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Conservation and Management of the Eastern Arc Mountain Forests,
Tanzania
GEF-UNDP: URT/01/G32

Uluguru Component Biodiversity Survey 2005
(Volume III)

Uluguru North Forest Reserve



Frontier-Tanzania

Frontier-Tanzania Environmental Research

CMEAMF: Uluguru Component Biodiversity Survey 2005 (Volume III)

Uluguru North Forest Reserve

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Uluguru Mountains Environmental Management and Conservation Project (UMEMCP)

This project is a component of the Conservation and Management of the Eastern Arc Mountain Forests (CMEAMF), a project of the Forest and Beekeeping Division of the Ministry of Natural Resources and Tourism - funded by the Global Environment Facility through the United Nations Development Programme. UMEMCP is managed by CARE International in Tanzania under a Memorandum of Understanding with the Forestry and Beekeeping Division of the Ministry of Natural Resources and Tourism. It aims to improve forest management and conservation of catchment forests in the Uluguru Mountains, as well as improve land husbandry practices in adjacent villages with local communities, government authorities and other stakeholders. Implementation of UMEMCP is over a six-year period from 2003-2008.

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The University of Dar es Salaam was established in July 1970 as a centre for learning and research in the arts and the physical, natural, earth, marine, medical and human sciences. The University is surveying and mapping the flora and fauna of Tanzania and is conducting research into the maintenance and improvement of the environment and the sustainable exploitation of Tanzania's natural resources.

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Frontier-Tanzania Forest Research Programme (FT FRP)

The Society for Environmental Exploration and the University of Dar es Salaam have been conducting collaborative research into environmental issues since July 1989 under the title of Frontier-Tanzania, of which one component is the Frontier-Tanzania Forest Research Programme (FT FRP). Biological field surveys were conducted in the coastal forests of Tanzania from 1989 to 1994, in the East Usambara mountains in collaboration with East Usambara Conservation Area Management Project (EUCAMP), Tanga from 1995 to 2002, the Udzungwa mountains in collaboration with Matumizi Endelevu ya Misititu ya Asili (MEMA), Iringa from 1999 to 2001, in the Mahenge Mountains in 2003 and in Mpanga / Kipengere Game Reserve, in collaboration with WWF-TPO, Dar es Salaam, in 2003.

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LIST OF ABBREVIATIONS / ACRONYMS

CITES	Convention on the International Trade of Endangered Species
CMEAMF	Conservation and Management of the Eastern Arc Mountain Forests
FBD	Forest and Beekeeping Division of the Ministry of Natural Resources and Tourism
FR	Forest Reserve
FT FRP	Frontier-Tanzania Forest Research Programme
FTEA	Flora of Tropical East Africa
ICBP	International Council for Bird Preservation (now called BirdLife International)
IUCN	The World Conservation Union
LEAP	List of East African Plants
S & H	Svendsen & Hansen
SEE	Society for Environmental Exploration
SUA	Sokoine University of Agriculture
UCBS	Uluguru Component Biodiversity Survey
UDSM	University of Dar es Salaam
UMADEP	Uluguru Mountains Agricultural Development Project
UMBCP	Uluguru Mountains Biodiversity Conservation Project
UMEMCP	Uluguru Mountains Environmental Management and Conservation Project
WCST	Wildlife Conservation Society of Tanzania

TABLE OF CONTENTS

Acknowledgements	iii
Executive Summary	1
1. Introduction.....	7
1.1 Report Structure	7
1.2 Background to the Biodiversity Survey	7
1.3 Linkages to Frontier-Tanzania Forest Research Programme	8
1.4 The Uluguru Mountains	8
1.5 Previous research and studies.....	10
2. Study Site	11
2.1 Location	11
2.2 Site Description.....	11
2.3 Topography	12
2.4 Climate	12
2.5 Land Use	12
2.6 History and Status	12
3. Methodology	14
3.1 Key definitions and information sources.....	14
3.2 Flora	18
3.3 Fauna.....	21
3.4 Human Disturbance.....	22
4. Results.....	25
4.1 Flora	25
4.1.1 Vegetation plots	27
4.1.2 Species composition/dominance	29
4.1.3 Overall species richness	29
4.1.4 Overall species diversity	29
4.1.5 Uluguru endemic species	30
4.1.6 Eastern Arc endemic and near endemic species.....	31
4.1.7 Species listed by IUCN/CITES as threatened and species listed as rare by LEAP	34
4.1.8 Invasive species.....	34
4.1.9 Uses of trees	35
4.2 Fauna.....	36
4.2.1 Mammals.....	37
4.2.2 Birds	42
4.2.3 Reptiles.....	47
4.2.4 Amphibians	50
4.3 Human disturbance.....	54
5. Discussion and Recommendations.....	59
5.1 Flora	59
5.2 Fauna.....	61
5.2.1 Mammals.....	61
5.2.2 Birds	62
5.2.3 Reptiles.....	64
5.2.4 Amphibians	64
5.3 Human disturbance	66
6. References.....	69

LIST OF FIGURES

Figure 1 Map of the Eastern Arc Mountains that support moist forest. Eastern Arc Forest shown in black. From Lovett (1993).....	9
Figure 2 Spot satellite image of the Uluguru Mountains (2003) (sourced from Dr. N. Burgess)	11
Figure 3 Topographical map of Uluguru North FR	13
Figure 4 Map of work sites at Uluguru North FR	17
Figure 5 Map of vegetation plots in Uluguru North FR.....	20
Figure 6 Map of transect lines in Uluguru North FR	24
Figure 7 Percentage of species within Uluguru North FR	25
Figure 8 Species accumulation rates of recorded species by vegetation plot (trees>10 cm dbh).....	26
Figure 9 Species coverage and abundance for the top twelve species within vegetation plots	28
Figure 10 Distribution of endemic species by location	31
Figure 11 Percentages of faunal species that are widespread or endemic	37
Figure 12 Number of times evidence recorded for both casual observations and dung surveys of large mammals along 15.15km of transect.....	38
Figure 13 shows the relative abundance (no. rodent per 100 traps) of rodents captured at each site.....	39
Figure 14 Relative abundance of shrews at each zoological trapping site (number of shrews per 100 bucket pitfall traps).....	40
Figure 15 Relative abundance at sites compared with altitude (number of birds per 1000 net metre hours).....	43
Figure 16 Relative abundance of selected birds at each netting site (number of birds per 1000 net metre hours)	44
Figure 17 Number of reptile species and individuals captured at each worksite	48
Figure 18 Relative abundance of amphibians captured in bucket pitfall traps (number of amphibians per 100 bucket pitfall traps)	51
Figure 19 Total number of captures of amphibians during systematic searches only.....	52
Figure 20 Comparison of Hymas 2000 cut pole data and all UCBS cut pole data.....	55
Figure 21 Comparison of Hymas 2000 cut timber data and all UCBS cut timber data.....	56
Figure 22 Map showing main areas of disturbance.....	58

LIST OF TABLES

Table 1 Summary of survey effort for UCBS work in Uluguru North FR.....	1
Table 2 Summary of biodiversity taxa surveyed by UCBS in Uluguru North FR	2
Table 3 Summary of survey effort	16
Table 4 Work site descriptions.....	16
Table 5 Summary of flora data for both Uluguru North and Uluguru South recorded by UCBS	25
Table 6 Summary of floral data for Uluguru North FR recorded by UCBS	26
Table 7 Species coverage and abundance for the top twelve species within 36 vegetation plots	27
Table 8 Dominant tree species by aspect and altitude.....	29
Table 9 Diversity indices and species richness for main aspects	30
Table 10 Uluguru endemic species found within Uluguru North FR by UCBS	30
Table 11 Distribution of endemic species	31
Table 12 Eastern Arc endemic and near endemic species recorded within Uluguru North FR by UCBS	32
Table 13 Distribution of Eastern Arc endemic and near endemic species	33
Table 14 Species listed as threatened or rare found within Uluguru North FR by UCBS	34
Table 15 List of tree species observed to be used by people, recorded by UCBS botanist.....	35
Table 16 A summary of fauna recorded in Uluguru North Forest Reserve by UCBS (Appendices 9-12 give full species lists of all known fauna in Uluguru North FR).....	36
Table 17 Near endemic mammal species of the Eastern Arc Mountains found by UCBS	41
Table 18 IUCN and CITES listed mammals of the Uluguru North FR found by UCBS	41
Table 19 Forest dependent mammal species of the Uluguru North FR found by UCBS.....	41
Table 20 New records of mammal species recorded in the Uluguru North FR by UCBS	42
Table 21 Near endemic bird species of the Eastern Arc Mountains found by UCBS.....	45
Table 22 IUCN and CITES listed bird species of the Uluguru North FR found by UCBS.....	45
Table 23 Forest dependent bird species of the Uluguru North FR found by UCBS	46
Table 24 New records of bird species recorded in the Uluguru North Forest Reserve by UCBS.....	47
Table 25 Endemic reptiles of the Eastern Arc Mountains found by UCBS	49
Table 26 Near endemic reptile species of the Eastern Arc Mountains found by UCBS	49
Table 27 Forest dependent species found in Uluguru North FR by UCBS.....	49
Table 28 New records of reptile species for Uluguru North FR by UCBS	50

Table 29 Endemic amphibians of the Eastern Arc Mountains found by UCBS	52
Table 30 Near endemic amphibians of the Eastern Arc Mountains found by UCBS	52
Table 31 IUCN and CITES listed amphibians of the Uluguru North FR found by UCBS	53
Table 32 New records of reptile species for Uluguru North FR by UCBS	53
Table 33 Summary results of a pole and timber cutting in Uluguru North FR	54
Table 34 Important species that UCBS did not verify the presence of	62

LIST OF APPENDICES

Appendix 1: CARE-Tanzania Consultant Agreement	74
Appendix 2: Taxonomic verifications	85
Appendix 3: Summary of weather conditions	86
Appendix 4: GPS Co-ordinates for Uluguru North FR	87
Appendix 5: Summary of transecting data	90
Appendix 6: Vegetation plot descriptions	91
Appendix 7: Regeneration plot descriptions	93
Appendix 8: Vegetative data	95
Appendix 9: Mammal data	121
Appendix 10: Bird data	127
Appendix 11: Reptile data	138
Appendix 12: Amphibian data	141

EXECUTIVE SUMMARY

1. The Conservation and Management of the Eastern Arc Mountain Forests (CMEAMF): Uluguru Component (GEF/UNDP: URT/01/G32) is a project of the Forest and Beekeeping Division of the Ministry of Natural Resources and Tourism and funded by the Global Environment Facility through the United Nations Development Programme. CARE International in Tanzania implements the Uluguru Component under the terms of an agreed Memorandum of Understanding with the Forest and Beekeeping Division that was signed on the 12th August 2003.
2. Frontier-Tanzania (a collaboration between the Society for Environmental Exploration (UK) and the University of Dar es Salaam (Tanzania)) were contracted from September 2004 – April 2005 to undertake systematic biodiversity and human disturbance assessments of the Uluguru North and Uluguru South Forest Reserves - aiming to establish a baseline for measuring the Uluguru Component Project's impact on maintaining biodiversity values and reducing threats over the long-term. This study was known as the Uluguru Component Biodiversity Survey (UCBS).

Overview

3. Uluguru North Forest Reserve (FR) is located within the Uluguru Mountains, part of the Eastern Arc Mountains, on a latitude 6° 51' - 7° 01' and longitude 37° 37' - 37° 45'. It is situated in Morogoro District, 6 km south of Morogoro, and was established in 1906 for its water catchment value supplying surrounding villages, Morogoro town and Dar es Salaam. It covers 8,356.7 ha and consists of submontane, montane and upper montane forest. It has an elevational range of 780 – 2340m above sea level (asl) and an average rainfall of 2900-4000 mm per year on eastern slopes and 1200 - 3100mm on the western slopes (Lovett and Pócs 1993).
4. Frontier-Tanzania accompanied by staff of CMEAMF, Catchment Forestry Project and District Natural Resources office, Morogoro conducted a baseline biodiversity survey of Uluguru North Forest Reserve lasting six weeks from 5th January to 15th February 2005. Both zoological and vegetation work was conducted within the FR. Work included systematic trapping, casual observations and collection of small mammals, reptiles, amphibians and birds. Transects confirmed the presence/absence of large mammals; disturbance transects quantified the level of human disturbance; and vegetation plots and regeneration plots confirmed botanical species present and their abundances (Table 1).

Table 1 Summary of survey effort for UCBS work in Uluguru North FR

Survey technique (and sampling unit)	Target taxa	Total sampling effort
Flora		
Vegetation plot (VP)	Trees, shrubs, herbs	36 Vegetation plots
Regeneration plot (RP)	Trees, shrubs, herbs	36 Regeneration plots
Opportunistic observation/collection	Trees, shrubs, herbs	-
Fauna		
Sherman traps (trap-nights)	Small mammals	1650 trap-nights
Bucket pitfall traps (trap-nights)	Reptiles, amphibians, rodents	528 trap-nights
Animal signs transects	Larger mammals	18 transects, 16.2 km
Bat netting (mist-net hours)	Bats	97 mist-net metre hours
Bird surveys (mist-net hours)	Birds	28, 588 mist-net metre hours
Timed searches (man-hours)	Reptiles, Amphibians	23.45 man-hours
Opportunistic observation/collection	All animal taxa	-
Human disturbance		
Transects	Human disturbance	17 transects, 15.15 km
Opportunistic observation	Human disturbance	-

5. Animal specimens have been deposited at the Department of Zoology and Marine Biology, University of Dar es Salaam and sent on loan to: The British Museum of Natural History, London (amphibians); Natural History Museum, Zimbabwe (reptiles); California Academy of Sciences, California (reptiles); Chicago Field Museum, Chicago (small mammals); Zoological Museum, Copenhagen (birds). Botanical specimens are held in the Herbarium at Dar es Salaam University, with specimens being sent to Missouri Botanical Gardens, USA.
6. Uluguru North Forest Reserve has exceptional conservation value at an international, national and local level. Our surveys recorded 28 Uluguru endemic species and subspecies of vertebrates and plants (out of more than 150 endemic vertebrate and plant taxa confined to this mountain) Our surveys also recorded 63 flora and vertebrate fauna species and subspecies limited to the Eastern Arc Mountains ecoregion, which is part of the Eastern Afromontane Hotspot and is therefore of high priority for conservation efforts (Table 2).

Table 2 Summary of biodiversity taxa surveyed by UCBS in Uluguru North FR

Taxa	No. of total species	No. of Uluguru endemic species (subspecies)	No. of Eastern Arc endemic and near endemic species (subspecies)	No. of IUCN listed threatened species	No. of CITES listed
Trees / shrubs	173	9	22	18	2
Herbs / grasses	57	9	7	0	1
Climbers	6	0	0	0	0
Ferns	1	0	0	0	0
Mammals	31	1 (1)	5	5	4
Birds	95	3 (4)	10 (1)	4	8
Reptiles	13	0	9	0	2
Amphibians	17	1	9	7	1
Total	393	28	63	34	18

*Note that additional species are known from the Uluguru Mountains but were not recorded during this survey

Species richness and diversity

7. In terms of plants, UCBS recorded 237 flora species from Uluguru North FR, with 153 species recorded from 36 vegetation and regeneration plots and 84 species from opportunistic surveys. Of these, 8.4% are strict Uluguru endemics and 11.4% are Eastern Arc endemic and near endemic species. 7.6% of species are threatened as listed by IUCN.
8. Of the 36 50m x 20m vegetation plots, 5.5 of plots were established in lowland forest (<800), 55.5% in submontane forest (800m – 1500m asl) and 39% in montane forest (1500m – 2100m asl). A total of 1489 individual stems were measured.
9. Of the more than 135 strict Uluguru Mountains endemic plants, UCBS recorded 18 species only. Of these, 11 species were recorded at Bondwa peak, eight species from Lupanga and three species from Morningside; all of these sites are >2000m asl. The main genera with endemic species are: *Impatiens* (herb), *Saintpaulia* (herb), *Lobelia* (herb), *Streptocarpus* (herb), *Lasianthus* (shrub), and *Schefflera* (tree).
10. Of the 29 Eastern Arc endemic and near endemic species, most were trees and shrubs in the genera: *Allanblackia*, *Cola*, *Coffea*, *Mesogyne*, *Psychotria*, *Uvariadendron* and *Dombeya*.
11. Of the key floristic species, such as *Allanblackia uluguruensis* and *Ocotea usambarensis*, population densities were low with only 18 stems recorded within four vegetation plots for *A. uluguruensis* and 13 stems within ten vegetation plots for *O. usambarensis*. This is due to the lower altitudinal band of most of the reserve (<1800m asl).

12. The five most abundant flora species within the vegetation plots for species coverage (presence in vegetation plots) are: *Myrianthus holstii* (69.4% plots), *Newtonia buchananii* (63.9% plots), *Leptonychia usambarensis* (61.11% plots), *Aphloia theiformis* (52.8% plots) and *Parinari excelsa* (50% plots).
13. The five most abundant flora species within the vegetation plots for species abundance (stems per vegetation plot) are: *Leptonychia usambarensis* (9.5% stems), *Myrianthus holstii* (7.3% stems), *Sorindeia madagascariensis* (3.9% stems), *Aphloia theiformis* (3.6% stems) and *Trilepsium madagascariense* (3.5% stems).
14. Of the total known Uluguru vertebrate fauna of 209 species, UCBS recorded 156 species in Uluguru North FR including an additional 45 species not previously known from the reserve. Of the 154 recorded species, 6% are strictly Uluguru endemic and 21% Eastern Arc endemic and near endemic. 10% of species are threatened as listed by IUCN.
15. This survey discovered two new species of *Nectophrynoides* toad (spp B and F) and one species of reptile, *Chameleo werneri* which has anatomical differences to the Udzungwa counterpart and may represent a new subspecies.
16. This survey added the following Eastern Arc strict and near endemic species / subspecies to the known list of species in Uluguru North: Lesser pouched rat (*Beamy hindei*), Brown woodland warbler (*Phylloscopus umbrovirens fugglescouchmani*), Usambara two-horned chameleon (*Bradypodion fischeri fischeri*), Usambara garter-snake (*Elapsoidea nigra*), Forest vine snake (*Thelotornis kirtlandii*), Tree frogs (*Leptopelis uluguruensis* and *Leptopelis vermiculatus*) and Kirk's caecilian (*Scolecomorphus kirkii*). In addition, one known species is important to mention: Horned bush-viper (*Atheris ceratophorus*) which was first recorded in 2000 (Doggart et al 2005) and confirmed in this study with two specimens.
17. This study also verified the presence of Stuhlmann's golden mole (*Chrysochloris stuhlmanni tropicalis*), an Uluguru endemic subspecies, which was last recorded in 1950.
18. Of the 32 strict Uluguru or Eastern Arc endemic fauna species / subspecies known from Uluguru North, this survey failed to locate twelve species: White-toothed shrew (*Crocidura telfordi*), Usambara eagle owl (*Bubo vosseleri*), Banded green sunbird (*Anthreptes rubritorques*), Ornate shovel-snake (*Prosymna ornatissima*), Uluguru blind snake (*Typhlops uluguruensis* and *Typhlops* sp. nov), Uluguru pigmy chameleon (*Rhampholeon uluguruensis*), Squeaker frog (*Arthroleptis xenodactylus*) and *Nectophrynoides* toads (*Nectophrynoides cryptus*, *N. minutus*, *N. tornieri* and *N. pseudotornieri*). *C. telfordii* and *Prosymna ornatissima* are critically endangered, whilst *N. cryptus* and *N. minutus* are endangered and *B. vosseleri* is vulnerable.
19. This survey also failed to locate three species of Eastern Arc near endemic vertebrates previously recorded at the site: Woolly bat (*Kerivoula Africana*), White-toothed shrew (*Crocidura monax*) and Abbot's duiker (*Cephalophus spadix*). The latter two species are vulnerable to extinction and Abbot's duiker has not been recorded in published papers in Uluguru North FR since 1950. It is under severe hunting pressure.
20. The most abundant species in each taxon group in the FR were: *Praomys* and *Hylomyscus* for rodents (5.4 and 3.6 individuals per 100 sherman trap nights, excluding recaptures); *Sylvisorex howelli* for shrews (4.9 individuals per 100 bucket pitfall trap nights); *Probeviceps macrodactylus loveridgei* (4.5 individuals per 100 bucket pitfall trap nights) and *Leptopelis uluguruensis* (11 individuals in 23.45 man hours) for amphibians, and; *Nectarinia olivacea* and *Cryptospiza reichnovii* for birds (1.8 and 1.3 individuals per 1000 net metre hour).

21. Several important bird species were recorded by this study: Uluguru bush-shrike (*Malaconotus alius*), a rare Uluguru endemic, which was recorded at four different localities in the forest above Bagilo village between 1600 – 1800m asl; Loveridge's sunbird (*Nectarinia loveridgei*), an Uluguru endemic, which was more abundant at 1300m and 1700m asl in this study; and Mrs Moreau's warbler (*Bathmocercus winifredae*), an Eastern Arc endemic whose largest population is in the Uluguru Mountains and was observed in this FR.

Human disturbance

22. This study conducted 17 transects of a total length of 15.15 km in Uluguru North FR. A total of 4,059 poles (defined as woody stems 5-15 cm dbh) and 3,807 timber trees (defined as woody stems 15cm dbh and above) were recorded. An average of 240.6 live, 11.6 dead and 15.8 cut poles were recorded per hectare, with an average of 214.8 live, 30.4 dead and 6.1 cut timbers recorded per hectare.
23. The transects were split into nine 'edge' (starting 0 -500m from the forest edge) and eight 'interior' transects (starting 500m and beyond from the forest edge). Comparison of these data using Mann Whitney U test revealed that pole and timber cutting is greater at the forest edge (cut poles, $Z = -2.814$, $P < 0.005$; cut timbers, $Z = -2.732$, $P < 0.006$).
24. Of the total poles and timbers recorded, 5.9% of poles and 2.4% of timbers were cut. However, when comparing old (three months and over) and new (less than three months) cutting, 91% and 86% were old cut poles and timbers, respectively. Most of these cutting data were recorded from the west of the mountain, but the majority (85.7%) of new cutting was recorded in the east near Tegetero mission along two transects (one and five).
25. Comparison of two datasets, the first from year 2000 (O.Hymas) and the second from 2005 (this study) allowed analysis of changes in human disturbance within the forest over time. Analysis of the data from nine edge transects on the east side of Uluguru North studied by Hymas and the east edge transects of this study shows no significant difference in the levels of pole cutting has occurred over the last five years ($Z = -1.197$, $P < 0.231$). However there has been a significant decrease in timber extraction from 2000 to the present ($Z = -4.633$, $P < 0.001$).
26. Assessment of the canopy cover along the transect lines revealed that few areas had large open gaps indicating little large scale disturbance or timber extraction. Twelve of the 17 transects had 75% of the line with $>51\%$ canopy cover. No transect had 75% of the line with 0-10% canopy cover along the transect, whilst only one had 75% of the transect line with 11-50% canopy cover.
27. Invasive species, such as *Rubus* brambles and *Maesopsis eminii* were observed around Morningside and Bunduki (*Rubus*) and at the forest edge near Tegetero and Kinole (*M. eminii*). However, the impact is minimal and not yet of concern, but should be monitored to prevent the extent of spread that is occurring in Uluguru South FR.
28. Hunting prevalence is low in Uluguru North FR, with only three monkey traps and one rodent trap recorded along the transect lines. The absence of dogs (either by visual or audio records) within the FR also indicates low hunting rates (in contrast to Uluguru South FR).
29. Firewood collection was seen on the west of the mountain above Morningside near basecamp two, with deadwood available along major pathways; activities such as ring-barking to facilitate firewood availability were not observed.
30. The records of illegal trade of chameleons at Bunduki, butterfly and moth collections at Morningside and the beetle (*Megalorhina harisi*) collection at Bagilo are of concern, particularly with the high richness of endemic chameleon species located in the forest reserve.

31. There is a lack of clear forest boundaries are found on the east; this should be addressed by tree planting as clear borders will help decrease encroachment into the forest. One such case was observed above Morningside where newly planted border trees had been removed to allow clearance of the forest.

Management and Monitoring Recommendations

32. Active patrols in the reserve by Forest Officers, involving local communities, such as environmental committees, to monitor activities such as pole cutting, pitsawing and tree clearance for farmland.
33. Clear border demarcation by planting boundary trees and / or beacons; this is particularly important in the east of the reserve. Encroachment of the forest is of particular concern as the greatest forest loss to date is from this mid altitudinal band (600m – 1600m asl) where endemic plants and vertebrates exist.
34. Consideration should be given to trying to reforest Bunduki gap to rejoin Uluguru North and South FRs, in light of the forest loss over time at this altitudinal band and the known negative effects on biodiversity value of reducing forest area and increasing fragmentation.
35. Monitoring the impact of human disturbance within the FR by repeating the disturbance transects from this study in five years and comparing to the datasets from 2000 and 2005.
36. Monitoring the extent of *Rubus* to prevent the spread reaching the level found within Uluguru South FR.
37. Monitoring the extent of *Maesopsis eminii* to ensure no spread of this invasive species.
38. Monitoring floral species change and forest structure by remeasuring the vegetation plots established in this study after five years to allow comparison of dbh values and species composition and abundance in vegetation and regeneration plots.
39. Monitoring the illegal trade of chameleons, butterflies, moths and beetles.
40. Biological monitoring of the most abundant flora species in the vegetation plots by remeasuring the vegetation plots established for this study. Those species are: *Myrianthus holstii*, *Newtonia buchananii*, *Leptonychia usambarensis*, *Aphloia theiformis*, *Parinari excelsa*, *Sorindeia madagascariensis* and *Trilepsium madagascariense*.
41. Biological monitoring of the most abundant fauna species in each taxa from systematic trapping methods of Sherman traps, bucket pitfall traps and mist netting by repeating the study in five years. Those species are *Praomys* and *Hylomyscus* for rodents; *Sylvisorex howelli* for shrews; *Probeviceps macrodactylus loveridgei* and *Leptopelis uluguruensis* for amphibians, and; *Nectarinia olivacea* and *Cryptospiza reichnovii* for birds.
42. Species level monitoring of key faunal and floral indicators, including those endemic, rare, threatened and/or have not been recorded in this study. The following key species are suggested:
 - Abundance and coverage in vegetation plots of *Ocotea usambarensis*, *Allanblackia stuhlmanni* and *Allanblackia uluguruensis*
 - Presence and population abundance of Abbot's duiker (*Cephalophus spadix*)
 - Population abundance of Black and white colobus (*Colobus angolensis*) and Mountain galago (*Galagoides orinus*)
 - Population abundance and distribution of *Sylvisorex howelli*, *Crociodura monax* and *Crociodura telfordi*

- Population abundance and distribution of Loveridge's sunbird (*Nectarinia loveridgei*) Uluguru bush-shrike (*Malaconotus alius*), Mrs Moreau's warbler (*Bathmocercus winifredae*) and Usambara eagle owl (*Bubo vosseleri*)
 - Presence of Banded green sunbird (*Anthreptes rubritorques*)
 - Presence of Ornate shovel-snake (*Prosymna ornatissima*) and Uluguru blind snakes (*Typhlops uluguruensis* and *Typhlops* sp. nov) at mid-altitude (1500m asl)
 - Population abundance of Horned bush-viper (*Atheris ceratophorus*)
 - Population abundance of all chameleons, in particular *Rhampholeon uluguruensis*
 - Population abundance of *Nectophrynoides* species and *Leptopelis uluguruensis*
43. Intensify research on amphibians to discover additional probable new species, in particular within the genus *Nectophrynoides*.

1. INTRODUCTION

1.1 Report Structure

This report provides a floral and faunal inventory recorded during six weeks of biodiversity survey of the Uluguru North Forest Reserve. Each species is described in terms of its ecological requirements and endemic status.

The report is comprised of six main sections: Executive Summary; Introduction; Methods; Results; Discussion; Appendices.

- The Executive Summary provides an overview of the UCBS project inclusive of key findings.
- The Introduction provides background information to the project aims and objectives as well as a brief history of previous research in the Uluguru Mountains.
- The Methods present a summary of the research methodologies implemented throughout this project. For a complete explanation of methodologies, please refer to Uluguru Component Biodiversity Survey Methods Manual (Volume I).
- The Results report the findings of this UCBS project within three main subsections: Flora; Fauna; Human disturbance. Each subsection quantifies relevant data and these provide the basis with which to monitor changes over time and to what extent, intensity and direction.
- The Discussion summarises the results and compares them to previous research within Uluguru North and South FRs, and concludes this report.
- The Appendices provide details of the CARE-Tanzania Consultant Agreement, Taxonomic verifications, GPS co-ordinates and full species lists for flora and fauna. The lists of faunal species found in the appendices update those of Daggart et al (2005), thus now providing a full inventory of those species recorded in the forest reserve over time. Species that were not recorded in the past but have been recorded by UCBS project have been shaded in grey and are found in the appropriate appendices.

1.2 Background to the Biodiversity Survey

The Conservation and Management of the Eastern Arc Mountain Forests (CMEAMF): Uluguru Component (GEF/UNDP: URT/01/G32) is a project of the Forest and Beekeeping Division of the Ministry of Natural Resources and Tourism and it is funded by the Global Environment Facility through the United Nations Development Programme. CARE International in Tanzania implements the Uluguru Component under terms of an agreed Memorandum of Understanding with the Forest and Beekeeping Division that was signed on the 12th August 2003.

The purpose of the Uluguru Component is:

Improved forest management and conservation and improved land husbandry practices in the Uluguru Mountain forests and adjacent villages implemented by local communities, government authorities and other stakeholders.

Frontier-Tanzania* was contracted by CARE International in Tanzania to undertake a biodiversity survey to provide a baseline to assess the impact of the project on the flora and fauna of the Uluguru Mountains and generate information relevant to the development of management plans for the Uluguru Mountain forests (Appendix 1). This report serves to detail the findings of the survey of the

* Frontier-Tanzania a collaboration between the University of Dar es Salaam and the Society for Environmental Exploration

Uluguru North Forest Reserve. It provides an inventory of flora and fauna compiled throughout the fieldwork, highlighting records of particular interest. An assessment of the level of human disturbance within the area is also made, giving the extent and potential threat of each form of 'disturbance' recorded.

Specific aims and objectives of the survey were defined in the ToRs as:

Aim: To undertake systematic biodiversity and resource-use assessment of the Uluguru North and Uluguru South Forest Reserves to establish a baseline for measuring the Uluguru Mountains Environmental Management and Conservation Project (UMEMCP) impact on maintaining biodiversity values and reducing threats in the longer term.

Objectives of the biodiversity assessment:

1. Major types of forest disturbance and proportion of habitat affected by forms of disturbance;
2. Population density of key floral indicator species e.g. *Allanblackia uluguruensis*; *Ocotea usambarensis*;
3. Species richness of flora and vertebrates; and
4. Crude abundance of endemic; globally threatened and Eastern Arc characteristic species.

1.3 Linkages to Frontier-Tanzania Forest Research Programme

Frontier-Tanzania has been conducting baseline biodiversity surveys within biologically the rich Eastern Arc and Coastal forests since 1989. Technical reports have been published from work in the Coastal forests and the following Eastern Arc Mountains: East Usambaras, Udzungwa, Mahenge; and Mpanga / Kipengere Game Reserve. *

During the East Usambara forest biodiversity surveys, Frontier-Tanzania Forest Research Programme (FT FRP) developed a methodology that allowed systematic baseline biodiversity surveys to be conducted in a cost-effective way. This methodology has been applied to the present study and is comprehensively documented in Volume I of this series of project reports[♦]. Frontier-Tanzania provides feedback to the Catchment Forest Project of the Forest and Beekeeping Division of the Ministry of Natural Resource and Tourism (FBD) on the strength of their research findings, as well as training in survey techniques used to facilitate future monitoring initiatives. The long-term aim of FT FRP is to provide baseline information about targeted areas, those understudied and unknown, within the Eastern Arc Mountains, thus helping to further scientific knowledge, identify conservation values and allow effective development of forest management plans.

1.4 The Uluguru Mountains

The Uluguru Mountains are one of thirteen mountain ranges that comprise the Eastern Arc Mountains, sweeping from Southern Kenya through Tanzania (see Figure 1). The Eastern Arc Mountains have been recognised as a Biodiversity Hotspot, a Globally Important Ecoregion and an Endemic Bird Area by conservation organisations such as Conservation International (Mittermeier et al 2004; Myers et al 2000), BirdLife International (ICBP 1992; Stattersfield

* Refer to Frontier Publications List www.frontier.ac.uk. Selected reports will be available for download on the website shortly and can also be accessed at www.easternarc.or.tz

♦ Report series: Uluguru Component Biodiversity Survey Methods Manual 2005 (Volume I); Uluguru Component Biodiversity Survey Uluguru South Forest Reserve 2005 (Volume II); Uluguru Component Biodiversity Survey Uluguru North Forest Reserve 2005 (Volume III)

et al 1998) and the Worldlife Fund for Nature (Olson and Dinerstein 1998, Burgess et al 2004).

