only. Kigogo and Lulanda forests contain the most restricted range species with 27 and 17 species respectively.

With five species endemic to Mufindi, it suggests that Mufindi has comparable rates of strict endemism with the East Usambara Mountains (four strict endemics), South Pare and Rubeho (two strict endemics each) or Ukaguru (one strict endemic) based on figures in Burgess *et al.* (2007). However three of the five endemic species recorded in Mufindi are new species that reflect taxonomic revisions following phylogenetic analyses. These revisions are likely to show that rates of endemism amongst the amphibian fauna across the Eastern Arc Mountains have been underestimated. As such it is difficult to make direct comparisons between our data and that published in Burgess *et al.* (2007).

In terms of species richness, the surveys recorded a total of 210 vertebrate species. Additional survey effort is likely to reveal more vertebrate species, particularly in terms of bats and fish which were not included in the current survey.

Table 93. Species richness in Mufindi Forests.

Forest	Amphibians	Reptiles	Mammals	Birds	Total
Ifupira	N/a	N/a	13	61	74
Igoda	N/a	N/a	4	N/a	4
Lupeme	6	6	9	N/a	21
Ipafu	N/a	N/a	13	74	87
Kidegemsitu	N/a	N/a	1	12	13
Kigogo	10	8	21	35	74
Mufindi Scarp East	N/a	N/a	18	N/a	18
Mufindi Scarp West	N/a	N/a	14	74	88
Lulanda	8	8	13	66	95
Total	20	27	37	126	210

The relative species richness of the nine forests visited by the survey team is difficult to determine given differences in survey effort. However, Table 93 shows that Kigogo had the most amphibian, reptile and mammal species given similar sampling effort to other reserves included in the herpetofauna and mammal surveys thus suggesting that this forest is particularly diverse. Lulanda with 95 vertebrate species, also appears to show high diversity, particularly given its small size at 197 ha.

Relative to other Eastern Arc Mountain blocks, the Mufindi forests have comparable species richness with the North Pare Mountains where the survey team recorded 207 vertebrates species (Doggart *et al.* 2008) but appear to be less diverse than the South Nguru Mountains where Doggart and Loserian (2005) recorded 319 vertebrate species.

The surveys recorded a total of 38 restricted range species (Table 94). Of these ten are endemic to the Udzungwa Mountains. Of those species endemic to the Udzungwa Mountains, it is possible that the three amphibian species and one reptile species that appear to be new to science, are endemic to Mufindi. The frog *Phlyctimantis keithae* is also endemic to the Mufindi area.

Table 94. Summary of species endemism by taxon.

Taxon	E	EA	EA N
Amphibians	4	1	5
Reptiles	5	5	3
Mammals	1	0	5
Birds	0	0	9
TOTAL	10	6	22

Of the 22 species that are near-endemic to the Eastern Arc Mountains and are found in Mufindi, the majority (20) are also found in some Southern Rift forests indicating the strong affinities between the Mufindi fauna and that of the Southern Rift forests.

The Mufindi area, more specifically the mosaic of forest and grasslands included in the area south west of a line, cutting the so called 'Mngeta corridor' and linking the villages of **Tanangozi** in the north west with Mngeta in the south east (see Map xx), shows certain differences in terms of the herpetofaunal composition relative to the more northerly Eastern Arc Mountains. The Mufindi area together with Uzungwa Scarp Forest Reserve seem to represent a biogeographic bridge between a northern and a southern faunal assemblage, with some local peculiarities such as the endemic species mentioned earlier. This makes the Mufindi area of particular interest in terms of the historical biogeography of the region.

In terms of globally threatened taxa, there are 26 species listed on the IUCN red list that are present in Mufindi. These are summarised in Table 95. It should be noted that most reptile species have not been assessed. Similarly the three new species of amphibian, the new chameleon species and the possible new galago taxon have not been assessed. However, given their restricted ranges and the rates of disturbance in Mufindi, it is likely that they will be considered vulnerable to extinction.

Table 95. Number of threatened species in Mufindi Forests.

Taxon	Endangered	Vulnerable	Near threatened	Least Concern
Amphibians	0	3	1	10
Reptiles			1	
Mammals	1	1		
Birds		1		8
Total	1	5	2	18

The species considered to be endangered is *Myosorex cf kishaulei*.

Species present in the Mufindi forest which are considered to be Vulnerable include:

Amphibians

Phlyctymantis keithae

Scolecophorus kirkii

Leptopelis barbouri

Nectophrynoides viviparus

Mammals

Paraxerus vexillarius byatti

Birds

Sheppardia lowei

Conservation

The Mufindi forests are part of the Eastern Arc Mountain forests with strong affinities with the Southern Rift forests. Both areas have recently been classified together as being part of the Eastern African Afromontane biodiversity hotspot (Mittermeier *et al.* 2005). As such they are part of a region considered a global priority in terms of biodiversity conservation. The area is also part of the 'Udzungwa Mountains Important Bird Area' which also highlights their international importance.

In terms of protected area management, the forests of Mufindi are an interesting mosaic of different management regimes. Three of the forests have been managed as Central Government catchment forest reserves including the forest that appears to have the highest biological values, Kigogo. Five of the forests visited by the survey team are local authority forest reserves: Ipafu, Igoda, Kidegemsitu and Lulanda of which Lulanda, Igoda and Ipafu have also benefited from investment from the Tanzania Forest Conservation Group to encourage participatory forest management. The remaining forests of Livalonge and Ifupira are owned and managed by Unilever Tea Tanzania Limited.

The results of the disturbance transects show the highest rates of disturbance, albeit mostly old, to be in Lulanda and Kigogo Forest Reserves. However, the team also noted that some of the 'best quality' forest to have been in these reserves, together with Livalonge, in terms of having a high canopy. Further research is required in order to fully understand this apparent paradox.

Overall however, the surveys have shown that the Mufindi Forests continue to provide habitat for a rich vertebrate fauna that includes many restricted range species. The high pressure on the forests from a growing human population appears to have resulted the serious decline (and possibly local extinction) of some vertebrate populations including buffalo, tree hyrax and leopard. Although efforts have been successful over the last decade to encourage more participatory forestry, there remains an urgent need for more direct management of the reserves, particularly Kigogo and Lulanda, in order to safeguard their biological values.

11) Recommendations

The current study has highlighted both the need for additional research in the Mufindi forests as well as increased efforts to improve the management of the remaining forests. Recommendations for further research and conservation interventions are listed below.

Conservation interventions

1) Establish and implement equitable and effective joint forest management for Kigogo and Mufindi Scarp West and identify ways of restoring connectivity between the western forests.

In terms of biodiversity conservation, one of the greatest challenges for the Mufindi forests is that they have become so fragmented. The consolidation of the western forests and the restoration of connectivity between forests around Kigogo, Mufindi Scarp West and Livalonge should be a priority. These areas contain the majority of the species found in Mufindi. Management actions that are needed in this area include the establishment of joint forest management including the preparation of a management plan for the area, training for Village Natural Resource Committees, clearing and marking the reserve boundaries, support for forest patrols and establishing mechanisms for improved coordination between local government, tea estates, Sao Hill and the communities. In establishing joint forest management, clear benefits must be provided to those supporting the joint forest management in the communities. At a minimum the government should provide direct financial support to the village natural resource committees to clear the forest boundaries and conduct patrols. Once the joint management plan has been developed and agreed, the Government should make every effort to sign joint management agreements promptly avoiding the delays that have undermined joint forest management in some other parts of Tanzania.

In terms of restoring forest connectivity, TFCG have gained considerable experience from the Mufindi Millennium Forest and from the Lulanda corridor. This experience has shown that given a long term commitment, sufficient investment and the right species, it is possible to restore forest corridors provided that the technical and political support are there.

2) Continue to support joint forest management for Lulanda Forest Reserve given its exceptionally high concentration of restricted range species.

Other priority areas requiring continued investment in forest management include the Lulanda forest that appears to provide habitat to several species not found in the more westerly forests. The Lulanda forest has exceptional levels of endemism and species richness given its small size. Although only 197 ha, the forest has at least 95 vertebrate species and 17 restricted range species.

3) Control hunting of forest mammals through awareness raising, joint forest management and coordination between stakeholders.

The study has shown that the forests of Mufindi have been heavily hunted to the point that some species such as tree hyrax, buffalo, blue duiker and leopard may now be extinct from some or all forests in Mufindi. It is possible however that some individuals of these species remain (particularly the tree hyrax and blue duiker) and could provide a source for population recoveries for these species. As such every effort should be made to control hunting through awareness raising campaigns, active joint forest management and a coordinated approach to address the issue by the tea estates, Sao Hill, village and district governments.

4) Control illegal logging through joint forest management and awareness raising campaigns

There are still signs of illegal logging within the reserves. Through joint forest management and awareness campaigns, every effort should be made to prevent further disturbance to the remaining pristine areas of forest from illegal logging.

5) Implement awareness raising campaigns on the values, threats and conservation needs of the Mufindi Forests and strengthen environmental education in schools

More effort is needed to raise awareness amongst the local populations regarding the values, threats and conservation needs of the Mufindi forests. Such awareness raising is also needed at the national level. This should link with the implementation of the Eastern Arc information, education and

communication strategy and the national forest programme communication strategy. Mufindi District council, NGOs and the private sector should also strengthen support for environmental education in primary and secondary schools through training of teachers, provision of teaching materials and systematic monitoring of school's performance standards on environmental education.

6) Identify and conserve critical montane grassland habitats in Mufindi.

Our research has also highlighted that some of the restricted range species found in Mufindi occur outside of the current protected areas on village land. Efforts need to be made to identify representative patches of grassland and to establish conservation strategies for these areas.

7) Support efforts to reduce local dependence on the unsustainable extraction of products from the forests particularly timber, poles and fuel wood.

More effort is needed to provide local communities with sustainable alternatives to forest products, particularly timber, poles and fuel wood. Such initiatives should include tree planting and the promotion of fuel efficient stoves. Additional work is also needed to support livelihood initiatives that provide sustainable incomes from forest-related products and services such as honey and eco-tourism.

8) Develop and implement a strategy to tackle human – wildlife conflicts

The indigenous knowledge survey showed that local people are experiencing problems in preventing crop damage from wildlife. Awareness raising and training on how to resolve human – wildlife conflicts is needed to address this issue as well as ongoing support to communities from the District Wildlife Officer in order to prevent further conflict. The strategy should link with the District strategic plans in order to ensure sustainability.

9) Develop and implement a strategy to address invasive alien species

Lupeme, Ifupira and Livalonge forests have high densities of two invasive alien species: Rubus and Lantana. Following on from research on how best to address these, action should be taken to prevent their spread and to control their populations within the forests currently affected. This might include linkages with the Flora and Fauna International programme on invasive alien species that has been conducting research in other parts of the Eastern Arc Mountains including the Uluguru and Usambara Mountains in conjunction with the Tropical Biology Association programme.

10) Develop and implement a strategy to prevent and tackle forest fires

Fires pose a significant threat to several of the forests including the two priority forests Kigogo and Lulanda. Through experience in Lulanda, it is evident that there is a need for a combination of awareness raising on fire prevention, training in fire prevention activities, support for fire prevention activities such as clearing fire breaks, provision of equipment for teams involved in fire prevention and fire fighting and training in safe and effective ways of stopping the spread of fires once they have started. Such activities need coordinated support from the tea estates, Sao Hill, Mufindi and NGOs. The strategy should link with the District strategic plans in order to ensure sustainability.

11) Improved coordination of conservation activities in Mufindi

The study has highlighted the patchwork of management regimes present in Mufindi with private sector (tea estates and tourist companies), local government, central government, villages and NGOs all playing active roles in the conservation of the forests. There is a need for improved coordination amongst stakeholders and it is recommended that the District is in the strongest position to take on this coordinating role, particularly if supported by private sector and NGOs.

Further research and monitoring

1) Further research on taxonomy, distribution and conservation status of some of the possibly new, scarce and cryptic species including dwarf galagos, black and white colobus, squirrels, tree hyrax, Lowe's genet and blue duiker.

The current study has raised a number of questions regarding the taxonomic and conservation status of a number of species found in the Mufindi forests. The galago research found differences in the vocalisations of the dwarf galago from Mufindi with the possibility that it is a distinct taxon. Further research is needed on the dwarf galago population in order to determine whether Mufindi has its own endemic primate. Genetic sampling of the black and white colobus in order to make comparisons with the populations in the Northern Udzungwa and Southern highlands would help in understanding their

phylogeography as well as the biogeography of Mufindi forests. Further research is needed in order to determine the status of tree hyrax populations in the area and to monitor whether their populations can recover should hunting be reduced. In terms of birds, further research is also needed on the unusual red-faced crimsonwing in order to determine whether this represents a different taxon. Researchers should also look out for the Uhehe fiscal in order to assess whether the perceived population declines are really occurring and if so, why.

2) Further analysis and description of the new amphibian and reptile species.

Further analysis is needed to describe and determine the status of the three potentially new amphibian and reptile species identified during this study. Research is then needed to determine their ecological needs and to relate those findings with conservation interventions. These species should also be assessed in terms of their red list status and the results of these analyses should be communicated to local and national stakeholders.

4) Support for biodiversity and threat monitoring

Biodiversity and threat monitoring should be carried out regularly in order to assess the effectiveness of conservation interventions and to detect changes in the populations of some of the restricted range species. Such monitoring should include a combination of threat monitoring using methods such as the disturbance transects used in the current study, with direct monitoring of the populations of some of the vulnerable species through e.g. camera trapping and periodical herpetofaunal studies.

5) Further surveys to provide additional information on the distribution and status of threatened and restricted range species.

While the current study has provided a firm baseline for our understanding of the biodiversity of Mufindi, the study was not able to conduct surveys in all of the forests for all of the taxa. Key gaps remain in terms of a systematic bird survey in Kigogo Forest Reserve; a survey of the bats throughout Mufindi; further mammal surveys in Kigogo forest reserves, particularly in terms of the hyrax populations.

6) Further research on the fauna of the montane grasslands with a view to identifying priority areas for conservation.

The montane grasslands of the Eastern Arc Mountains provide important habitat for several restricted range and threatened species. Further research is needed to document the vertebrate fauna of Mufindi's montane grasslands and to identify critical areas for conservation investment.

7) Further research on optimal methods for restoring forest connectivity and in identifying priority areas in the western Mufindi forests.

Whilst TFCG has gained considerable experience on the restoration of forest connectivity, additional work is needed to monitor ecological succession in the restored areas and to translate this experience into clear guidelines for forest restoration in other areas. Using GIS combined with ground truthing, it would also be useful to identify the critical and feasible corridors that could help in restoring connectivity in the Western Mufindi forests.

8) Research on control measures for invasive alien plant species.

Several of the forests visited by the survey team including Ifupira, Livalonge and Lupeme were affected by the invasive alien species, *Rubus* sp. and *Lantana camara*. Further research is needed to document the extent of the problem in Mufindi and to identify the best ways in which their spread can be controlled and the populations reduced.

9) Conservation genetic studies on minimum viable populations sizes for species vulnerable to extinction, particularly the three new amphibian and one chameleon species.

Given the fragmented nature of the forests in Mufindi, a critical question that needs to be answered is whether the current isolated populations are viable. Through a combination of population studies and genetics, further research is needed to determine which species are most vulnerable to extinction due to the fragmentation and what steps can be taken to prevent the negative impacts of forest fragmentation on the survival of vulnerable species in Mufindi.

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APPENDICES

Appendix 1. Details of primate census walks in Mufindi forests.

Site	walk #	habitat	forest habitat	altitude	UTM start	UTM end
Kigogo	1	regenerating forest	montane/bamboo	1800-1940	748889/9041146	748051/9042936
Kigogo	2	regenerating forest	montane/bamboo	1800-1940	748889/9041146	747939/9043082
Kigogo	3	regenerating forest	montane/bamboo	1875-1800	746664/9041340	746579/9040348
Kigogo	4	regenerating forest	sub-montane and montane/bamboo	1875-1600	746664/9041340	746965/9039232
Mufindi Scarp W	5	closed-canopy and regenerating	montane	1790-1770	736195/9037950	735607/9037418
Mufindi Scarp W	6	regenerating forest	montane	1875-1670	737554/9038884	736195/9037950
Mufindi Scarp W (Unilever)	7	regenerating forest	montane	1875-1900	737554/9038884	737588/9039702
Mufindi Scarp W	8	regenerating forest	montane	1828-1790	736188/9039044	736195/9037950
Lulanda (Fufu)	9	closed-canopy	sub-montane	1560-1526	788748/9047716	788108/9046500
Lulanda (Fufu)	10	closed-canopy	sub-montane	1560-1526	788748/9047716	788108/9046500

Appendix 2. Details of camera-trap sites in Mufindi forests.

Forest site	Camera locations (UTM)	Altitude	Forest habitat	Canopy cover	Floor cover
Lupeme	764220/9057436	1900	Montane	Closed	Seedlings and leaf litter
Lupeme	200m of 764220/9057436	1900	Montane	Regenerating	Seedlings and leaf litter
Lupeme	764220/9057436	1900	Montane	Closed	Seedlings and leaf litter
Lupeme	769429/9057032	1745	Regenerating	Open	Seedlings and leaf litter
Ipafu	50m SW of 777728/9052898	1750	Montane	Open	Seedlings, leaf litter and shrub >2m
Ipafu	50m SW of 777728/9052898	1750	Montane	Open	Seedlings, leaf litter and shrub >2m
Ipafu	777447/9053088	1735	Montane	Open	Seedlings, leaf litter and grass
Ipafu	150m W of 777447/9053088	1730	Montane	Open	Seedlings, leaf litter and shrubs <2m
Lulanda	788108/9046500	1526	Sub-montane	Open	Seedlings, stems and leaf litter
Lulanda	350m N of 788108/9046500	1528	Sub	Closed	Seedlings, herbs and leaf litter
Lulanda	788620/9046900	1525	Sub	Open	Seedlings and leaf litter
Lulanda	200m NE of 788620/9046900	1525	Sub	Closed	Seedlings, leaf litter and herbs
Lulanda	788748/9047716	1560	Sub	Closed	Seedlings, leaf litter and grass
Lulanda	788748/9047716	1560	Sub	Closed	Stream bed
Kigogo	748889/9041146	1800	Montane/bamboo	Closed	Seedlings and grass
Kigogo	200m W of 748889/9041146	1800	Montane/bamboo	Closed	Seedlings and grass
Kigogo	100m N of 748889/9041146	1800	Montane/bamboo	Closed	Seedlings and grass
Kigogo	747514/9042598	1880	Montane/bamboo	Closed	Herbs and grass
Kigogo	150m SE of 747514/9042598	1800	Montane/bamboo	Open	Grass
Kigogo	746579/9040348	1800	Montane	Closed	Grass
Kigogo	300m N of 746579/9040348	1800	Montane	Closed	Grass and herbs
Kigogo	400m N of Camera no. 23	1800	Montane	Open	Seedlings and leaf litter
Mufindi Scarp West	736120/9037989	1800	Montane	Open	Seedlings and shrubs >2m
Mufindi Scarp West	12m W of 736120/9037989	1800	Montane	Open	Seedlings and leaf litter
Mufindi Scarp West	737599/9083201	1860	Montane	Regenerating	Seedlings and leaf litter
Mufindi Scarp West	736724/9037576	1809	Montane	Open	Seedlings and leaf litter
Mufindi Scarp West	768086/9061476	1915	Montane	Open	Seedlings, herbs and leaf litter
Mufindi Scarp West	50m S of 768086/9061476	1915	Montane	Open	Seedlings and leaf litter
Mufindi Scarp West	737567/9039580	1910	Montane	Open	Seedlings, leaf litter and shrub <2m
Mufindi Scarp West	737594/9039542	1900	Montane	Open	Seedlings, leaf litter and shrubs <2m
Mufindi Scarp West	50m N of 737594/9039542	1900	Montane	Open	Seedlings, leaf litter and shrubs <2m

Appendix 3. Small mammal specimen numbers from Mufindi Scarp East Forest Reserve.

Genus	Species	No. Captured (excl. recaptured)		Total (excl. recaptures)	% Total	Specimen no.
		Sherman	Bucket pitfall			
Beamys	hindei major	2	0	2	3.57	25834
Graphiurus	murinus	2	0	2	3.57	25837
Hylomyscus	arcimontensis	7	1	8	14.29	25839, 25840
Mus	sp A minutoides	0	3	3	5.36	25835
Mus	sp B triton	13	0	13	23.21	25836, 25838
Praomys	delectorum	15	1	16	28.57	25832, 25833
Crocidura	sp A hildegardeae	0	4	4	7.14	26151, 26154, 26157, 26158
Crocidura	sp B hildegardeae	0	6	6	10.71	26152, 26153, 26155, 26156, 26160
Crocidura	sp C monax	0	1	1	1.79	26159
Myosorex	cf kihaulei	0	1	1	1.79	26161
TOTAL		39	17	56	100.00	

Appendix 4. Small mammal specimen numbers from Kigogo Forest Reserve.

Genus	Species	No. Captured (excl. recaptured)		Total (excl. recaptures)	% Total	Specimen no.
		Sherman	Bucket pitfall			
Chrysochloris	stuhlmanni	0	1	1	1.69	26165
Beamys	hindei major	2	2	4	6.78	26163
Grammomys	dolichurus	1	0	1	1.69	25849
Hylomyscus	arcimontensis	11	2	13	22.03	
Mus	sp B triton	2	1	3	5.08	26164
Praomys	delectorum	17	15	32	54.24	25850
Crocidura	sp B hildegardeae	0	1	1	1.69	26162
Crocidura	sp D	0	2	2	3.39	26167, 26168
Myosorex	kihaulei	0	1	1	1.69	26166
Suncus	megalura	0	1	1	1.69	26169
TOTAL		33	26	59	100.00	

Appendix 5. Small mammal specimen numbers from Ifupira Forest.

Genus	Species	No. Captured (excl. recaptured)		Total (excl. recaptures)	% Total	Specimen no.
		Sherman	Bucket pitfall			
Grammomys	dolichurus	6	0	6	12.50	
Hylomyscus	arcimontensis	5	2	7	14.58	25865
Praomys	delectorum	17	15	32	66.67	25850
Mus	minutoides	0	1	1	2.08	
Crocidura	cf. monax	0	1	1	2.08	26563
Myosorex	kihaulei	0	1	1	2.08	25866
TOTAL		28	20	48		

Appendix 6. Small mammal specimen numbers from Ipafu Forest.

Genus	Species	No. Captured (excl. recaptured)		Total (excl. recaptures)	% Total	Specimen no.
		Sherman	Bucket pitfall			

Grammomys	dolichurus	3	0	3	16.67	
Hylomyscus	arcimontensis	1	0	1	5.56	
Praomys	delectorum	12	0	12	66.67	25868
Crocidura	hildegardeae	0	1	1	5.56	25867
Myosorex	kihaulei	0	1	1	5.56	25870
TOTAL		16	2	18	100.00	

Appendix 7. Small mammal specimen numbers from Mufindi Scarp West Forest Reserve.

Genus	Species	No. Captured (excl. recaptured)		Total (excl. recaptures)	% Total	Specimen no.
		Sherman	Bucket pitfall			
Grammomys	dolichurus	3	0	3	13.64	
Hylomyscus	arcimontensis	6	3	9	40.91	25873
Praomys	delectorum	9	1	10	45.45	25871, 25874
Dendromus		0	1	1	4.55	25872
TOTAL		18	5	22	100.00	

Appendix 8. Bird observations

cardno	square	locality	species	month	yr	latitude	longitude	alt
9062	3508A	Kidege msitu	fulleborn's black boubou	6	2006	-8.46070	35.45760	1286
9062	3508A	Kidege msitu	eastern double-collared sunbird	6	2006	-8.46070	35.45760	1286
9062	3508A	Kidege msitu	chapin's apalis	6	2006	-8.46070	35.45760	1286
9062	3508A	Kidege msitu	dusky flycatcher	6	2006	-8.46070	35.45760	1286
9062	3508A	Kidege msitu	green-throated greenbul	6	2006	-8.46070	35.45760	1286
9062	3508A	Kidege msitu	Dark batis	6	2006	-8.46070	35.45760	1286
9062	3508A	Kidege msitu	black-lored cisticola	6	2006	-8.46070	35.45760	1286
9062	3508A	Kidege msitu	robin chat	6	2006	-8.46070	35.45760	1286
9062	3508A	Kidege msitu	churring cisticola	6	2006	-8.46070	35.45760	1286
9062	3508A	Kidege msitu	livingstone's turaco	6	2006	-8.46070	35.45760	1286
9062	3508A	Kidege msitu	crowned hornbill	6	2006	-8.46070	35.45760	1286
9062	3508A	Kidege msitu	eastern olive sunbird	6	2006	-8.46070	35.45760	1286
9062	3508A	Kidege msitu	red-eyed dove	6	2006	-8.46070	35.45760	1286
9062	3508A	Small river crossing	small river	6	2006	-8.45616	35.47403	1818
9062	3508A	Small river crossing	yellow white-eye	6	2006	-8.14562	35.47403	1818
9062	3508A	Small river crossing	eastern double-collared sunbird	6	2006	-8.14562	35.47403	1818
9062	3508A	Small river crossing	moustached green tinkerbird	6	2006	-8.14562	35.47403	1818
9062	3508A	Small river crossing	red-faced cisticola	6	2006	-8.14562	35.47403	1818
9062	3508A	Small river crossing	fulleborn's black boubou	6	2006	-8.14562	35.47403	1818
9062	3508A	Small river crossing	tropical boubou	6	2006	-8.14562	35.47403	1818
9062	3508A	Small river crossing	east african citril	6	2006	-8.14562	35.47403	1818
9062	3508A	Small river crossing	yellow-vented bulbul	6	2006	-8.14562	35.47403	1818
9062	3508A	Small river crossing	yellow-bellied waxbill	6	2006	-8.14562	35.47403	1818
9062	3508A	Small river crossing	lizard buzzard	6	2006	-8.14562	35.47403	1818
9062	3508A	Small river crossing	silvery-cheeked hornbill	6	2006	-8.14562	35.47403	1818
9062	3508A	Ludilo village	village	6	2006	-8.45999	35.47688	1845
9062	3508A	Ludilo village	ped crow	6	2006	-8.45999	35.47688	1845
9062	3508A	Ludilo village forest	greater honeyguide	6	2006	-8.45999	35.47688	1845
9062	3508A	Ludilo village forest	spot-throat	6	2006	-8.45999	35.47688	1845
9062	3508A	Ludilo village forest	red-rumped swallow	6	2006	-8.45999	35.47688	1845
9062	3508A	Ludilo village forest	striped swallow	6	2006	-8.45999	35.47688	1845
9062	3508A	Phillip house	yellow-rumped seedeater	6	2006	-8.45999	35.47688	1845
9062	3508A	Phillip house	paradise flycatcher	6	2006	-8.45999	35.47688	1845
9062	3508A	Phillip house	common waxbill	6	2006	-8.45999	35.47688	1845
9062	3508A	Phillip house	red-eyed dove	6	2006	-8.45999	35.47688	1845
9062	3508A	Ifupira guesthouse	african pied wagtail	6	2006	-8.48743	35.40894	2012
9062	3508A	Ifupira forest patch 1	common waxbill	6	2006	-8.48169	35.42645	2013
9062	3508A	Ifupira forest patch 1	dusky flycatcher	6	2006	-8.48169	35.42645	2013
9062	3508A	Ifupira forest patch 1	livingstone's turaco	6	2006	-8.48169	35.42645	2013
9062	3508A	Ifupira forest patch 1	yellow-browed seedeater	6	2006	-8.48169	35.42645	2013
9062	3508A	Ifupira forest patch 1	chapin's apalis	6	2006	-8.48169	35.42645	2013
9062	3508A	Ifupira forest patch 1	fulleborn's black boubou	6	2006	-8.48169	35.42645	2013
9062	3508A	Ifupira forest patch 1	eastern double-collared sunbird	6	2006	-8.48169	35.42645	2013
9062	3508A	Ifupira forest patch 1	red-eyed dove	6	2006	-8.48169	35.42645	2013
9062	3508A	Ifupira forest patch 1	african pied wagtail	6	2006	-8.48169	35.42645	2013
9062	3508A	Ifupira forest patch 1	ped crow	6	2006	-8.48169	35.42645	2013
9062	3508A	Ifupira forest patch 1	black-fronted bush shrike	6	2006	-8.48169	35.42645	2013
9062	3508A	Ifupira forest patch 1	evergreen forest warbler	6	2006	-8.48169	35.42645	2013
9062	3508A	Ifupira forest patch 1	eastern olive sunbird	6	2006	-8.48169	35.42645	2013
9062	3508A	Ifupira forest patch 1	spot-throat	6	2006	-8.48169	35.42645	2013
9062	3508A	Ifupira forest patch 1	black-backed puffback	6	2006	-8.48169	35.42645	2013
9062	3508A	Ifupira forest patch 1	stonechat	6	2006	-8.48169	35.42645	2013
9062	3508A	Ifupira forest patch 1	chin-spot batis	6	2006	-8.48169	35.42645	2013
9062	3508A	Ifupira forest patch 1	east african citril	6	2006	-8.48169	35.42645	2013
9062	3508A	Ifupira forest patch 1	paradise flycatcher	6	2006	-8.48169	35.42645	2013
9062	3508A	Ifupira small dam	cinnamon bracken warbler	6	2006	-8.48375	35.43576	2033