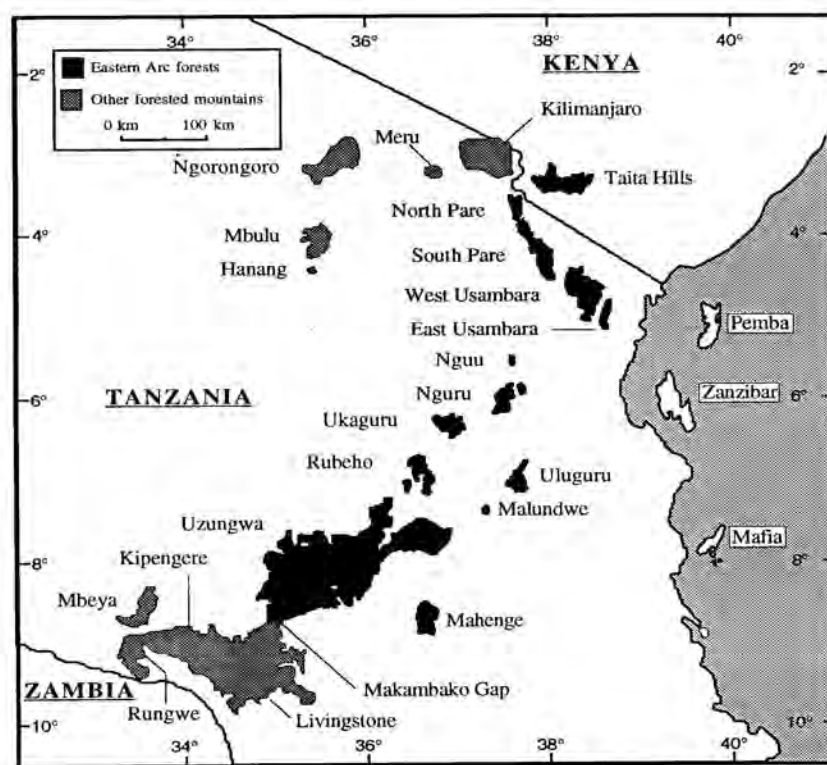


Figure 1 Map of the Eastern Arc Mountains that support moist forest. Eastern Arc Forest shown in black. From Lovett (1993)

The Eastern Arc Mountains are ancient crystalline block-faulted mountains upon which forests grow under the climatic influence of the Indian Ocean. Due to millions of years of isolation the Eastern Arc Mountains have diversified into a biologically rich area for both flora and fauna species. Many of these species are endemic, contained predominantly within around 5,000 sq. km of highly fragmented and isolated forests. Approximately 30% of vascular plants (c.650 species) and 74 vertebrate species (Burgess et al 2002) in the Eastern Arc Mountains are endemic.

The Uluguru Mountain range is located in Morogoro District, Morogoro Region within 180 km of the Indian Ocean. It stretches 45 km on a north-south axis and is divided into two main ridges by the Bunduki Gap, a saddle which until 1955 joined the two ridges. Deforestation for clearance of new farmland is the major cause of habitat loss and subsequent losses occurring throughout the mountains. An estimation of the potential natural closed forest cover is 500 km² but due to deforestation this had been reduced to 300km² in 1955 and to c.230km² by 2001; forest loss has been greatest at 600m – 1600m asl outside the reserves (Burgess et al 2002). The 1.7% forest loss per annum from 1955-1977 has declined to 0.6% per annum. However, with the Uluguru human population growth being approximately 2.5 – 3% per annum (a double in the population over 20 years) the threats are huge to the forest. Almost all of the remaining forest is found within forest reserves at 1700m asl and above. The two largest forest reserves (FRs) containing almost all of the high altitude forest fall within Uluguru North Forest Reserve and Uluguru South Forest Reserve. These FRs encompass a total area of 256.50 km² with 83.57 km² in Uluguru North FR and 172.93 km² in Uluguru South FR. Uluguru North rises to 2340m asl and Uluguru South to 2638m asl. These mountains rise steeply out of the foothills and plains below, and are separated from the Selous Game Reserve in the east and south east, and Mikumi National Park in the south west, by a mosaic of agriculture and woodland.

1.5 Previous research and studies

The Uluguru North FR has been the subject of biodiversity research since the early part of the last century (for example, Barbour and Loveridge 1928). The vegetation and water catchment have also been studied (Pócs 1974, Pócs 1976). More recently studies conducted in the Uluguru North and South FRs have documented both biodiversity values and human disturbance, with most time spent in Uluguru North FR: a vegetation survey conducted during the 1980's and up to 1992 (Lovett 1985, Lovett 1986, Lovett 1988, Lovett 1990, Lovett and Pócs 1993, Lovett 1996, Lovett et al in press), a fauna survey conducted in 1993 (Svendsen and Hansen 1995), a human disturbance survey conducted in 2000 (Hymas 2001) and a biodiversity survey conducted in 2000 (Doggart et al 2005, Perkin 2000).

Fourteen vertebrate species and two sub-species are found only in the Uluguru Mountains. More than 135 plant taxa are endemic to the Ulugurus (Burgess et al 2002). The Uluguru Mountains were recently assessed as the third most important of the Eastern Arc Mountains in terms of conservation of endemic fauna (Burgess et al 1998). Within a National Survey of Catchment FRs in 1993 it was ranked most important (Lovett and Pócs 1993) given its extensive water catchment value, supplying both Morogoro and Dar es Salaam via the Ruvu, Morogoro and Ngerengere rivers. The economic significance of these forests, as well as their biological significance, makes the Uluguru Mountains a main target of conservation efforts.

Recent surveys of birds (e.g., Stuart and Jensen 1985, Jensen and Brøgger-Jensen 1992, Svendsen and Hansen 1995, Tøttrup et al 2004, Doggart et al 2005) have failed to locate the endangered Tanzanian mountain weaver (*Ploceus nicolli*) and the vulnerable Banded green sunbird (*Anthreptes rubritorques*) which were previously found in the mountains. Five endemic species of vertebrate have not been recorded in the last 10 years (prior to this study): three endemic snakes (*Typhlops uluguruensis*^{*}, *Typhlops* sp. nov and *Prosymna ornatissima*); the sub-species of the Golden mole (*Chrysochloris stuhlmanni tropicalis*); and one amphibian (*Hyperolius tornieri*). Of particular concern are those species typically confined to lower altitudes where destruction of forest is at its greatest, such as the snakes and Banded green sunbird.

The most recent biodiversity survey of the Uluguru Mountains conducted in 2000 (prior to this study) (Doggart et al 2005) located all near-endemic species of mammal, reptile and amphibians shared with other Eastern Arc Mountain forests. Rare species previously known from other Eastern Arc Mountain forest blocks and *not* the Uluguru Mountains were also discovered e.g. Horned bush-viper (*Atheris ceratophorus*). Other research has described five new *Nectophrynoides* species (toads) last year alone (Menegon et al 2004), two of which are Uluguru endemics (*Nectophrynoides pseudotornieri* from Uluguru North FR and *Nectophrynoides laevis* from Uluguru South FR). This suggests that there may be other undiscovered species that exist and that may have existed in deforested areas.

* One specimen of *T. uluguruensis* has been collected *near* Uluguru North FR (pers comm. Simon Loader, British Natural History Museum)

2. STUDY SITE

2.1 Location

Uluguru North Forest Reserve (FR) is located on the main Uluguru range, Eastern Tanzania. It covers an area of 83.57 km² (8,356.7 ha) in Morogoro District, Morogoro Region, covering land approximately 5 km east of Morogoro town, located on latitude 6° 51' – 7° 01' S and longitude 37° 37' – 37° 45' E. The Selous Game Reserve is located to the south, with Mikumi National Park to the south west. Agricultural land and woodland plains separate these protected areas from Uluguru North FR.

2.2 Site Description

Name: Uluguru North Forest Reserve

Area: 8 356.7 ha

Status: Catchment Forest Reserve [protective]

Maps: Ordnance Survey topographic maps 1:50,000, Series Y 742 183/3, 201/1; Forestry and Beekeeping Division Map No. Jb. 536

Delineated and described on Forest and Bee Keeping Division Map No. Jb. 536 in 1986.

Gazettement notice GN 219 of 23/06/1961, GN 578 of 22/11/1963.

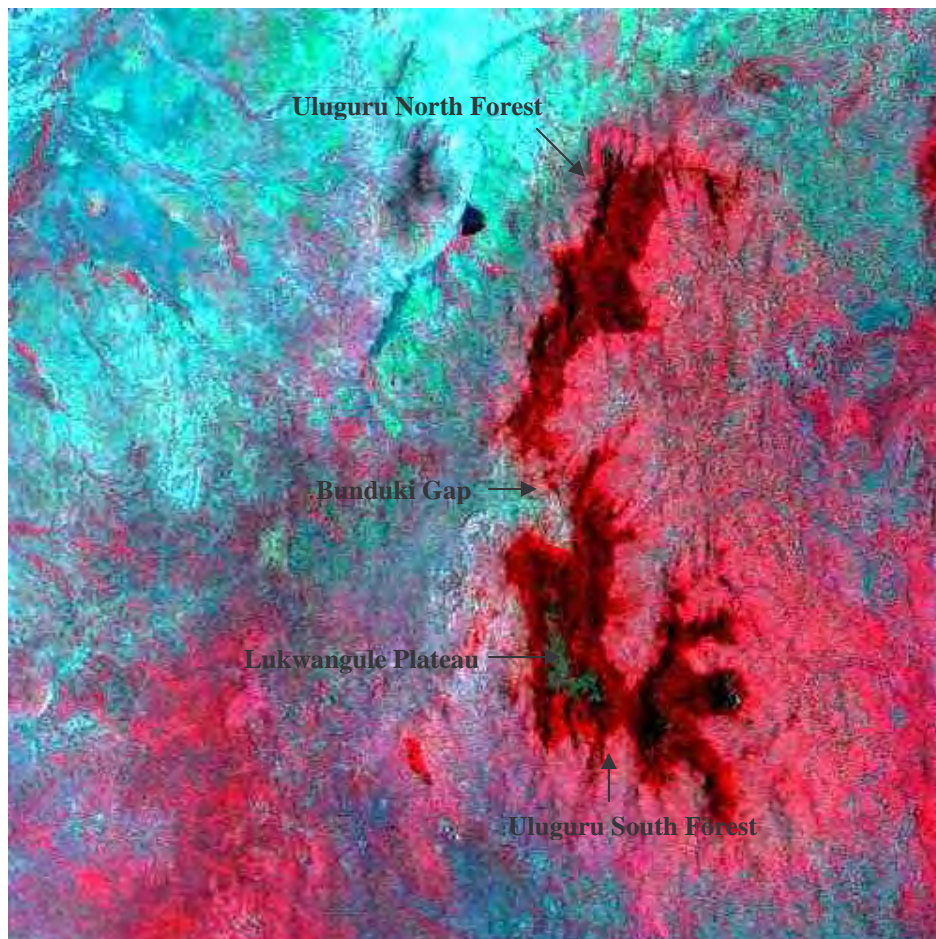


Figure 2 Spot satellite image of the Uluguru Mountains (2003) (sourced from Dr. N. Burgess)

Red indicates closed forest, and it graduates to pink indicating woodland, tree-crop agricultural systems, agroforestry and bracken. Green indicates no cover at all, which can represent natural grassland such as the Lukwangule plateau, or areas cleared of trees such as the east side of Uluguru South FR.

2.3 Topography

Uluguru North FR is largely inaccessible due to extremely steep rocky outcrops, especially on the west side of the mountain (Figure 3). The main summits in the FR are: Lupanga (2138m), Kinazi (2150m), Bondwa (2120m), Nziwane (2270m), Magari (2340m), Miwa (1900m), Mnyanza (2140m) and Kifuru (2010m). Submontane forest occurs on the eastern slopes between 800 and 1500m asl, with the best stands above Bagilo and Tegetero villages. There used to be significant areas of sub montane forest in the 'chiefly' forest that was not included in Uluguru North FR above Kinole on the Kitumbaku Hills, but this has largely been cleared since 1992 (Burgess et al 2002). On the western slopes this forest type is restricted to valley bottoms near to the lower edge of the FR. Montane forest occurs between 1500 and 1900m asl. Upper montane forest occurs on the wetter slopes and ridges in the cloud belt, with elfin forest (low canopy height) on the highest ridges. The eastern part of the reserve is a water catchment area for the Ruvu River, which supplies water to Dar es Salaam. The western side supplies Morogoro and surrounding villages with water.

Soil types are acidic lithosols and ferralitic red, yellow and brown latosols, which have developed on Precambrian granulite, gneiss and migmatite rocks (Lovett and Pócs, 1993).

2.4 Climate

The Uluguru Mountains are one of the wettest areas in Tanzania, particularly the eastern slopes with 2900 – 4000 mm per annum and 1200-3100 mm per annum on the western slopes. There is no marked dry season. Daytime temperatures range from 22°C to 17°C (min/max) on the lower slopes, while high altitudes are colder but no records are available (Lovett and Pócs, 1993).

2.5 Land Use

Most of the reserve is covered in moist forest. Cultivation occurs up to the FR's borders and occasionally within the FR itself. Many well used paths cut across the FR connecting villages surrounding it. These facilitate entry into the interior of the FR, which can be exploited to hunt and extract timber and non-timber resources. Fires outside of the forest threaten the FR in the dry season and intensive agriculture increases risk of landslides. Clearance of land on the edge and inside of the FR removes the regenerating vegetation. Activities within the FRs are illegal. Catchment FRs have protective status meaning resources should not be extracted, however within Uluguru North illegal activities still occur.

2.6 History and Status

Uluguru North FR was gazetted for its extremely important water catchment value by the Germans in 1906 and to protect the remaining moist forests. Some of the western boundary and also part of the southern boundary near Bunduki are well demarcated by *Eucalyptus* and *Cupressus* trees. The eastern side of the FR is not clearly demarcated. Although the lowland forests for example Mkangala Local Authority FR, Mvuha and Chamanyani Catchment FR are being severely degraded by charcoal burning, pitsawing, pole extraction, mining and fire, the higher altitude forests on the western slopes of the Uluguru Mountains have also been exploited and timber extracted, for example for fuelwood. Hunting for large mammals has occurred for many years and continues. It is also well known that collectors buy chameleons from around the Bunduki area and from Bagilo village in the east. The west side of the mountain is intensively cultivated using terracing and fertiliser. Bananas are a main source of income and they cover the slopes below the FR, along with maize. At Bunduki, the southern end of Uluguru North FR, the Forest and Beekeeping Division has established tree nurseries outside of the reserve, mainly for use as border marking with a small proportion of trees for villages. Both Wildlife Conservation Society of Tanzania (WCST) and Uluguru Mountains Agricultural Development Project (UMADEP) work in Uluguru North assisting the communities in good agricultural practices and environmental education.

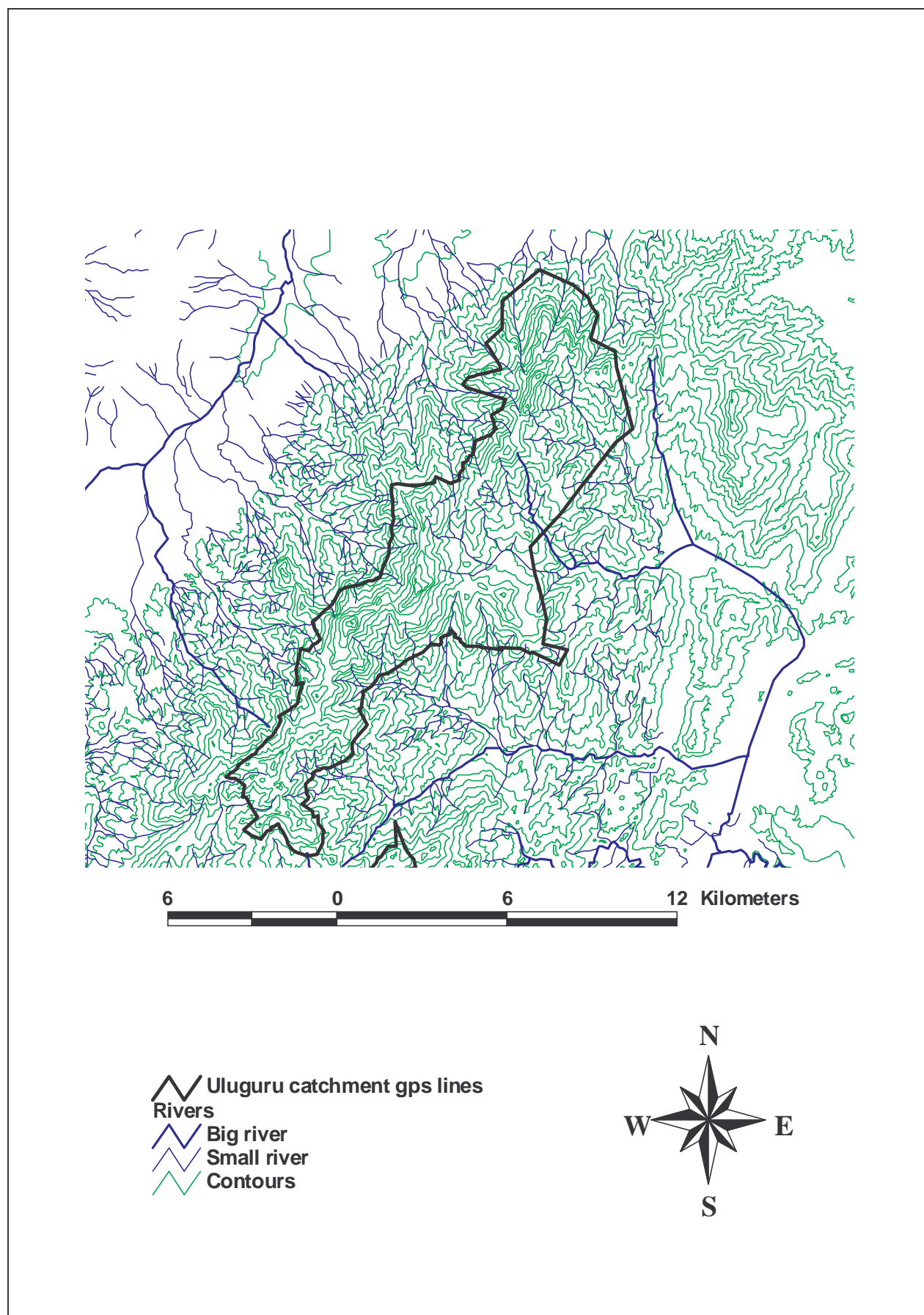


Figure 3 Topographical map of Uluguru North FR

3. METHODOLOGY

Please refer to the *Uluguru Component Biodiversity Survey Methods Manual 2005 (Volume I)* for full details of the systemic survey techniques. The original dataset is lodged at the University of Dar es Salaam. Soft copies of this dataset are provided with this report series.

Fieldwork was conducted during the end of the short rains between 5th January and 15th February 2005 for six weeks. Survey work concentrated on investigations of the reserve's flora, fauna and human disturbance, with methods based on those employed by FT FRP in the East Usambara Biodiversity Survey and Udzungwa Mountains Biodiversity Survey. Two full zoological sites (with 100 sherman traps and three bucket pitfall lines) and two with 20 sherman traps only were conducted (Figure 4), 36 vegetation plots (Figure 5) were surveyed and 17 transect lines (Figure 6) were undertaken within the FR. The survey effort for each technique is shown in Table 3. For worksite descriptions see Table 4. Please see Appendix 4 for GPS co-ordinates of all working locations.

Three criteria of ecological type, habitat preference and endemic status were used to analyse the uniqueness of the biodiversity of the reserve and its vulnerability to disturbance. Key definitions and information sources are outlined below.

3.1 Key definitions and information sources

Ecological Type (Iversen, 1991b)

- FF – Forest dependent species: Species previously recorded as restricted to primary or closed canopy forest only e.g. wet evergreen forest, dry evergreen forest and/or riverine forest; does not include forest edge or secondary forest species;
- F - Forest dwelling but not forest dependent: Species previously recorded in primary or closed canopy forest as defined above and/or in forest edge, clearings, secondary forest, deciduous forest and woodland, thus they may also be adversely affected by forest destruction;
- O - Non-forest species: These are species that do not occur in primary or secondary forest or forest edge e.g. species that have been recorded in bushland, heathland, thicket, secondary scrub, grassland, rocky outcrops, swamps, wastelands and cultivation.

Habitat (Pócs, 1976)

Contrary to the usual categorisation of vegetation types by Lovett and Pócs (1993), Pócs' (1976) study mapping the Uluguru Mountains vegetation has been used, as it is a more accurate representation of vegetation change according to altitude and rainfall within this Eastern Arc block.

- L – Lowland: Species occurring at altitudes of <800m above sea level;
- S - Submontane: Species occurring at altitudes of 800m – 1500m above sea level;
- M - Montane: Species occurring at altitudes of 1500m – 2100m above sea level.
- U – Upper montane: Species occurring at altitudes of >2100m above sea level.

Endemic Status (based on Iversen, 1991b):

- E – Endemic: Occuring only in the Uluguru Mountains;
- N – Near endemic: Species with limited ranges in the Eastern Arc mountains and/or the East African lowland forests;
- W - Widespread distribution

The categories are based on information from various sources. For plants the ecological type and endemic status are primarily based on Iversen (1991b). Forest dependent species refers to those species listed as being exclusively associated with Iversen's categories 1a (wet evergreen forest), 1b (dry evergreen forest) and/or 1c (riverine forest). Species defined as forest dwelling also occur in other habitats.

Information provided in the appendices with regards to flora is taken from the Flora of Tropical East Africa (FTEA) or the List of East African Plants (LEAP) (Knox 2000)

Endemic and near endemic status for plants are taken from Iversen (1991b) and FTEA categories Tanzania T3, T6, T8 and Kenya K7. Rare plant species are defined by the LEAP database as being present in less than two out of eight vegetation regions in Tanzania.

For animals, endemic and near endemic status was gleaned from a table from Burgess et al (in press) which has up to date information for forest, endemic, near endemic and red list status.

The following references were also used for identification purposes (in order of priority):

Mammals:	Kingdon (1997), Kingdon (1989), Kingdon (1974)
Birds:	Stevenson & Fanshawe (2002)
Reptiles:	Spawls et al (2002), Howell (1993).
Amphibians:	Channing (2001), Passmore and Carruthers (1995), Schiotz (1999)
Plants:	FTEA, LEAP, Palgrave (1983), Polhill (1988), Heywood (1993), Mabberley (1997)

Flora and fauna lists were compiled with regard to status and threat within Tanzania and East Africa, using Burgess et al (in press) for IUCN (2004) and also CITES (2002). Explanations of each are given below:

Threat status IUCN

CR = Critically endangered; *extremely* high risk of extinction in the wild

EN = Endangered; *very* high risk of extinction in the wild

VU = Vulnerable; high risk of extinction in the wild

NT = Near threatened; Taxa that do not qualify as Critically Endangered, Endangered or Vulnerable now, but is close to qualifying for or is likely to qualify for a threatened category in the near future

DD = Data deficient

Threat status CITES

CITES I = Threatened with extinction and excluded from commercial international trade

CITES II = Not yet threatened with extinction, but may be so if trade is not regulated, thus export permits are required

It must be noted that many newly described species will not be found within any listing of threat status, but are more than likely to come under a Vulnerable or greater category once recognised.

Within the tables in the Appendices acronyms are used for three projects to cite the most recent records within the FR for each species. The faunal species lists update those of Doggart et al (2005) who compiled a lists for each FR based on all known research conducted prior to this work. Other recordings directly cite the authors:

S&H 1995	Uluguru Biodiversity Survey	Svendsen and Hansen 1995
UMBCP 2000	Uluguru Mountains Biodiversity Conservation Project	Doggart et al 2005
UCBS 2005	Uluguru Component Biodiversity Survey	Frontier-Tanzania 2005

Table 3 Summary of survey effort

Survey technique (and sampling unit)	Target taxa	Total sampling effort
Flora		
Vegetation plot (VP)	Trees, shrubs, herbs	36 VPs
Regeneration plot (RP)	Trees, shrubs, herbs	36 RPs
Opportunistic observation/collection	Trees, shrubs, herbs	-
Fauna		
Sherman traps (trap-nights)	Small mammals	1650 trap-nights
Bucket pitfall traps (trap-nights)	Reptiles, amphibians, rodents	528 trap-nights
Animal signs transects	Larger mammals	18 transects, 16.2 km
Bat netting (mist-net hours)	Bats	97 mist-net metre hours
Bird surveys (mist-net hours)	Birds	28, 588 mist-net metre hours
Timed searches (man-hours)	Reptiles, Amphibians	23.45 man-hours
Opportunistic observation/collection	All animal taxa	-
Human disturbance		
Transects	Human disturbance	17 transects, 15.15 km
Opportunistic observation	Human disturbance	-

Table 4 Work site descriptions

Site no.	Waypoint	Description of location	Zoological site	Grid ref (E) UPS	Grid ref (N) UTM	Altitude (m)
1	UN-BC1	Basecamp 1, at Tegetero mission	Zoological site 1	358436	9232832	1000
2	UN-SC1	Satellite camp 1, forest edge coming along path from Kinole village	Bird mist netting & 20 Sherman traps	360542	9239747	980
2	UN-SC2	Satellite camp 2, forest edge, by river on Morogoro path	Bird mist netting & 20 Sherman traps	357385	9236579	1300
2	US-SC3	Satellite camp 3, at forestry campsite near Bunduki village		348832	9223207	1284
3	UN-BC2	Basecamp 2, forest edge at Morningside	Zoological site 2 & bird mist netting	352821	9237947	1480

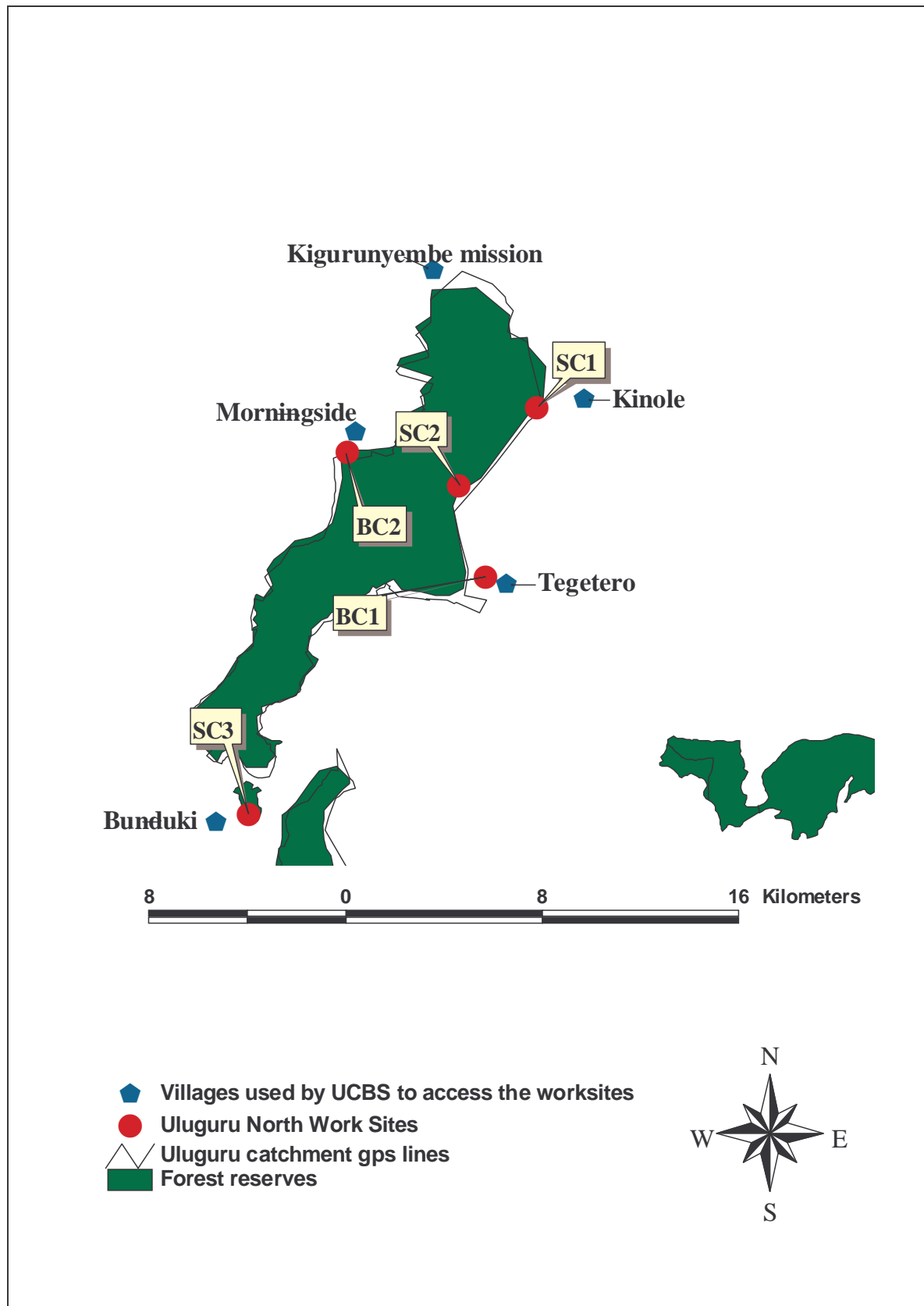


Figure 4 Map of work sites at Uluguru North FR

Zoological sites and bird mist netting sites were based at basecamps (BC) and satellite camps (SC) one & two. On the GIS map, there are alignment problems between the forest / contour layers and the forest reserve boundary layer, particularly the northern boundary / forest interface.

3.2 Flora

A species inventory was compiled of trees and shrubs found within the Uluguru North Forest Reserve (FR). Simple, quantitative and repeatable methods were employed; these results are comparable with other forest surveys undertaken by FT FRP, and can be used for future monitoring purposes.

The forest reserve was stratified into 'edge' (classified as starting from forest edge and up to 500m inside the forest) and 'interior' (starting 500m and beyond from the forest edge), with 900m disturbance transects placed randomly within these two strata. Vegetation and regeneration plots were placed along the disturbance transect where vegetation was considered representative. The location of vegetation plots and disturbance transects were recorded using Global Positioning System (GPS) (Appendix 4).

Three methods were used to analyse forest composition:

- (1) vegetation plots;
- (2) regeneration plots;
- (3) opportunistic observations.

- *Vegetation plots (VPs)*

Usually two plots 50m x 20m were sampled along each 900m disturbance transect line, which produced a sampling intensity of 0.04% across the overall FR area. Within each vegetation plot, every tree with a 10cm diameter at breast height (dbh, 1.3m) and over was recorded, marked with red paint, and identified. A botanist provided the field identification of plant species. Specimen collection was made of fertile individuals and species difficult to identify. These were given preliminary identification at the University of Dar es Salaam herbarium before being sent to Missouri Botanical Gardens, USA.

- *Regeneration plots (RPs)*

The regeneration layer was sampled within 6m x 6m nested subplots at the centre of each vegetation plot. All trees and shrubs with <10cm dbh were counted and identified within these plots. The ground cover (herbaceous vegetation, bare soil, leaf litter and rocks), and the dominance of other vegetation (such as grasses, forbs, mosses, lichens and ferns) were documented as percentages.

Systematically sampled vegetation data are presented in the form of checklists and analytical calculations summarised in tables, graphs and maps. These data will provide the baseline information with which to monitor vegetation plot dbh and species composition changes over time.

- *Opportunistic collections and observations*

Opportunistic collections and observations of ground, shrub and tree floras were made throughout the survey. Fertile individuals were collected as specimens and dried in the field using a kerosene stove. Detailed field notes were made of each specimen and are stored with the specimens. All botanical specimens are held at the University of Dar es Salaam's Herbarium, Tanzania, and sent to Missouri Botanical Gardens, USA. Opportunistic data are presented as a checklist, with location information for specimens that were collected.