cardno	square	locality	species	month	yr	latitude	longitude	alt
9062	3508A	lfupira small dam	mountain buzzard	6	2006	-8.48375	35.43576	2033
9062	3508A	lfupira small dam	black-backed puffback	6	2006	-8.48375	35.43576	2033
9062	3508A	lfupira small dam	speckled mousebird	6	2006	-8.48375	35.43576	2033
9062	3508A	lfupira small dam	white-tailed crested flycatcher	6	2006	-8.48375	35.43576	2033
9062	3508A	lfupira small dam	bar-throated apalis	6	2006	-8.48375	35.43576	2033
9062	3508A	lfupira small dam	chapin's apalis	6	2006	-8.48375	35.43576	2033
9062	3508A	lfupira small dam	little greenbul	6	2006	-8.48375	35.43576	2033
9062	3508A	lfupira small dam	white-browed robin chat	6	2006	-8.47877	35.42469	1998
9062	3508A	lfupira office	oriole finch	6	2006	-8.47877	35.42469	1998
9062	3508A	lfupira office	black-headed oriole	6	2006	-8.47877	35.42469	1998
9062	3508A	lfupira office	common moorhen	6	2006	-8.47877	35.42469	1998
9062	3508A	lfupira office	east african citril	6	2006	-8.47877	35.42469	1998
9062	3508A	lfupira office	moustached green tinkerbird	6	2006	-8.47877	35.42469	1998
9062	3508A	lfupira office	green-throated greenbul	6	2006	-8.47877	35.42469	1998
9062	3508A	lfupira office	lanner falcon	6	2006	-8.47877	35.42469	1998
9062	3508A	lfupira big forest	mountain buzzard	6	2006	-8.48557	35.43582	1929
9062	3508A	lfupira big forest	cinnamon bracken warbler	6	2006	-8.48557	35.43582	1929
9062	3508A	lfupira big forest	livingstone's turaco	6	2006	-8.48557	35.43582	1929
9062	3508A	lfupira big forest	eastern double-collared sunbird	6	2006	-8.48557	35.43582	1929
9062	3508A	lfupira big forest	little grebe	6	2006	-8.48557	35.43582	1929
9062	3508A	lfupira big forest	lemon dove	6	2006	-8.48557	35.43582	1929
9062	3508A	lfupira big forest	red-faced crimsonwing	6	2006	-8.48557	35.43582	1929
9062	3508A	lfupira big forest	robin chat	6	2006	-8.48557	35.43582	1929
9062	3508A	lfupira big forest	white-tailed crested flycatcher	6	2006	-8.48557	35.43582	1929
9062	3508A	lfupira big forest	yellow white-eye	6	2006	-8.48557	35.43582	1929
9062	3508A	lfupira big forest	common moorhen	6	2006	-8.48557	35.43582	1929
9062	3508A	lfupira big forest	fulleborn's black boubou	6	2006	-8.48557	35.43582	1929
9062	3508A	lfupira big forest	moustached green tinkerbird	6	2006	-8.48557	35.43582	1929
9062	3508A	lfupira big forest	african wood owl	6	2006	-8.48557	35.43582	1929
9062	3508A	lfupira big forest	african goshawk	6	2006	-8.48557	35.43582	1929
9062	3508A	lfupira big forest	spot-throat	6	2006	-8.48557	35.43582	1929
9062	3508A	lfupira big forest	Dark batis	6	2006	-8.48557	35.43582	1929
9062	3508A	lfupira big forest	shelley's greenbul	6	2006	-8.48557	35.43582	1929
9062	3508A	lfupira big forest	olive mountain greenbul	6	2006	-8.48557	35.43582	1929
9062	3508A	lfupira big forest	bar-throated apalis	6	2006	-8.48557	35.43582	1929
9062	3508A	lfupira big forest	martial eagle	6	2006	-8.48557	35.43582	1929
9062	3508A	lfupira big forest	olive pigeon	6	2006	-8.48557	35.43582	1929
9062	3508A	lfupira big forest	olive mountain greenbul	6	2006	-8.48557	35.43582	1929
9062	3508A	lfupira big forest	yellow white-eye	6	2006	-8.48557	35.43582	1929
9062	3508A	lfupira big forest	black-chested snake eagle	6	2006	-8.48557	35.43582	1929
9062	3508A	lfupira big forest	iringa akalat	6	2006	-8.48557	35.43582	1929
9062	3508A	lfupira big forest	olive-flanked robin chat	6	2006	-8.48557	35.43582	1929
9062	3508A	lfupira big forest	white-eyed slaty flycatcher	6	2006	-8.48557	35.43582	1929
9062	3508A	lfupira big forest	montane nightjar	6	2006	-8.48557	35.43582	1929
9062	3508A	lfupira big forest	red-faced crimsonwing	6	2006	-8.48557	35.43582	1929
9062	3508A	lfupira big forest	white-chested alethe	6	2006	-8.48557	35.43582	1929
9062	3508A	lfupira big forest	cardinal woodpecker	6	2006	-8.48557	35.43582	1929
9062	3508A	lfupira big forest	livingstone's turaco	6	2006	-8.48557	35.43582	1929
9062	3508A	lfupira big forest	moustached green tinkerbird	6	2006	-8.48557	35.43582	1929
9062	3508A	lfupira big forest	african goshawk	6	2006	-8.48557	35.43582	1929
9062	3508A	lfupira big forest	eastern double-collared sunbird	6	2006	-8.48557	35.43582	1929
9062	3508A	lfupira big forest	iringa akalat	6	2006	-8.48557	35.43582	1929
9062	3508A	lfupira big forest	little grebe	6	2006	-8.48557	35.43582	1929
9062	3508A	lfupira big forest	fulleborn's black boubou	6	2006	-8.48557	35.43582	1929
9062	3508A	lfupira big forest	evergreen forest warbler	6	2006	-8.48557	35.43582	1929
9062	3508A	lfupira big forest	red-eyed dove	6	2006	-8.48557	35.43582	1929
9062	3508A	lfupira big forest	olive pigeon	6	2006	-8.48557	35.43582	1929
9062	3508A	lfupira big forest	green-throated greenbul	6	2006	-8.48557	35.43582	1929

cardno	square	locality	species	month	yr	latitude	longitude	alt
9062	3508A	Ifupira big forest	white-tailed crested flycatcher	6	2006	-8.48557	35.43582	1929
9062	3508A	Ifupira big forest	african pied wagtail	6	2006	-8.48557	35.43582	1929
9062	3508A	Ifupira big forest	emerald-spotted wood dove	6	2006	-8.48557	35.43582	1929
9062	3508A	Ifupira big forest	pied crow	6	2006	-8.48557	35.43582	1929
9062	3508A	Ifupira big forest	white-tailed crested flycatcher	6	2006	-8.48557	35.43582	1929
9062	3508A	Ifupira big forest	olive thrush	6	2006	-8.48557	35.43582	1929
9062	3508A	Ifupira big forest	african hill babbler	6	2006	-8.48557	35.43582	1929
9062	3508A	Ifupira big forest	giant kingfisher	6	2006	-8.48557	35.43582	1929
9062	3508A	Ifupira big forest	broad-tailed warbler	6	2006	-8.48557	35.43582	1929
9062	3508A	Ifupira big forest	red-rumped swallow	6	2006	-8.48557	35.43582	1929
9062	3508A	Ifupira big forest	white-eyed slaty flycatcher	6	2006	-8.48557	35.43582	1929
9062	3508A	Ifupira big forest	lemon dove	6	2006	-8.48557	35.43582	1929
9062	3508A	Ifupira big forest	malachite sunbird	6	2006	-8.48557	35.43582	1929
9062	3508A	Ifupira big forest	yellow-billed stork	6	2006	-8.48557	35.43582	1929
9062	3508D	Ipafu forest	starred robin	6	2006	-8.56238	35.52331	1949
9062	3508D	Ipafu forest	robin chat	6	2006	-8.56238	35.52331	1949
9062	3508D	Ipafu forest	stripe-faced greenbul	6	2006	-8.56238	35.52331	1949
9062	3508D	Ipafu forest	lemon dove	6	2006	-8.56238	35.52331	1949
9062	3508D	Ipafu forest	olive mountain greenbul	6	2006	-8.56238	35.52331	1949
9062	3508D	Ipafu forest	african hill babbler	6	2006	-8.56238	35.52331	1949
9062	3508D	Ipafu forest	little greenbul	6	2006	-8.56238	35.52331	1949
9062	3508D	Ipafu forest	mountain buzzard	6	2006	-8.56238	35.52331	1949
9062	3508D	Ipafu forest	livingstone's turaco	6	2006	-8.56238	35.52331	1949
9062	3508D	Ipafu forest	black-fronted bush shrike	6	2006	-8.56238	35.52331	1949
9062	3508D	Ipafu forest	tropical boubou	6	2006	-8.56238	35.52331	1949
9062	3508D	Ipafu forest	tambourine dove	6	2006	-8.56238	35.52331	1949
9062	3508D	Ipafu forest	white-chested alethe	6	2006	-8.56238	35.52331	1949
9062	3508D	Ipafu forest	yellow-rumped tinkerbird	6	2006	-8.56238	35.52331	1949
9062	3508D	Ipafu forest	malachite sunbird	6	2006	-8.56238	35.52331	1949
9062	3508D	Ipafu forest	black-backed puffback	6	2006	-8.56238	35.52331	1949
9062	3508D	Ipafu forest	fulleborn's black boubou	6	2006	-8.56238	35.52331	1949
9062	3508D	Ipafu forest	bar-throated apalis	6	2006	-8.56238	35.52331	1949
9062	3508D	Ipafu forest	Dark batis	6	2006	-8.56238	35.52331	1949
9062	3508D	Ipafu forest	peters' twinspace	6	2006	-8.56238	35.52331	1949
9062	3508D	Ipafu forest	evergreen forest warbler	6	2006	-8.56238	35.52331	1949
9062	3508D	Ipafu forest	eastern double-collared sunbird	6	2006	-8.56238	35.52331	1949
9062	3508D	Ipafu forest	marsh tchagra	6	2006	-8.56238	35.52331	1949
9062	3508D	Ipafu forest	black cuckoo shrike	6	2006	-8.56238	35.52331	1949
9062	3508D	Ipafu forest	white-eyed slaty flycatcher	6	2006	-8.56238	35.52331	1949
9062	3508D	Ipafu forest	yellow white-eye	6	2006	-8.56238	35.52331	1949
9062	3508D	Ipafu forest	shelley's greenbul	6	2006	-8.56238	35.52331	1949
9062	3508D	Ipafu forest	fawn-breasted waxbill	6	2006	-8.56238	35.52331	1949
9062	3508D	Ipafu forest	variable sunbird	6	2006	-8.56238	35.52331	1949
9062	3508D	Ipafu forest	white-tailed crested flycatcher	6	2006	-8.56238	35.52331	1949
9062	3508D	Ipafu forest	red-capped robin chat	6	2006	-8.56238	35.52331	1949
9062	3508D	Ipafu forest	yellow-vented bulbul	6	2006	-8.56238	35.52331	1949
9062	3508D	Ipafu forest	yellow-bellied waxbill	6	2006	-8.56238	35.52331	1949
9062	3508D	Ipafu forest	brown-headed apalis	6	2006	-8.56238	35.52331	1949
9062	3508D	Ipafu forest	collared sunbird	6	2006	-8.56238	35.52331	1949
9062	3508D	Ipafu forest	cardinal woodpecker	6	2006	-8.56238	35.52331	1949
9062	3508D	Ipafu forest	white-browed robin chat	6	2006	-8.56238	35.52331	1949
9062	3508D	Ipafu forest	eastern olive sunbird	6	2006	-8.56238	35.52331	1949
9062	3508D	Ipafu forest	spot-throat	6	2006	-8.56238	35.52331	1949
9062	3508D	Ipafu forest	barred long-tailed cuckoo	6	2006	-8.56238	35.52331	1949
9062	3508D	Ipafu forest	crowned eagle	6	2006	-8.56238	35.52331	1949
9062	3508D	Ipafu forest	spectacled weaver	6	2006	-8.56238	35.52331	1949
9062	3508D	Ipafu forest	crowned hornbill	6	2006	-8.56238	35.52331	1949
9062	3508D	Ipafu forest	paradise flycatcher	6	2006	-8.56238	35.52331	1949