A botanist was employed to identify all opportunistic observations and individuals recorded in VPs and RPs. When necessary and if possible, up to five specimens of leaves and preferably flowers and fruits were taken to aid identification of an individual. All specimens were pressed and dried in the field and later identified in the University of Dar es Salaam's Herbarium, with specimens also being sent to the National Herbarium, Arusha, Tanzania; Missouri Botanical Gardens, USA, and; Kew Botanical Gardens, UK (see Appendix 2 for named experts used for taxonomic verifications).

Vegetation data were analysed using various statistical techniques. The diversity of species was determined using a Shannon Wiener Diversity Index. This diversity index was preferred as it looks at the species richness as well as their proportional abundance. Parametric t – test and one-way analysis of variance (ANOVA) test were used to compare various parameters with aspect and altitude. Both techniques compare the arithmetic mean and require a normal distribution with equal variance.

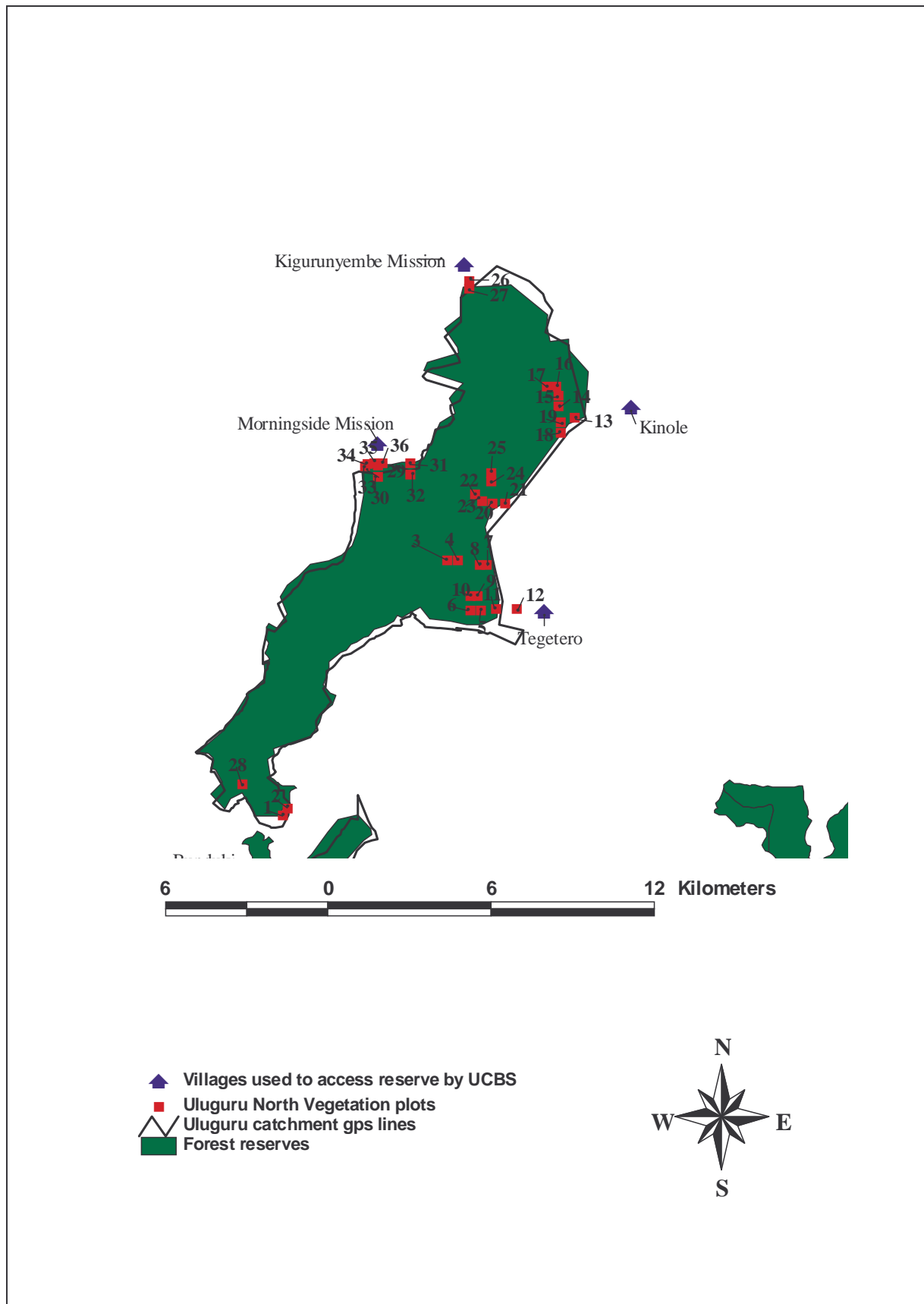


Figure 5 Map of vegetation plots in Uluguru North FR

3.3 Fauna

The fauna of Uluguru North FR was studied to assess diversity within specific taxonomic groups. Inventories were compiled of mammal, reptile, amphibian and bird species. Practicalities of capture methods, identification techniques and potential information that could be extracted from these data influenced the taxonomic groups chosen for the study. The results of the inventories were analysed to assess the relative biodiversity value of the reserve's fauna. Relative abundance of each taxa was calculated by correcting for the differences of survey effort between sites thereby quantifying capture rates per chosen unit (Sherman trap night and bucket pitfall trap night units are: X animal per 100 trap nights and mist net units are: X birds per 1000 mist net metre hours). Such data can be used for future monitoring.

Within Uluguru North FR, target groups of fauna were surveyed using a combination of standardised, repeatable methods at 'zoological trappingsites', which were surveyed for eight nights each. Each zoological trap site and bird netting site was located within 500m of a basecamp. Basecamp location was selected to sample representative habitat types within the FR. Transect surveys of dung and other animal signs, and the opportunistic collection and observation of all animals were also implemented. Brief descriptions of the methods employed and trappingsite locations follow.

- *Sherman traps*

Small rodents and insectivores were sampled using 100 Sherman traps (standard size) baited with toasted coconut and peanut butter. At main trappingsites, traps were placed around three bucket pitfall lines, approximately 5m apart. Where appropriate Sherman traps were placed in branches to increase the chances of capturing arboreal species. Two satellite camps were also carried out using 20 Sherman traps laid out for four nights at each site. The number of Sherman traps was reduced due to time constraints. Satellite camps were conducted to focus on vegetation and human disturbance sampling at less accessible sites.

Traps were baited each evening (1600hr or later) for the duration of the trappingsite and checked early the following morning (0800hr or earlier). Traps were closed manually during each day time of the trappingsite. Data regarding the identification, sex, breeding status and biometrics of each animal captured, as well as habitat notes, were recorded on standardised data sheets. Specimens were retained when species level could not be ascertained and in cases where sexed specimens were required; these specimens were subsequently sent to international taxonomic experts (refer to Appendix 2). In the case of small rodents, individuals to be released were each given a distinct mark-code made by trimming small patches of fur in a given pattern. 'Recaptured' individuals were thus identifiable.

- *Bucket Pitfall Traps*

Small mammals, amphibians and reptiles were sampled using bucket pitfall traps. Three 50m linear transects were created at a zoological trappingsite location whereby eleven 10 litre plastic buckets were positioned 5m apart from each other. Buckets were sunk into the ground with their rims flush to ground level. Buckets had small holes in their base to allow rainwater to drain from them. A sheet of vertical plastic (approximately 0.5m high, and no less than 0.2m) was run along the bucket line crossing the centre of each bucket to form a 'drift fence'. A 10-15cm lip of plastic sheeting was left flat on the ground onto which soil and leaf litter was placed to prevent any gap in the drift fence at ground level. Animals moving into the area from either side would be channelled along the plastic sheet towards the bucket traps. Each bucket pitfall line was placed no more than 50m apart, but was located to encompass a range of micro-habitats. Brief habitat notes were taken for each bucket position. Traps were checked early each morning for the duration of the trappingsite period and data recorded on standardised data sheets regarding the identification of each animal captured.

- *Bat mist netting*

Bats were sampled using varying combinations and configurations of mist-nets within the trapping sites. Up to three mist-nets of varying sizes (2.6 m x 2.6 m, 6m x 2.6m, 9m x 2.6m) were utilised at any one time. Nets were placed across assumed 'flight corridors' such as rivers and paths. Nets were

opened at dusk (approximately 1830hr) and checked every 10 to 15 minutes for the duration of the netting session. Data were recorded on standardised data sheets regarding the identification, sex, breeding status, weight and biometrics of each bat captured. Detailed habitat notes were taken for each mist-netting location and the number of net-metre hours calculated for each session.

- *Bird mist netting*

Birds were sampled using varying combinations and configurations of mist-nets within the trapping sites. Approximately 80m lines were cut through the vegetation to permit the erection of the mist nets. This type of methodology targets birds of the lower storey (other birds from mid to upper storey are recorded through visual and vocal observations). Two trapping days were conducted at each mist net site. Nets were opened from approximately 0530 hour until 1815 hour and checked every hour. Nets were closed if rain ensued. Data were recorded on standardised data sheets regarding the identification and whether blood and/or tissue samples were taken. Birds were marked by cutting a small amount off the tail feather to enable identification of recaptures. Net-metre hours were calculated for each session. An ornithologist conducted this work.

- *Timed man-hour searches*

The reptile and amphibian fauna of the reserve was additionally surveyed through timed searches. Searches were conducted during both the day and the night, were of various lengths (1-4 man hours) and were conducted by various numbers of the survey team (2-5 people). Data were recorded on standard recording forms and included the survey effort, habitat and altitude of each search, as well as the identification of any captures. If not taken as specimens, captures were released unmarked.

- *Animal sign transects*

Spoor and other signs of animal presence were assessed along every established transect line (that also sampled human disturbance) through the Forest Reserve (Figure 6). A 5m strip either side of each transect line was assessed for animal dung, tracks and paths, as well as other signs such as burrows, diggings, feathers etc. All animal signs were recorded along with brief geographical and habitat details. To determine identification of indirect evidence, the knowledge of experienced field assistants was utilised in conjunction with the fieldguide Walker (1996).

- *Opportunistic collection and observations*

All taxa were collected and observed on an opportunistic, casual basis throughout the survey period to determine the presence of species otherwise omitted by the standardised techniques. Opportunistic collections of amphibians and reptiles were made with direct and indirect observations of birds and larger mammals recorded. Vocalisations of amphibians were also recorded and identified by Michele Menegon. Within the species lists in the Appendices, the distinction between casual collections and those collected by systematic methods are specified.

3.4 Human Disturbance

- *'Disturbance transects'*

Disturbance transects were used to record the intensity of pole and timber cutting and incidence of other disturbance types in the forest reserve. The GPS positions of the starting point (0m) of each transect were recorded to enable repetitions of data collection to take place in the future to assess changes of disturbance over time. The disturbance transects were randomly placed within the FR (Figure 6). Each 900m transect sampled either the edge (classified as starting from the forest edge and up to 500m inside the forest) or interior (starting 500m and beyond from the forest edge) of the FR. Disturbance was recorded per 50m section along each transect. Every self-standing tree and sapling (not lianas or creepers) 5cm or above dbh was measured within 5m either side of the transect line. Each plant was recorded under one of four categories: live, old cut, new cut or naturally dead. Within these categories a distinction was made between poles and timbers. Poles were classified as having a dbh between 5 and 15cm with a minimum of 2m of relatively straight trunk. Timbers were classified as having a dbh of 15cm or above with a minimum of 3m of relatively straight trunk. These divisions are based on their differences in use. New cut stems were recognised by a cream

coloured slash and classified as freshly cut within recent months (approximately within the past 3 months). Old cut stems were recognised by black coloured slash and classified as old cut (approximately more than 3 months old). Timber and pole cutting data are presented as an average per hectare and summarised in graphs and maps. The level of human disturbance in the forest can be quantified by comparing the categories of live, naturally dead, new cut and old cut within each 50m section of the transect. Other types of human disturbance were noted within each 50m section, such as the presence of fire damage, pitsawing, charcoal production, animal traps, cultivation, settlement and mining. The presence or absence of these disturbance data per 50m section could be used to assess disturbance in the FR by calculating the percentages of total transect 50m sections where disturbance was observed.

Previous work by Olivier Hymas for WCST in 2000 (Hymas 2001) also assessed forest disturbance within Uluguru South and Uluguru North FRs, as well as forest (public land) to the east of Uluguru North FR; nine transects were carried out around Lanzi on the east and nine around Tchenzema and Bunduki on the west of Uluguru South FR; nine transects were carried out from Tegetero north to Kinole in Uluguru North FR; and nine transects were carried out in forest (public land) just north of Kinole, approximately 5km east of the FR. One kilometre transects were placed at the forest edge and disturbance was assessed using the same methodology as UCBS. Comparison of the two pole and timber datasets from 2000 and 2005, using the Mann Whitney U two-tailed test, enabled assessment of changes over time in human disturbance and provides key information for future monitoring.

- *Opportunistic observations*

Observations of human disturbance were made in each vegetation plot and throughout the reserve to complement the standard quantifiable methods employed and give a fuller picture of the state of the reserve with regards to human impact.

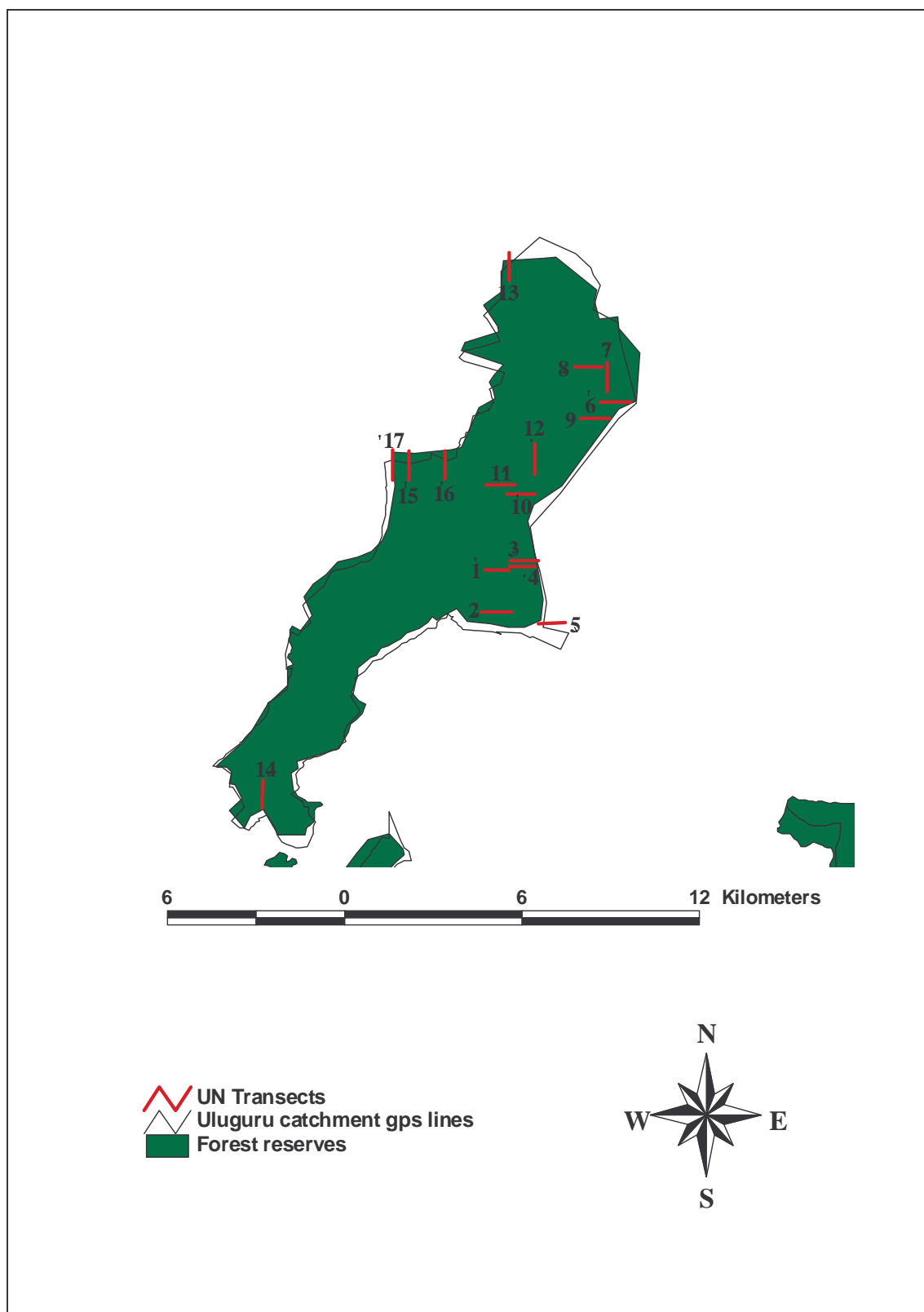


Figure 6 Map of transect lines in Uluguru North FR

4. RESULTS

All data presented in this results section are from the UCBS study only. Appendices 6 to 8 present the vegetative data. Appendices 9 to 12 list the faunal data, incorporating UCBS' results with previous research, thus updating Doggart et al (2005).

4.1 Flora

Preliminary plant identifications have been carried out by Mr. George Sangu and Mr. Frank Mbago at the Herbarium of UDSM. These await verification from Missouri Botanical Gardens, Kew Gardens and National Herbarium, Arusha.

A total of 237 species were recorded from 70 families in Uluguru North FR by UCBS (Table 5), with 153 species recorded from 36 vegetation and regeneration plots (65% of species) and 84 species from opportunistic surveys (35%). This includes four exotic species and three specimens known to a family level only, which were found in both survey localities, Uluguru North and Uluguru South FR. 18 species in Uluguru North FR were Uluguru endemics (7.6% of species recorded) and 29 species were Eastern Arc endemic and near endemic species (12.2%) (Figure 7). 18 species are listed as IUCN threatened with three as CITES listed and five as rare, categorised by LEAP (Table 6). 217 species were found to overlap between both Uluguru North and Uluguru South FRs, of which 17 were Uluguru endemics and 27 Eastern Arc endemic and near endemic species.

Table 5 Summary of flora data for both Uluguru North and Uluguru South recorded by UCBS

Species	No. of species recorded in Uluguru North	No. of species recorded in Uluguru South	No. of species recorded in both FRs
Uluguru endemic	18	24	17
Eastern Arc endemic and near endemic	29	34	27
Widespread	190	219	173
Total	237	277	217

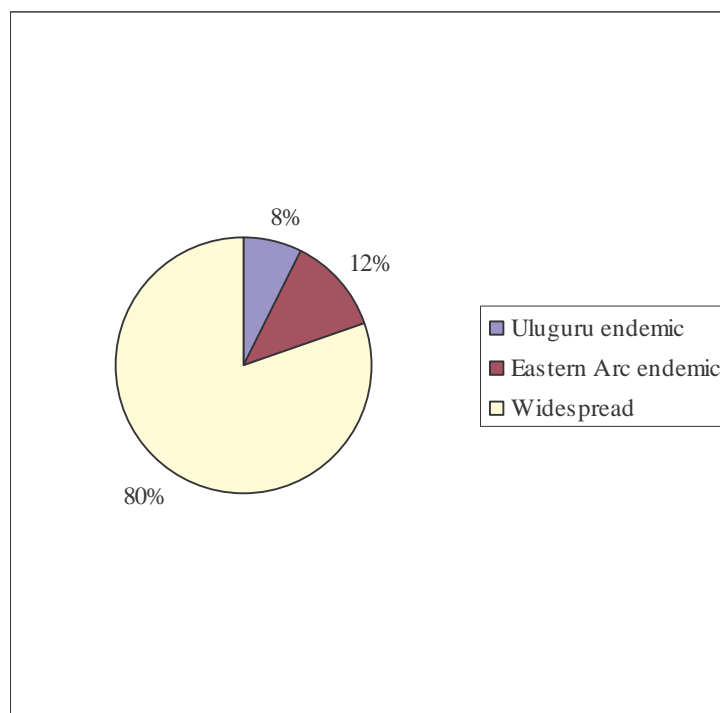


Figure 7 Percentage of species within Uluguru North FR

Table 6 provides a break-down of the 237 total species UCBS recorded in Uluguru North FR. Species have been split into widespread species, Uluguru endemics, Eastern Arc endemics and near endemics; these categories are mutually exclusive and represent accumulatively the full species list. Data representing the IUCN and CITES listed species and rare species are with regards to the total 237 species, these data are not mutually exclusive.

Table 6 Summary of floral data for Uluguru North FR recorded by UCBS

	Widespread	Uluguru endemic ^a	Eastern Arc Endemic and near endemic ^b	Threat status listed by IUCN ^c	Threat status listed by CITES ^d	Rarity as defined by LEAP ^e
Trees / shrub	142	9	22	18	2	3
Herb	38	9	7	0	1	1
Climber	6	0	0	0	0	1
Grass	3	0	0	0	0	0
Fern	1	0	0	0	0	0
Total	190	18	29	18	3	5
% of Total	80.2	7.6	12.2			
Grand total of all species		237				

a Those species restricted to the Uluguru Mountains only

b Those species restricted to the Eastern Arc Mountains and/or East African lowland forests and other adjacent locations

c Those species listed by IUCN as threatened by extinction to varying degrees, such as Endangered or Vulnerable

d Those species listed by CITES which have restrictions on trade, such as Cites I and II

e Those species listed by LEAP as rare, rare defined by LEAP as occurring in two of eight vegetation regions

72.9% percent of species recorded were trees and shrubs, with 22.8% herbs, 2.5% climbers, 1.3% grass and 0.5% ferns.

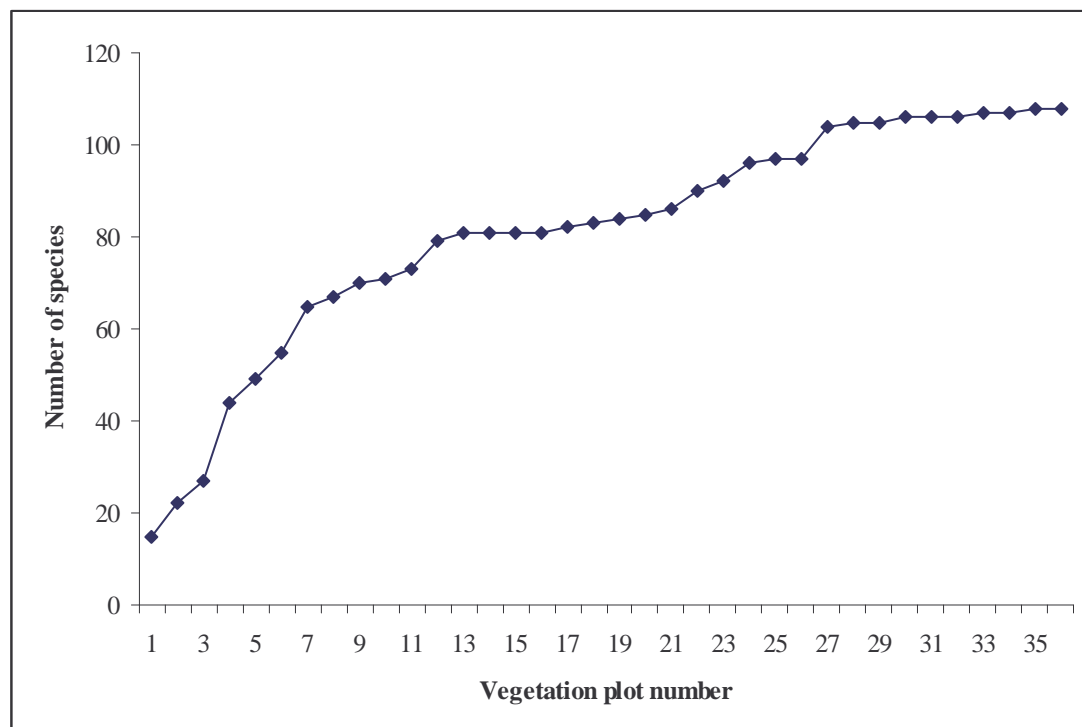


Figure 8 Species accumulation rates of recorded species by vegetation plot (trees > 10 cm dbh)

Figure 8 shows the accumulation of tree and shrub species recorded in the vegetation plots. The curve is levelling out from vegetation plot 27 upwards, suggesting that the majority of woody species have been recorded; this will not include herbaceous plants which were accounted for during casual collections.

4.1.1 Vegetation plots

A total of 153 species were recorded from the systematic vegetation survey within 36 vegetation plots from a total of 1489 individual trees. An average of 41.33 (standard deviation (SD) = 16) individual trees and an average of 18.9 species (SD = 9.13) were recorded within each plot. 5.5% of plots were within lowland forest (<800m asl) at Kigurunyembe with 55.5% in submontane forest (800m – 1500m asl) and 39% within montane forest (1500m – 2100m asl). 33% of vegetation plots were placed on an east aspect, 8% on a west aspect, 25% on a north aspect and 31% on a south aspect with 3% on flat areas with no aspect.

Species were ranked according to coverage and abundance; the top twelve are presented in Table 7 and Figure 9. Species coverage presents the frequency of plots the species were recorded in and species abundance relates to the number of individuals recorded as a percentage of all individuals recorded within the plots.

Table 7 Species coverage and abundance for the top twelve species within 36 vegetation plots

Family	Species	Rank species coverage ¹	No. plots present	% plots	Rank: species abundance ²	No. indivs	% indivs.
Moraceae	<i>Myrianthus holstii</i>	1	25	69.44	2	109	7.32
Leguminosae	<i>Newtonia buchananii</i>	2	23	63.89	7	42	2.82
Sterculiaceae	<i>Leptonychia usambarensis</i>	3	22	61.11	1	141	9.47
Flacourtiaceae	<i>Aphloia theiformis</i>	4	19	52.78	4	53	3.56
Chrysobalanaceae	<i>Parinari excelsa</i>	5	18	50.00	6	50	3.36
Guttiferae	<i>Garcinia buchananii</i>	6	15	41.67	8	38	2.55
Moraceae	<i>Trilepisium madagascariense</i>	6	15	41.67	5	52	3.49
Icacenaceae	<i>Apodytes dimidiata</i>	8	14	38.89	8	38	2.55
Flacourtiaceae	<i>Rawsonia lucida</i>	9	13	36.11	8	38	2.55
Anacardiaceae	<i>Sorindeia madagascariensis</i>	9	13	36.11	3	58	3.90
Anacardiaceae	<i>Uvaria sp</i>	11	11	30.56	12	29	1.95
Araliaceae	<i>Cussonia spicata</i>	12	8	22.22	11	32	2.15

Top 12 ranking

Species Coverage¹: most common species recorded during systematic survey (recorded by vegetation plot; 36 in total)

Species Abundance²: individuals of a species recorded during the systematic survey compared with the total number of individuals recorded (number of individual trees recorded; 1,489 in total)

Myrianthus holstii was ranked first for species coverage as it was recorded in 69% of all plots. It was also ranked second for species abundance representing 7.32% of all individual trees. Ranked second for species coverage was *Newtonia buchananii* recorded in 64% of all plots. Its ranking for species abundance was seventh with 2.82% of all individuals. It is targeted in Uluguru North for timber extraction. *Leptonychia usambarensis* was ranked third for species coverage being present in 61% of all plots. It was the most abundant species with 9.47% of individuals recorded. When comparing actual numbers, it can be seen that *Myrianthus holstii* and *Leptonychia usambarensis* were by far the most abundant individual species with 109 and 141 individuals recorded, respectively. All of these trees are common to moist forest and many are good timber species, such as *Parinari excelsa*, *Leptonychia usambarensis* and *Trilepisium madagascariense*. The latter two are known to be used

for making beds locally (Schulman et al 1998). None of the key floral indicator species, such as *Allanblackia uluguruensis* and *Ocotea usambarensis*, were in high abundance within the vegetation plots, which contrasts with Uluguru South FR where they ranked second and fifth in abundance, respectively. However they are predominantly montane species and 55.5% of vegetation plots were within submontane forest.

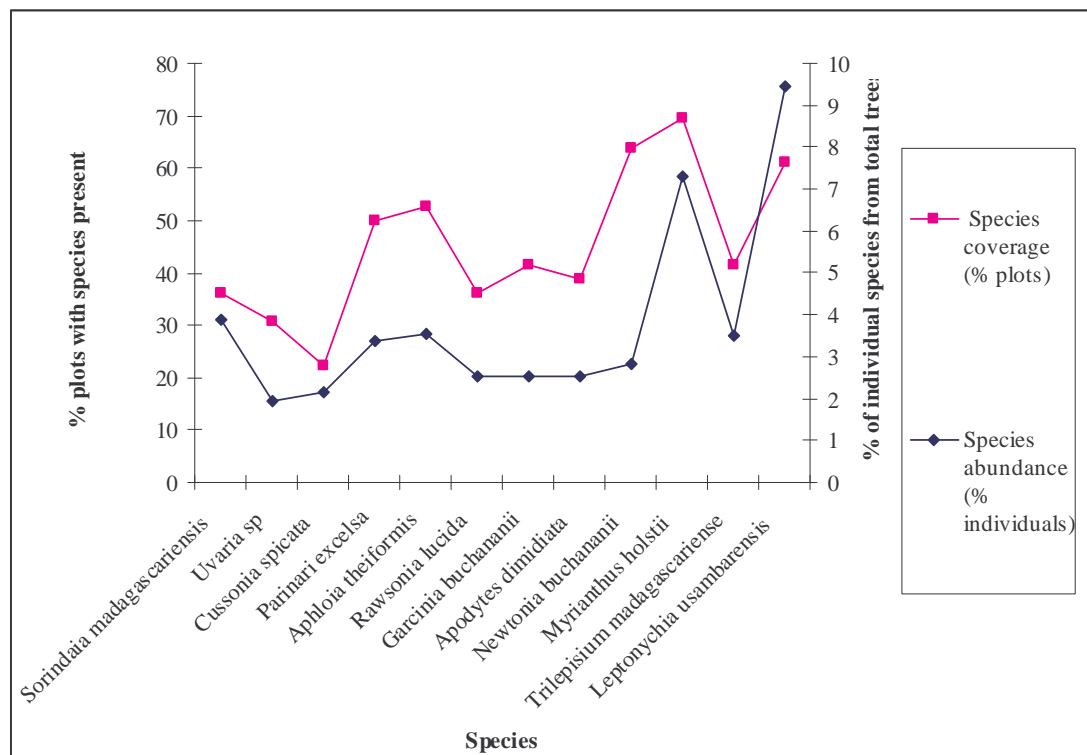


Figure 9 Species coverage and abundance for the top twelve species within vegetation plots

Species abundance differed according to aspect and altitude. Within the altitudinal range of 1200–1600m asl there was the highest abundance of species, however 80% of plots were within this range. At high altitude (above 2000m asl) the most abundant species were *Allanblackia uluguruensis* and species from the genera *Syzygium*, *Maesa* and *Schefflera*. The highest density of trees was found to be in the east aspects, with 463 stems per hectare (ha) followed by the south slopes and flat areas (valley bottoms and ridge tops) both with 430 stems per ha and the north with 315 stems per ha. These calculations apply to those aspects with more than four vegetation plots (aspect is not synonymous with sides of the mountain, for example, a vegetation plot may have been established on an east aspect on the western side of the mountain).

4.1.2 Species composition/dominance

The characteristic species throughout the reserve varied in dominance by aspect and altitude (Table 8)

Table 8 Dominant tree species by aspect and altitude

Aspect	<1800 m asl		>1800 asl	
	Tree layer	Shrub layer	Tree layer	Shrub layer
East	<i>Ocotea usambarensis</i> , <i>Allanblackia uluguruensis</i> , <i>Allanblackia stuhlmannii</i> , <i>Drypetes gerrardii</i> , <i>Newtonia buchananii</i> , <i>Uvariiodendron usambarense</i> , <i>Myrianthus holstii</i> , <i>Nesogordonia holtzii</i> , <i>Mesogyne isignis</i> <i>Sorindeia madagascariensis</i>	Families: Rubiaceae, Apocynaceae, Euphorbiaceae, Violaceae	<i>Ocotea usambarensis</i> , <i>Schefflera spicata</i> <i>Schefflera umbellifera</i> , <i>Aphloia theiformis</i> , <i>Myrica salicifolia</i> , <i>Agaurea salicifolia</i> , <i>Rapanea melanophloeos</i> , <i>Cussonia spicata</i> , <i>Allanblackia uluguruensis</i> , <i>Syzygium cordatum</i> , <i>Syzygium parvulum</i>	Species from families: Rubiaceae, Euphorbiaceae, Apocynaceae, Flacouritaceae
West	<i>Kiggelaria africana</i> , <i>Allophylus abyssinica</i> , <i>Parinari excelsa</i> , <i>Cussonia spicata</i> , <i>Garincia kingaensis</i> , <i>Dovyalis abyssinica</i> , <i>Maytenus accuminata</i> , <i>Aphloia theiformis</i>	Families: Rubiaceae, Apocynaceae, Euphorbiaceae, Violaceae		
North	In lowland area: <i>Albizia gummifera</i> , <i>Diplorinchus</i> sp, <i>Lamprothamnas zanguebarica</i> , <i>Sorindeia madagascariensis</i> , <i>Englerophytum natalense</i>	Species from families: Rubiaceae, Euphorbiaceae, Flacourtiaceae, Apocynaceae		
South	<i>Myrianthus holstii</i> , <i>Draceana afromontana</i> , <i>Aphloia theiformis</i> , <i>Uvariiodendron usambarense</i> , <i>Mimusopsis scliebenii</i>	Species from families: Rubiaceae, Euphorbiaceae, Sterculiaceae, Apocynaceae		

4.1.3 Overall species richness

The highest number of species was recorded at lower altitude (<1800m asl) with a greater species richness on the east aspects with 85 species, followed by south aspect with 72 species and west and north with 53 and 47 species respectively. Comparing common with endemic species, higher altitudes (>2000m asl) had greater endemic species richness than common species, particularly on Bondwa hill (Appendix 8). Lovett et al (in press) also found that overall species richness and diversity decreases with an increase in altitude.