cardno	square	locality	species	month	yr	latitude	longitude	alt
9062	3508D	Ipafu forest	fulleborn's black boubou	6	2006	-8.56238	35.52331	1949
9062	3508D	Ipafu forest	grey-backed camaroptera	6	2006	-8.56238	35.52331	1949
9062	3508D	Ipafu forest	lemon dove	6	2006	-8.56238	35.52331	1949
9062	3508D	Ipafu forest	olive woodpecker	6	2006	-8.56238	35.52331	1949
9062	3508D	Ipafu forest	ped crow	6	2006	-8.56238	35.52331	1949
9062	3508D	Ipafu forest	fulleborn's black boubou	6	2006	-8.55988	35.52396	1969
9062	3508D	Ipafu forest	bronze mannikin	6	2006	-8.55988	35.52396	1969
9062	3508D	Ipafu forest	churring cisticola	6	2006	-8.55988	35.52396	1969
9062	3508D	Ipafu forest	moustached green tinkerbird	6	2006	-8.55988	35.52396	1969
9062	3508D	Ipafu forest	livingstone's turaco	6	2006	-8.55988	35.52396	1969
9062	3508D	Ipafu forest	little greenbul	6	2006	-8.55988	35.52396	1969
9062	3508D	Ipafu forest	black-backed puffback	6	2006	-8.55988	35.52396	1969
9062	3508D	Ipafu forest	jameson's firefinch	6	2006	-8.55988	35.52396	1969
9062	3508D	Ipafu forest	variable sunbird	6	2006	-8.55988	35.52396	1969
9062	3508D	Ipafu forest	starred robin	6	2006	-8.55988	35.52396	1969
9062	3508D	Ipafu forest	red-eyed dove	6	2006	-8.55988	35.52396	1969
9062	3508D	Ipafu forest	yellow-vented bulbul	6	2006	-8.55988	35.52396	1969
9062	3508D	Ipafu forest	yellow white-eye	6	2006	-8.55988	35.52396	1969
9062	3508D	Ipafu forest	black-fronted bush shrike	6	2006	-8.55988	35.52396	1969
9062	3508D	Ipafu forest	brown-headed apalis	6	2006	-8.55988	35.52396	1969
9062	3508D	Ipafu forest	stripe-faced greenbul	6	2006	-8.55988	35.52396	1969
9062	3508D	Ipafu forest	Dark batis	6	2006	-8.55988	35.52396	1969
9062	3508D	Ipafu forest	yellow-rumped tinkerbird	6	2006	-8.55988	35.52396	1969
9062	3508D	Ipafu forest	red-capped tailorbird	6	2006	-8.55988	35.52396	1969
9062	3508D	Ipafu forest	collared sunbird	6	2006	-8.55988	35.52396	1969
9062	3508D	Ipafu forest	eastern roughwing	6	2006	-8.55988	35.52396	1969
9062	3508D	Ipafu forest	eastern double-collared sunbird	6	2006	-8.55988	35.52396	1969
9062	3508D	Ipafu forest	olive-flanked robin chat	6	2006	-8.55988	35.52396	1969
9062	3508D	Ipafu forest	spot-throat	6	2006	-8.55988	35.52396	1969
9062	3508D	Ipafu forest	red-faced cisticola	6	2006	-8.55988	35.52396	1969
9062	3508D	Ipafu forest edge	ped crow	6	2006	-8.55577	35.52259	1731
9062	3508D	Ipafu forest edge	tropical boubou	6	2006	-8.55577	35.52259	1731
9062	3508D	Ipafu forest edge	red-faced crimsonwing	6	2006	-8.55577	35.52259	1731
9062	3508D	Ipafu forest edge	evergreen forest warbler	6	2006	-8.55577	35.52259	1731
9062	3508D	Ipafu forest edge	red-naped widowbird	6	2006	-8.55577	35.52259	1731
9062	3508D	Ipafu forest edge	tambourine dove	6	2006	-8.55577	35.52259	1731
9062	3508D	Ipafu forest edge	yellow-browed seedeater	6	2006	-8.55577	35.52259	1731
9062	3508D	Ipafu forest edge	emerald-spotted wood dove	6	2006	-8.55037	35.51791	1870
9062	3508D	Ipafu forest edge	yellow-vented bulbul	6	2006	-8.55037	35.51791	1870
9062	3508D	Ipafu forest edge	spectacled weaver	6	2006	-8.55037	35.51791	1870
9062	3508D	Ipafu forest edge	waller's starling	6	2006	-8.55037	35.51791	1870
9062	3508D	Ipafu forest edge	dusky flycatcher	6	2006	-8.55037	35.51791	1870
9062	3508D	Ipafu forest edge	common waxbill	6	2006	-8.55037	35.51791	1870
9062	3508D	Ipafu forest edge	yellow bishop	6	2006	-8.56247	35.51388	1806
9062	3508D	Ipafu forest edge	stonechat	6	2006	-8.56247	35.51388	1806
9062	3508D	Ipafu forest edge	500 mt site	6	2006	-8.57001	35.51760	1681
9062	3508D	Ipafu forest edge	white-browed robin chat	6	2006	-8.57001	35.51760	1681
9062	3508D	Ipafu forest edge	robin chat	6	2006	-8.57001	35.51760	1681
9062	3508D	Ipafu forest edge	yellow-browed seedeater	6	2006	-8.57001	35.51760	1681
9062	3508D	Ipafu forest edge	common waxbill	6	2006	-8.57001	35.51760	1681
9062	3508D	Ipafu forest edge	black-lored cisticola	6	2006	-8.57001	35.51760	1681
9062	3508D	Ipafu forest edge	variable sunbird	6	2006	-8.57001	35.51760	1681
9062	3508D	Ipafu forest edge	dusky flycatcher	6	2006	-8.57001	35.51760	1681
9062	3508D	Ipafu forest edge	yellow bishop	6	2006	-8.57001	35.51760	1681
9062	3508D	Ipafu forest edge	holub's golden weaver	6	2006	-8.56716	35.52693	1639
9062	3508D	Ipafu forest edge	tambourine dove	6	2006	-8.56716	35.52693	1639
9062	3508D	Ipafu forest edge	uhehe fiscal	6	2006	-8.56716	35.52693	1639
9062	3508D	Ipafu forest edge	east african citril	6	2006	-8.56716	35.52693	1639

cardno	square	locality	species	month	yr	latitude	longitude	alt
9062	3508D	Ipafu forest edge	bar-throated apalis	6	2006	-8.56716	35.52693	1639
9062	3508D	Ipafu forest edge	black-throated wattle-eye	6	2006	-8.56716	35.52693	1639
9062	3508D	Ipafu forest edge	african hill babbler	6	2006	-8.56716	35.52693	1639
9062	3508D	Ipafu forest edge	barred long-tailed cuckoo	6	2006	-8.56716	35.52693	1639
9062	3508D	Ipafu forest edge	eastern yellowbill	6	2006	-8.56716	35.52693	1639
9062	3508D	Ipafu forest edge	green barbet	6	2006	-8.56716	35.52693	1639
9062	3508D	Ipafu forest edge	white-chested alethe	6	2006	-8.56716	35.52693	1639
9062	3508D	Ipafu forest edge	olive thrush	6	2006	-8.56716	35.52693	1639
9062	3508D	Lulanda village	black-backed puffback	6	2006	-8.61330	35.61309	1640
9062	3508D	Lulanda village	oriole finch	6	2006	-8.61330	35.61309	1640
9062	3508D	Lulanda village	red-necked spurfowl	6	2006	-8.61330	35.61309	1640
9062	3508D	Lulanda village	angola swallow	6	2006	-8.61330	35.61309	1640
9062	3508D	Lulanda village	stonechat	6	2006	-8.61330	35.61309	1640
9062	3508D	Lulanda village	tawny-flanked prinia	6	2006	-8.61330	35.61309	1640
9062	3508D	Lulanda village	black-lored cisticola	6	2006	-8.61330	35.61309	1640
9062	3508D	Lulanda village	east african citril	6	2006	-8.61330	35.61309	1640
9062	3508D	Lulanda village	yellow-browed seedeater	6	2006	-8.61330	35.61309	1640
9062	3508D	Lulanda TFCG office	livingstone's turaco	6	2006	-8.60749	35.62351	1930
9062	3508D	Lulanda TFCG office	little greenbul	6	2006	-8.60749	35.62351	1930
9062	3508D	Lulanda TFCG office	black-backed puffback	6	2006	-8.60749	35.62351	1930
9062	3508D	Lulanda TFCG office	amethyst sunbird	6	2006	-8.60749	35.62351	1930
9062	3508D	Lulanda TFCG office	moustached green tinkerbird	6	2006	-8.60749	35.62351	1630
9062	3508D	Lulanda TFCG office	grey-backed camaroptera	6	2006	-8.60749	35.62351	1630
9062	3508D	Lulanda TFCG office	black-lored cisticola	6	2006	-8.60749	35.62351	1630
9062	3508D	Lulanda TFCG office	variable sunbird	6	2006	-8.60749	35.62351	1630
9062	3508D	Lulanda TFCG office	crowned hornbill	6	2006	-8.60749	35.62351	1630
9062	3508D	Lulanda TFCG office	tropical boubou	6	2006	-8.60749	35.62351	1630
9062	3508D	Lulanda TFCG office	green barbet	6	2006	-8.60749	35.62351	1630
9062	3508D	Lulanda TFCG office	ped crow	6	2006	-8.60749	35.62351	1630
9062	3508D	Lulanda TFCG office	fulleborn's black boubou	6	2006	-8.60749	35.62351	1630
9062	3508D	Lulanda TFCG office	red-faced crimsonwing	6	2006	-8.60749	35.62351	1630
9062	3508D	Lulanda TFCG office	eastern olive sunbird	6	2006	-8.60749	35.62351	1630
9062	3508D	Lulanda TFCG office	bar-throated apalis	6	2006	-8.60749	35.62351	1630
9062	3508D	Lulanda TFCG office	grey-backed camaroptera	6	2006	-8.60749	35.62351	1630
9062	3508D	Lulanda TFCG office	starred robin	6	2006	-8.60749	35.62351	1630
9062	3508D	Lulanda TFCG office	olive mountain greenbul	6	2006	-8.60749	35.62351	1630
9062	3508D	Lulanda TFCG office	chin-spot batis	6	2006	-8.60749	35.62351	1630
9062	3508D	Lulanda TFCG office	yellow-streaked greenbul	6	2006	-8.60749	35.62351	1630
9062	3508D	Lulanda TFCG office	olive pigeon	6	2006	-8.60749	35.62351	1630
9062	3508D	Lulanda TFCG office	spot-throat	6	2006	-8.60749	35.62351	1630
9062	3508D	Lulanda TFCG office	moustached green tinkerbird	6	2006	-8.60749	35.62351	1630
9062	3508D	Lulanda TFCG office	yellow-rumped tinkerbird	6	2006	-8.60749	35.62351	1630
9062	3508D	Lulanda TFCG office	chapin's apalis	6	2006	-8.60749	35.62351	1630
9062	3508D	Lulanda TFCG office	mountain greenbul	6	2006	-8.60749	35.62351	1630
9062	3508D	Lulanda TFCG office	black-fronted bush shrike	6	2006	-8.60749	35.62351	1630
9062	3508D	Lulanda TFCG office	orange ground thrush	6	2006	-8.60749	35.62351	1630
9062	3508D	Lulanda TFCG office	cardinal woodpecker	6	2006	-8.60749	35.62351	1630
9062	3508D	Lulanda TFCG office	red-eyed dove	6	2006	-8.60749	35.62351	1630
9062	3508D	Lulanda TFCG office	collared sunbird	6	2006	-8.60749	35.62351	1630
9062	3508D	Lulanda TFCG office	shelley's greenbul	6	2006	-8.60749	35.62351	1630
9062	3508D	Lulanda TFCG office	yellow-vented bulbul	6	2006	-8.60749	35.62351	1630
9062	3508D	Lulanda TFCG office	square-tailed drongo	6	2006	-8.60749	35.62351	1630
9062	3508D	Lulanda TFCG office	white-tailed crested flycatcher	6	2006	-8.60749	35.62351	1630
9062	3508D	Lulanda TFCG office	white-browed coucal	6	2006	-8.60749	35.62351	1630
9062	3508D	Lulanda TFCG office	brown-headed apalis	6	2006	-8.60749	35.62351	1630
9062	3508D	Lulanda TFCG office	spotted eagle owl	6	2006	-8.60749	35.62351	1630
9062	3508D	Lulanda TFCG office	black-headed apalis	6	2006	-8.60749	35.62351	1630
9062	3508D	Lulanda TFCG office	yellow white-eye	6	2006	-8.60749	35.62351	1630