4.1.4 Overall species diversity

When assessing species diversity, which considers both species richness and abundance, a similar trend was found. At lower altitude (forest boundary – 1800m asl), there was a higher diversity of species with an average diversity index of 3.456. Species diversity is greatest in the eastern slopes of the mountains with an index score of 3.859 followed by the south and north with index scores of

3.525 and 3.455 respectively (Table 9). When considering common species and endemic species, the diversity of endemics is greatest at high altitude (>2000m asl).

Table 9 Diversity indices and species richness for main aspects

Aspect	Diversity	Richness
East	3.859	85
West	2.274	54
South	3.833	72
North	3.525	53

4.1.5 Uluguru endemic species

18 Uluguru endemic plants were recorded by UCBS, which were recorded for tree/shrub species and herb species only (50% for each lifeform) (Table 10). This constitutes only 13.3% of the known 135 species known within the Uluguru Mountains.

Table 10 Uluguru endemic species found within Uluguru North FR by UCBS

Family	Species	Altitudinal range (m asl)	Distribution ^a	Life form
Acanthaceae	<i>Justicia beloperonoides</i>			Herb
Aqualifoliaceae	<i>Ilex mitis</i> var <i>schliebenii</i>	2400	Tchenzema-Lukwangule; Lupanga; Bondwa	Shrub
Araliaceae	<i>Schefflera lukwangulensis</i>	1400 - 2600		Tree
Balsaminaceae	<i>Impatiens lukwangulensis</i>	1650-2250	Bondwa; Lukwangule plateau	Herb
Balsaminaceae	<i>Impatiens serpens</i>	1550 - 2350	Bondwa; Lukwangule plateau; Kibungo-Mkambaku	Herb
Balsaminaceae	<i>Impatiens uluguruensis</i>	1600-2550	Bondwa; Lukwangule; Kibungo mission	Herb
Gesnariaceae	<i>Saintpaulia goetzeana</i>			Herb
Gesnariaceae	<i>Saintpaulia inconspicua</i>			Herb
Gesnariaceae	<i>Streptocarpus glandulosissimus</i>	2700	U2; K1,4,7; T2,3,6,7; Rwanda, Burundi	Herb
Gesnariaceae	<i>Streptocarpus</i> sp			Herb
Lobeliaceae	<i>Lobelia graniticola</i>		Mkambaku Mt	Herb
Lobeliaceae	<i>Lobelia lukwangulensis</i>	0 - 1780	Bondwa; Lukwangule plateau	Herb
Moraceae	<i>Syzygium parvulum</i>	1100 - 2600		Shrub
Rubiaceae	<i>Lasianthus grandiflorus</i>	1200 - 2040	Bondwa	Shrub
Rubiaceae	<i>Lasianthus macrocalyx</i>	1200 -2400	Bondwa; Lukwangule plateau	Shrub
Rubiaceae	<i>Lasianthus microcalyx</i>	2100 - 2600	Bondwa; Lukwangule plateau	Shrub
Rubiaceae	<i>Lasianthus wallacei</i>	1100 - 1900	Bondwa; Lukwangule plateau; Kinolo road	Shrub
Rubiaceae	<i>Pavetta</i> aff. <i>sparsipila</i>		NW Uluguru; Bondwa; Bunduki	Shrub

a Uluguru endemics taken from Temu and Nsolomu (2000) and Burgess et al (2002)

Table 11 Distribution of endemic species

Site	No of family	No of genera	No of species
Bondwa hill	5	6	11
Lupanga hill	2	2	8
Morningside	2	2	3
Other	2	2	2

Abundance of endemic species was greatest at higher altitude, such as Bondwa peak with 11 species, followed by 8 species from Lupanga and three species from Morningside (Table 11). For near

endemic species, abundance was greatest at Lupanga and Morningside (Figure 10). Overall 61% of endemic species were found above 2000m asl, such as Bondwa and Lupanga, and the remaining 39% below 1800m asl. The family Rubiaceae had the greatest abundance of endemic species, followed by Balsaminaceae, Lobeliaceae and Euphorbiaceae. At genus level, the most abundant species are found in *Impatiens*, followed by *Lobelia*, *Saintpaulia* and *Streptocarpus*.

4.1.6 Eastern Arc endemic and near endemic species

29 plant species were recorded by UCBS, of which 76% were tree/shrub species and 24% were herb species (Table 12).

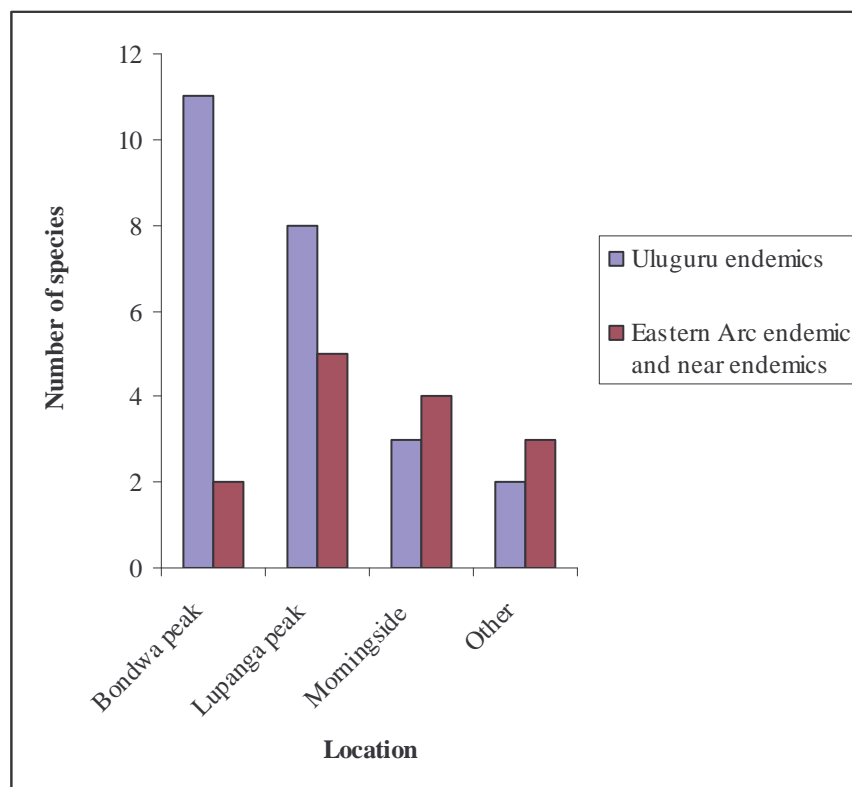
**Figure 10** Distribution of endemic species by location

Table 12 Eastern Arc endemic and near endemic species recorded within Uluguru North FR by UCBS

Family	Species	Altitudinal range (m asl)	Distribution	Life form
Acanthaceae	<i>Isoglossa lacteal</i>	250 - 800	T6;	Herb
Acanthaceae	<i>Justicia interrupta</i>	810-1530	T2,6;	Herb
Anacardiaceae	<i>Sorindeia madagascariensis</i>	1 - 1830	K4,7; T2,3,5-8; P;Z; Malawi, Mozambique and Mascarene Islands	Tree
Annonaceae	<i>Uvariadendron usambarense</i>	1230-2100		Tree
Araceae	<i>Amorphophallus stuhlmannii</i>	0 - 1400 m	T3, 6; not known elsewhere.	Herb
Balsaminaceae	<i>Impatiens hamata</i>	1350-2200		Herb
Ebenaceae	<i>Diospyras sp</i>	1500-1900		Tree
Guttiferae	<i>Allanblackia stuhlmannii</i>	540-2100	T6, T7	Tree
Guttiferae	<i>Allanblackia uluguruensis</i>	750-2300	T3,T7	Tree
Leguminosae	<i>Cyanometra sp</i>			Tree
Liliaceae	<i>Aloe bussei</i>	580 - 1500	T5-7;	Herb
Melastomataceae	<i>Memecylon cogniauxii</i>			Tree
Moraceae	<i>Dorstenia schliebenii</i>	300 - 2000	T 6-8; Malawi	Herb
Moraceae	<i>Mesogyne insignis</i>	500 - 1300	T3,6; S. Tome	Tree
Rubiaceae	<i>Chassalia discolour</i>	1200 -1900		Shrub
Rubiaceae	<i>Coffea pseudozanguebaricae</i>			Tree
Rubiaceae	<i>Lasianthus kilimandcharicus</i>	1000-2300	T6; not known elsewhere	Shrub
Rubiaceae	<i>Pavetta crebilifolia var crebilifolia</i>	950- 1900		Shrub
Rubiaceae	<i>Psychotria brucei</i>	300-1000	T3, T6; not known elsewhere	Herb
Rubiaceae	<i>Psychotria megalopus</i>	1140 - 1850		Shrub
Rubiaceae	<i>Rytigynia lichenoxenos</i>	950 - 1830	K7; T3,6; not known elsewhere	Shrub
Rubiaceae	<i>Tricalysia pedicellata</i>	300 - 700	T6; not known elsewhere.	Shrub
Sterculiaceae	<i>Cola clavata</i>		T2,3,5;	Tree
Sterculiaceae	<i>Cola greenwayi</i>	1050 - 2300	U2,4; T3,4,8; Rwanda, Burundi	Tree
Sterculiaceae	<i>Cola scheffleri</i>	100 - 750	K7; T6,8; Z;	Tree
Sterculiaceae	<i>Cola usambarensis</i>			Tree
Sterculiaceae	<i>Dombeya shupangae</i>	600	T2,3,4; Madagascar	Tree
Sterculiaceae	<i>Leptonychia usambarensis</i>			Tree
Zamiaceae	<i>Encephalartos hildebrandtii</i>	0 - 600	U2; K7; T3,6; Z;	Tree

Eastern Arc endemics from Iversen 1991b and FTEA

Distribution of Eastern Arc endemic and near endemic species by location (

Table 13) varied to those of the Uluguru endemics with more species present at Lupanga and Morningside (Figure 10).

Table 13 Distribution of Eastern Arc endemic and near endemic species

	No family	No genera	No species
Lupanga hill	4	4	5
Morningside	3	3	4
Others	2	2	3
Bondwa	1	1	2

4.1.7 Species listed by IUCN/CITES as threatened and species listed as rare by LEAP

Table 14 Species listed as threatened or rare found within Uluguru North FR by UCBS

Family	Species	Altitudinal range (m asl)	Life form	Species listed as IUCN threatened	Species listed as CITES threatened	Rare species as defined by LEAP
Annonaceae	<i>Uvariadendron usambarense</i>	1230-2100	Tree	Vu		
Aqualifoliaceae	<i>Ilex mitis var schliebenii</i>	2400	Shrub	Vu		
Araliaceae	<i>Schefflera lukwangulensis</i>	1400 - 2600	Tree	Vu		
Euphorbiaceae	<i>Drypetes gerrardinoides</i>	1500-2100	Tree	Vu		
Euphorbiaceae	<i>Drypetes natalensis</i>	15 - 1500	Tree	Vu		
Guttiferae	<i>Allanblackia stuhlmannii</i>	540-2100	Tree	Vu		
Guttiferae	<i>Allanblackia uluguruensis</i>	750-2300	Tree	Vu		
Liliaceae	<i>Aloe bussei</i>	580 - 1500	Herb		CITES II	
Moraceae	<i>Mesogyne insignis</i>	500 - 1300	Tree	Vu		
Rosaceae	<i>Prunus africana</i>	1500 - 2600	Tree		CITES II	
Rubiaceae	<i>Coffea pseudozanguebaricae</i>		Tree	Vu		
Rubiaceae	<i>Lasianthus grandiflorius</i>	1200 - 2040	Shrub	Vu		
Rubiaceae	<i>Lasianthus wallacei</i>	1100 - 1900	Shrub	Vu		
Rubiaceae	<i>Pavetta aff. sparsipila</i>		Shrub	Vu		
Rubiaceae	<i>Psychotria brucei</i>	300 - 1000	Herb			R
Rubiaceae	<i>Psychotria megalopus</i>	1140 - 1850	Shrub	Vu		
Rubiaceae	<i>Rytigynia bogoyensis</i>		Shrub	Vu		
Rubiaceae	<i>Rytigynia lichenoxenos</i>	950 - 1830	Shrub	Vu		R
Rubiaceae	<i>Tricalysia ovalifolia</i>	0 - 1000	Shrub	Vu		
Rubiaceae	<i>Tricalysia pedicellata</i>	300 - 700	Shrub	Vu		
Rutaceae	<i>Zanthoxylum gillettii</i>	1700	Climber			R
Sapindaceae	<i>Allophylus abyssinica</i>	1000 - 2100	Tree			R
Sterculiaceae	<i>Cola scheffleri</i>	100 - 750	Tree	Vu		
Theaceae	<i>Balthasaria schliebenii</i>	1300- 1900	Tree			R
Zamiaceae	<i>Encephalartos hildebrandtii</i>	0 - 600	Tree		CITES I	

Vu = Vulnerable to extinction as listed by IUCN, CITES I represents a ban on trade of species, whilst CITES II regulates any trade. R = Rare species as defined by LEAP

Five species making 2.1% of total species were found to be rare, which is defined by the LEAP database as found in less than two of eight vegetation regions of Tanzania (Table 14). *Allophylus abyssinica* was actually recorded as a common species in Uluguru North, particularly in the north-west with a more uniform distribution. 18 species of trees were recorded as vulnerable to extinction by IUCN and three species were CITES listed, two species as CITES II and one species as CITES I. The distribution of the species was localised as most species were recorded through opportunistic collections.

4.1.8 Invasive species

Two genera were noted to be invasive in terms of their ability to outcompete the indigenous species; *Rubus* bramble, and *Maesopsis eminii*, which has also been recorded as invasive in the East Usambaras. *M. eminii* was located on the forest edge at Tegetero and within the forest at Kinole.

The brambles were identified as *Rubus albata*, *Rubus pinnatus* and *Rubus* sp. These are not known to be native to Tanzania; they could be from South Africa (pers comm Frank Mbago, UDSM). These species prefer less moist areas particularly south around Bunduki and Tanana villages, where they will hinder forest regeneration.

The presence of other exotic species within Bunduki FR is of concern as their seeds may be spread to the North and South reserves and their growth will interfere with the growth of indigenous species. *Lantana camara* was seen outside of the Uluguru North and South FRs and should be monitored.

4.1.9 Uses of trees

Various tree species have been used by local villagers for a variety of purposes; noted by the botanist through casual observations and informal discussions with the local populous (Table 15):

Table 15 List of tree species observed to be used by people, recorded by UCBS botanist

Family	Species	Uses			
		Building material	Firewood	Medicine	Tools
Flacourtiaceae	<i>Aphloia theiformis</i>	x	x		x
Ebenaceae	<i>Diospyros sp</i>			x	
Lauraceae	<i>Ocotea usambarensis</i>	x		x	
Euphrobiaceae	<i>Macaranga capensis</i>		x		
Piperaceae	<i>Piper capense</i>			x	
Begoniaceae	<i>Begonia oxyloba</i>			x	
Cyatheaceae	<i>Cyathea maniana</i>	x		x	
Euphrobiaceae	<i>Drypetes gerrardii</i>		x		x
Guttiferae	<i>Allanblackia uluguruensis</i>			x	
Leguminosae	<i>Newtonia buchananii</i>	x			
Podocarpaceae	<i>Podocarpus latifolius</i>	x			x

4.2 Fauna

UCBS recorded 156 faunal species within 66 families in Uluguru North forest reserve (Table 16), an addition of 45 species (22%) to the total known fauna for this FR (those species highlighted in Appendices 9, 10, 11 and 12). 16% of the total species are endemic to the Uluguru Mountains and Eastern Arc Mountains, whilst 12% are near endemic. 10% of species found are threatened and/or have trading restrictions, recognised by either IUCN and/or CITES. 40% of species are strictly forest dependent / associated (see definitions in Table 16). Bird species account for 61% of these 156 species with 20% of species being mammals. Reptiles and amphibians make a lower contribution 8% and 11% of the total species respectively. These latter contributions may reflect previous research focusing on specific taxa, such as avifauna. It is clear that this FR has extremely high biodiversity value, particularly with regard to small fauna.

Table 16 provides a break-down of the 156 total species recorded by UCBS in the Uluguru North FR. Species have been split into widespread species, Uluguru endemics, Eastern Arc endemics and Eastern Arc near endemics; these categories are mutually exclusive and represent accumulatively the full species list from this study. Data representing the IUCN and CITES listed species and forest dependant species are with regards to the total 156 species, these data are not mutually exclusive.

Table 16 A summary of fauna recorded in Uluguru North Forest Reserve by UCBS (Appendices 9-12 give full species lists of all known fauna in Uluguru North FR)

Taxa	Number of families	Number of species ^b	No. of wide-spread species	No. of Uluguru endemic species (sub-species)	No. of Eastern Arc endemic species ^c (sub-species)	No. of Eastern Arc near-endemics ^d	No. Species listed as IUCN ^e threatened	No. Species listed as CITES ^f threatened	No. forest dependent species ^g
Mammals	19	31	24	1 (1)	2	3	5	5	7
Birds ^a	34	95	77	3 (4)	1 (1)	9	4	8	42
Reptiles	7	13	4	0	5	4	0	2	5
Amphibians	6	17	7	1	6	3	7	1	8
Total	66	156	112	10	15	19	16	16	62
% total of species			72	6	10	12	10	10	40

a Includes those birds seen on the forest edge

b Includes all opportunistic observations together with those from systematic survey work

c Those species that are found strictly in the Eastern Arc mountains

d Those species that are found in the Eastern Arc mountains, Coastal forest and other adjacent locations e.g. Southern Highlands, N. Malawi/Mozambique

e Those species threatened with extinction by varying degrees, such as Endangered, Vulnerable, Near threatened

f Those species that have restrictions on trade, such as Cites I and II

g Those species dependent and associated with primary forest, not forest edge or secondary forest

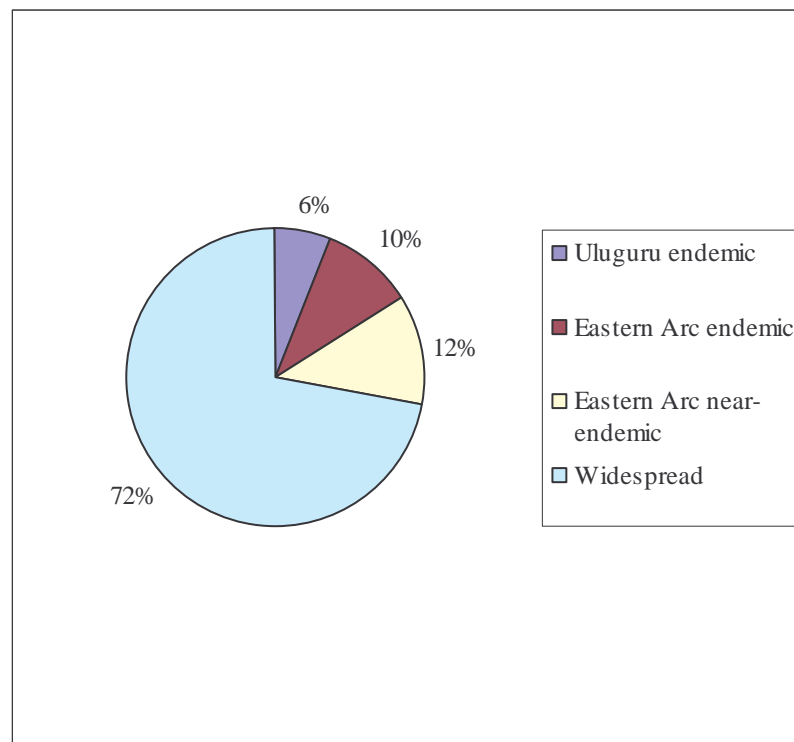


Figure 11 Percentages of faunal species that are widespread or endemic

4.2.1 Mammals

Although the identification of most species is certain, those species that were captured remains tentative whilst awaiting taxonomic verifications (i.e. all small mammals, including bats) and some of the dung found could only be identified to genus. All taxonomy and nomenclature follows that of Kingdon (1997). Preliminary identifications based on biometric data were made by Dr. Bill Stanley for shrews; these await confirmation by skull and dentition analysis.

4.2.1.1 Species richness

During this survey 31 mammal species representing 19 families were recorded in the reserve (Appendix 9). Of these 6.5% are Uluguru endemics, 6.5% Eastern Arc endemics, 10% near endemic to the Eastern Arc and approximately 35% of species threatened by extinction. Uluguru North FR has more small mammal fauna species than large fauna (74% of total mammal species) (40cm head-body and smaller), with large fauna low in species number and abundance.

4.2.1.2 General / Species abundance

Overall abundance of large fauna is low within Uluguru North FR. Of the larger mammals recorded by UCBS most were by indirect observation, such as vocalisations and spoor. The most commonly directly observed large mammals were Black and white colobus (*Colobus angolensis*) and Blue monkey (*Cercopithecus mitis*) (nine times in six weeks and four times in six weeks respectively). Blue monkey were recorded more frequently at the forest edge, where they are known as crop raiding pests. Black and white colobus were more commonly seen in the interior of the forest. Vocalisations of the Tree hyrax (*Dendrohyrax validus*) were heard at satellite camp one and two on the eastern side of the mountain, whilst the Mountain galago (*Galagoides orinus*) was heard at both satellite camps and basecamp two. Uluguru North has the type locality for *Galagoides orinus* at Bagilo and there are an estimated 23,000 occurring in Uluguru North and South (Perkin 2000). The Small-eared galago (*Otolemur garnetti*) was heard at basecamp two located above Morningside within the FR.

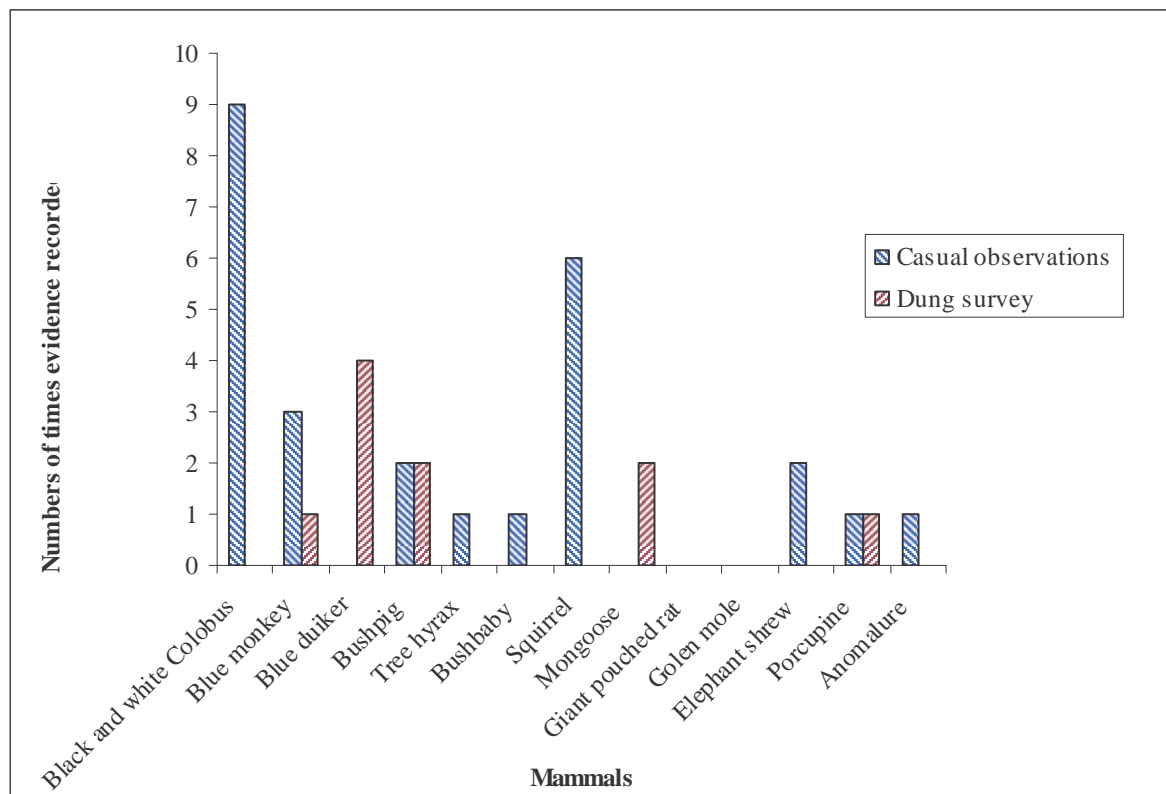


Figure 12 Number of times evidence recorded for both casual observations and dung surveys of large mammals along 15.15km of transect

Spoor of Bushpig (*Potamochoerus larvatus*), Blue duiker (*Cephalophus monticola*), Water Mongoose (*Atilax paludinosus*) and Slender mongoose (*Herpestes sangiunea*) were found throughout the reserve in low numbers. Porcupine (*Hystrix cristata*) diggings were also seen, the first record for Uluguru North, as were the Mongooses. Stuhlmann's golden mole (*Chrysochloris stuhlmanni tropicalis*) was recorded indirectly using evidence of mole hills. This has not been recorded since Swynnerton and Hayman (1950). The vulnerable Abbot's duiker (*Cephalophus spadix*) was not recorded during this survey; the last observations of it were by Swynnerton and Hayman (1950).

No signs of domestic animals were recorded within the reserve.

Of the small mammals, zoological trapping resulted in the capture of 12 species within eight families, including bats. 24 specimens of rodents were taken from 196 captures (excluding 102 recaptures) from 1,650 Sherman trapping nights. Common species found were; Soft-furred rat (*Praomys* sp), African wood mouse (*Hylomyscus denniae*) and Brush-furred mouse (*Lophuromys flavopunctatus*). This confirms Stanley et al's (1998) findings during a survey in Uluguru North above Tegetero. Less commonly recorded were the; Narrow-footed woodland mouse (*Grammomys*), the Lesser pouched rat (*Beamys hindei*) and the African dormouse (*Graphiurus murinus*). Stanley also caught *Graphiurus* and *Grammomys* when in Uluguru North, but not *Beamys*, although it was recorded in other study sites, e.g. Usambaras, Nguru and Udzungwas.

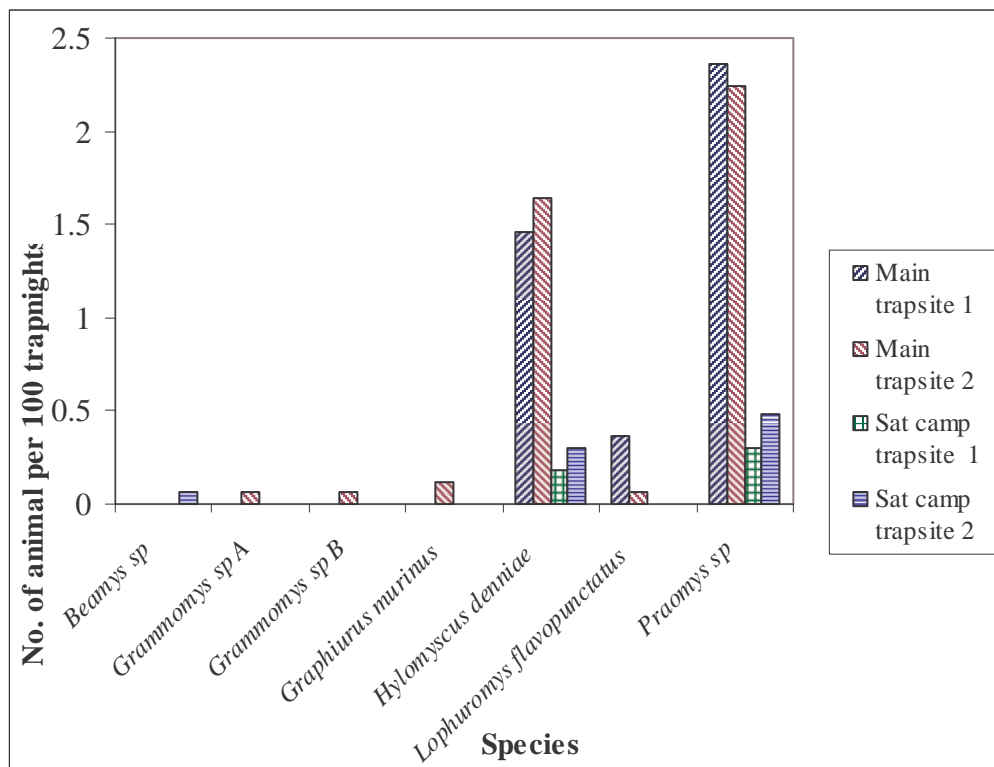


Figure 13 shows the relative abundance (no. rodent per 100 traps) of rodents captured at each site

Relative abundance of *Praomys* and *Hylomyscus* was high such that they dominated all trapsites. *Praomys* was the most commonly caught rodent, with abundance particularly high at main trapsites one and two with 2.4 and 2.2 animals caught per 100 sherman trap nights respectively. The other rodents had low abundance and were not captured at all trapsites. Only one *Beamys* was recorded within the UCBS work (at satellite camp two), which was surprising as this genus is a relic species of the Eastern Arc Mountains and it was expected that these would be captured in greater numbers. However it is known to be very trap-shy and this may explain the absence at trapsites. *Lophuromys* was captured at both the main trapsites but relative abundance was low (0.4 and 0.06 animal per 100 trap night at main trapsites one and two). These animals are burrowers and are actually more active during the daytime, thus this may contribute to low capture numbers. They rely on moisture and grass making it hard to survive under closed canopy. *Grammomys* was captured at main trapsite two only, with two individuals whose measurements suggest two species, although this is tentative and awaiting verification. This is an arboreal rodent found from forest margins to the sparse scrub of the Athi plains. It was found at a forest edge trapsite, where the species richness was greatest with six species present. Forest edge allows those more generalist species to exploit the transitional habitat between *shamba* (woodland) and dense closed canopy forest. This accounts for species such as *Graphiurus* and *Grammomys*.

Of the shrews, zoological trapping resulted in captures of five species within one family. 11 specimens were taken from 39 captures in 528 bucket pitfall trapping nights. Relative abundance of shrews was dominated by the Climbing shrew, *Sylvisorex howelli*, commonly captured at both trapsites (a total of 4.9 *S. howelli* per 100 bucket pitfall trap nights across all sites). This species is an Eastern Arc endemic, thus such high abundance of this species highlights the Ulugurus as an important conservation area for it. *Crocidura hirta* was the second most abundant shrew, particularly at trapsite two. Other species, *C. oliveri*, *C. nana/elongius* and *Myosorex geata* were captured in low numbers.

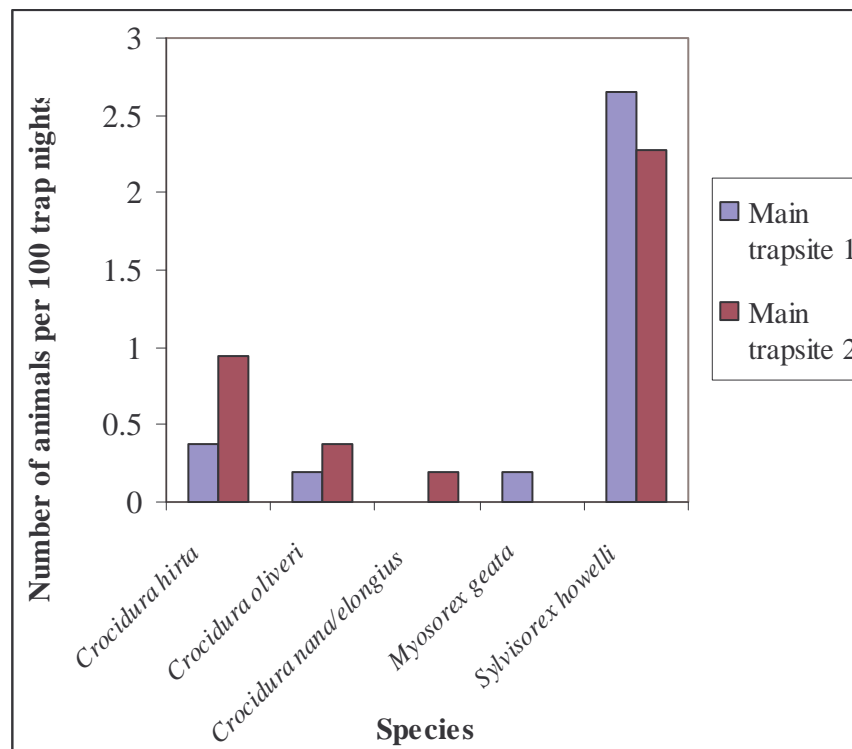


Figure 14 Relative abundance of shrews at each zoological trapping site (number of shrews per 100 bucket pitfall trap night)

14 bats within three families were captured by UCBS during 97 mist-net metre hours. Only these six species were recorded; Mountain fruitbat (*Stenonycteris lanosus*), Epauletted fruitbat (*Eponophorus labiatus*), Horseshoe bat (*Rhinolophus hildebrandti*), Evening bat (*Scotoecus hirundo hindei*), Serotine (*Eptesicius* sp) and Pipistrelle bat (*Pipistrellus nanus*). Abundance was low for all species and this may be contributed in part to low sampling intensity.

4.2.1.3 Endemics

UCBS recorded one Uluguru endemic species and one subspecies in Uluguru North FR: Mouse shrew (*Myosorex geata*) and Stuhlmann's golden mole (*Chrysochloris stuhlmanni tropicalis*), respectively. The Golden mole was last recorded by Swynnerton and Hayman (1950) and was observed indirectly by mole hill sightings.

There are two other species that are strictly endemic to the Eastern Arc Mountains: Climbing shrew (*Sylvisorex howelli*) and the Mountain galago (*Galagoides orinus*). *S. howelli* is found in Northern and Central Eastern Arc ranges; West and East Usambaras, Nguru, Nguu, Uluguru and Ukaguru.

4.2.1.4 Near endemics

UCBS recorded four Eastern Arc near endemic species in Uluguru North FR (Table 17).

Table 17 Near endemic mammal species of the Eastern Arc Mountains found by UCBS

Species	Common name	Range
<i>Beamys hindei</i>	Lesser pouched rat	Usambara, Uluguru, Udzungwa, Nguru, Pare, Coastal forest and Southern rift
<i>Dendrohyrax validus</i>	Tree hyrax	Eastern Arc, Coastal forests, Kilimanjaro
<i>Otolemur garnetti</i>	Small-eared galago	Coastal forests and Eastern Arc
<i>Rhynchocyon petersi</i>	Zanj elephant shrew	S. Pare, Usambara, Uluguru, Nguru?, Coastal Forests

4.2.1.5 Threatened species

UCBS recorded five species categorised as IUCN threatened and five as CITES restricted (Table 18).

Table 18 IUCN and CITES listed mammals of the Uluguru North FR found by UCBS

Species	Common name	IUCN	CITES
<i>Beamys hindei</i>	Lesser pouched rat	Vulnerable	
<i>Cephalophus monticola</i>	Blue duiker		II
<i>Cercopithecus mitis</i>	Gentle monkey		II
<i>Colobus angolensis</i>	Angola pied colobus		II
<i>Dendrohyrax validus</i>	Tree hyrax	Vulnerable	
<i>Galagoides orinus</i>	Usambara galago		II
<i>Myosorex geata</i>	Mouse shrew	Endangered	
<i>Otolemur garnetti</i>	Small-eared galago		II
<i>Rhynchocyon petersi</i>	Zanj elephant shrew	Endangered	
<i>Sylvisorex howelli</i>	Climbing shrew	Vulnerable	

Important to note are seven threatened species that are known from Uluguru North FR by from previous research but were not recorded by UCBS: Abbot's duiker (*Cephalophus spadix*), Leopard (*Panthera pardus*), Serval cat (*Leptailurus serval*), African clawless otter (*Aonyx capensis*), Red bellied coastal squirrel (*Paraxerus palliatus*) and White-toothed shrews (*Crocidura monax* and *Crocidura telfordi*).

4.2.1.6 Forest dependent species

UCBS recorded seven forest dependent species in Uluguru North FR (Table 19).

Table 19 Forest dependent mammal species of the Uluguru North FR found by UCBS

Species	Common name
<i>Cephalophus monticola</i>	Blue duiker
<i>Colobus angolensis</i>	Black and white colobus
<i>Dendrohyrax validus</i>	Tree hyrax
<i>Galagoides orinus</i>	Usambara galago
<i>Myosorex geata</i>	Mouse shrew
<i>Paraxerus lucifer</i>	Tanganyika mountain squirrel
<i>Sylvisorex howelli</i>	Climbing shrew

4.2.1.7 UCBS new records for Uluguru North

UCBS listed an additional 10 species to the species list compiled by Doggart et al (2005) (Table 20). This may reflect in some cases the lack of intensive species specific research conducted within Uluguru North FR, thus most species are common and widespread.

Table 20 New records of mammal species recorded in the Uluguru North FR by UCBS

Species	Common name	Range
<i>Atilax paludinosus</i>	Water mongoose	Widespread
<i>Beamys hindei</i>	Lesser pouched rat	Usambara, Uluguru, Udzungwa, Nguru, Pare, Coastal forest and Southern rift
<i>Epomophorus labiatus</i>	Epauletted fruit bat	Widespread
<i>Eptesicus sp</i>	Serotine	
<i>Grammomys spA</i> 26104	Narrow-footed woodland mouse	?
<i>Grammomys spB</i> 26103	Narrow-footed woodland mouse	?
<i>Herpestes sanguinea</i>	Slender mongoose	Widespread
<i>Hystrix cristata</i>	Crested porcupine	Widespread
<i>Rhinolophus hildebrandti</i>	Horseshoe bat	Widespread
<i>Scotoecus hirundo hindei</i>	Evening bat	Widespread

4.2.2 Birds

All taxonomy and nomenclature follows that of Stevenson and Fanshawe (2002). Identifications await confirmation by Professor J. Fjeldså in Copenhagen.

4.2.2.1 Species richness

This survey recorded 95 species of birds representing 34 families in Uluguru North FR (Appendix 10) during 28,588 mist-net hours by the ornithologist and casual observations by the ornithologist and field team. Eight species were netted at satellite camp one, 18 at satellite camp two, 16 at Ngong'olo camp and 20 at base camp two. Therefore basecamp two had the greatest species richness, although when assessing species richness of endemic and near endemic birds, Ngong'olo camp had five species, with satellite camp two having four species, base camp two, three species and satellite camp one, two species. Basecamp two located at the forest edge increased capture of more secondary forest / forest edge bird species. 7% of all the species recorded were Uluguru endemics, 2% Eastern Arc endemics and 9.5% near endemics to the Eastern Arc and approximately 13% threatened to extinction. 44% were forest dependent species.

4.2.2.2 General / Species abundance

Within 28,588 mist net metre hours, seven skins and 91 DNA samples were taken (Appendix 10d). A total of 252 birds were captured in mist nets: 37 birds were caught at satellite camp one, 93 at satellite camp two, 36 at Ngong'olo camp and 86 at basecamp two (Appendix 10e). Relative abundance was calculated correcting for different survey effort at each site (Figure 15).

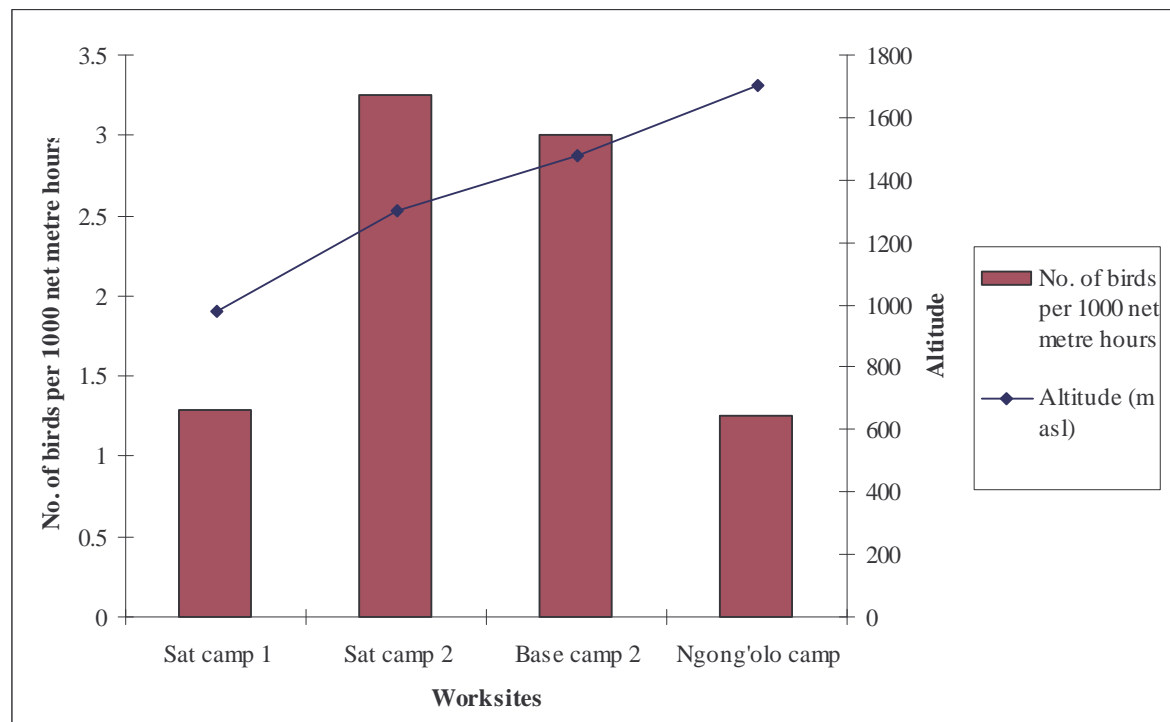


Figure 15 Relative abundance at sites compared with altitude (number of birds per 1000 net metre hours)

The overall greatest abundance of birds for systematic mist netting work (i.e. those bird species inhabiting lower and mid canopy forest) was at satellite camp two, a pristine submontane forest situated near a stream at an altitude of 1300m asl and at basecamp two at 1480m asl. The lower and higher altitude sites had half the number of birds per 1000 mist net hours compared to the mid altitude trapping sites (1.25 birds per 1000 net metre hours compared to 3 birds per 1000 net metre hours). Rainfall and less favourable weather conditions for trapping may partially account for this. However Ngong'olo camp had more numbers of endemic/near endemic bird species.

The most common birds in absolute number and those of conservation interest such as endemic/near endemic and threatened species were selected to calculate relative abundance per site (bird capture numbers per 1000 net metre hours) (Figure 16). The Olive sunbird (*Nectarinia olivacea*) was the most abundant bird captured at satellite camps one and two (0.65 bird and 0.75 bird per 1000 net metre hours), with the Red-faced crimsonwing (*Cryptospiza reichenovii*) having highest capture numbers at basecamp two (0.75 birds per 1000 net metre hours). Loveridge's sunbird (*Nectarinia loveridgei*), an Uluguru endemic, was abundant at satellite camp two and at higher altitude at Ngong'olo (0.35 birds caught per 1000 net metre hours). It was captured in low numbers at satellite camp one (0.05 birds per 1000 net metre hours) and was not present at basecamp two, the only site on the west of the mountain on forest edge.

Both Sharpe's akalat (*Sheppardia sharpei bangsi*) and the African tailorbird (*Orthotomus metopias altus*), two Uluguru endemic subspecies, were most abundant at satellite camp two. At Ngong'olo camp, the Bar-throated apalis (*Apalis thoracica uluguru*), an Uluguru endemic subspecies, and the Forest batis (*Batis mixta*), a near endemic to the Eastern Arc, were found in small numbers. Thus, satellite camp two and Ngong'olo camp had the greatest abundance of conservationally important birds; both were pristine areas of forest on the east of the mountain. Other birds found in abundance were Shelley's greenbul (*Andropadus masukuensis*) at satellite camp two and basecamp two; the Little greenbul (*Andropadus virens*), the White-starred robin (*Pogonocichla stellata*) and Red-faced crimsonwing (*Cryptospiza reichenovii*) at basecamp two.

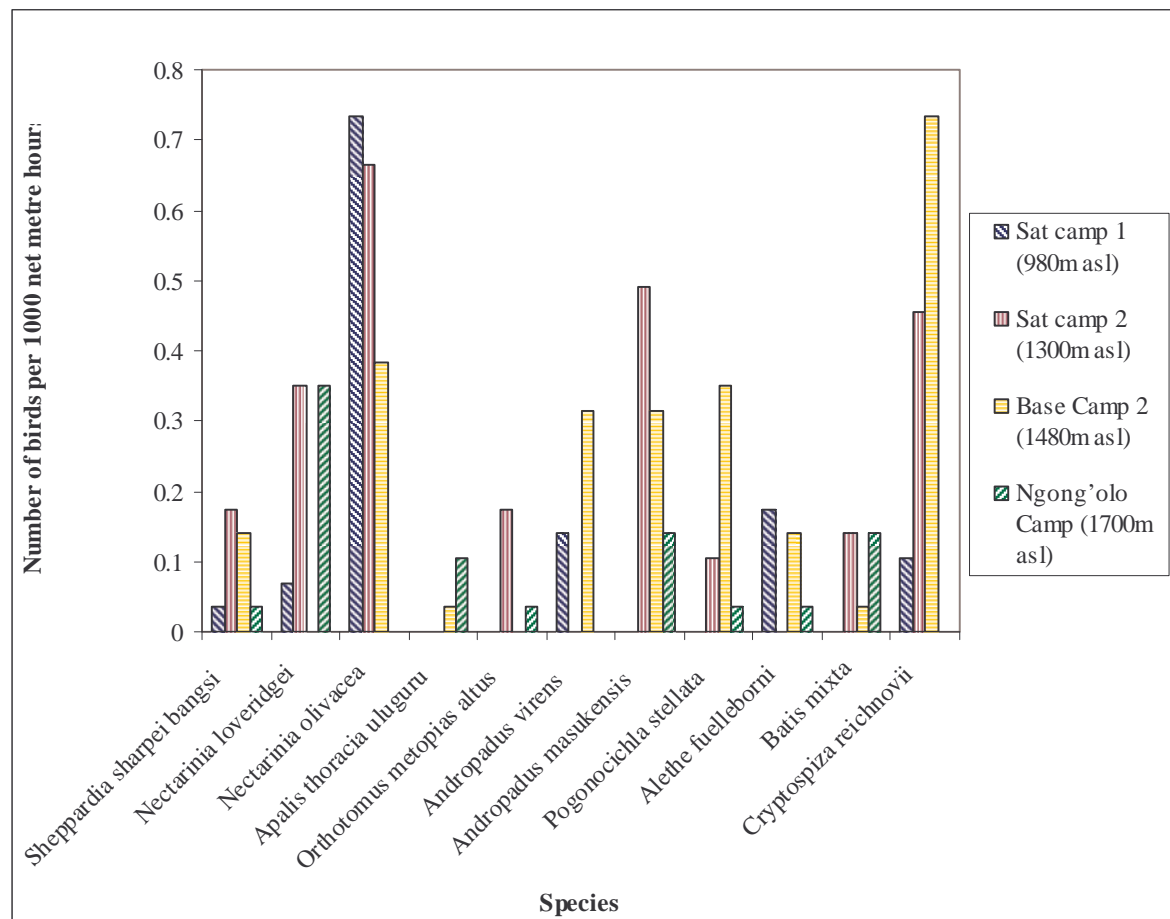


Figure 16 Relative abundance of selected birds at each netting site (number of birds per 1000 net metre hours)

*Ngong'olo camp was a separate ornithologist's camp

Four individuals of the Uluguru bush-shrike (*Malaconotus alius*) were recorded at different localities in the forest above Bagilo village between 1600-1800m asl, which is where it was first discovered in 1926. A pair of White-winged apalis (*Apalis chariessa macpharsoni*) was recorded in the forest above Bagilo village at 1600m asl in a mixed feeding party.

4.2.2.3 Endemics

UCBS recorded three species and four subspecies strictly endemic to the Uluguru Mountains: Loveridge's sunbird (*Nectarinia loveridgei*), Uluguru mountain greenbul (*Andropadus neumanni*) Uluguru bush-shrike (*Malaconotus alius*), Brown woodland warbler (*Phylloscopus umbrovirens fugglescouchmani*), Bar-throated apalis (*Apalis thoracica uluguru*), African tailorbird (*Orthotomus metopias altus*) and Sharpe's akalat (*Sheppardia sharpei bangsi*).

UCBS recorded one species and one subspecies that are strictly endemic to the Eastern Arc mountains: Mrs Moreau's warbler (*Bathmocercus winifredae*), located in Ukagurus, Ulugurus, Rubehos and Udzungwas; and White-winged apalis (*Apalis chariessa macpharsoni*), limited to the Ulugurus and Udzungwas.

4.2.2.4 Near endemics

UCBS recorded nine Eastern Arc near endemic species in Uluguru North FR (Table 21).

Table 21 Near endemic bird species of the Eastern Arc Mountains found by UCBS

Species	Common name	Range
<i>Andropadus masukuensis</i>	Shelley's greenbul	Eastern Arc / Southern rift
<i>Apalis chariessa</i>	White-winged apalis	Very localised, Coastal S Kenya, Eastern Arc highlands & S Malawi
<i>Apalis chapini</i>	Chestnut-headed apalis	Highlands in Tanz. & Malawi
<i>Batis mixta</i>	Forest batis	Eastern Arc & Coastal forests / Southern rift
<i>Cossypha anomala</i>	Olive-flanked robin-chat	N Tanz. & C&S Eastern Arc, Southern highlands and S Malawi and N Moz.
<i>Laniarius fuelleborni</i>	Fulleborn's black boubou	Eastern Arc and highlands of N Malawi
<i>Modulatrix stictigula</i>	Spot-throat	Eastern Arc & Mt Rungwe
<i>Oriolus chlorocephalus</i>	Green-headed oriole	Very localised and disjunct pop from S Kenya via Tanz. to S Malawi & C Moz.
<i>Poeoptera kenricki</i>	Kenrick's starling	Kenya C highlands through E Arc to S Tanz.

4.2.2.5 Threatened species

UCBS recorded four IUCN threatened and eight CITES restricted species (Table 22):

Table 22 IUCN and CITES listed bird species of the Uluguru North FR found by UCBS

Species	Common name	IUCN	CITES
<i>Accipiter tachiro</i>	African goshawk		II
<i>Apalis chariessa</i>	White-winged apalis	Vulnerable	
<i>Bathmocercus winifredae</i>	Mrs Moreau's warbler	Vulnerable	
<i>Buteo augur</i>	Augur Buzzard		II
<i>Buteo oreophilus</i>	Mountain buzzard		II
<i>Falco cuvieri</i>	African Hobby		II
<i>Malaconotus alius</i>	Uluguru bush-shrike	Endangered	
<i>Nectarinia loveridgei</i>	Loveridge's sunbird	Near threatened	
<i>Polyboroides typus</i>	African harrier hawk		II
<i>Stephanoaetus coronatus</i>	African crowned eagle		II
<i>Strix woodfordii</i>	African wood owl		II
<i>Tauraco livingstonii</i>	Livingstone's turaco		II

Important to note are two threatened bird species that were not recorded by UCBS but have been recorded in the past: Usambara eagle owl (*Bubo vosseleri*) and Banded green sunbird (*Anthreptes rubritorques*).

4.2.2.6 Forest dependent species

UCBS recorded 42 forest dependent species (Table 23):

Table 23 Forest dependent bird species of the Uluguru North FR found by UCBS

Species	Common name
<i>Alethe fuelleborni</i>	White-chested alethe
<i>Andropadus masukuensis</i>	Shelley's greenbul
<i>Andropadus milanjensis</i>	Stripe-cheeked greenbul
<i>Andropadus neumanni</i>	Uluguru mountain greenbul
<i>Apalis chapini</i>	Chestnut-headed apalis
<i>Apalis chariessa</i>	White-winged apalis
<i>Apalis melanocephala</i>	Black-headed apalis
<i>Apalis thoracica uluguru</i>	(Uluguru) Bar-throated apalis
<i>Bathmocercus winifredae</i>	Mrs Moreau's warbler
<i>Batis mixta</i>	Forest batis
<i>Bradypterus mariae</i>	Evergreen forest warbler
<i>Chloropeta similis</i>	Mountain yellow warbler
<i>Coracina caesia</i>	Grey cuckoo-shrike
<i>Cossypha anomala</i>	Olive-flanked robin-chat
<i>Cryptospiza reichenovii</i>	Red-faced crimsonwing
<i>Dendropicos griseocephalus</i>	Olive woodpecker
<i>Dicrurus ludwigii</i>	Square-tailed drongo
<i>Laniarius fuelleborni</i>	Fulleborn's black boubou
<i>Linurgus olivaceus</i>	Oriole finch
<i>Malaconotus alius</i>	Uluguru bush-shrike
<i>Mandingoa nitidula</i>	Green-backed twinspot
<i>Modulatrix stictigula</i>	Spot-throat
<i>Nectarinia loveridgei</i>	Loveridge's sunbird
<i>Onychognathus walleri</i>	Waller's starling
<i>Oriolus chlorocephalus</i>	Green-headed oriole
<i>Orthotomus metopias altus</i>	Red-capped forest warbler / African tailorbird
<i>Phyllastrephus flavostriatus</i>	Yellow-streaked greenbul
<i>Phylloscopus ruficapillus</i>	Yellow-throated woodland warbler
<i>Phylloscopus umbrovirens fugglescouchmani</i>	Brown woodland warbler
<i>Phyllostrephus cabanisi</i>	Cabanis' Greenbul
<i>Poeoptera kenricki</i>	Kenrick's starling
<i>Pogoniulus leucomystax</i>	Moustached green tinkerbird
<i>Pseudoalcippe abyssinica</i>	African hill babbler
<i>Sheppardia sharpei bangsi</i>	Sharpe's akalat
<i>Smithornis capensis</i>	African broadbill
<i>Stactolaema olivacea</i>	Green barbet
<i>Stephanoaetus coronatus</i>	African crowned eagle
<i>Tauraco livingstonii</i>	Livingstone's turaco
<i>Telophorus nigrifrons</i>	Black-fronted bush-shrike
<i>Trochocercus albonotatus</i>	White-tailed crested flycatcher
<i>Turdus olivaceus</i>	Olive thrush
<i>Zoothera gurneyi</i>	Orange ground thrush

4.2.2.7 UCBS new records for Uluguru North

UCBS listed an additional 17 species to the list compiled by Doggart et al (2005). Most of these species are widespread (Table 24). Two species that were not recorded by UCBS, but which are of conservation concern are: Usambara eagle owl (*Bubo vosseleri*) and Banded green sunbird (*Antheptes rubritorques*).

Table 24 New records of bird species recorded in the Uluguru North Forest Reserve by UCBS

Species	Common name	Range
<i>Andropadus milanjensis</i>	Stripe-cheeked greenbul	Widespread
<i>Anthreptes collaris</i>	Collared Sunbird	Widespread
<i>Bycanistes bucinator</i>	Trumpeter hornbill	Widespread
<i>Chloropeta similis</i>	Mountain yellow warbler	Widespread
<i>Chrysococcyx cupreus</i>	African Emerald cuckoo	Widespread
<i>Chrysococcyx klaas</i>	Klaas's cuckoo	Widespread
<i>Corvus albicollis</i>	White-naped raven	Widespread
<i>Estrilda quartinia</i>	Yellow-bellied waxbill	Widespread
<i>Guttera pucherani</i>	Crested guineafowl	Widespread
<i>Linurgus olivaceus</i>	Oriole finch	Eastern Arc and few highlands, S Somalia, N Malawi, Albertine Rift & Cameroon
<i>Mandingoa nitidula</i>	Green-backed twinspot	Widespread
<i>Motacilla clara</i>	Montane wagtail	Widespread palearctic migrant
<i>Phyllostrephus cabanisi</i>	Cabanis' Greenbul	Widespread
<i>Phylloscopus umbrovirens fugglescouchmani</i>	Brown woodland warbler	Widespread, however very uncommon in the Eastern Arc's montane forests. Uluguru endemic subspecies
<i>Polyboroides typus</i>	African harrier hawk	Widespread
<i>Telophorus nigrifrons</i>	Black-fronted bush-shrike	Widespread
<i>Tockus alboterminatus</i>	Crowned hornbill	Widespread

4.2.3 Reptiles

All specimens were identified by Mr. Michele Menegon in country, whilst taxonomic verification of snake specimens was confirmed from Dr. Don Broadley at the Natural History Museum in Zimbabwe. Other reptile specimens (chameleons and skinks) await taxonomic verification.

Taxonomy and nomenclature follows that of Spawls et al (2002).

4.2.3.1 Species richness

This survey recorded 13 species of reptiles representing seven families in Uluguru North FR during 528 bucket pitfall trapping nights, 23.45 man-hour timed searches and casual collections (Appendix 11). 13 of the 16 captures were taken as specimens. 38% of the species are strictly Eastern Arc endemics with 31% near endemic to the Eastern Arc and 15% are listed as threatened by IUCN and/or CITES. Uluguru North has a low species richness recorded for reptiles but this probably reflects a low intensity of herpetological research.

4.2.3.2 General / Species abundance

Abundance of reptiles is hard to quantify as the number of individuals was so low (16) and corresponded with the number of species recorded (13) (Figure 17). The two satellite camps on the east side of the mountains had highest numbers of species and individuals captured. Satellite camp one was only 980m asl. Reptilian abundance would be expected to be greater at lower altitudes due to their physiology and reliance on external warmth. All reptiles except one individual, Werner's three-horned chameleon (*Chamaeleo cf. werneri*), were located on the east slopes of the mountains.

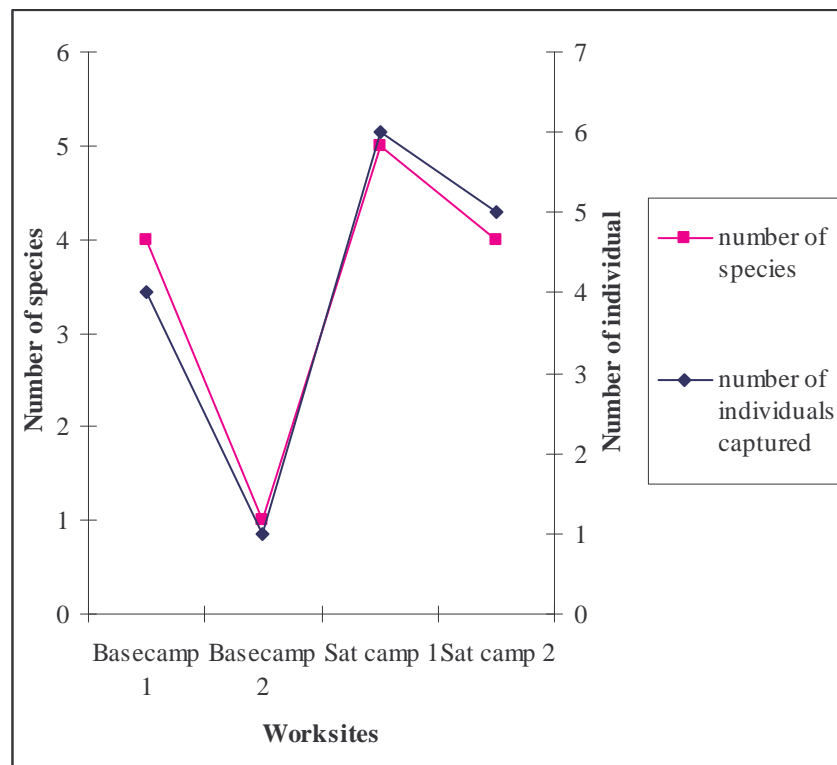


Figure 17 Number of reptile species and individuals captured at each worksite

Two species of the Vine snake (*Thelotornis mossambicanus* and *T. kirtlandii*) were captured at satellite camp one, above Kinole on the east side. These are both new records for Uluguru North FR. *Thelotornis kirklandii* has previously been recorded from Udzungwa escarpment forest and Mahale peninsula only. M. Menegon compared anatomical features and found differences that indicate two species; ventral count (169, *T.kirtlandii*; 148, *T. mossambicanus*); infralabials (9, *T.kirtlandii*; 9, *T. mossambicanus*); loreals (1/2, *T.kirtlandii*; 2/2, *T. mossambicanus*). Also the colour patterns assisted identification, for example the black spots on the side of the head and throat of specimen KMH 26228 differentiated between *T. kirtlandii* and *T. mossambicanus*.

The Uluguru fossorial skink (*Scelotes uluguruensis*) has not recently been recorded within the Uluguru Mountains. It was found at satellite camp two near Bagilo where it was originally discovered. The Horned bush-viper's (*Atheris ceratophorus*) presence in the Uluguru Mountains was first confirmed by UMBCP (2000), thus UCBS acquired the next two specimens on the east side of the mountains. They represented two colour phases of this snake species.

Species of interest that UCBS recorded were: the Western forest stiletto-snake record (*Atractaspis aterrima*) which is widespread in West Africa with “peculiar” isolated records in the Tanzania’s Udzungwas and Ulugurus; Werner’s chameleon (*Chamaeleo cf. weneri*), which differs from its counterpart in the Udzungwas and may represent a subspecies; and the Usambara two-horned chameleon (*Bradypodion fischeri fischeri*), which represents the first record within the Uluguru Mountains.

4.2.3.3 Endemics

UCBS recorded five strictly Eastern Arc endemic species (Table 25):

Table 25 Endemic reptiles of the Eastern Arc Mountains found by UCBS

Species	Common name	Range
<i>Atheris ceratophorus</i>	Horned bush-viper	Usambara, Uluguru & Udzungwas
<i>Bradypodion fischeri fischeri</i>	Usambara two-horned chameleon	Usambara and Nguru only, new record for Ulugurus
<i>Chamaeleo cf. Wernerii</i>	Werner's three-horned chamaeleon	Uluguru & Udzungwas
<i>Elapsoidea nigra</i>	Usambara garter-snake	N Pare, Usambara & Ulugurus
<i>Scelotes uluguruensis</i>	Uluguru fossorial skink	Usambara, Uluguru & Ngurus

It can be seen that four of these species are restricted to three mountain ranges within the Eastern Arc itself. *B. f. fischeri* was limited to two mountains blocks such that its presence in Uluguru North extends its range.

4.2.3.4 Near endemics

UCBS recorded four species that are near endemic to the Eastern Arc (Table 26):

Table 26 Near endemic reptile species of the Eastern Arc Mountains found by UCBS

Species	Common name	Range
<i>Crotaphopeltis tornieri</i>	Tornier's cat snake	Tanz. Eastern Arc & coastal forest plateau, S. Highlands and N Malawi
<i>Philothamnus hoplogaster</i>	South-eastern green snake	South-eastern Tanzania; other isolated records in West Africa
<i>Rhampholeon brevicaudatus</i>	Bearded pigmy chamaeleon	Tanzania endemic; Coastal Tanzania and Eastern Arc
<i>Thelotornis kirtlandii</i>	Forest vine snake	Two isolated Tanz records, Mahale peninsula & Udzungwa escarpment forest

4.2.3.5 Threatened species

UCBS recorded two CITES II listed reptiles: Usambara two-horned chameleon (*Bradypodion fischeri fischeri*) and Werner's three-horned chamaeleon (*Chamaeleo cf. wernerii*).

4.2.3.6 Forest dependent species

UCBS recorded five forest dependent species (Table 27):

Table 27 Forest dependent species found in Uluguru North FR by UCBS

Species	Common name
<i>Bradypodion fischeri fischeri</i>	Usambara two-horned chameleon
<i>Crotaphopeltis tornieri</i>	Tornier's cat snake
<i>Elapsoidea nigra</i>	Usambara garter-snake
<i>Rhampholeon brevicaudatus</i>	Bearded pigmy chamaeleon
<i>Scelotes uluguruensis</i>	Uluguru fossorial skink

4.2.3.7 UCBS new records for Uluguru North

UCBS listed an additional nine species to the list compiled by Doggart et al (2005) (Table 28).