cardno	square	locality	species	month	yr	latitude	longitude	alt
9062	3508D	Lulanda TFCG office	dusky flycatcher	6	2006	-8.60749	35.62351	1630
9062	3508D	Lulanda TFCG office	red-capped tailorbird	6	2006	-8.60749	35.62351	1630
9062	3508D	Lulanda TFCG office	waller's starling	6	2006	-8.60749	35.62351	1630
9062	3508D	Lulanda Forest nth	eastern roughwing	6	2006	-8.60749	35.62351	1630
9062	3508D	Lulanda Forest nth	common waxbill	6	2006	-8.61280	35.62639	1555
9062	3508D	Lulanda Forest nth	yellow-bellied waxbill	6	2006	-8.61280	35.62639	1555
9062	3508D	Lulanda Forest nth	yellow bishop	6	2006	-8.61280	35.62639	1555
9062	3508D	Lulanda Forest nth	spectacled weaver	6	2006	-8.61280	35.62639	1555
9062	3508D	Lulanda Forest nth	yellow-crowned canary	6	2006	-8.61280	35.62639	1555
9062	3508D	Lulanda Forest nth	robin chat	6	2006	-8.61280	35.62639	1555
9062	3508D	Lulanda Forest nth	long-crested eagle	6	2006	-8.61280	35.62639	1555
9062	3508D	Lulanda Forest nth	augur buzzard	6	2006	-8.61280	35.62639	1555
9062	3508D	Lulanda Forest nth	rufous-backed mannikin	6	2006	-8.61280	35.62639	1555
9062	3508D	Lulanda Forest nth	pin-tailed whydah	6	2006	-8.61280	35.62639	1555
9062	3508D	Lulanda Forest nth	bronze mannikin	6	2006	-8.61280	35.62639	1555
9062	3508D	Lulanda Forest nth	great sparrowhawk	6	2006	-8.61280	35.62639	1555
9062	3508D	Lulanda Forest nth	african wood owl	6	2006	-8.61280	35.62639	1555
9062	3508D	Lulanda Forest nth	montane nightjar	6	2006	-8.61280	35.62639	1555
9062		road - Mufindi Scarp W	fulleborn's black boubou	6	2006			
9062		road - Mufindi Scarp W	eastern double-collared sunbird	6	2006			
9062		road - Mufindi Scarp W	square-tailed drongo	6	2006			
9062		road - Mufindi Scarp W	eastern roughwing	6	2006			
9062		road - Mufindi Scarp W	livingstone's turaco	6	2006			
9062	3508A	Mufindi Scarp Forest	olive-flanked robin chat	6	2006	-8.41530	35.08480	1799
9062	3508A	Mufindi Scarp Forest	emerald-spotted wood dove	6	2006	-8.41530	35.08480	1799
9062	3508A	Mufindi Scarp Forest	grey-backed camaroptera	6	2006	-8.41530	35.08480	1799
9062	3508A	Mufindi Scarp Forest	red-winged francolin	6	2006	-8.41530	35.08480	1799
9062	3508A	Mufindi Scarp Forest	yellow white-eye	6	2006	-8.41530	35.08480	1799
9062	3508A	Mufindi Scarp Forest	white-tailed crested flycatcher	6	2006	-8.41530	35.08480	1799
9062	3508A	Mufindi Scarp Forest	spot-throat	6	2006	-8.41530	35.08480	1799
9062	3508A	Mufindi Scarp Forest	livingstone's turaco	6	2006	-8.41530	35.08480	1799
9062	3508A	Mufindi Scarp Forest	eastern roughwing	6	2006	-8.41530	35.08480	1799
9062	3508A	Mufindi Scarp Forest	african wood owl	6	2006	-8.41530	35.08480	1799
9062	3508A	Mufindi Scarp Forest	montane nightjar	6	2006	-8.41530	35.08480	1799
9062	3508A	Mufindi Scarp Forest	cinnamon bracken warbler	6	2006	-8.41530	35.08480	1799
9062	3508A	Mufindi Scarp Forest	pieb crow	6	2006	-8.41530	35.08480	1799
9062	3508A	Mufindi Scarp Forest	african hill babbler	6	2006	-8.41530	35.08480	1799
9062	3508A	Mufindi Scarp Forest	shelley's greenbul	6	2006	-8.41530	35.08480	1799
9062	3508A	Mufindi Scarp Forest	olive mountain greenbul	6	2006	-8.41530	35.08480	1799
9062	3508A	Mufindi Scarp Forest	spot-throat	6	2006	-8.41530	35.08480	1799
9062	3508A	Mufindi Scarp Forest	striped swallow	6	2006	-8.41530	35.08480	1799
9062	3508A	Mufindi Scarp Forest	robin chat	6	2006	-8.41530	35.08480	1799
9062	3508A	Mufindi Scarp Forest	eastern olive sunbird	6	2006	-8.41530	35.08480	1799
9062	3508A	Mufindi Scarp Forest	moustached green tinkerbird	6	2006	-8.41530	35.08480	1799
9062	3508A	Mufindi Scarp Forest	black-backed puffback	6	2006	-8.41530	35.08480	1799
9062	3508A	Mufindi Scarp Forest	yellow-vented bulbul	6	2006	-8.41530	35.08480	1799
9062	3508A	Mufindi Scarp Forest	little greenbul	6	2006	-8.41530	35.08480	1799
9062	3508A	Mufindi Scarp Forest	tambourine dove	6	2006	-8.41530	35.08480	1799
9062	3508A	Mufindi Scarp Forest	collared sunbird	6	2006	-8.41530	35.08480	1799
9062	3508A	Mufindi Scarp Forest	african wood owl	6	2006	-8.41530	35.08480	1799
9062	3508A	Mufindi Scarp Forest	african scops owl	6	2006	-8.41530	35.08480	1799
9062	3508A	Mufindi Scarp Forest	montane nightjar	6	2006	-8.41530	35.08480	1799
9062	3508A	Mufindi Scarp Forest	stripe-faced greenbul	6	2006	-8.41530	35.08480	1799
9062	3508A	Mufindi Scarp Forest	silvery-cheeked hornbill	6	2006	-8.41530	35.08480	1799
9062	3508A	Mufindi Scarp Forest	yellow white-eye	6	2006	-8.41530	35.08480	1799
9062	3508A	Mufindi Scarp Forest	Dark batis	6	2006	-8.41530	35.08480	1799
9062	3508A	Mufindi Scarp Forest	iringa akalat	6	2006	-8.41530	35.08480	1799
9062	3508A	Mufindi Scarp Forest	chapin's apalis	6	2006	-8.41530	35.08480	1799

cardno	square	locality	species	month	yr	latitude	longitude	alt
9062	3508A	Mufindi Scarp Forest	crowned hornbill	6	2006	-8.41530	35.08480	1799
9062	3508A	Mufindi Scarp Forest	long-crested eagle	6	2006	-8.41530	35.08480	1799
9062	3508A	Mufindi Scarp Forest	waller's starling	6	2006	-8.41530	35.08480	1799
9062	3508A	Mufindi Scarp Forest	black-fronted bush shrike	6	2006	-8.41530	35.08480	1799
9062	3508A	Mufindi Scarp Forest	african goshawk	6	2006	-8.41530	35.08480	1799
9062	3508A	Mufindi Scarp Forest	great sparrowhawk	6	2006	-8.41530	35.08480	1799
9062	3508A	Mufindi Scarp Forest	white-chested alethe	6	2006	-8.41530	35.08480	1799
9062	3508A	Mufindi Scarp Forest	waller's starling	6	2006	-8.41530	35.08480	1799
9062	3508A	Mufindi Scarp Forest	black-headed oriole	6	2006	-8.41530	35.08480	1799
9062	3508A	Mufindi Scarp Forest	red-faced cisticola	6	2006	-8.41530	35.08480	1799
9062	3508A	Mufindi Scarp Forest	olive woodpecker	6	2006	-8.41530	35.08480	1799
9062	3508A	Mufindi Scarp Forest	crowned hornbill	6	2006	-8.41530	35.08480	1799
9062	3508A	Mufindi Scarp Forest	Dark batis	6	2006	-8.41530	35.08480	1799
9062	3508A	Mufindi Scarp Forest	grey-backed camaroptera	6	2006	-8.41530	35.08480	1799
9062	3508A	Mufindi Scarp Forest	tambourine dove	6	2006	-8.41530	35.08480	1799
9062	3508A	Mufindi Scarp Forest	olive mountain greenbul	6	2006	-8.41530	35.08480	1799
9062	3508A	Mufindi Scarp Forest	little greenbul	6	2006	-8.41530	35.08480	1799
9062	3508A	Mufindi Scarp Forest	lemon dove	6	2006	-8.41530	35.08480	1799
9062	3508A	Mufindi Scarp Forest	bar-throated apalis	6	2006	-8.41530	35.08480	1799
9062	3508A	Mufindi Scarp Forest	red-eyed dove	6	2006	-8.41530	35.08480	1799
9062	3508A	Mufindi Scarp Forest	eastern roughwing	6	2006	-8.41530	35.08480	1799
9062	3508A	Mufindi Scarp Forest	striped swallow	6	2006	-8.41530	35.08480	1799
9062	3508A	Mufindi Scarp Forest	livingstone's turaco	6	2006	-8.41530	35.08480	1799
9062	3508A	Mufindi Scarp Forest	yellow white-eye	6	2006	-8.41530	35.08480	1799
9062	3508A	Mufindi Scarp Forest	dusky flycatcher	6	2006	-8.41530	35.08480	1799
9062	3508A	Mufindi Scarp Forest	amethyst sunbird	6	2006	-8.41530	35.08480	1799
9062	3508A	Mufindi Scarp Forest	starred robin	6	2006	-8.41530	35.08480	1799
9062	3508A	Mufindi Scarp Forest	spot-throat	6	2006	-8.41530	35.08480	1799
9062	3508C	Mufindi Scarp Forest edge	ped crow	6	2006	-8.69169	35.14832	1618
9062	3508C	Mufindi Scarp Forest edge	african goshawk	6	2006	-8.69169	35.14832	1618
9062	3508C	Mufindi Scarp Forest edge	chapin's apalis	6	2006	-8.69169	35.14832	1618
9062	3508C	Mufindi Scarp Forest edge	yellow white-eye	6	2006	-8.69169	35.14832	1618
9062	3508C	Mufindi Scarp Forest edge	cinnamon bracken warbler	6	2006	-8.69169	35.14832	1618
9062	3508C	Mufindi Scarp Forest edge	yellow-vented bulbul	6	2006	-8.69169	35.14832	1618
9062	3508C	Mufindi Scarp Forest edge	variable sunbird	6	2006	-8.69169	35.14832	1618
9062	3508C	Mufindi Scarp Forest edge	black-lored cisticola	6	2006	-8.69169	35.14832	1618
9062	3508C	Mufindi Scarp Forest edge	lesser honeyguide	6	2006	-8.69169	35.14832	1618
9062	3508C	Mufindi Scarp Forest edge	dusky flycatcher	6	2006	-8.69169	35.14832	1618
9062	3508C	Mufindi Scarp Forest edge	white-eyed slaty flycatcher	6	2006	-8.69169	35.14832	1618
9062	3508C	Mufindi Scarp Forest edge	tawny-flanked prinia	6	2006	-8.69169	35.14832	1618
9062	3508C	Mufindi Scarp Forest edge	collared sunbird	6	2006	-8.69169	35.14832	1618
9062	3508C	Mufindi Scarp Forest edge	fulleborn's black boubou	6	2006	-8.69169	35.15305	1774
9062	3508C	Mufindi Scarp Forest edge	little greenbul	6	2006	-8.69169	35.15305	1774
9062	3508C	Mufindi Scarp Forest edge	tambourine dove	6	2006	-8.69169	35.15305	1774
9062	3508C	Mufindi Scarp Forest edge	livingstone's turaco	6	2006	-8.69169	35.15305	1774
9062	3508C	Mufindi Scarp Forest edge	east african citril	6	2006	-8.69169	35.15305	1774
9062	3508C	Mufindi Scarp Forest edge	red-eyed dove	6	2006	-8.69169	35.15305	1774
9062	3508C	Mufindi Scarp Forest edge	yellow-rumped tinkerbird	6	2006	-8.69169	35.15305	1774
9062	3508C	Mufindi Scarp Forest edge	Dark batis	6	2006	-8.69169	35.15305	1774
9062	3508C	Mufindi Scarp Forest edge	yellow-browed seedeater	6	2006	-8.69169	35.15305	1774
9062	3508C	Mufindi Scarp Forest edge	stonechat	6	2006	-8.69169	35.15305	1774
9062	3508C	Mufindi Scarp Forest edge	yellow-bellied waxbill	6	2006	-8.69169	35.15305	1774
9062	3508C	Mufindi Scarp Forest edge	black-backed puffback	6	2006	-8.69169	35.15305	1774
9062	3508C	Mufindi Scarp Forest edge	eastern roughwing	6	2006	-8.69169	35.15305	1774
9062	3508C	Mufindi Scarp Forest edge	red-faced crimsonwing	6	2006	-8.16904	35.14735	1806
9062	3508A	Mufindi Scarp Forest edge	olive mountain greenbul	6	2006	-8.16904	35.14735	1806
9062	3508A	Mufindi Scarp Forest edge	crowned hornbill	6	2006	-8.16904	35.14735	1806
9062	3508A	Mufindi Scarp Forest edge	eastern double-collared sunbird	6	2006	-8.16904	35.14735	1806