Table 28 New records of reptile species for Uluguru North FR by UCBS

Species	Common name	Range
<i>Atractaspis aterrima</i>	Western forest stiletto-snake	Widespread in W Africa with “peculiar” isolated records in Tanz Eastern Arc.
<i>Bradypodion fischeri fischeri</i>	Usambara two-horned chameleon	Tanzania endemic, known from Usambara and Nguru only, new record for Ulugurus
<i>Chamaeleo cf. werneri</i>	Werner's three-horned chameleon	Tanzania endemic, Uluguru, Udzungwa, Nguru and Ukaguru
<i>Elapsoidea nigra</i>	Usambara garter-snake	Tanzania endemic, N Pare., Usam. & Uluguru
<i>Philothamnus battersbyi</i>	Battersby green snake	Widespread
<i>Philothamnus hoplogaster</i>	South-eastern green snake	South-eastern Tanzania; other isolated records in West Africa
<i>Rhinotyphlops lineolatus</i>	Blind snake	Widespread
<i>Thelotornis kirtlandii</i>	Forest vine snake	Two isolated Tanz records, Mahale peninsula & Udzungwa escarpment forest
<i>Thelotornis mossambicanus</i>	Vine snake	Widespread

4.2.4 Amphibians

All specimens were identified by Michele Menegon in country. They will be sent to the British Natural History Museum (BNHM) for taxonomic verifications, particularly of those unidentified.

4.2.4.1 Species richness

UCBS recorded 17 species of amphibians representing six families in Uluguru North forest reserve (Appendix 12). Fifty specimens were taken from 86 individuals captured during 528 bucket pitfall trapping nights, 23.45 man-hour timed searches and casual collections. Of these, 6% are strictly Uluguru endemics, 35% strictly Eastern Arc endemics, 41% threatened and 47% forest dependent. Species richness across worksites was similar with six species for basecamp one, seven for satellite camps one and two and eight for basecamp two. When comparing endemic species only basecamps one and two together with satellite camp one had three endemic species. Satellite two recorded only one endemic species.

4.2.4.2 General / Species abundance

Abundance of amphibians during bucket pitfall trapping was greatest at the zoological site one from basecamp one (Figure 18) in terms of capture numbers per 100 bucket pitfall traps. This site was located above Tegetero mission in pristine submontane forest, where three species were captured; of which *Probreviceps macrodactylus loveridgei* was the most abundant (4.5 animals per 100 bucket pitfall traps). The zoological site two (basecamp two) recorded low capture numbers of amphibians per 100 bucket pitfall traps, although the species diversity was marginally higher than basecamp one with four species captured.

Two species of *Nectophrynoides* toad were unknown, *Nectophrynoides* sp B and sp F. Species B maybe *N. minutus*, but will need clarification and comparison to other specimens at the British Natural History Museum. Species B was recorded from zoological site one, whilst species F was located at zoological site two in the forest above Morningside (basecamp 2). UCBS recorded *Nectophrynoides viviparus*, a toad found most commonly in the Eastern Arc Mountains, as well as a *Nectophrynoides* that was most like the *viviparus* group, but not with certainty the *viviparus* species (Menegon pers comm).

Also recorded from the zoological sites in low abundance were: *Scolecophorus kirkii* from zoological site one and *Arthroleptis* sp and *Scolecophorus uluguruensis* from zoological site two.

Interestingly the two Caecilian species were recorded at different locations, with *S. uluguruensis* at main trapse two and *S. kirkii* at main trapse one and satellite camp two.

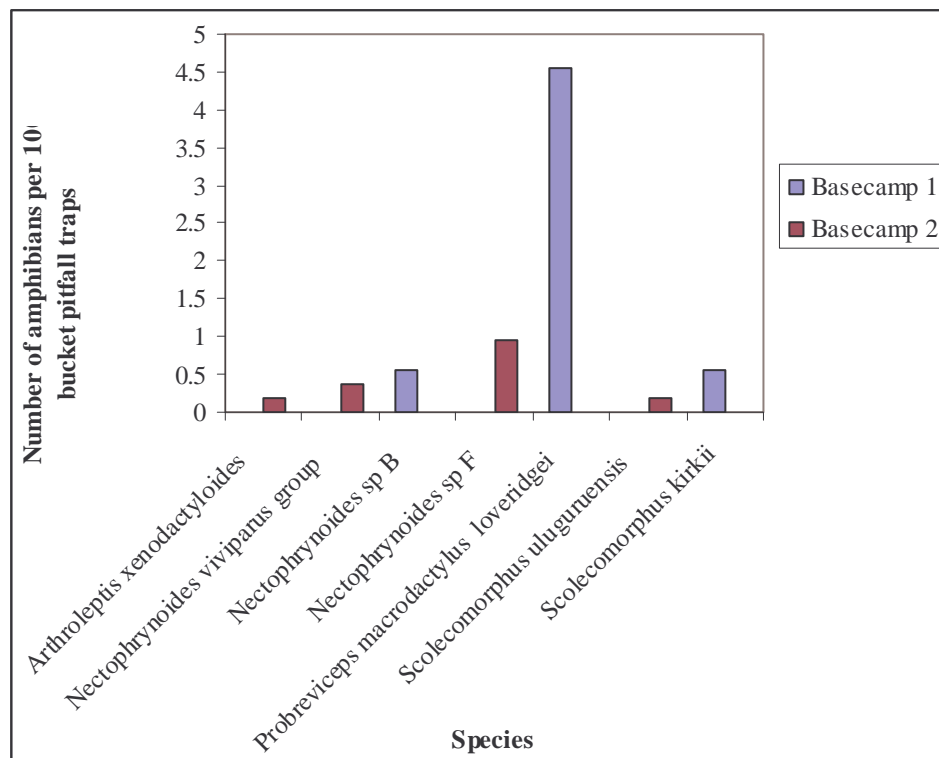


Figure 18 Relative abundance of amphibians captured in bucket pitfall traps (number of amphibians per 100 bucket pitfall traps)

When conducting herpetological searches, different species were captured to those caught in the bucket pitfall traps thus the two methods of bucket pitfall trapping and systematic searches should be combined to target different species and increase the species list. Biasing occurs with searches depending on the conspicuousness of each species and thus the ease of capture. This makes quantifying the data difficult as it cannot reflect a true measure of abundance. Total capture numbers for herpetological searches only are shown in Figure 19.

Tree frogs were the most common species caught by hand. The tree frogs are easy to locate once they are vocalising as they stay approximately 1 to 1.5 metres above the ground and will continue to call despite the researcher's presence. *Leptopelis uluguruensis* was the most commonly captured species at satellite camp one and two (Figure 19), with *L. parkeri* at basecamp two.

Stream dwelling frogs were captured at satellite camps one and two, *Arthroleptides yakusini* and *Phrynobatrachus*. All *Nectophrynoides* species were captured from basecamp two, possibly as this was the highest altitude work site and *Nectophrynoides* is a montane species.

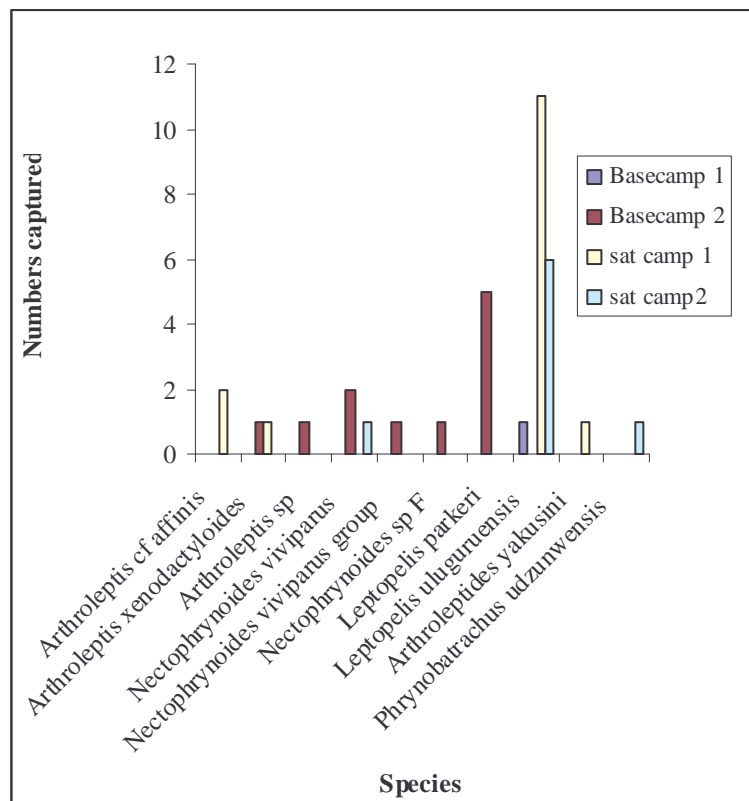


Figure 19 Total number of captures of amphibians during systematic searches only

4.2.4.3 Endemics

UCBS recorded one strictly Uluguru endemic species and five strictly Eastern Arc endemic species (Table 29):

Table 29 Endemic amphibians of the Eastern Arc Mountains found by UCBS

Species	Range
<i>Arthroleptides yakusini</i>	Uluguru, Mahenge and Udzungwas
<i>Leptopelis parkeri</i>	Usambaras, Ulugurus and Udzungwas
<i>Leptopelis uluguruensis</i>	East Usambara, Nguu, Nguru, Uluguru & Udzungwas
<i>Phrynobatrachus udzungwensis</i>	Uluguru, Nguru & Udzungwas
<i>Probreviceps macrodactylus loveridgei</i>	Uluguru and Udzungwas
<i>Scolecophorus uluguruensis</i>	Uluguru endemic

It can be seen that one species is restricted to two mountains ranges only and three species to three mountain ranges only.

4.2.4.4 Near endemics

UCBS recorded three species near endemic to the Eastern Arc (Table 30):

Table 30 Near endemic amphibians of the Eastern Arc Mountains found by UCBS

Species	Range
<i>Leptopelis vermiculatus</i>	West & East Usambaras, Nguu, Udzungwa, Southern rift
<i>Nectophrynoides viviparus</i>	Tanzania endemic, Ulu., Rub., Udz. & Mt Rungwe
<i>Scolecophorus kirkii</i>	Eastern Arc and Southern Rift

4.2.4.5 Threatened species

UCBS recorded seven IUCN threatened species and one CITES I restricted (Table 31):

Table 31 IUCN and CITES listed amphibians of the Uluguru North FR found by UCBS

Species	IUCN	CITES
<i>Arthroleptides yakusini</i>	Endangered	
<i>Leptopelis parkeri</i>	Vulnerable	
<i>Leptopelis uluguruensis</i>	Vulnerable	
<i>Leptopelis vermiculatus</i>	Vulnerable	
<i>Nectophrynoides viviparous</i>	Vulnerable	I
<i>Phrynobatrachus udzungwensis</i>	Endangered	
<i>Probreviceps macrodactylus loveridgei</i>	Vulnerable	

4.2.4.6 Forest dependent species

Eight forest dependent species were recorded in Uluguru North: *Arthroleptis* cf. *affinis/reichei*, *Leptopelis parkeri*, *Leptopelis vermiculatus*, *Leptopelis uluguruensis*, *Probreviceps macrodactylus loveridgei*, *Arthroleptides yakusini*, *Scolecophorus uluguruensis* and *Scolecophorus kirkii*.

4.2.4.7 UCBS new records for Uluguru North

UCBS listed an additional nine species to Doggart et al's (2005) species list (Table 32).

Table 32 New records of reptile species for Uluguru North FR by UCBS

Species	Range
<i>Arthroleptis</i> cf. <i>affinis/reichei</i>	
<i>Arthroleptis xenodactyloides</i>	N. Tanz. Through Malawi, N & C Mozam. To E Zimbabwe
<i>Arthroleptis</i> cf. <i>xenodactyloides</i>	
<i>Leptopelis uluguruensis</i>	East Usambara, Nguu, Nguru, Uluguru & Udzungwa endemic
<i>Leptopelis vermiculatus</i>	West & east Usambaras, Nguu, Udzungwa, Southern rift
<i>Nectophrynoides viviparus</i> group	
<i>Nectophrynoides</i> sp B	
<i>Nectophrynoides</i> sp F	
<i>Scolecophorus kirkii</i>	Eastern Arc and Southern Rift

4.3 Human disturbance

Survey work aimed at investigating the level of human disturbance within the reserve.

Table 33 Summary results of a pole and timber cutting in Uluguru North FR

	Total transect length (m)	Total area of transect (m ²)	Total no. sampled	Live (% of total)	Average live per area hectare (ha)	Dead (% of total)	Average dead per area hectare (ha)	Cut (% of total)	Average cut per area hectare (ha)
Poles	15,150	151,500	4,059	3645 (89.8)	240.6	175 (4.3)	11.6	239 (5.9)	15.8
Timbers	15,150	151,500	3,807	3255 (85.5)	214.8	461 (12.1)	30.4	92 (2.4)	6.1

A total of 4,059 poles and 3,807 timbers were surveyed along transect lines (Table 33). An average of 15.8 poles were cut per hectare with timber cutting observed with an average of 6.1 timbers per hectare. However with 5.9% and 2.4% of total poles and timbers cut, extraction is still low. Averages of dead timbers are higher than average of cut timbers at 30.4 and 6.1 per hectare, respectively; depending on steepness of the slope, large trees fall naturally or from lightening strikes, this may explain the higher average of dead timbers.

When comparing nine edge transects (numbers 3,4,5,6,13,14,15,16,17) with eight interior transects (numbers 1,2,7,8,9,10,11,12) for cut poles and cut timbers using a Mann Whitney U two tailed test, significant differences were found which indicate that higher numbers of cut poles and timbers occur at the forest edge (Cut poles, $Z = -2.814$, $P < 0.005$; Cut timbers, $Z = -2.732$, $P < 0.006$) (Figure 20). This would be expected as access is easier due to the proximity of the FR to villages. Although there are more trees outside of Uluguru North compared to Uluguru South FR, there is obviously still some pressure exerted within the FR. However, if one compares the percentage of new vs old cut poles and timbers, it is mainly old cutting that has been recorded (that of three months and more); 91% of cut poles were old with 86% old cut timbers. Thus, when calculating the same percentages for Uluguru South, it is found that old cut poles account for 77% and 59% are old cut timbers. Therefore, the main problem area for timber resource extraction is in Uluguru South FR, where more pitsawing sites were also seen as casual observations.

The majority of the cutting data along transect lines was recorded from the west side of the mountains with 67.3% for old cut poles, 90.5% for new cut poles, 74.6% for old cut timbers and 14.3% for new cut timber, suggesting new timber extraction is more prevalent on the eastern side of the mountains. However actual numbers for new cut timbers are very low with only seven recorded within Uluguru North FR, of which five were recorded from transect five located near Tegetero mission in a heavily disturbed area of forest edge. Transect 13 (northern tip of Uluguru North FR) had high levels of both cut poles and timbers. The edge of the FR is located behind the teacher's training college at Kigurunyembe at low altitude and easy access. It is interesting to note that Black and white colobus were seen at the forest edge, suggesting disturbance mainly constitutes timber extraction and not hunting.

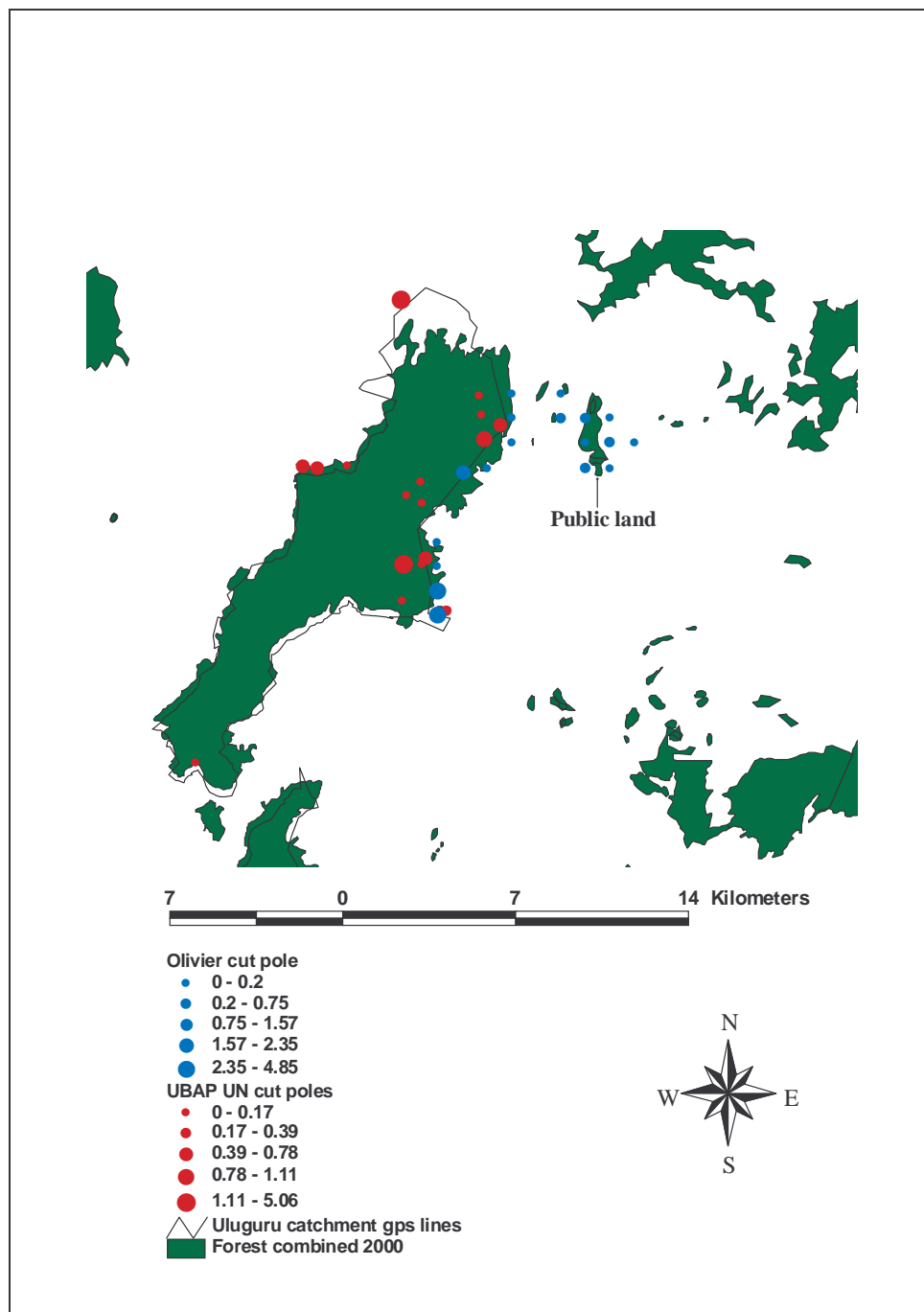


Figure 20 Comparison of Hymas 2000 cut pole data and all UCBS cut pole data

The circles represent the average number of cut poles for each transect, with size of circle directly correlating to the number of cut poles. Each circle marks the beginning of the transect line. The average number is taken as Hymas used 1000m transects and UCBS 900m transects.

When comparing UCBS's forest east edge transects (transect numbers 1,2,3,4,5,6,7,8,9,10,11,12) with Hymas' FR transects for cut poles and timbers (Mann Whitney U two tailed test), it was found that there is a significant difference between the two data sets for cut timbers showing that there has been a decrease over time in timber resource extraction ($Z = -4.633$, $P < 0.001$). With pole cutting there has been no significant change over time ($Z = -1.197$, $P < 0.231$).

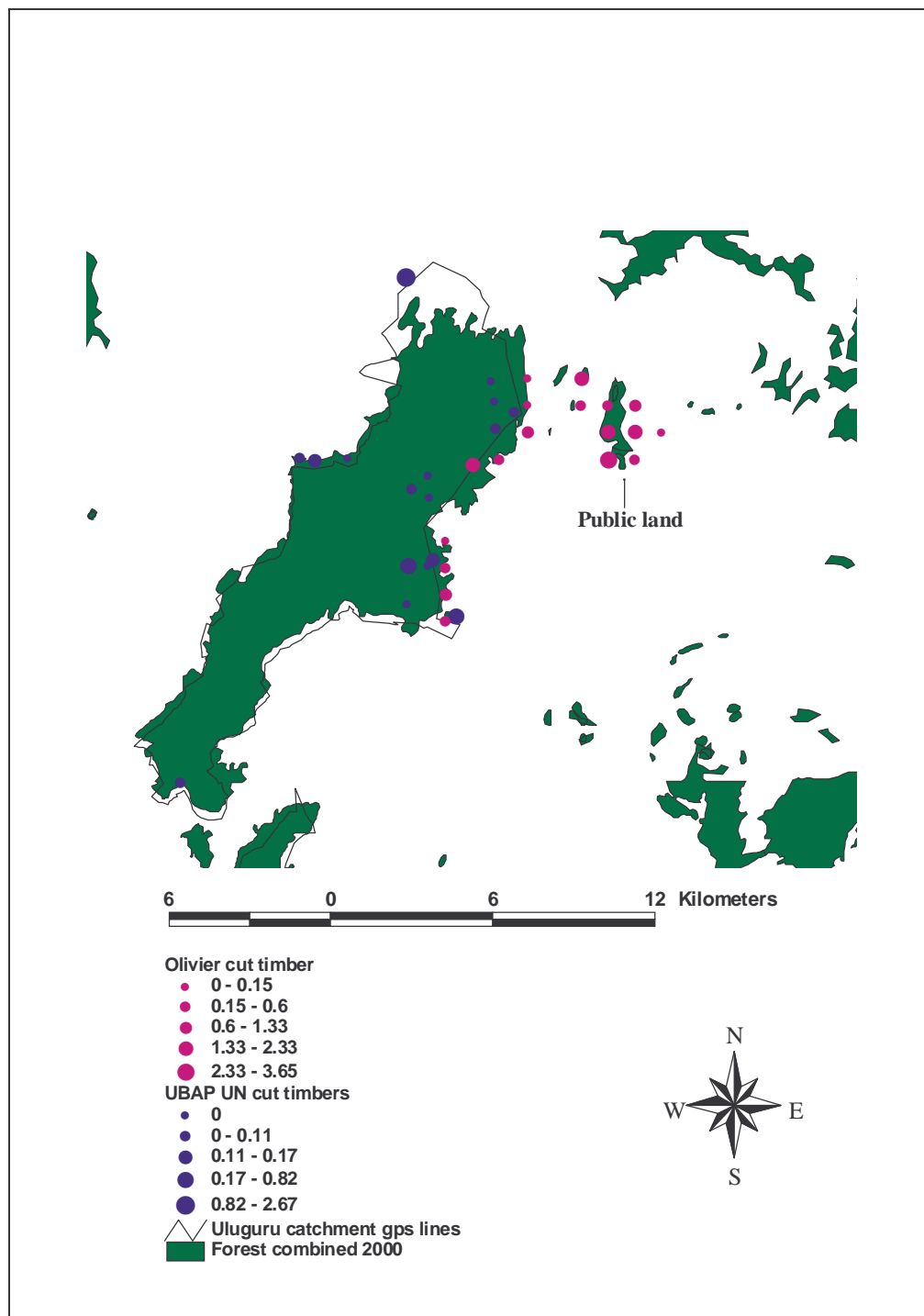


Figure 21 Comparison of Hymas 2000 cut timber data and all UCBS cut timber data

The circles represent the average number of cut timber for each transect, with size of circle directly correlating to the number of cut timbers. Each circle marks the beginning of the transect line. The average number is taken as Hymas used 1000m transects and UCBS 900m transects.

In addition to pole and timber data collection, other disturbance was noted along the transect lines. If the general assumption is made that open gaps in the forest are most likely associated with human disturbance, although natural tree falls also create this effect, then assessing the canopy cover along transect lines can indicate areas of disturbance. Transects are highlighted here if 75% (and over) of the 50m sections fell in to one of three categories used: canopy cover 0-10%, 11-50% and >51%. No transect line had such a dominance of open canopy and five of 17 transects had any recordings of 0-10% canopy cover. Transect 14 had 45% open canopy; this was located south of the reserve near

Bunduki where casual observations also noted human disturbance. Only one transect had 75% of the 50m section with 11-50% of canopy cover. This was located on the west of the reserve above Morningside. 12 transect lines had 75% (and over) of $\geq 51\%$ canopy cover, all of which were located on the east of the mountain above Tegetero, Bagilo and Kinole, except transect 13 which was located in the north at Kigurunyembe. Of these transect lines, five had 100% closed canopy coverage (transects 1, 6, 7, 8 and 11). Thus, based on this assessment it can be seen that the forest surveyed had few areas with open gaps suggesting little disturbance, such as timber extraction, occurring in Uluguru North, particularly the east of the reserve.

19% of the 50m sections (57 out of 303 50m sections) have paths crossing them. These were predominantly on the western side of the FR, although large traditional paths that link villages on either side of the mountains are common on both sides. Paths varied in size with a network of well-used paths in the forest above Morningside and an old road that leads to the tower at Bondwa peak. Firewood collection was noted along transects 13 and 16, one time at each. Old cutting was seen along transect ten. General disturbance was noted along transects 5, 14, 15, 16, 17, all of which are edge transects. Encroachment into the forest by shamba expansion was noted at the beginning of transect 16 with removal of the border trees. Transect five is by the 'arm' of the FR by Tegetero but it is already degraded and on the GIS map it doesn't exist anymore, although this may be partially to do with the GIS mapping alignment. Some bramble (*Rubus* spp) invasion is occurring on the forest edge, mainly above Morningside, but it is not as severe as that occurring in Uluguru South although this issue still needs to be addressed. There is also a potential problem in the south of the Uluguru North FR near Bunduki.

Two old pitsawing sites were seen along transects 16 and 17, with another casually observed on the forest edge near satellite camp one on the east side. These targeted *Newtonia buchananii*, not *Ocotea usambarensis*, as in Uluguru South. Large mammal traps, mainly targeting monkeys, were recorded; two along transect eight and one along transect 14. A rodent trap was also recorded from transect 14. Hunting is less prevalent within Uluguru North FR than Uluguru South FR. Diggings for medicine was recorded along transect 13, although it is not known which root was being targeted.

Chameleon collection for the pet trade at Bunduki and Bagilo, butterfly and moth collection at Morningside and beetle (*Megalorhina harisi*) collection at Bagilo are known to occur (pers comm with locals). At Morningside they brought the beetles so that the UCBS team could identify them.

Overall, as with Uluguru South FR, boundary marking of the FR with trees (*Eucalyptus* and *Grevillea* species) is better established and clearly visible on the west side, although the forest boundary between Tegetero and Lukenge has recently been planted with *Eucalyptus* and *Grevillea*. Systematic planting needs to be conducted for overall clear demarcation in both FRs.

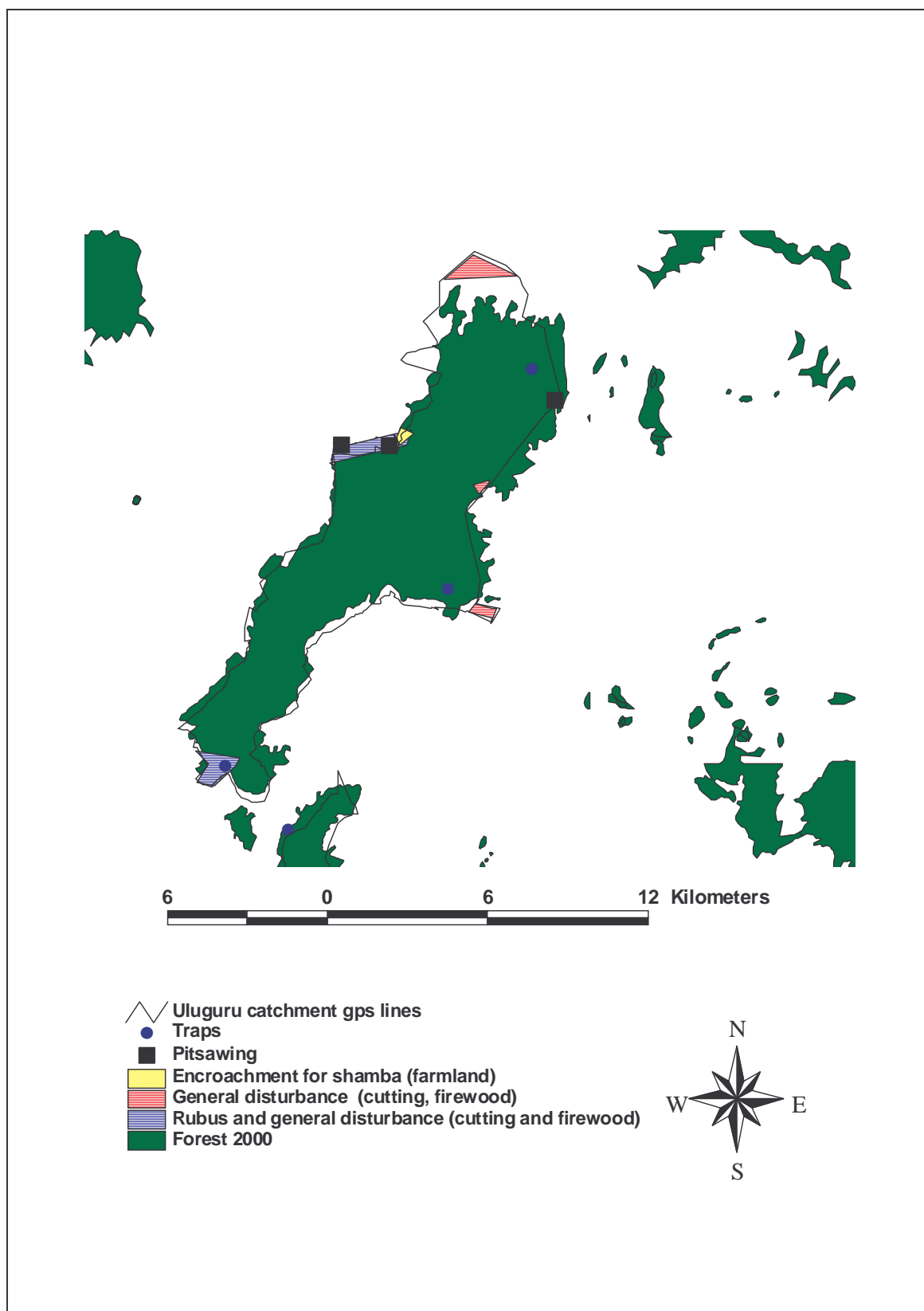


Figure 22 Map showing main areas of disturbance

5. DISCUSSION AND RECOMMENDATIONS

5.1 Flora

Uluguru North FR is a typical Eastern Arc moist forest. It is composed mainly of submontane forest (1200m-1500m asl) and montane forest (1500m-2100m asl). At the northern end of the reserve at Kigurunyembe, tertiary forest differentiates into open woodland, where such species as *Brachystegia spiciformis*, *Albizia gummifera* and *Lonchocarpus carpusa* are found. Typical upper montane forest (>2100m asl) is found around the peaks of Bondwa, Kinazi, Magari and Lupanga.

UCBS recorded 237 species in Uluguru North FR, of which 153 were recorded from 36 vegetation and regeneration plots and 84 species from opportunistic surveys (Appendix 7). 7.6% of species recorded were Uluguru endemics; however this is only 13.3% of the known strict Uluguru Mountain endemics. It may be that the sampling intensity was too small due to time constraints. 12.2% of recorded species were Eastern Arc endemics and 18 species were listed by IUCN. 217 species were found in both Uluguru North and South FRs.

These high altitude areas of the FR are abundant in endemic species (>2000m asl) with 61% recorded in these locations, for example *Ilex mitis var schliebenii*, *Impatiens* species, *Streptocarpus glandulosissimus*, *Lobelia lukwangulensis*, *Syzygium parvalum* and *Lasianthus* species. 39% of endemic species are recorded below 1800m asl, such as *Saintpaulia* species and *Psychotria brucei*. The high level of endemism is found within the families of Rubiaceae and Balsaminaceae, whose species are capable of adapting and surviving in the extreme terrains found in Uluguru North. Within Balsaminaceae, high rates of hybridisation for *Impatiens* produce many variants which are capable of inhabiting a wide range of ecological environments. *Saintpaulia*, the African violet, is also recorded within Uluguru North and highlights the importance of conserving moist closed canopy forest to enable species that are forest dependent and endemic to the Eastern Arc forests to survive. Such areas would be those of pristine forest located on the eastern side of the mountain near Tegetero, Bagilo and Kinole villages. There the structure of the forest is more complex like that of rain forest with higher dbh values and a greater average tree height (25-30m, with emergent trees at 50m) compared with the western side of the mountain. The east also contains evergreen submontane forests that are of great biological importance, for example they house the rare endemic Uluguru bush-shrike. Both the north and the west of the FR show less forest stratification due to less rainfall (an effect of aspect) and more human disturbance.

Allanblackia stuhlmannii, *Allanblackia uluguruensis* and *Ocotea usambarensis*, as specified key floristic indicators, are found in low abundance in Uluguru North FR, especially if you compare it to Uluguru South FR where both *O. usambarensis* and *A. stuhlmannii* are dominant species within the vegetation plots. This may in part be attributable to the high proportion of plots being in submontane forest as Lovett et al (in press) found a high abundance of *A. uluguruensis* at 1800m asl at Lupanga. Only four stems were recorded of *A. stuhlmannii* within vegetation plots 8, 15, 21 and 22, all of which are located in submontane forest on the east of the mountain above Tegetero and Kinole. *A. uluguruensis* had 18 stems in four vegetation plots (21, 22, 28 and 36). It is more widely distributed in the reserve but still in low abundance; two plots (21 and 22) are found above Bagilo village at 1300m – 1500m asl, one plot at the southern end of the reserve (28) at 1810m asl and one on the west (plot 36) at 1790m asl. *O. usambarensis* had a low stem count within the vegetation plots with 13 individuals spread across ten vegetation plots located on both east and west sides of the reserve predominantly in submontane forest. Uluguru South FR is the stronghold for these key species. *O. usambarensis* cannot reproduce below 1500m asl (Schulman et al 1998) so it is becoming rare and this may explain its low abundance in Uluguru North FR. *Khaya anthotheca*, the African mahogany tree, is an extremely valuable timber species that is often targeted intensively for this reason; it is a very tall rainforest species with a massive bole. In Uluguru North FR it was recorded in low abundance within submontane forest on the east of the mountain above Tegetero and Kinole. 11 stems were found within five vegetation plots. *K. anthotheca* had overall species dominance in plot 19 located above Kinole at 1100m asl.

Widespread species are recorded at lower altitudes (<1800m asl) in higher densities, such as those described within Table 5, where the most abundant species recorded are *Leptonychia usambarensis*, *Myrianthus holstii*, *Sorindeia madagascariensis*, *Aphloia theiformis* and *Trilepisium madagascariense*. In terms of greatest species coverage within the vegetation plots, *Myrianthus holstii*, *Newtonia buchananii*, *Leptonychia usambarensis*, *Aphloia theiformis* and *Parinari excelsa* are most commonly recorded in the vegetation plots. *Newtonia buchananii* is targeted for timber extraction being used in joinery for pestles, tool handles and wooden spoons. It is found in abundance in Uluguru North FR. In comparison, *Ocotea usambarensis* has been the most abundant timber for extraction in Uluguru South FR. This is likely to do with the difference between the availability of each species between the two reserves, as *Ocotea usambarensis* is the fifth most abundant tree within the vegetation plots and has the second greatest species coverage in Uluguru South FR. The east of the mountain has the highest diversity index of species, which varies according to altitude with more diversity of endemic species at higher altitude. Species dominance is shared by several species; similar results have been reported by Sangu (2005) in Uluguru South FR, Mremi (1998), Moshi (2000) in the Udzungwa Scarp FR. The richness and abundance of species at low altitude maybe associated with the higher temperatures enabling microbial activity to release nutrients required for plant growth (Sangu 2005). Similarly lower altitudes are associated with high nutrient flowing from higher altitudes as a result of rain water percolating into the soil.

Invasive species noted within the FR are *Rubus* species and *Maesopsis eminii*. Both favour disturbed areas with gaps and therefore of greatest concern are the west and south of the mountains, such as above Morningside and Bunduki where most forest disturbance is occurring. However the effect of *Rubus* invasion in Uluguru North FR is minimal and should be monitored to prevent the same spread that is occurring in the forests and plateau above Tchenzema in Uluguru South FR. The *Rubus* bramble is thought to be from South Africa (pers comm., Frank Mbago, UDSM). Some management controls are highlighted in the *human disturbance section 5.3*. *Maesopsis eminii* was seen on the east above Tegetero and within the forest above Kinole. Originally from western parts of East Africa it is an aggressive invader of disturbed forest, as seen in Amani Nature Reserve, but within closed canopy forest it will not out compete indigenous trees. This is not of priority concern, but should be monitored. *Lantana camara*, another invasive species commonly seen in disturbed areas was not seen within the reserve but outside of it around Bunduki. This should also be monitored in the future.

The forest has low levels of disturbance and houses pristine closed canopy forest especially on the east, although the affect of disturbance could be seen by the changes to forest structure and composition within the 'arm' of forest by Tegetero mission. Tree cutting for timber extraction will destroy the canopy trees, species such as *Newtonia buchananii*, as well as shrub and herbs that are destroyed as the trees fall, with gaps resulting, encouraging invasive species (*Rubus* spp) to spread. Selective removal of trees for poles and utensil making (*Aphloia theiformis*, *Drypetes gerrardii*) alters the balance of species (Mremi, 1998). Removal of deadwood (*Aphloia theiformis*, *Macaranga capensis*) in the form of fire wood collection affects the ecology and the population of invertebrates utilising dead trees as their habitat. This has implications for organisms predating on them (Price, 1975) and consequently throughout the food chain.

The presence of the African violet and the above key floristic species predominantly in the east of Uluguru North FR highlights the pristine condition of the forest and the importance of conserving these areas. The submontane rainforests in Uluguru North are of extreme importance, particularly as Uluguru South FR has all but lost its tracts of submontane forest. The submontane forest shows the best growth in East Africa (Svendsen and Hansen 1995).

Lovett et al (in press) carried out research in 1981 in Uluguru North FR at Lupanga and investigated species composition between montane and upper montane forest, species diversity differences with elevational changes and the effect of aspect. Vegetation plots were established on west and east aspects. It was found that the highest stem density is at 1600m asl corresponding with the highest species richness, which decreased with altitude as did overall species diversity. Species composition

varied linearly and continuously with altitude. Higher altitude western plots, such as 2000m asl were similar to 1800m asl plots on the east aspect. This can be contributed to the differences in exposure moisture levels and wind for each aspect, as slopes receiving lower rainfall would be expected to have higher and more available nutrient levels enabling maintenance of higher diversity at higher altitude. This study found similar results for effects on overall species richness and diversity with changes in elevational ranges and the higher stem density found in the east aspect.

The flora of the Uluguru North FR has many typical Eastern Arc forest tree species with a rich abundance of important endemics situated at higher altitude in particular at Lupanga and Bondwa. Furthermore the eastern side of the mountain houses important primary submontane forest, which must be a priority for conservation as Uluguru South FR has almost no tracts of submontane forest remaining.

5.2 Fauna

156 species have been recorded by UCBS in Uluguru North FR, most of which are small fauna, such as birds, rodents, shrews, amphibians and reptiles. In total, when compiling the species list of this study and that of Doggart et al (2005), which combines all previous research in Uluguru North FR, there are 209 faunal species present in Uluguru North FR (full lists are given in Appendices 9, 10, 11 and 12). UCBS has added 45 records not previously listed by Doggart et al (2005) and it has confirmed the presence of 111 species, mainly avifauna.

5.2.1 Mammals

UCBS research recorded a low species richness and abundance of large fauna. Most commonly recorded were the Black and white colobus (*Colobus angolensis*), Blue monkey (*Cercopithecus mitis*), Bushpig (*Potamochoerus larvatus*), Blue duiker (*Cephalophus monticola*), Tree hyrax (*Dendrohyrax validus*) and Mountain galago (*Galagoides orinus*). Perkin (2000) estimated the population numbers of the Mountain galago at 23,000 in Uluguru North and South FRs. Its type locality is at Bagilo in Uluguru North FR. Important records from this study were Stuhlmann's golden mole (*Chrysochloris stuhlmanni tropicalis*), which was last recorded in 1950 (Swynnerton and Hayman) and is an Uluguru endemic subspecies, and the Zanj elephant shrew (*Rhynchocyon petersi*) which is an Eastern Arc/coastal forest endemic species.

Small fauna are abundant with typical Eastern Arc rodent species, such as *Praomys*, *Hylomyscus* and *Lophuromys*. This confirms Stanley et al's findings (1998) during a survey in Uluguru North above Tegetero. Stanley did not capture *Beamys hindei*; although UCBS confirmed its presence in Uluguru North FR with one specimen only. This species is believed to be trap-shy; however previous Frontier-Tanzania research has found it abundant in lowland forest, for example Nambiga FR, Kilombero Valley, and in coastal forests in Mtwara (pers comm, C. Bracebridge). It is possible that abundance within trap sites is low due to the submontane and montane habitats UCBS worked within. Doggart et al (2005) recorded the presence of *Beamys hindei* within Kasanga Local Authority Forest Reserve, which has an altitudinal range of 660m – 940m asl and is located to the east of Kimhandu peak in Uluguru South FR. It would be interesting to conduct further trapping within lowland forest, such as Kimboza FR, as Doggart et al (2005) during their 2000 survey did not record the presence of *Beamys* within Kimboza FR, but sampling intensity may have been too low.

Several endemic shrews are found within the reserve, of which two have not been recorded since 1998 (*Crocidura monax* and *Crocidura telfordi*) (Table 34). These species are of conservation concern as both are threatened by extinction as listed by IUCN. *C. telfordii* is an Uluguru and Udzungwa endemic species. UCBS did record the presence of *Sylvisorex howelli*, an Eastern Arc endemic shrew and found it to have abundant population numbers throughout the reserve. In general shrews have a more disjunct species distribution than rodents and are more vulnerable to environmental changes, thus should be targeted for future monitoring.

This study did not confirm the presence of several species recorded during previous research. Of greatest concern is Abbot's duiker (*Cephalophus spadix*), which has not been sighted since 1950. It is listed as vulnerable by IUCN and its larger size compared to that of the Blue duiker means it is targeted by hunters. It is particularly hunted around Bunduki/Vinile, where they use the meat and the skins (pers comm, local villager). If Abbot's duiker is still present in Uluguru North, the numbers are likely to be very low. Other populations of Abbot's duiker are found in isolated massifs, such as Kilimanjaro National Park, other Eastern Arc mountains such as the Udzungwa Mountains and the Southern rift. Further surveys targeting this species should be undertaken.

UCBS did not record the presence of Leopard (*Panthera pardus*), Serval cat (*Leptailurus serval*), African civet (*Civettictis civetta*) and Blotched genet (*Genetta tigrina*) (Table 34) within this study. The last recordings of Leopard, Genet, Civet and Serval were by Swynnerton and Hayman (1950). A local (pers comm, local villager) stated that a Leopard had been known to come out of the forest near Bunduki to take a goat. If this is true, then it may indicate that natural prey numbers within the forest are low, due to hunting and habitat destruction.

Elephant (*Loxodonta africana*), Buffalo (*Syncerus caffer*) and Aardvark (*Orycteropus afer*) are also noticeably absent in the Ulugurus but present in other Eastern Arc Mountains, both undisturbed (Udzungwa) and disturbed (Rubeho) areas. It is not known if they were ever present in the Uluguru Mountains, and if they were when they were removed.

Table 34 Important species that UCBS did not verify the presence of

Species	Common name	IUCN	CITES	Last recorded
<i>Crocidura monax</i>	White-toothed shrew	Vulnerable		Stanley et al 1998
<i>Crocidura telfordii</i>	White-toothed shrew	Critically endangered		Stanley et al 1998
<i>Paraxerus palliatus</i>	Red-bellied coast squirrel	Vulnerable		Swynnerton and Hayman 1950
<i>Aonyx capensis</i>	African clawless otter		II	Swynnerton and Hayman 1950
<i>Leptailurus serval</i>	Serval cat		II	Swynnerton and Hayman 1950
<i>Panthera pardus</i>	Leopard		I	Swynnerton and Hayman 1950
<i>Cephalophus spadix</i>	Abbot's duiker	Vulnerable		Swynnerton and Hayman 1950

Ten new species were recorded from this research in Uluguru North, of which nine species are widespread and one is an Eastern Arc near endemic, the Lesser pouched rat (*Beamys hindei*).

5.2.2 Birds

Avifauna has been well surveyed during previous research, for example Jensen and Brøgger-Jensen 1992; Svendsen and Hansen 1995; Tøttrup et al 2004. Comparisons are made to a list compiled by Doggart et al (2005) which includes all previous research for avifauna in Uluguru North FR. Most of the species UCBS recorded confirmed the presence of many widespread and common species.

Loveridges sunbird (*Nectarinia loveridgei*), an Uluguru endemic, was found in abundance within both the Uluguru North and South FRs. This is a forest dependent species with a range restricted to these two forest reserves. It is known from altitudes between 800-2000m asl, mainly above 1500m asl (Stevenson and Fanshawe 2002). Tøttrup et al (2004) have estimated the population to be 36,971 within the Uluguru Mountains with highest densities (number per km²) within the altitudinal bands 1500-1800m and lowest densities at the extremes of the forest altitudinal ranges 1300-1400m asl and >2300m asl. Tøttrup et al had their highest catch rates at 1800m and 2200m asl, whilst Svendsen and

Hansen (1995) captured most birds at 1520m and 1920m asl. UCBS captured most birds at 1300 and 1700m asl within Uluguru North FR.

The Uluguru bush-shrike (*Malaconotus alius*), endangered as listed by IUCN, was recorded by this study and it is of major conservation concern. It is a distinct species occurring at very low densities. Romdal and Rahner (in prep) suggest a population size of 1200 pairs. It has been heard only once in Uluguru South FR above Tchenzema at 2100m asl in 1981 (Collar and Stuart 1985, Collar and Jensen 1985). The surveys in 2000 (Doggart et al 2005) failed to locate it, thus perhaps it is already extinct in Uluguru South FR. It is almost exclusively confined to high canopy and thus very hard to detect unless heard. Birds mainly inhabit submontane and lower montane forest such that presence of forest within this altitudinal range is fundamental to maintaining viable populations. Thus Uluguru North FR is vital to its survival, particularly in light of its absence in the 2000 survey. Monitoring and specific population studies should be undertaken for this species. Conservation considerations such as reforesting the Bunduki gap to rejoin Uluguru North and South FRs may increase survival chances for this species and many forest dependent species endemic to these FRs.

UCBS confirmed the presence of five species and subspecies endemic to the Uluguru Mountains and/or Eastern Arc Mountains: White-winged apalis (*Apalis chariessa macpharsoni*), Mrs Moreau's warbler (*Bathmocercus winifredae*), Brown woodland warbler (*Phylloscopus umbrovirens fugglescouchmani*), the Bar-throated apalis (*Apalis thoracia uluguru*) and the African tailorbird (*Orthotomus metopias altus*). The White-winged apalis (*Apalis chariessa macpharsoni*) is endemic to the Uluguru and Udzungwa mountains only with the Udzungwa Mountains having higher population numbers. However, the Uluguru Mountains have the largest population numbers for Mrs Moreau's warbler (*Bathmocercus winifredae*), an Eastern Arc endemic. This species was observed in Uluguru North and captured in Uluguru South. The presence of three Uluguru endemic subspecies, the Brown woodland warbler (*Phylloscopus umbrovirens fugglescouchmani*), the Bar-throated apalis (*Apalis thoracia uluguru*) and the African tailorbird (*Orthotomus metopias altus*) was recorded in low numbers for the latter two species; six individuals for the African tailorbird and four for the Bar-throated apalis. The Brown woodland warbler was recorded by casual observation rather than by mist netting.

Two bird species were not recorded by UCBS, both of which are vulnerable to extinction: Usambara eagle owl (*Bubo vosseleri*) and Banded green sunbird (*Anthreptes rubritorques*). The Usambara eagle owl (*Bubo vosseleri*) was not known from the Uluguru Mountains until 1995 (Hunter et al 1998). Romdal and Rahner (in press) heard it frequently on the east of the mountain and estimated 12 pairs per km² or a population of almost 1000 pairs in Uluguru North. Doggart et al (2005) confirmed its presence in their 2000 study. The Banded green sunbird (*Anthreptes rubritorques*), an Eastern Arc endemic, prefers submontane forest but has not been recorded in any surveys since 1950s. It is suspected to be extinct in the Uluguru Mountains. Only five specimens have been collected from Uluguru North FR (Svendsen and Hansen 1995).

The following two bird species are predominantly lowland species and are found within the Uluguru Mountains. They are both near threatened and maybe present within Uluguru North submontane forest. This study did not record their presence:

The Southern banded snake eagle (*Circaetus fasciolatus*) has been recorded in Kimboza FR and is potentially found in the submontane forest on the east side of Uluguru North. Previous records have located it at 1450m asl in the West Usambaras and 1600m asl in the Ngurus (Stuart and Turner 1980, Britton 1980, Fuggles-Couchman 1984).

The Uluguru violet-backed sunbird (*Anthreptes neglectus*) is more commonly located in the foothills. Svendsen and Hansen (1995) conclude from their Uluguru North FR survey by its noted absence that the Uluguru violet-backed sunbird is uncommon above 1250m asl on the eastern slopes.

The Uluguru Mountains have long been recognised as important for forest birds. In a review of key forests for the protection of threatened bird species in Africa (Collar and Stuart 1988), the Uluguru Mountains (including foothills) were ranked fourth among all forests in East Africa (and 16th within the African continent) in terms of conservation value for the protection of threatened and near threatened bird species. They are also an important part of C24, one of the 221 priority areas for global conservation listed by Birdlife International (1992). Uluguru North FR has the largest submontane evergreen forest within the Uluguru Mountains and is of great conservation value, especially for the Uluguru bush-shrike whose future remains dependent on this FR.

5.2.3 Reptiles

Small fauna, such as reptiles can be good indicators of forest health due to their sensitivity to changes in the forest, such as human disturbance; this is particularly true of endemic species (Spawls et al 2002). This can be very useful in determining the status of the forest condition and the management requirements based on such information, especially as there are many Eastern Arc endemic reptiles within Uluguru North FR that are dependent on healthy forest conditions, e.g. Usambara two-horned chameleon (*Bradypodion fischeri fischeri*) and Werner's chameleon (*Chamaeleo werneri*). Comparisons are made to a list compiled by Doggart et al (2005) which includes all previous research for reptiles in Uluguru North FR.

The Usambara two-horned chameleon (*Bradypodion fischeri fischeri*) was recorded for the first time by this study, representing a range extension for this subspecies originally recorded from the Usambaras and Ngurus only. In Uluguru South the Uluguru subspecies was recorded, *Bradypodion fischeri uluguruensis*, however these subspecies are quite distinct in size and therefore easy to define. There has already been some discussion that the three *Chamaeleo fischeri* subspecies represent three good evolutionary species (Spawls et al 2002). This new record may help validate this argument.

Werner's chameleon was recorded as 'being like that of' as this species may later be recognised as several subspecies. Specimens that M. Menegon has compared from South and North Udzungwa and the Ulugurus show some anatomical differences, for example the type of spines on the dorsal ridge. Other specimens previously collected from the Uluguru Mountains, housed at University of Dar es Salaam, also confirm that the Uluguru Werner's chameleon looks quite different to the Udzungwa specimen.

Of the data compiled by Doggart et al (2005) for previous research in Uluguru North FR, one record was not confirmed by UCBS: Uluguru pigmy chameleon (*Rhampholeon uluguruensis*), which was last collected by Professor Howell (UDSM) in 1985. This species is endemic to the Uluguru, Ukaguru and Rubeho mountains ranges.

UCBS did not locate two snake species of conservation concern which were originally recorded from lower altitude forests in areas which have now been deforested: Ornate shovel-snake (*Prosymna ornatissima*) (Critically endangered) and the Uluguru blind snakes (*Typhlops uluguruensis* and *Typhlops* sp. nov.). One specimen of *T. uluguruensis* has been collected near Uluguru North FR since Doggart et al conducted their survey in 2000 (pers comm Simon Loader). For each snake very little is known about their behaviour and ecology. Only a few isolated specimens have been collected. Uluguru North FR provides suitable habitat as these species predominate within lower submontane elevations. However, habitat loss is greatest at low to mid altitude so severely threatens these species.

5.2.4 Amphibians

Small fauna, such as amphibians can be good indicators of forest health due to their sensitivity to changes in the forest, such as human disturbance. This can be very useful in determining the status of the forest condition and the management requirements based on such information. In addition, it is clear from this research that further studies can reveal a lot more about the amphibian fauna of the Uluguru North FR. Comparisons are made to a list compiled by Doggart et al (2005) which includes all previous research for amphibians in Uluguru North FR.

Of interest, two species of *Nectophrynoides* toad collected by this study are unknown; *Nectophrynoides* species B and F. *Nectophrynoides* species are forest associated in submontane and montane forest patches in the Eastern Arc. The genus is considered an ancient Afrotemperate relict (Poynton 2003) but is poorly defined. The distribution of this species is thought to reflect the long history of the Eastern Arc forests and periods of isolation within fragmented mountain blocks. *Nectophrynoides* may be a useful indicator for reconstruction of the biogeography of the Eastern Arc (Menegon et al 2004). Six species of *Nectophrynoides* are known to be present in the Uluguru Mountains, three are strictly endemic (Figure 23).

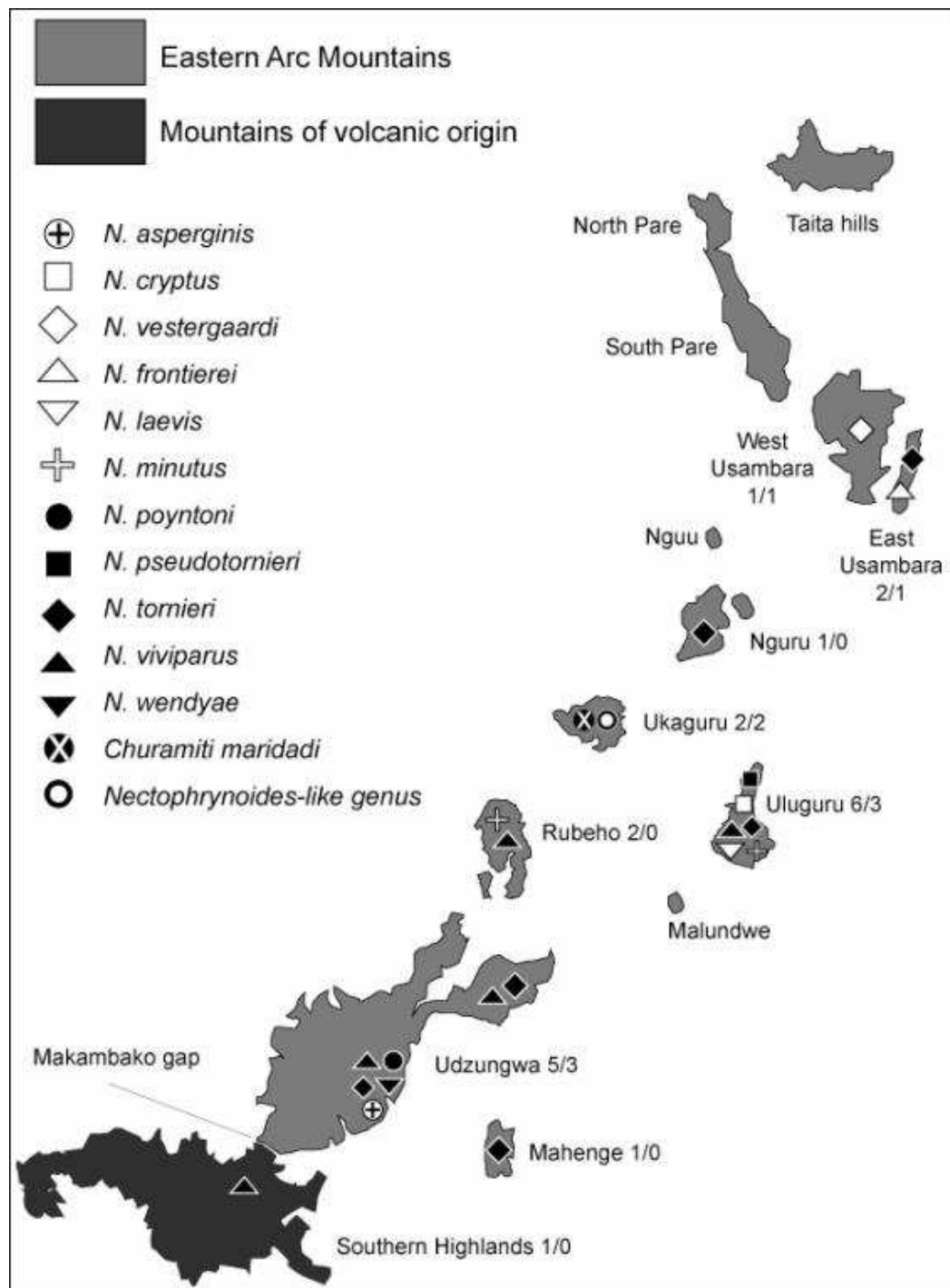


Figure 23 Distribution of *Nectophrynoides* species in the Eastern Arc Mountains and Southern Highlands (from Menegon et al 2004).

Nectophrynoides cryptus, both endangered and CITES I, has not been recorded since 1993; obviously this is of great conservation concern. Likewise, *Nectophrynoides minutus*, endangered, has not been recorded in the last 12 years although UCBS is currently awaiting taxonomic verification of a specimen which may be *Nectophrynoides minutus*. One further species, *Arthropleptis xenodactylus*, was not recorded by this study and is of conservation concern as it is vulnerable to extinction.

Important species collected by this study, those of conservation concern, are: *Nectophrynoides viviparus* (vulnerable and CITES I), *Leptopelis parkeri* (vulnerable), *Leptopelis vermiculatus* (vulnerable), *Leptopelis uluguruensis* (vulnerable), *Probreviceps macrodactylus loveridgei* (vulnerable), *Arthropleptis yakusini* (endangered) and *Phrynobatrachus udzungwensis* (endangered). *Leptopelis uluguruensis* is common above Bagilo village at 1300m asl, where six males were captured whilst they were vocalising within an hour of searching. *Leptopelis parkeri* was also caught in abundance when conducting a herpetological search above Morningside; these individuals were mostly juveniles.

Thirteen species listed by previous research were not recorded by this study, most of which are widespread species. The sampling intensity for amphibians in terms of systematic night searches was low and this is reflected in those species not recorded that are unlikely to be captured within the bucket pitfall traps.

Uluguru North FR has high biodiversity value with many endemic and threatened species relying on its habitat, for example the submontane forests. Degradation of forests is occurring within this altitudinal band and monitoring of key species, such as the Uluguru bush-shrike, Uluguru blind snake and Ornate-shovel snake, should be a priority. Key species, such as Loveridges sunbird, Usambara eagle owl and Abbot's duiker should be monitored, with specific studies focusing on abundance and distribution. Furthermore there is great potential for discovering new species; more intensive studies concentrating on specific taxa, such as reptiles and amphibians, need to be conducted to try to provide a full faunal inventory of Uluguru North FR.

5.3 Human disturbance

Human disturbance is low within Uluguru North FR, especially if compared with Uluguru South FR. The inaccessibility of approximately 50% of the FR due to extremely steep slopes and cliffs helps to protect the area. The main issues for management are:

- Pole cutting, occurring predominantly on the west
- Encroachment of shamba into FR near Morningside
- Pet trade of chameleons around Bunduki
- Chameleon and beetle (*Megalorhina harisi*) collection at Bagilo village, near satellite camp two
- Butterfly and moth collecting at Morningside
- Lack of clear forest boundaries, especially on the east side
- Forest edge disturbance on the west, south and the arm of forest by Tegetero
- Some *Rubus* bramble invasion

Analysis of cut poles and timbers within this study shows that cutting is more prevalent on the edge of the forest, where access is easier for those exploiting forest resources. However it is mainly old cutting that has been recorded (91% and 86% old cut poles and timbers). The main disturbance area for extracting poles is the west side of the reserve. Comparison of the dataset from this study and that of Hymas (2001) indicates that pole cutting has increased over time and there are no significant changes to timber extraction from 2000 to 2005.

Hunting pressure is low in Uluguru North FR. This may in part be due to a difference in religious practices of the communities surrounding each forest reserve. Uluguru North communities are predominantly Muslims are prohibited to hunt (although this may not be adhered to by all individuals), whilst Uluguru South FR is surrounded by Christian communities who do hunt. This was seen in the prevalence of Black and white colobus sightings and their behavioural reactions to the research team within Uluguru North FR compared to Uluguru South FR.

It is clear that people use the forest to locomote between villages separated by this mountain range and 19% (57 out of 303) of the 50m sections of the disturbance transects recorded paths, which varied from large paths to smaller, the latter more likely to be trails leading to traps, and so on. Paths are effectively a lifeline between villages geographically divided by this mountain range and should be considered when reviewing the status of the Uluguru North FR.

The illegal trade of chameleons needs to be investigated further as there are several threatened and endemic species occurring in the FRs. Sustainability of trade needs to be ascertained. Further information needs to be collected on butterfly and moth collections at Morningside and beetles (*Megalorhina harisi*) at Bagilo. Long-term management plans need to consider a total ban on this activity by enforcement and in the meantime monitor the trade.

With regards to *Rubus* invasion, the threat to Uluguru North is much lower than Uluguru South where the spread has occurred rapidly within the last five years. Only some small areas found above Morningside and Buduki have been recorded as having *Rubus* species within Uluguru North FR. Other countries also have problems with *Rubus* invasion; such as *Rubus fruticosus* in New Zealand; *Rubus alceifolius* in cleared areas in Queensland (but is a native to south east Asia) and; *Rubus discolor*, a pest in moist temperate regions of the world, native to western Europe. *Rubus* is usually spread by bird droppings and it is not easy to eliminate the actual spread, therefore management must consider germination, growth and proliferation. Methods suggested and used in other parts of the world fall into several categories, however these techniques are not necessarily used within a protected area. Viable methods would be biological controls and/or cultural controls (seedling regeneration is not as vigorous in well shaded areas, thus healthy forests and pastures may help prevent germination).

Observations by Dr. Neil Burgess (pers comm) during his visit to the UCBS team at satellite camp one (east side) and basecamp two (west side) compare changes from 1999 to the present to the surrounding villages and the forest itself; this information is helpful for monitoring purposes.

In Kinole village, visited in 1999 and 2001, the roads have improved with more trees planted, *Cedrella* and *Khaya*, along its edge and in the surrounding farmland. These tree species are being promoted by the WCST project that has also improved the grounds of the primary school. The farming system 0.5 to 1km from Kinole seems unchanged, although bananas and peppers are being grown as cash crops near to the forest edge. The main cash crop is the banana with a new market in Kinole for trading; more pineapples are also being grown (WCST project). Forest loss on Kitambaku hill (Chief Kingalu area) seems to have slowed down but thinning is still occurring and the banana is the main undercrop.

Around the Morningside area, which has been visited for the past 15 years, it was observed that crops farmed have changed from maize to banana and other higher value crops such as leeks, strawberries, raspberries, celery, parsley, carrots and carnation flowers. These are sold in Morogoro. Encroachment into the forest for farming and firewood collection still occurs with a lot of deadwood on major forest pathways; however the intensity of collection is lower than Uluguru South FR. Newly planted boundary trees have been cut to clear space for farmland. There are open areas of forest with few trees, but it is not clear if this is natural or disturbed. However such areas facilitate the spread of invasive species, *Rubus* spp and *Maesopsis eminii*, and regeneration should be monitored.