cardno	square	locality	species	month	yr	latitude	longitude	alt
9062	3508C	Mufindi Scarp Forest edge	fawn-breasted waxbill	6	2006	-8.71210	35.15728	1758
9062	3508C	Mufindi Scarp Forest edge	robin chat	6	2006	-8.71210	35.15728	1758
9062	3508C	Mufindi Scarp Forest edge	red-faced cisticola	6	2006	-8.71210	35.15728	1758
9062	3508C	Mufindi Scarp Forest edge	bertram's weaver	6	2006	-8.71210	35.15728	1758
9062	3508C	Mufindi Scarp Forest edge	jameson's firefinch	6	2006	-8.71210	35.15728	1758
9062	3508C	Mufindi Scarp Forest edge	starred robin	6	2006	-8.71210	35.15728	1758
9062	3508C	Mufindi Scarp Forest edge	variable sunbird	6	2006	-8.71210	35.15728	1758
9062	3508C	Mufindi Scarp Forest edge	little sparrowhawk	6	2006	-8.71210	35.15728	1758
9062	3508C	Kigogo point	black-fronted bush shrike	6	2006	-8.67256	35.26369	1791
9062	3508C	Kigogo point	chapin's apalis	6	2006	-8.67256	35.26369	1791
9062	3508C	Kigogo point	stonechat	6	2006	-8.67256	35.26369	1791
9062	3508C	Kigogo point	bronze mannikin	6	2006	-8.67256	35.26369	1791
9062	3508C	Kigogo point	olive pigeon	6	2006	-8.67256	35.26369	1791
9062	3508C	Kigogo point	fulleborn's black boubou	6	2006	-8.67256	35.26369	1791
9062	3508C	Kigogo point	ped crow	6	2006	-8.67256	35.26369	1791
9062	3508C	Kigogo point	tambourine dove	6	2006	-8.67256	35.26369	1791
9062	3508C	Kigogo point	red-eyed dove	6	2006	-8.67256	35.26369	1791
9062	3508C	Kigogo point	african pipit	6	2006	-8.67256	35.26369	1791
9062	3508C	Kigogo point	Dark batis	6	2006	-8.67256	35.26369	1791
9062	3508C	Kigogo point	little greenbul	6	2006	-8.67256	35.26369	1791
9062	3508C	Kigogo point	african pied wagtail	6	2006	-8.67256	35.26369	1791
9062	3508C	Kigogo point	eastern double-collared sunbird	6	2006	-8.67256	35.26369	1791
9062	3508C	Kigogo River	livingstone's turaco	6	2006	-8.68407	35.15942	1929
9062	3508C	Kigogo River	black-backed puffback	6	2006	-8.68407	35.15942	1929
9062	3508C	Kigogo River	mountain buzzard	6	2006	-8.68407	35.15942	1929
9062	3508C	Kigogo River	african firefinch	6	2006	-8.68407	35.15942	1929
9062	3508C	Kigogo River	moustached green tinkerbird	6	2006	-8.68407	35.15942	1929
9062	3508C	Kigogo River	mountain greenbul	6	2006	-8.68407	35.15942	1929
9062	3508C	Kigogo River	yellow white-eye	6	2006	-8.68407	35.15942	1929
9062	3508C	Kigogo River	spot-throat	6	2006	-8.68407	35.15942	1929
9062	3508C	Kigogo River	cinnamon bracken warbler	6	2006	-8.68407	35.15942	1929
9062	3508C	Kigogo River	eastern olive sunbird	6	2006	-8.68407	35.15942	1929
9062	3508C	Kigogo River	square-tailed drongo	6	2006	-8.68407	35.15942	1929
9062	3508C	Kigogo River	olive mountain greenbul	6	2006	-8.68407	35.15942	1929
9062	3508C	Kigogo River	bar-throated apalis	6	2006	-8.68407	35.15942	1929
9062	3508C	Kigogo River	shelley's greenbul	6	2006	-8.68407	35.15942	1929
9062	3508C	Kigogo River	white-tailed crested flycatcher	6	2006	-8.68407	35.15942	1929
9062	3508C	Kigogo River	collared sunbird	6	2006	-8.68407	35.15942	1929
9062	3508A	Mufindi Scarp Forest	speckled mousebird	6	2006	-8.41530	35.08480	1799
9062	3508A	Mufindi Scarp Forest	african wood owl	6	2006	-8.41530	35.08480	1799
9062	3508A	Mufindi Scarp Forest	montane nightjar	6	2006	-8.41530	35.08480	1799
9062	3508A	Mufindi Scarp Forest	brown-headed apalis	6	2006	-8.41530	35.08480	1799
9062	3508A	Mufindi Scarp Forest	tambourine dove	6	2006	-8.41530	35.08480	1799
9062	3508A	Mufindi Scarp Forest	lanner falcon	6	2006	-8.41530	35.08480	1799

Appendix 9. List of bird caught in mist nets with biometrics and locality information.

date	site	No	time	ring	species	re	age	sex	net	wing	bill	tar	tail	fat	BP	molt	r'ger	latitude	longitude	alt
13/06/06	Ifupira Forest	A	7.53	A65445	Andropadus masukuensis	-	AD	-	24.5	82.0	15.8	21.3	84.0	-	1	No	LM	-8.488557	35.43582	1929
13/06/06	Ifupira Forest	A	9.23	T45080	Batis crypta	-	AD	F	18.0	62.0	14.4	17.9	37.0	-	0	No	LM	-8.488557	35.43582	1929
13/06/06	Ifupira Forest	A	9.23	A65446	Phyllastrephus placidus	-	AD	-	19.5	77.0	18.2	22.2	77.0	2	-	No	LM	-8.488557	35.43582	1929
13/06/06	Ifupira Forest	A	10.33	A65447	Phyllastrephus placidus	-	AD	-	23.0	85.0	19.0	22.0	86.0	-	-	No	LM	-8.488557	35.43582	1929
13/06/06	Ifupira Forest	A	10.33	T45081	Batis crypta	-	AD	M	10.0	57.0	15.0	18.7	35.0	-	-	No	LM	-8.488557	35.43582	1929
13/06/06	Ifupira Forest	B	13.24	A65448	Andropadus masukuensis	-	AD	-	23.5	87.0	15.7	21.0	87.0	-	-	No	LM	-8.488557	35.43582	1929
13/06/06	Ifupira Forest	B	13.24	T45082	Batis crypta	-	AD	F	10.5	62.0	15.9	19.2	37.0	-	-	No	LM	-8.488557	35.43582	1929
13/06/06	Ifupira Forest	A	13.24	T45083	Batis crypta	-	AD	M	12.0	61.0	15.4	18.8	38.0	-	-	No	LM	-8.488557	35.43582	1929
13/06/06	Ifupira Forest	B	13.24	T45084	Nectarinia mediocris	-	AD	-	8.5	55.0	20.4	17.2	38.0	-	-	No	LM	-8.488557	35.43582	1929
13/06/06	Ifupira Forest	B	13.24	T45085	Apalis thoracica	-	AD	-	9.5	51.0	14.0	19.0	47.0	-	5	No	LM	-8.488557	35.43582	1929
13/06/06	Ifupira Forest	B	13.24	T45086	Apalis thoracica	-	AD	-	8.5	54.0	14.7	20.3	57.0	-	3	No	LM	-8.488557	35.43582	1929
13/06/06	Ifupira Forest	B	14.00	T45087	Apalis thoracica	-	AD	-	19.0	52.0	15.5	21.6	55.0	-	2	No	LM	-8.488557	35.43582	1929
13/06/06	Ifupira Forest	B	14.00	T45088	Apalis thoracica	-	AD	-	8.0	53.0	14.3	19.7	52.0	-	5	No	LM	-8.488557	35.43582	1929
13/06/06	Ifupira Forest	B	14.00	T45089	Batis crypta	-	AD	-	11.0	60.0	15.2	18.1	55.0	-	-	No	LM	-8.488557	35.43582	1929
13/06/06	Ifupira Forest	B	14.00	T45090	Batis crypta	-	AD	M	10.5	61.0	15.5	17.6	45.0	-	-	No	LM	-8.488557	35.43582	1929
13/06/06	Ifupira Forest	B	14.00	A65449	Andropadus masukuensis	-	AD	-	22.0	85.0	18.0	22.6	87.0	-	-	No	LM	-8.488557	35.43582	1929
13/06/06	Ifupira Forest	A	14.00	T45091	Batis crypta	-	AD	-	13.0	60.0	15.1	18.4	36.0	-	-	No	LM	-8.488557	35.43582	1929
13/06/06	Ifupira Forest	C	15.07	A65450	Andropadus masukuensis	-	AD	-	24.0	81.0	16.3	20.0	80.0	-	-	No	LM	-8.488557	35.43582	1929
13/06/06	Ifupira Forest	B	15.07	A99685	Modulatrix stictigula	-	AD	-	29.0	80.0	18.7	29.3	71.0	-	-	No	LM	-8.488557	35.43582	1929
13/06/06	Ifupira Forest	A	16.42	T45092	Apalis thoracica	-	AD	-	54.0	51.0	15.2	20.0	47.0	-	-	No	GM	-8.488557	35.43582	1929
13/06/06	Ifupira Forest	A	16.42	A99686	Phyllastrephus placidus	-	AD	-	26.0	84.0	20.3	21.6	83.0	-	-	No	GM	-8.488557	35.43582	1929
13/06/06	Ifupira Forest	A	16.42	A99687	Phyllastrephus placidus	-	AD	-	24.0	85.0	19.8	21.0	82.0	-	-	No	GM	-8.488557	35.43582	1929
13/06/06	Ifupira Forest	A	18.28	T45093	Apalis thoracica	-	AD	-	11.5	50.0	13.7	19.8	51.0	-	-	No	LM	-8.488557	35.43582	1929
13/06/06	Ifupira Forest	B	18.28	K41665	Sheppardia lowei	-	AD	-	24.5	71.0	16.5	30.3	55.0	-	-	No	LM	-8.488557	35.43582	1929
13/06/06	Ifupira Forest	A	18.28	A99688	Cossypha anomala	-	AD	-	28.5	80.0	17.7	31.2	68.0	-	-	No	LM	-8.488557	35.43582	1929
13/06/06	Ifupira Forest	B	18.46	A99689	Modulatrix stictigula	-	AD	-	33.0	86.0	18.0	30.0	76.0	-	-	No	GM	-8.488557	35.43582	1929
13/06/06	Ifupira Forest	B	18.46	A99690	Cossypha anomala	-	AD	-	28.0	85.0	17.3	13.3	63.0	-	-	No	GM	-8.488557	35.43582	1929
13/06/06	Ifupira Forest	C	18.46	K41666	Cryptospiza reichenovii	-	AD	-	11.5	57.0	11.4	17.2	40.0	-	-	No	GM	-8.488557	35.43582	1929
14/06/06	Ifupira Forest	A	7.33	A99691	Modulatrix stictigula	-	AD	-	31.0	87.0	19.9	30.3	75.0	-	-	No	GM	-8.488557	35.43582	1929
14/06/06	Ifupira Forest	A	7.33	A99692	Modulatrix stictigula	-	AD	-	29.0	80.0	15.6	37.0	75.0	-	-	No	GM	-8.488557	35.43582	1929
14/06/06	Ifupira Forest	A	7.33	K41667	Sheppardia lowei	-	AD	-	20.0	75.0	14.4	29.2	56.0	-	-	No	GM	-8.488557	35.43582	1929
14/06/06	Ifupira Forest	C	8.35	A99693	Aethya fueleborni	-	AD	-	47.0	105.0	23.5	34.5	76.0	-	-	No	GM	-8.488557	35.43582	1929
14/06/06	Ifupira Forest	B	8.35	A99694	Modulatrix stictigula	-	AD	-	19.5	85.0	18.8	30.4	75.0	-	-	No	GM	-8.488557	35.43582	1929
14/06/06	Ifupira Forest	B	9.56	A99695	Phyllastrephus placidus	-	AD	-	25.5	84.5	18.9	22.4	84.0	-	-	No	LM	-8.488557	35.43582	1929
14/06/06	Ifupira Forest	B	9.56	A99696	Phyllastrephus placidus	-	AD	-	21.5	86.0	20.1	21.2	87.0	-	-	No	LM	-8.488557	35.43582	1929
14/06/06	Ifupira Forest	B	9.56	A99697	Phyllastrephus placidus	-	AD	-	22.5	84.0	19.9	22.4	83.0	-	-	No	LM	-8.488557	35.43582	1929
14/06/06	Ifupira Forest	B	9.56	A99698	Phyllastrephus placidus	-	AD	-	20.0	75.0	17.4	20.7	77.0	-	-	No	LM	-8.488557	35.43582	1929

date	site	No	time	ring	species	re	age	sex	net	wing	bill	tar	tail	fat	BP	molt	r'ger	latitude	longitude	alt
14/06/06	Ipupira Forest	B	9.56	A99699	Phyllastrephus placidus	-	AD	-	22.5	75.0	16.7	21.1	75.0	-	-	No	LM	-8.488557	35.43582	1929
14/06/06	Ipupira Forest	C	9.56	A99700	Andropadus chlorigula	-	AD	-	32.5	88.0	19.3	24.0	90.0	-	-	No	LM	-8.488557	35.43582	1929
14/06/06	Ipupira Forest	B	11.30	K41668	Modulatrix stictigula	-	AD	-	29.0	84.0	17.6	29.8	75.0	-	-	No	GM	-8.488557	35.43582	1929
14/06/06	Ipupira Forest	B	17.24	K41669	Bradypterus lopezi	-	AD	-	20.5	64.0	16.1	13.5	67.0	-	-	Yes	LM	-8.488557	35.43582	1929
14/06/06	Ipupira Forest	B	17.24	K41670	Modulatrix stictigula	-	AD	-	20.7	82.0	16.3	20.3	71.0	-	-	No	LM	-8.488557	35.43582	1929
14/06/06	Ipupira Forest	A	18.25	K41671	Sheppardia lowei	-	AD	-	19.0	75.0	16.0	30.0	61.0	-	-	No	LM	-8.488557	35.43582	1929
14/06/06	Ipupira Forest	A	18.25	T45094	Cryptospiza reichenovii	-	AD	-	10.5	53.0	9.9	16.0	41.0	-	5	No	LM	-8.488557	35.43582	1929
14/06/06	Ipupira Forest	B	18.25	T45095	Cryptospiza reichenovii	-	AD	-	11.0	55.0	11.5	17.0	43.0	-	-	No	LM	-8.488557	35.43582	1929
15/06/06	Ipupira Forest	C	7.40	T45096	Trochocercus albanotatus	-	AD	-	17.0	63.5	13.3	16.9	89.0	-	-	No	LM	-8.488557	35.43582	1929
15/06/06	Ipupira Forest	B	7.40	T45097	Trochocercus albanotatus	-	AD	-	175.0	60.0	12.6	17.0	65.0	-	-	No	LM	-8.488557	35.43582	1929
15/06/06	Ipupira Forest	C	8.53	E0445	Andropadus chlorigula	-	AD	-	36.0	97.0	19.4	25.3	102.0	-	-	No	GM	-8.488557	35.43582	1929
15/06/06	Ipupira Forest	C	8.53	E0446	Turdus olivaceus	-	AD	-	60.5	114.0	25.6	32.7	86.0	-	-	No	GM	-8.488557	35.43582	1929
15/06/06	Ipupira Forest	C	8.53	E0447	Andropadus chlorigula	-	AD	-	44.0	97.0	20.4	25.6	100.0	-	-	No	LM	-8.488557	35.43582	1929
15/06/06	Ipupira Forest	A	15.30	K41672	Pseudoalcippe abyssinica	-	AD	-	17.0	76.0	15.0	22.2	62.0	-	1	No	LM	-8.488557	35.43582	1929
15/06/06	Ipupira Forest	A	15.30	K41673	Trochocercus albanotatus	-	AD	-	7.5	65.0	13.9	17.4	71.0	-	-	No	GM	-8.488557	35.43582	1929
15/06/06	Ipupira Forest	B	15.30	E0448	Modulatrix stictigula	-	AD	-	29.0	81.0	18.4	30.9	75.0	-	-	No	GM	-8.488557	35.43582	1929
15/06/06	Ipupira Forest	C	15.30	K41674	Trochocercus albanotatus	-	AD	-	19.0	62.0	11.3	17.2	70.0	-	-	No	GM	-8.488557	35.43582	1929
15/06/06	Ipupira Forest	A	15.30	T45098	Cryptospiza reichenovii	-	AD	-	11.0	55.0	13.9	17.3	42.0	-	2	No	GM	-8.488557	35.43582	1929
15/06/06	Ipupira Forest	A	15.30	K41675	Sheppardia lowei	-	AD	-	19.0	71.0	15.3	28.3	51.0	-	-	No	GM	-8.488557	35.43582	1929
20/06/06	Ipafu forest	A	9.39	T45099	Batis crypta	-	AD	-	11.0	63.0	15.2	20.1	39.0	-	-	No	LM	-8.56235	35.52331	1949
20/06/06	Ipafu forest	B	9.39	A65451	Andropadus virens	-	AD	-	25.0	89.0	17.8	20.3	80.0	-	-	No	LM	-8.56235	35.52331	1949
20/06/06	Ipafu forest	A	9.39	T45100	Batis crypta	-	AD	-	12.5	63.0	14.7	18.5	38.0	-	-	No	LM	-8.56235	35.52331	1949
20/06/06	Ipafu forest	A	9.39	A65452	Andropadus virens	-	AD	-	24.0	85.0	15.2	20.9	79.0	-	-	No	LM	-8.56235	35.52331	1949
20/06/06	Ipafu forest	B	10.25	A65453	Andropadus strifacies	-	AD	-	41.0	102.0	21.3	24.1	96.0	-	-	No	LM	-8.56235	35.52331	1949
20/06/06	Ipafu forest	A	10.25	A65454	Phyllastrephus placidus	-	AD	-	17.0	88.0	21.1	22.0	91.0	-	-	No	LM	-8.56235	35.52331	1949
20/06/06	Ipafu forest	A	10.25	A65455	Andropadus virens	-	AD	-	21.0	86.0	15.5	20.3	84.0	-	-	No	GM	-8.56235	35.52331	1949
20/06/06	Ipafu forest	A	10.25	A65456	Andropadus masukuensis	-	AD	-	28.0	84.0	16.9	21.0	83.0	-	-	No	GM	-8.56235	35.52331	1949
20/06/06	Ipafu forest	B	10.55	K41676	Pseudoalcippe abyssinica	-	AD	-	19.0	70.0	14.5	21.6	60.0	-	-	No	GM	-8.56235	35.52331	1949
20/06/06	Ipafu forest	B	10.55	K41677	Pogonocichla stellata	-	AD	-	16.5	81.0	15.1	21.7	63.0	-	-	No	GM	-8.56235	35.52331	1949
20/06/06	Ipafu forest	B	11.17	A65457	Modulatrix stictigula	-	AD	-	29.5	76.0	17.2	29.2	71.0	-	-	No	LM	-8.56235	35.52331	1949
20/06/06	Ipafu forest	B	11.17	A65458	Modulatrix stictigula	-	AD	-	30.5	77.0	18.3	28.0	70.0	-	-	No	LM	-8.56235	35.52331	1949
20/06/06	Ipafu forest	A	11.17	K41678	Pseudoalcippe abyssinica	-	AD	-	16.5	68.0	14.0	22.0	61.0	-	-	No	LM	-8.56235	35.52331	1949
20/06/06	Ipafu forest	A	11.17	A65459	Andropadus virens	-	AD	-	25.5	86.0	15.2	19.8	80.0	-	-	No	LM	-8.56235	35.52331	1949
20/06/06	Ipafu forest	A	11.17	A65460	Andropadus strifacies	-	AD	-	43.0	95.0	18.3	24.2	96.0	-	-	No	LM	-8.56235	35.52331	1949
20/06/06	Ipafu forest	A	13.05	A65460	Alethe fuelleborni	-	AD	-	45.0	11.0	22.5	33.4	80.0	-	-	No	GM	-8.56235	35.52331	1949
20/06/06	Ipafu forest	B	15.26	A65461	Phyllastrephus placidus	-	AD	-	35.0	84.0	18.3	22.4	86.0	-	-	No	GM	-8.56235	35.52331	1949
20/06/06	Ipafu forest	B	15.26	A65463	Phyllastrephus placidus	-	AD	-	47.5	84.0	25.1	30.8	86.0	-	3	No	GM	-8.56235	35.52331	1949
20/06/06	Ipafu forest	A	17.15	T36880	Cryptospiza reichenovii	-	AD	-	12.5	56.0	14.5	13.8	45.0	-	3	No	GM	-8.56235	35.52331	1949
20/06/06	Ipafu forest	A	17.15	T36881	Cryptospiza reichenovii	-	AD	-	14.0	52.0	13.8	17.7	41.0	-	3	No	GM	-8.56235	35.52331	1949

date	site	No	time	ring	species	re	age	sex	net	wing	bill	tar	tail	fat	BP	molt	r'ger	latitude	longitude	alt
20/06/06	ipafu forest	C	18.17	A65464	Alethe fuelleborni	-	AD	-	46.0	112.0	23.1	34.5	83.0	-	-	No	LM	-8.56235	35.52331	1949
20/06/06	ipafu forest	C	18.17	T36882	Batis crypta	-	AD	F	12.5	62.0	15.2	19.3	38.0	-	-	No	LM	-8.56235	35.52331	1949
20/06/06	ipafu forest	C	18.17	T36883	Batis crypta	-	AD	M	12.0	62.0	15.2	18.2	38.0	-	-	No	LM	-8.56235	35.52331	1949
20/06/06	ipafu forest	C	18.17	T36884	Batis crypta	-	AD	F	13.5	63.0	13.9	17.8	38.0	-	-	No	GM	-8.56235	35.52331	1949
20/06/06	ipafu forest	C	18.17	A65465	Cossypha anomala	-	AD	-	26.0	81.0	17.5	30.0	71.0	-	-	No	GM	-8.56235	35.52331	1949
20/06/06	ipafu forest	C	18.36	A65466	Cossypha anomala	-	AD	-	12.0	75.0	17.6	29.3	62.0	-	-	No	GM	-8.56235	35.52331	1949
21/06/06	ipafu forest	A	6.30	T36885	Trochocercus albonotatus	-	AD	-	9.0	64.0	13.3	16.9	70.0	-	-	No	LM	-8.56235	35.52331	1949
21/06/06	ipafu forest	A	6.30	A65467	Andropadus virens	-	AD	-	25.0	85.0	16.0	21.3	84.0	-	-	No	GM	-8.56235	35.52331	1949
21/06/06	ipafu forest	C	6.30	T36886	Cryptospiza reichenovii	-	AD	M	12.0	54.0	13.3	17.2	44.0	-	-	No	GM	-8.56235	35.52331	1949
21/06/06	ipafu forest	B	6.30	A65468	Modulatrix stictigula	-	AD	-	33.0	80.0	18.6	31.1	79.0	-	-	No	GM	-8.56235	35.52331	1949
21/06/06	ipafu forest	B	6.30	A65469	Andropadus virens	-	AD	-	35.0	86.0	15.4	19.8	42.0	-	-	No	LM	-8.56235	35.52331	1949
21/06/06	ipafu forest	B	6.30	T36887	Batis crypta	-	AD	-	16.5	60.0	18.5	18.4	39.0	-	-	No	LM	-8.56235	35.52331	1949
21/06/06	ipafu forest	B	6.30	T36888	Batis crypta	-	AD	F	11.0	60.0	15.4	18.3	36.0	-	-	No	LM	-8.56235	35.52331	1949
21/06/06	ipafu forest	B	6.30	T36889	Batis crypta	-	AD	F	26.5	61.0	14.4	18.4	36.0	-	-	No	LM	-8.56235	35.52331	1949
21/06/06	ipafu forest	B	12.20	T36890	Nectarinia olivacea	-	AD	-	15.0	54.0	24.6	14.8	53.0	-	-	No	LM	-8.56235	35.52331	1949
21/06/06	ipafu forest	A	12.20	K41679	Cryptospiza reichenovii	-	AD	M	10.0	56.0	10.1	17.8	43.0	-	-	No	LM	-8.56235	35.52331	1949
21/06/06	ipafu forest	A	12.20	K41680	Cryptospiza reichenovii	-	AD	F	18.0	56.0	10.5	17.5	45.0	-	-	No	LM	-8.56235	35.52331	1949
21/06/06	ipafu forest	B	14.15	A65470	Andropadus chlorigula	-	AD	-	34.5	93.0	19.9	23.8	90.0	-	-	No	GM	-8.56235	35.52331	1949
21/06/06	ipafu forest	B	14.15	T36891	Cryptospiza reichenovii	-	AD	M	12.5	56.0	13.4	18.0	41.0	-	-	No	GM	-8.56235	35.52331	1949
21/06/06	ipafu forest	A	14.15	T36892	Apalis thoracica	-	AD	-	12.5	52.0	14.4	19.0	50.0	-	4	No	GM	-8.56235	35.52331	1949
21/06/06	ipafu forest	C	14.15	T36893	Orthotomus metopias	-	AD	-	9.0	53.0	16.0	21.0	42.0	-	3	No	LM	-8.56235	35.52331	1949
21/06/06	ipafu forest	A	14.15	T36894	Apalis thoracica	-	AD	-	11.5	54.0	15.7	21.0	52.0	-	2	No	LM	-8.56235	35.52331	1949
22/06/06	ipafu forest	A	8.05	A65471	Modulatrix stictigula	-	AD	-	27.0	80.0	18.3	30.7	72.0	-	0	No	LM	-8.56235	35.52331	1949
22/06/06	ipafu forest	B	8.05	A65472	Andropadus virens	-	AD	-	23.5	83.0	16.1	21.3	83.0	-	0	Yes	LM	-8.56235	35.52331	1949
22/06/06	ipafu forest	C	8.05	T36895	Cryptospiza reichenovii	-	AD	F	14.0	54.0	11.2	18.3	40.0	-	5	No	LM	-8.56235	35.52331	1949
22/06/06	ipafu forest	A	9.36	A65473	Dendropicos griseocephalus	-	AD	F	37.5	104.0	23.0	18.2	66.0	-	2	No	GM	-8.56235	35.52331	1949
22/06/06	ipafu forest	B	9.36	A65474	Laniarius fuelleborni	-	AD	-	42.0	88.0	25.0	31.8	87.0	-	0	No	GM	-8.56235	35.52331	1949
22/06/06	ipafu forest	B	9.36	T36896	Batis crypta	-	AD	M	11.0	62.0	14.9	17.7	40.0	-	0	No	GM	-8.56235	35.52331	1949
26/06/06	Mufindi Scarp W	B	12.45	A65475	Modulatrix stictigula	-	AD	-	31.5	81.0	20.0	30.2	77.0	-	0	No	GM	-8.41530	35.0848	1791
26/06/06	Mufindi Scarp W	A	12.45	K41681	Pseudoalcippe abyssinica	-	AD	-	13.6	65.0	15.2	21.6	59.0	-	3	No	LM	-8.41530	35.0848	1791
26/06/06	Mufindi Scarp W	A	12.45	K41682	Bradypterus cinnamomeus	-	AD	-	15.5	68.0	15.7	24.9	75.0	-	2	No	LM	-8.41530	35.0848	1791
26/06/06	Mufindi Scarp W	A	12.45	A65476	Phyllastrephus placidus	-	AD	-	20.0	75.0	17.9	20.1	77.0	-	1	No	LM	-8.41530	35.0848	1791
26/06/06	Mufindi Scarp W	A	12.45	A65477	Andropadus masukuensis	-	AD	-	20.5	78.0	16.0	21.8	76.0	-	0	No	GM	-8.41530	35.0848	1791
26/06/06	Mufindi Scarp W	B	12.45	K41683	Cryptospiza reichenovii	-	AD	F	16.5	56.0	11.0	17.8	41.0	-	4	No	LM	-8.41530	35.0848	1791
26/06/06	Mufindi Scarp W	B	12.45	K41684	Cryptospiza reichenovii	-	AD	M	13.5	54.0	10.4	17.6	41.0	-	4	No	LM	-8.41530	35.0848	1791
26/06/06	Mufindi Scarp W	B	17.20	B39457	Turtur tympanistris	-	AD	F	64.0	109.0	17.9	20.5	87.0	-	0	No	LM	-8.41530	35.0848	1791
27/06/06	Mufindi Scarp W	A	7.04	A65470	Modulatrix stictigula	-	AD	-	30.0	80.0	18.9	31.2	71.0	-	0	No	LM	-8.41530	35.0848	1791
27/06/06	Mufindi Scarp W	A	7.04	A65479	Cossypha anomala	-	AD	-	26.0	82.0	18.3	31.4	67.0	-	0	No	GM	-8.41530	35.0848	1791
27/06/06	Mufindi Scarp W	B	7.04	A65480	Andropadus strifacis	-	AD	-	46.5	103.0	20.9	24.4	99.0	-	1	No	LM	-8.41530	35.0848	1791

date	site	No	time	ring	species	re	age	sex	net	wing	bill	tar	tail	fat	BP	molt	r'ger	latitude	longitude	alt
27/06/06	Mufindi Scarp W	B	7.04	K41685	Sheppardia lowei	-	AD	-	16.5	70.0	16.2	28.9	53.0	-	0	No	LM	-8.41530	35.0848	1791
27/06/06	Mufindi Scarp W	B	7.04	K41686	Sheppardia lowei	-	AD	-	19.0	72.0	16.0	29.9	57.0	-	0	No	LM	-8.41530	35.0848	1791
27/06/06	Mufindi Scarp W	A	7.04	K41687	Cryptospiza reichenovii	-	AD	-	11.5	56.0	12.5	17.6	45.0	-	0	No	GM	-8.41530	35.0848	1791
27/06/06	Mufindi Scarp W	B	7.04	A65481	Andropadus strifacies	-	AD	-	44.5	100.1	21.0	25.0	96.0	-	3	No	GM	-8.41530	35.0848	1791
27/06/06	Mufindi Scarp W	B	9.14	T36897	Trochocercus albanotatus	-	AD	-	7.5	63.0	12.6	16.4	69.0	-	0	No	LM	-8.41530	35.0848	1791
27/06/06	Mufindi Scarp W	A	10.15	A65482	Phyllastrephus placidus	-	AD	-	22.5	81.0	20.2	21.6	84.0	-	0	No	GM	-8.41530	35.0848	1791
27/06/06	Mufindi Scarp W	B	14.41	A65483	Andropadus masukuensis	-	AD	-	21.5	86.0	17.1	22.2	85.0	-	0	No	GM	-8.41530	35.0848	1791
27/06/06	Mufindi Scarp W	B	14.41	A65484	Andropadus virens	-	AD	-	24.0	84.0	14.4	18.6	81.0	-	0	No	GM	-8.41530	35.0848	1791
27/06/06	Mufindi Scarp W	B	14.41	A65485	Andropadus masukuensis	-	AD	-	26.5	86.0	17.8	21.5	85.0	-	0	No	GM	-8.41530	35.0848	1791
27/06/06	Mufindi Scarp W	B	14.41	A65486	Andropadus masukuensis	-	AD	-	30.5	82.0	16.8	21.3	80.0	-	0	No	GM	-8.41530	35.0848	1791
27/06/06	Mufindi Scarp W	B	14.41	K41688	Batis crypta	-	AD	F	17.0	57.0	15.7	18.9	38.0	-	0	No	GM	-8.41530	35.0848	1791
27/06/06	Mufindi Scarp W	B	14.41	A65487	Phyllastrephus placidus	-	AD	-	22.5	76.0	19.7	20.6	75.0	-	0	No	GM	-8.41530	35.0848	1791
27/06/06	Mufindi Scarp W	B	14.41	K41689	Cryptospiza reichenovii	-	AD	M	13.0	55.0	11.6	18.8	41.0	-	0	NoW	GM	-8.41530	35.0848	1791
27/06/06	Mufindi Scarp W	B	17.25	A65488	Andropadus masukuensis	-	AD	-	27.5	81.0	16.1	21.4	80.0	-	0	No	GM	-8.41530	35.0848	1791
28/06/06	Mufindi Scarp W	A	10.10	K41690	Cryptospiza reichenovii	-	AD	M	18.0	56.0	14.6	18.8	47.0	-	0	No	GM	-8.41530	35.0848	1791
28/06/06	Mufindi Scarp W	B	10.10	T36898	Cryptospiza reichenovii	-	AD	F	7.5	54.5	11.7	18.1	43.0	-	5	No	LM	-8.41530	35.0848	1791
28/06/06	Mufindi Scarp W	B	10.10	A65489	Andropadus masukuensis	-	AD	-	21.0	80.0	16.3	20.2	81.0	-	0	No	LM	-8.41530	35.0848	1791
28/06/06	Mufindi Scarp W	B	10.10	K41691	Sheppardia lowei	-	AD	-	25.0	75.0	15.0	31.0	41.0	-	0	No	LM	-8.41530	35.0848	1791
28/06/06	Mufindi Scarp W	B	10.10	A65490	Andropadus virens	-	AD	-	24.0	85.0	15.0	20.6	84.0	-	0	No	LM	-8.41530	35.0848	1791
28/06/06	Mufindi Scarp W	A	12.15	T36899	Zosterops senegalensis	-	AD	-	8.5	58.0	13.4	16.8	40.0	-	0	No	GM	-8.41530	35.0848	1791
28/06/06	Mufindi Scarp W	A	12.15	A65491	Phyllastrephus placidus	-	AD	-	20.0	77.5	18.8	22.3	80.0	-	0	No	GM	-8.41530	35.0848	1791
28/06/06	Mufindi Scarp W	B	12.15	K41692	Bradypterus cinnamomeus	-	AD	-	22.5	85.0	17.0	23.4	70.0	-	0	No	GM	-8.41530	35.0848	1791
28/06/06	Mufindi Scarp W	B	12.15	A65492	Andropadus masukuensis	-	AD	-	24.5	86.0	16.4	20.9	81.0	-	1	No	LM	-8.41530	35.0848	1791
28/06/06	Mufindi Scarp W	B	12.15	T36900	Nectarinia mediocris	-	AD	-	7.5	54.0	21.6	15.0	33.0	-	3	No	LM	-8.41530	35.0848	1791
28/06/06	Mufindi Scarp W	B	12.15	A65493	Andropadus masukuensis	-	AD	-	27.5	89.0	16.1	20.4	85.0	-	3	NoW	LM	-8.41530	35.0848	1791
28/06/06	Mufindi Scarp W	B	12.15	A65494	Andropadus masukuensis	-	AD	-	24.0	80.0	15.6	18.8	80.0	-	3	NoW	LM	-8.41530	35.0848	1791
28/06/06	Mufindi Scarp W	A	12.15	A65495	Andropadus masukuensis	-	AD	-	23.0	80.0	16.4	19.0	80.0	-	0	No	GM	-8.41530	35.0848	1791

Appendix 10. List of the herptiles specimens recorded (collected and observed)

Obs, pic	<i>Chamaeleo laterispinis</i>	Reptilia	Chamaeleonidae	Fox Farm , Mufindi
MTSN 8671	<i>Afrixalus cf. uluguruensis</i>	Amphibia	Hyperolidae	Kigogo FR
MTSN 8691	<i>Afrixalus cf. uluguruensis</i>	Amphibia	Hyperolidae	Kigogo FR
KMH 25548	<i>Arthroleptis cf. reichei</i>	Amphibia	Arthroleptidae	Kigogo FR
KMH 25843	<i>Arthroleptis cf. reichei</i>	Amphibia	Arthroleptidae	Kigogo FR
KMH 25844	<i>Arthroleptis cf. reichei</i>	Amphibia	Arthroleptidae	Kigogo FR
KMH 25845	<i>Arthroleptis cf. reichei</i>	Amphibia	Arthroleptidae	Kigogo FR
MTSN 8672	<i>Arthroleptis cf. reichei</i>	Amphibia	Arthroleptidae	Kigogo FR
MTSN 8689	<i>Arthroleptis cf. reichei</i>	Amphibia	Arthroleptidae	Kigogo FR
MTSN 8697	<i>Arthroleptis cf. reichei</i>	Amphibia	Arthroleptidae	Kigogo FR
KMH 25547	<i>Arthroleptis cf. xenodactyloides</i>	Amphibia	Arthroleptidae	Kigogo FR
KMH 25848	<i>Arthroleptis cf. xenodactyloides</i>	Amphibia	Arthroleptidae	Kigogo FR
MTSN 8688	<i>Arthroleptis cf. xenodactyloides</i>	Amphibia	Arthroleptidae	Kigogo FR
MTSN 8689	<i>Arthroleptis cf. xenodactyloides</i>	Amphibia	Arthroleptidae	Kigogo FR
MTSN 8696	<i>Arthroleptis cf. xenodactyloides</i>	Amphibia	Arthroleptidae	Kigogo FR
MTSN 8872	<i>Arthroleptis cf. xenodactyloides</i>	Amphibia	Arthroleptidae	Kigogo FR
MTSN 8874	<i>Atheris ceratophorus</i>	Reptilia	Viperidae	Kigogo FR
MTSN 8686	<i>Bradypodion sp.</i>	Reptilia	Chamaeleonidae	Kigogo FR
Obs, pic	<i>Chamaeleo laterispinis</i>	Reptilia	Chamaeleonidae	Kigogo FR
MTSN 8691	<i>Chamaeleo tempeli</i>	Reptilia	Chamaeleonidae	Kigogo FR
MTSN 8692	<i>Chamaeleo tempeli</i>	Reptilia	Chamaeleonidae	Kigogo FR
KMH 25666	<i>Chamaeleo werneri</i>	Reptilia	Chamaeleonidae	Kigogo FR
MTSN 8690	<i>Chamaeleo werneri</i>	Reptilia	Chamaeleonidae	Kigogo FR
MTSN 8875	<i>Duberria lutrix shirana</i>	Reptilia	Colubridae	Kigogo FR
MTSN 8876	<i>Duberria lutrix shirana</i>	Reptilia	Colubridae	Kigogo FR
MTSN 8877	<i>Duberria lutrix shirana</i>	Reptilia	Colubridae	Kigogo FR
MTSN 8878	<i>Duberria lutrix shirana</i>	Reptilia	Colubridae	Kigogo FR
KMH 25841	<i>Hyperolius puncticulatus</i>	Amphibia	Hyperolidae	Kigogo FR
MTSN 8670	<i>Hyperolius sp.</i>	Amphibia	Hyperolidae	Kigogo FR
MTSN 8670	<i>Leptopelis barbouri</i>	Amphibia	Leptopelidae	Kigogo FR
KMH 25576	<i>Melanoseps cf. loveridgei</i>	Reptilia	Scincidae	Kigogo FR
Obs, pic	<i>Nectophrynoides viviparus</i>	Amphibia	Bufonidae	Kigogo FR
KMH 25846	<i>Probreviceps cf. rungwensis</i>	Amphibia	Microhylidae	Kigogo FR
KMH 25847	<i>Probreviceps cf. rungwensis</i>	Amphibia	Microhylidae	Kigogo FR
MTSN 8687	<i>Probreviceps cf. rungwensis</i>	Amphibia	Microhylidae	Kigogo FR
MTSN 8871	<i>Probreviceps cf. rungwensis</i>	Amphibia	Microhylidae	Kigogo FR
MTSN 8879	<i>Probreviceps cf. rungwensis</i>	Amphibia	Microhylidae	Kigogo FR
Obs, pic	<i>Rana angolensis</i>	Amphibia	Ranidae	Kigogo FR
KMH 25667	<i>Rhampholeon moyeri</i>	Reptilia	Chamaeleonidae	Kigogo FR
KMH 25668	<i>Rhampholeon moyeri</i>	Reptilia	Chamaeleonidae	Kigogo FR
KMH 25842	<i>Scolecophorus kirkii</i>	Amphibia	Scolecophoridae	Kigogo FR
MTSN 8673	<i>Hyperolius pictus</i>	Amphibia	Hyperolidae	Mufindi
MTSN 8674	<i>Hyperolius pictus</i>	Amphibia	Hyperolidae	Mufindi
MTSN 8677	<i>Hyperolius pictus</i>	Amphibia	Hyperolidae	Mufindi
MTSN 8678	<i>Hyperolius pictus</i>	Amphibia	Hyperolidae	Mufindi
MTSN 8683	<i>Hyperolius pictus</i>	Amphibia	Hyperolidae	Mufindi
MTSN 8675	<i>Hyperolius pseudargus</i>	Amphibia	Hyperolidae	Mufindi
MTSN 8676	<i>Hyperolius pseudargus</i>	Amphibia	Hyperolidae	Mufindi
MTSN 8693	<i>Hyperolius puncticulatus</i>	Amphibia	Hyperolidae	Mufindi
MTSN 8680	<i>Phrynobatrachus sp.</i>	Amphibia	Petropedetidae	Mufindi
MTSN 8837	<i>Crotaphopeltis tornieri</i>	Reptilia	Colubridae	Mufindi

Obs.	<i>Trachylepis varia</i>	Reptilia	Scincidae	Mufindi
MTSN 8837	<i>Crotaphopeltis tornieri</i>	Reptilia	Colubridae	Mufindi

Appendix 11. Location and description of disturbance transects.

Forest	Transect No	Start point		End point		Vegetation description
		Eastings	Northings	Eastings	Northings	
Kigogo	KG1	748387	9042784	748993	9042390	Montane forest with some bamboo and ferns. The forest borders tea fields along its western / southwestern side. The forest extends along the top of the Mufindi escarpment and contains a series of river valleys. The canopy cover ranged from 10-50% in many parts of the forest while in some parts the canopy cover exceeded 50% (especially along the Kigogo River).
	KG2	747700	9042519	747812	9041605	
	KG3	745799	9042086	745729	9041134	
	KG4	743793	9044662	743686	9043719	
	KG5	743278	9038489	743242	9039362	
Mufindi Scarp East	ME1	749324	9041551	749444	9042498	Montane forest along the upper slope of the escarpment. The canopy cover, shrub layer and ground layer ranged from 10 – 50 % in many parts of the forest.
	ME2	747071	9038363	746318	9038998	
Mufindi Scarp West	MW1	736248	9038073	736169	9039070	Montane forest with canopy cover, shrub layer and ground layer cover ranging from 10 – 50 % with the exception of forest along streams and on top of some ridges which had a canopy cover of more than 50 %.
	MW2	736476	9037024	735462	9036897	
Livalonge	LV	737579	9029699	737570	9038724	Montane forest on a gentle upper slope. The forest extends across a valley at its southern end which is contiguous with Mufindi Scarp West FR. The canopy cover, shrub layer and ground layer range from 10 – 50 % with some areas having a cover of more than 50 %.
Ifupira	IF1	768086	9061479	769201	9061529	Montane forest dominated by shrubs including <i>Rubus</i> sp.. The area is characterized by the presence of scattered forest patches in a mosaic of shrub tangled <i>Rubus</i> ps.. The forest extends along a gentle upper slope on the top of the Mufindi escarpment. The canopy cover mostly ranged from 10 – 50 %. Canopy cover occasionally exceeded 50 % especially in the vicinity of the dam.. In areas dominated by brambles, the canopy cover was below 10%. The ground and shrub layer cover mostly ranged from 10 - 50% and above 50% in some areas. Close to the dam, there was a chunk of forest planted with Pines and <i>Eucalyptus</i> trees.
	IF2	769189	9062288	768984	9063209	
Lulanda	LU	788903	9047563	788140	9046887	Fufu patch is a montane forest with canopy cover, shrub layer and ground layer cover ranging between 10-50% with some forest areas showing a vegetation cover above 50%. In the forest interior there are some scattered open grassy areas dominated by trees such as <i>Albizia</i> .
Kidegemitsu	KD	770097	9064932	770097	9065960	Montane forest with broken canopy cover.
Ipafu	IP	777106	9054291	777245	9053371	Montane forest with <i>rubus</i> dominated scrub along some of its northern part. In this area the canopy cover and the ground layer mostly ranged from less than 10 % to 50 % while the shrub layer was mostly above 50 %. Further in, there is good montane forest with canopy cover, shrub layer and ground layer from 10-50% and above 50%.