The Uluguru Mountains are one of the biologically most important areas of the Eastern Arc Mountains (Burgess et al 2002) with the third largest area of natural forest (Newmark 1998). Uluguru North FR has an extremely rich flora and fauna that have been highlighted in this baseline biodiversity study by assessing the richness and abundance of key taxa and species, confirming presence and absence of conservationally important species and finding potentially new species. This study provides a dataset that can be used as a monitoring baseline with which to assess changes over time to the biodiversity values and continuing human resource use in terms of disturbance to the forest. The conservation of its forests is crucial to the survival of the endemic species. Uluguru North FR houses some of the last (and best in East Africa) submontane forest in the Uluguru Mountains, which in turn has species dependent on it for survival, such as the Uluguru bush-shrike; these forests are severely threatened by the increasing pressure that human population growth is having on the demands for natural resources such as firewood and poles. With agriculture being the dominant economy in the area, trees have been cleared over time and have forced people to look for their natural resources within the FR. These activities are strictly illegal and should be stopped but with clear alternatives to the local communities. Realistic management plans should involve the communities in how best to address the current problems facing Uluguru North FR, such as patrolling borders and well used paths within the FR, encouraging tree planting on farm land (an activity already implemented in some areas of the mountain by WCST) and other joint management initiatives. As a globally recognised biodiversity hotspot both the larger and smaller perspectives and the short-term and long-term goals need careful planning and assimilation if this area is to be conserved for the future.

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Appendix 1: CARE-Tanzania Consultant Agreement

CARE-TANZANIA CONSULTANT AGREEMENT

Appendix K

Ms. THE SOCIETY FOR ENVIRONMENTAL EXPLORATION/FRONTIER (the "Consultant") of 50-52 Rivington Street, LONDON, U.K. EC2A 3QP and CARE, an international non-governmental development and relief organization, hereinafter referred to as CARE-Tanzania, P.O. Box 10242, Dar es Salaam, Tanzania, hereby agree to the following:

1. **Duties.** The Consultant shall complete the work described in the attached Schedule A, hereby incorporated into this Agreement, within the time frame specified therein. The Consultant shall not subcontract or sublicense any work hereunder without the written consent of CARE.
2. **Compensation.** The Consultant shall be compensated according to the terms specified in Schedule A, and shall not receive vacations, sick pay, insurance or other benefits usually afforded the employees of CARE.
3. **CARE Name.** The Consultant shall use the CARE name or marks only for activities authorized by CARE in writing. All other uses will be deemed infringements of the CARE trademark.
4. **Taxes.** The Consultant shall pay all personal taxes, social security, and other taxes per the national laws governing consultancy payments.
5. **Indemnity.** The Consultant shall indemnify and hold harmless CARE, and its officers, directors, employees, agents and its and their respective heirs, legal representatives, successors and assigns, from and against any and all claims, demands, liabilities, expenses (including reasonable attorney's fees and disbursements, court costs, judgments, settlements and fines), whether of omission or commission, that may be committed or suffered in connections with the performance of this Agreement by the Consultant or a partner or agent of the Consultant or the Consultant's general business operations. This paragraph shall survive termination or expiration of this Agreement.
6. **Ownership of Work.** The Consultant represents and warrants that all work created pursuant to this Agreement shall be original work and that no third party will hold any rights in or to such work. The Consultant agrees that CARE shall, solely and exclusively, own all rights in and to any work created by the Consultant in connection with this Agreement, including all data, documents, information, copyrights, patents, trademarks, trade secrets, or other proprietary rights in and to the work. By entering into this Agreement, the Consultant hereby expressly transfers all such rights to CARE.

7. **Disclosure.** The Consultant agrees not to disclose any matters of a confidential nature to which it may be or become privy as a result of the Agreement. Upon the expiration or termination of this Agreement, the Consultant shall surrender to CARE all confidential material relating to CARE in his or her possession, of whatever origin and including, without limitation, duplicates, facsimiles, models, prototypes and notes relating thereto. The Consultant shall promptly direct all inquiries relating to confidential and proprietary information from the public (whether from an individual, a government agency or official, the media or other sources) to your supervisor, except as CARE may otherwise provide by written instructions to the Consultant. This Article shall survive any termination or expiration of the Agreement.
8. **Business and Office Policies.** During the term of this Agreement, the Consultant shall comply with the business and office policies of CARE.
9. **Inability to Complete.** If the Consultant is unable to complete the described activities and duties described for any reason, then CARE Tanzania shall have the option to terminate this Agreement on five (5) business days written notice unless the Consultant furnishes another individual satisfactory to CARE. Otherwise, the Consultant's non-performance of the duties described in Schedule A will constitute a breach of this Agreement. CARE may withhold fees and compensation due to the Consultant until a settlement of any dispute between the parties has been reached.
10. **Termination.** This Agreement shall automatically terminate 30 days after the date set forth on Schedule A for the completion of the Consultant's duties. It may be terminated by CARE at any time for any reason, upon five (5) days written notice to the Consultant. Provisions which are intended to survive termination or expiration of this Agreement include, without limitation, to paragraphs 3, 4, 5, 6, and 7 hereof.
11. **Information.** CARE shall furnish the Consultant with such information as the Consultant deems necessary to perform agreed upon services, and CARE warrants that such information will be true and correct.
12. **No Joint Venture.** The Consultant is an independent contractor with respect to CARE. Nothing herein shall be deemed to create a joint venture, agency or partnership between the parties, and neither party shall have the power to obligate or bind the other in any manner whatsoever, except as specifically provided herein.
13. **Governing Law; Disputes.** This Agreement shall be construed and enforced in accordance with, and governed by the substantive laws of country in which the agreement is signed. CARE may withhold fees and compensation due to the Consultant until a settlement has been reached.

14. **Notices.** Any notice or other communication required or permitted hereunder shall be delivered in person or sent by first-class (certified mail return receipt requested) to the address set forth above. Such notice or communication shall be deemed to have been given as of the date so delivered, sent or mailed.
15. **Security Notice.** In connection with your consultation work for CARE, and travel relating to your work, you may encounter difficult conditions and hazards. The risks inherent in that travel and work include personal injury, illness, kidnapping, civil unrest and the loss of, or damage to, your property. In addition, emergency rescue, medical facilities or an adequate level of medical expertise may not be available to you. CARE cannot assure your safety or that of your property. It is your obligation to understand in advance all the risks inherent in your travel and work because, in accepting this consulting contract, you accept those risks. **CARE strongly recommends that you obtain appropriate insurance, including emergency medical evacuation coverage, to protect yourself against the risks inherent in your consulting work for CARE.**
16. **Entire Agreement.** This Agreement contains the entire understanding of the parties hereto with respect to the subject matter contained herein. This Agreement supersedes all prior agreements and understandings between the parties with respect to such subject matter and may only be modified or discharged by a written document executed by the parties hereto. No terms hereof may be waived or modified except by written amendment.
17. **Representations.** By his or her signature below, each signatory hereto represents and warrants that he or she is duly authorized to enter this Agreement on their behalf. Upon execution and delivery, this Agreement shall be a binding obligation of such party. The Consultant further represents and warrants that her or she has provided CARE with his or her correct social security number, and true and accurate information concerning citizenship and/or residency status. The Consultant agrees to notify CARE of any change in his or her citizenship and/or residency status during the term of this Agreement.

18. Headings. Article headings herein are included for convenience of reference only and shall not affect the construction or interpretation of this Agreement.

19. Time is of the essence of the Agreement.

20. The CARE contact person for this contract is: GABRIEL BATULAINÉ.

IN WITNESS WHEREOF, the parties have duly executed this Agreement as of the 23rd day of AUGUST, 2004.

CARE INTERNATIONAL IN TANZANIA


Name: NICK SOUTHERN
Title: COUNTRY DIRECTOR

24/8/04

CONSULTANT


Name: CIBLEIS FANNING

Circle Applicable Status: U.S. Citizen Resident of U.S. Non-U.S. Citizen

Social Security Number (for U.S. Citizens and Residents): _____

SCHEDULE A

Conservation & Management of the Eastern Arc Mountain Forests: Uluguru Mountains Environmental Management & Conservation Project (GEF/UNDP:URT/01/G32)

Introduction

The Uluguru Mountains Environmental Management and Conservation Project (UMEMCP) is a component of the Conservation and Management of the Eastern Arc Forests (GEF/UNDP: URT/01/G32). The project is implemented by the Forest and Beekeeping Division of the Ministry of Natural Resources and Tourism and it is funded by the Global Environment Facility through the United Nations Development Programme. CARE International in Tanzania (CARE) implements the UMEMCP component under the terms of an agreed Memorandum of Understanding with the Forest and Beekeeping Division that was signed on the 12th August 2003.

Objectives of the Consultancy

The purpose of the UMEMCP component is:

Improved forest management and conservation and improved land husbandry practices in the Uluguru Mountain forests and adjacent villages implemented by local communities, government authorities and other stakeholders.

Improving the management and protection systems of the Catchment Forest Reserves of the Ulugurus (North and South) is a key project output to achieving this objective. Central to improving the management of the forests is first understanding their biodiversity values and being able to measure any change in those biodiversity values. The project is now in its first year of implementation and the objective of the consultancy is to establish a baseline for measuring the Project's impact on maintaining biodiversity values and reducing threats in the longer term.

Therefore, CARE Tanzania is inviting proposals from service providers to undertake a biodiversity assessment of the Uluguru North and South Catchment Forest Reserves. The assessment will determine:

- i) Major types of forest disturbance and proportion of habitat affected by forms of disturbance;
- ii) Population density of key floral indicator species e.g. *Allanblackia uluguruensis*; *Ocotea usambarensis*;
- iii) Species richness of flora and vertebrates¹; and
- iv) Crude abundance of endemic; globally threatened and Eastern Arc characteristic species.

¹ Detailed population estimates of the Uluguru Bushshrike and Loveridge's Sunbird will be undertaken separately to indicate population trends in these key endemic species since 2000.

Potential service providers should note that CARE Tanzania works locally in partnership with: the District Councils of Morogoro and Mvomero Districts; the Morogoro Regional Catchment Forestry Office, Morogoro; The Tanzania Forest Conservation Group (TFCG); The Wildlife Conservation Society of Tanzania (WCST); and the Uluguru Mountains Agricultural Development Project (UMADEP).

Expected Products of the Consultancy

A detailed consultancy report presenting the assessment in both hard (3 copies) and soft copies together with the original data sets.

These will be lodged with:

- The proposed Eastern Arc Conservation Centre;
- Forest and Beekeeping Division; and
- The Tanzania National Biodiversity Database, UDSM.

Methods

The project requires service providers to outline their methodological approach and indicate how they propose to integrate relevant government partners into their methodology.

Special Issues

Service providers should:

- i) Specify how they intend to address the issue of specimen collection, storage, export permits and CITES clearance.
- ii) Indicate how their methods compare with those used for previous assessments within the Eastern Arc Mountains.

Implementation Arrangements

- 1) **Time-frame:** Field implementation to begin in October 2004 with a draft report completed by March 2005.
- 2) **Preparation & Briefings:** The project will provide a full briefing and copies of previous studies undertaken at the site and field orientation at the start of the field-work period.
- 3) **Debriefs:** The project will expect regular monthly debriefs throughout the implementation period to ensure timely execution of the contract. The Project Office should be used as the main operational base for the fieldwork.
- 4) **Reporting:** The Project expects to see a draft report of the first analysis by March 2005. A final report (after specimen identifications have been completed) will be produced not later than the end of 2005.
- 5) **Resources:** The project will provide a vehicle with a driver. The project will also provide access to office space and internet connection in Morogoro.

ULUGURU NORTH AND SOUTH FOREST RESERVES BIODIVERSITY AND RESOURCE-USE ASSESSMENT

Aim: To undertake systematic biodiversity and forest resource-use assessment of the Uluguru North and Uluguru South Catchment Forest Reserves to establish a baseline for measuring the Uluguru Environmental Management and Conservation Project's (UMEMCP) impact on maintaining biodiversity values and reducing threats in the longer term.

Objectives:

1. To conduct baseline biodiversity surveys (flora and fauna), assessing both species richness and diversity, using systematic surveys methodologies, field observations, and opportunistic collections.
2. To conduct baseline forest disturbance surveys, using systematic survey methodologies, field observations, and casual collections to quantify anthropogenic threats.
3. To collate and disseminate baseline biodiversity and forest resource-use information through the production of reports.
4. To provide information on the biological value and use of the forests based on systematic surveys.

Proposed work area and Justification: The proposed biodiversity and forest resource-use assessments will take place in both the Uluguru North and Uluguru South Catchment Forest Reserves. These reserves encompass a total area of 25,649.4 ha, with 8,356.7 ha in the Uluguru North and 17,292.7 ha in the Uluguru South. Uluguru North is characterised by large areas of sub-montane to upper montane forest while the Uluguru South is characterised by large areas of montane to upper montane forest with some grasslands. According to information collected by previous Uluguru Mountain Biodiversity Surveys (Doggart *et. al*, 2000), 15 endemic and 54 near-endemic vertebrates have been documented in the Ulugurus. These reports state that more than 300 vertebrate species inhabit the Uluguru Mountains and their foothills, with birds as the most diverse order with over 140 species.

Organisational Capacity and Previous Methodologies: Frontier-Tanzania (F-T) has been successfully conducting biodiversity surveys within the Eastern Arc and Coastal forests since 1989. The majority of biodiversity data in existence for this biodiversity hotspot was collected by Frontier-Tanzania via numerous partnerships, and in collaboration with the Forestry and Beekeeping Division at both national and local levels. During this time, Frontier-Tanzania has developed and utilised systematic methodologies for biodiversity surveys, allowing comparative analysis across the hotspot. These methodologies are briefly outline in the section below. Using these methodologies for data collection in the Uluguru Catchment Forest Reserves will allow comparative analysis with Frontier-Tanzania's previous assessments of the Eastern Arc Mountains, including the East Usambara mountains (1995-2002), Udzungwa mountains (1999-2001) and Mahenge mountains (2003). From these data, Frontier-Tanzania has produced 21 reports from the East Usambara Mountains, 7 reports from Udzungwa Mountains, 22 reports from coastal forests, Kipengere and Mahenge reports and over 50 peer-review manuscripts

and articles from the forest research programme alone. (Please refer to our Publications list for details.)

Methods: The proposed methods for this project will build upon the systematic methods traditionally used by Frontier-Tanzania, more specifically those utilised for the Udzungwa Mountains Biodiversity Surveys: West Kilombero Scarp Forest Reserve. Please note that degrees of flexibility exist within our traditional, systemised methodologies and that the proposed methodologies for the Uluguru project will first be approved and amended by members of the Frontier Tropical Resource Advisory Committee and relevant players within Tanzania prior to implementation in the field. This will be conducted during the initial preparation period within the project.

i). *Major types of forest disturbance and proportion of habitat affected by forms of disturbance:* This will be achieved through conducting forest disturbance and resource-use surveys. Disturbance is categorised via quantitative assessment of pole ($5 > 15\text{cm dbh}$) and timber ($\geq 15\text{cm dbh}$) cutting along systematic transect lines. Transect lines form a "grid system" for demarcating vegetation plots, allowing quantitative vegetation analysis. Each transect is demarcated at 3km intervals throughout each reserve. Evidence of grazing, burning, charcoal production, settlement, hunting/trapping, pit-sawing, honey-collection is recorded per 50m. For field purposes, habitat is initially categorised as either lowland ($X < 850\text{m A.S.L.}$), sub-montane ($1200\text{m} > X > 850\text{m}$) or montane ($X > 1200\text{m}$), and then further categorised during report production. For further detail please refer to Frontier-Tanzania Methods manual (2001).

ii). *Population density of key floral indicator species e.g. Allanblackia uluguruensis; Ocotea usambarensis.* Quantitative vegetation analysis will be achieved through the demarcation of 0.1 ha ($50 \times 20\text{m}$) vegetation plots at a sampling intensity of approximately 0.04%, within a grid system of 900m x 3000m, where vegetation plots are sited every 900m along transect lines. Tree species composition is evaluated using the vegetation plot data. Each tree $\geq 10\text{cm}$ diameter at breast height (dbh) is identified, marked and measured. Regeneration subplots ($3 \times 3\text{m}$) are established to identify those genera/species regenerating through ground and shrub layers ($0.5\text{cm} \geq 10\text{cm dbh}$). There is huge potential for utilising multivariate analyses (such as DECORANA) with these data from the Ulugurus, East Usambaras, Udzungwas and Mahenge mountains, where systematic data exists for comparative analysis within the hotspot. Specific indicator species data can be extracted from the major project data-set.

Opportunistic botanical sampling is conducted to supplement systematic data collection, to compile a more comprehensive botanical inventory. This will include herbaceous and woody plants.

Plant species will be identified in the field by botanists. Botanical samples will be collected where field identification is not possible, with duplicate specimens deposited for identification and curation at the University of Dar es Salaam Herbarium, Arusha Herbarium. Selected specimens will be sent to Missouri

and Kew botanical gardens for future verification description of potential new species.

iii) *Species richness of flora and vertebrates. Floral species richness will be determined from the vegetation plot and opportunistic botanical recording and collection. This can be presented as a species inventory checklist.*

Vertebrate species richness will be determined using a variety of methods and survey techniques. Zoological traps sites are conducted within representative forest habitats. Trap sites are sampled for an eight trap night duration, to record mammal, bird, amphibian and reptile species utilising: 100 sherman traps with a 10x10m grid system [small mammals]; 33 bucket pitfall traps within 3 trap lines (11 buckets/line) [small mammals, reptiles and amphibians]; standardised timed searches (15 man hours per trap site) for amphibians and reptiles; mist nets and potential use of harp traps to sample bats (mega and micro-chiroptera) within a standardised effort calculated by net metre hours; bird point counts, standardised time per trap site; bird transect counts (along standard transect lines); dung and track survey along transect lines. Opportunistic species records and specimen collection will occur throughout the field-work.

Each animal will be identified with appropriate data recorded (i.e. sex, weight, and location of capture), entered onto data sheets titled MAMMAL, BATS, REPTILE and AMPHIBIAN. Bird and bat data books will store effort, location and species data from each location (trap site, transect, opportunistic). In total, six systematic trap sites will be studied during the project period, spending 8 nights at each trap site.

iv) *Crude abundance of endemic; globally threatened and Eastern Arc characteristic species.*

Analysis of the project raw data will include species categorisation, using for example: IUCN Redlist, CITES, National Biodiversity Database, LEAP database (Knox 2000), Iversen (1991). Species can be categorised, for example, by: ecological requirements (forest dependent, forest non-dependent, non-forest species), endemism (endemic, near-endemic, wide-spread), habitat (lowland, sub-montane, montane), using a variety of references readily available to Frontier-Tanzania (2001). Crude abundance can be illustrated by using GIS applications. Categories will be defined during the preparation and report production period of the project.

Taxonomic verification: Selected specimens will be sent to a number of taxonomic authorities at established institutions via UDSM's collaborative links. Frontier-Tanzania has been successfully *collecting, storing, and exporting specimens* for 15 years. Voucher specimens are sorted and deposited at UDSM for reference and teaching purposes. Professor Kim Howell (Zoology Dept. UDSM) is able to *facilitate export permits and obtain CITES clearance* from the Wildlife Division, Ministry of Natural Resources and Tourism. All specimens are the property of UDSM. Species lists will be sent back to the UDSM and Frontier-Tanzania when specimens have been identified in order to

and Kew botanical gardens for future verification description of potential new species.

iii) Species richness of flora and vertebrates. *Floral species richness will be determined from the vegetation plot and opportunistic botanical recording and collection. This can be presented as a species inventory checklist.*

Vertebrate species richness will be determined using a variety of methods and survey techniques. Zoological traps sites are conducted within representative forest habitats. Trap sites are sampled for an eight trap night duration, to record mammal, bird, amphibian and reptile species utilising: 100 sherman traps with a 10x10m grid system [small mammals]; 33 bucket pitfall traps within 3 trap lines (11 buckets/line) [small mammals, reptiles and amphibians]; standardised timed searches (15 man hours per trap site) for amphibians and reptiles; mist nets and potential use of harp traps to sample bats (mega and micro-chiroptera) within a standardised effort calculated by net metre hours; bird point counts, standardised time per trap site; bird transect counts (along standard transect lines); dung and track survey along transect lines. Opportunistic species records and specimen collection will occur throughout the field-work.

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verify and update field identifications. Please refer to Annex A for taxonomic verification.

Additional surveys: Upon request, the following specialised surveys could also be conducted: primate transect, galagos night-work, hyrax counts, chameleon transects, and bush-fire surveys.

Project Partners: Frontier-Tanzania is a collaborative venture between the Society for Environmental Exploration and UDSM. UDSM will play a large role in the formal identification of specimens during the project period, zoological and botanical. The Morogoro Regional Catchment Forestry Office of the Forest and Beekeeping Division can be integrated into the project through placement of forestry officers as research assistants on the project. However, associated costs such as per diems are not included in the budget. UMEMCP, as with our previous work, (EUCAMP, MEMA) would need to cover these costs. The District Councils of Morogoro and Mvomero will be consulted to seek local permissions, inform community representatives of the work aims and seek local knowledge and expertise to assist the project. Regular communication will be made after liaison with UMEMCP and FBD.

Timetable: The proposed work will take place over a period of 7 months, including 5 months of field work and 2 months of report production. Work is scheduled to begin in October 2004, with a draft report completed by May 2005. Monthly de-briefs will be conducted via update meetings at the UMEMCP office in Morogoro with the Frontier-Tanzania Project Co-ordinator.

Appendix 2: Taxonomic verifications

BOTANY

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ZOOLOGY

Mammals:

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Dr. Bill Stanley	Chicago Field Museum	Mammal Section, Field Museum, Chicago, IL 60605, USA stanley@fieldmuseum.org

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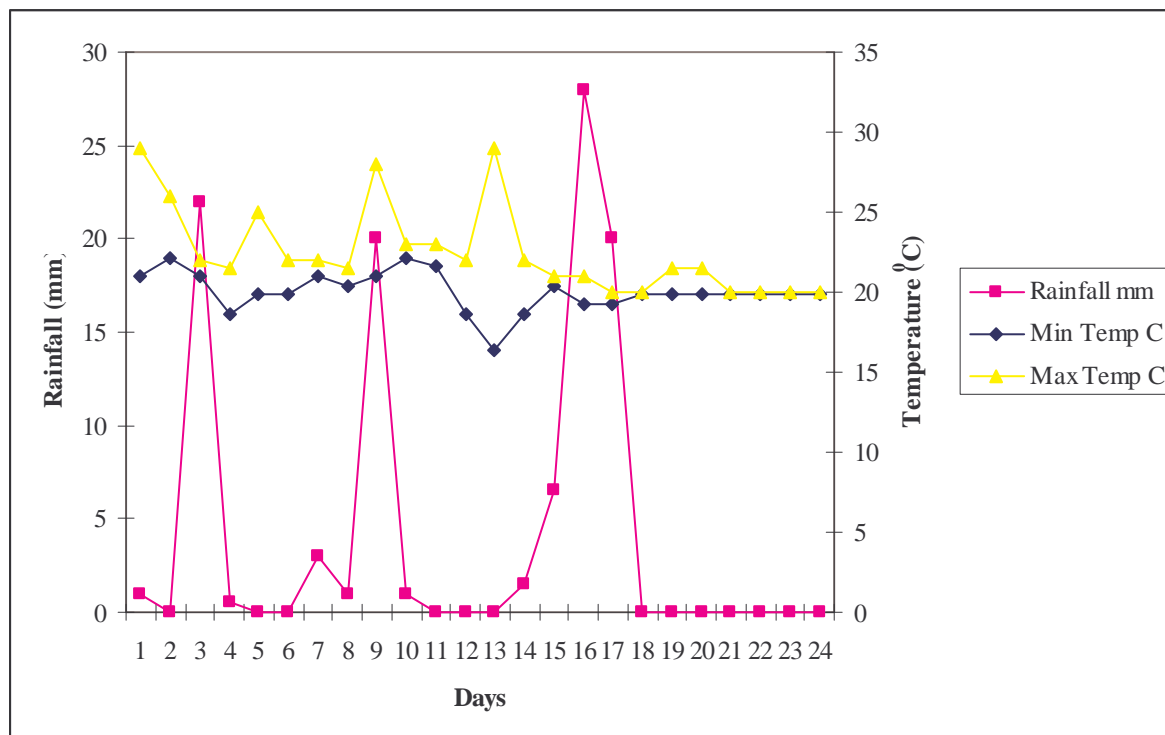
Reptiles:

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Mr. Michele Menegon	Museo Tridentino Di Scienze Naturali	Trento, Italy menegon@MTSN.TN.IT
Dr. Don Broadley	The Natural History Museum of Zimbabwe	P.O. Box 240, Bulawayo, Zimbabwe
Dr. R.C. Drewes	California Academy of Sciences	Department of Herpetology, Golden Gate Park San Francisco, California 94118, USA bdrewes@calacademy.org

Birds:

Mr. Jakob Kiure	Independent consultant	kiure@hotmail.com
Prof. Jon Fjeldså	Zoological Museum	Universitetsparken 15, DK-2100, Copenhagen, Denmark

Appendix 3: Summary of weather conditions



Day 1-8	Basecamp 1	1000 m asl	06/01/05 – 13/01/05
Day 9-12	Sat camp 1	980 m asl	21/01/05 – 24/01/05
Day 13-16	Sat camp 2	1300 m asl	25/01/05 – 28/01/05
Day 17-24	Basecamp 2	1480 m asl	07/02/05 – 14/02/05

Appendix 4: GPS Co-ordinates for Uluguru North FR

Longitude and Latitude in degrees, seconds, minutes and Grid references in UTM/UPS

4a Summary of basecamp and satellite campsites

Site no.	Waypoint	Description of location	Date	Longitude (S)	Latitude (E)	Grid ref (E)	Grid ref (N)	Altitude (m)
1	UN-BC1	At Tegetero mission	06/01/05 - 13/01/05	06 56' 21.7"	037 43' 07.0"	358436	9232832	1000
2	UN-SC1	Forest edge coming along path from Kinole village	21/01/05 - 24/01/05	06 52' 36.4"	037 44' 15.8"	360542	9239747	980
2	UN-SC2	Forest edge, by river on Morogoro path	25/01/05 - 28/01/05	06 54' 19.7"	037 42' 33.1"	357385	9236579	1300
2	US-SC3	At forestry campsite near Bunduki village	30/01/05 - 03/02/05	07° 01' 34.3"	037° 37' 53.2"	348832	9223207	1284
3	UN-BC2	Forest edge at morningside	07/02/05 - 14/02/05	06 53' 34.7"	037 40' 04.5"	352821	9237947	1480

4b Summary of zoological sites

Site no.	Waypoint	Description of location	Date	Longitude (S)	Latitude (E)	Grid ref (E)	Grid ref (N)	Altitude (m)
1	UN-Z1	Zoo site 1, good submontane forest	06/01/05 - 13/01/05	06 56' 21.7"	037 42' 36.8"	357511	9232716	1280m
1	UN-BA1	Bat site, forest edge bat netting site	06/01/05 - 13/01/05	06 56' 25.0"	037 42' 41.9"	357665	9232730	1000
2	UN-BC2	Zoo site 2, forest edge at morningside	08/02/05 - 15/02/05	06 53' 34.7"	037 40' 04.5"	352821	9237947	1480

4c Summary of transects

Transect no.	Waypoint	Description of location	Direction of transect	Date	Latitude (S)	Longitude (E)	Grid ref (E)	Grid ref (N)	Altitude (m)
1	UN-T1	Near forest edge, above Tegetero	W	06/01/05	06 55' 40.3"	037 42' 07.3"	35660	9234100	1220
2	UN -T2	Inside forest following path from Tegetero	W	08/01/05	06 56' 27.5"	037 42' 05.5"	256550	9232650	1370
3	UN-T3	Forest edge just off Morogoro path	W	10/01/05	06 55' 33.2"	037 42' 32.0"	357513	9234322	1180
4	UN-T4	Forest border	W	12/01/05	06 56' 10.7"	037 42' 32.0"	357363	9234100	1356
5	UN-T5	Forest border on "arm"	W	15/01/05	06 56' 41.2"	037 43' 05.2"	358383	9232234	1000
6	UN-T6	From sat camp 1	W	20/01/05	06 52' 36.4"	037 44' 15.8"	360542	9239747	980
7	UN-T7	Up on ridge above sat camp 1	N	21/01/05	06 52' 23.6"	037 43' 52.1"	359800	9240150	1350
8	UN-T8	Near end of T7	W	22/01/05	06 51' 59.2"	037 43' 48.8"	359700	9240900	1440
9	UN-T9	Starts at forest edge	W	23/01/05	06 52' 55.6"	037 43' 54.4"	359875	9239167	1100
10	UN-T10	From sat camp 2	W	25/01/05	06 54' 19.7"	037 42' 33.1"	357385	9236579	1300
11	UN-T11	At 0m on morogoro path	W	26/01/05	06 54' 09.1"	037 42' 12.4"	356750	9236900	1550

Transect no.	Waypoint	Description of location	Direction of transect	Date	Latitude (S)	Longitude (E)	Grid ref (E)	Grid ref (N)	Altitude (m)
12	UN-T12	Starts on ridge path	N	27/01/05	06 53' 52.8"	037 42' 31.6"	357339	9237403	1450
13	UN-T13	Edge of forest Kigurunyembe mission/Teacher training college	S	30/01/05	06 49' 52.4"	037 42' 06.3"	356541	9244784	720
14	UN-T14	In valley above Bunduki, north	N	02/02/05	07 00' 01.9"	037 37' 32.3"	348182	9226042	1815
15	UN-T15	Forest edge near BC 2	S	08/02/05	06 53' 33.2"	037 40' 14.9"	353140	9237993	1540
16	UN -T16	Forest edge	S	09/02/05	06 53' 31.3"	037 40' 54.3"	354350	9238056	1500
17	UN-T17	Forest edge	S	12/02/05	06 53' 30.6"	037 39' 56.3"	352568	9238071	1610

4d Summary of vegetation plots

Plot no.	Waypoint	Description of location	Date	Latitude (S)	Longitude (E)	Grid ref (E)	Grid ref (N)	Altitude (m)
1	UN-V1	Edge of forest	16/12/2004	07 00' 32.4"	037 38' 20.5"	349664	9225110	1700
2	UN-V2	Edge of forest	16/12/2004	07 00' 23.6"	037 38' 26.3"	349842	9225379	1700
3	UN-V3	0-50m along Transect 1 (T1)	07/01/2005	06 55' 27.2"	037 41' 38.0"	355700	9834500	1220
4	UN-V4	300-350m along T1	07/01/2005	06 53' 27.1"	037 41' 51.0"	356100	9234500	1220
5	UN-V5	0-50m along T2	09/01/2005	06 56' 27.6"	037 42' 18.5"	356950	9232650	1400
6	UN-V6	400-450m along T2	09/01/2005	06 56' 27.6"	037 42' 05.5"	356550	923650	1320
7	UN-V7	350-400m along T3	11/01/2005	06 55' 33.1"	037 42' 25.6"	357163	9234322	1270
8	UN-V8	600-650m along T3	11/01/2005	06 55' 33.1"	037 42' 17.5"	356913	9234322	1250
9	UN-V9	550-600m along T4	14/01/2005	06 56' 10.6"	037 42' 14.1"	356813	9233170	1260
10	UN-V10	800-850m along T4	14/01/2005	06 56' 10.6"	037 42' 06.6"	356563	9233170	1280
11	UN-Z1	zoo site 1	14/01/2005	06 56' 21.7"	037 42' 36.8"	357511	9232716	1280
12	UN-V12	100-150m along T5	15/01/2005	06 56' 25.5"	037 43' 02.0"	358283	9232716	1000
13	UN-V13	0-50m along T6	20/01/2005	06 52' 36.4"	037 44' 15.8"	360420	9239747	980
14	UN-V14	0-50m along T7	21/01/2005	06 52' 23.6"	037 43' 52.1"	359800	9240150	1350
15	UN-V15	400-450M along T7	21/01/2005	06 52' 10.6"	037 43' 52.1"	359800	9240550	1370
16	UN-T8	0-50m along T8	22/01/2005	06 51' 59.2"	037 43' 48.8"	359700	9240900	1440
17	UN-V17	300-350m along T8	22/01/2005	06 51' 59.1"	037 43' 39.1"	359400	9240900	1500
18	UN-T9	0-50m along T9	23/01/2005	06 52' 55.6"	037 43' 54.4"	359875	9239167	1100
19	UN-V19	400-450m along T9	23/01/2005	06 52' 42.6"	037 43' 54.4"	359875	9239567	1100
20	UN-SC2	From sat camp 2	25/01/2005	06 54' 19.7"	037 42' 33.1"	357385	9236579	1300
21	UN-V21	400-450m along T10	25/01/2005	06 54' 20.0"	037 42' 32.8"	375835	9236579	1300

Plot no.	Waypoint	Description of location	Date	Latitude (S)	Longitude (E)	Grid ref (E)	Grid ref (N)	Altitude (m)
22	UN-T11	Along Morogoro path	26/01/2005	06 54' 09.1"	037 47' 12.4"	356750	9236900	1550
23	UN-V23	Along Morogoro path	26/01/2005	06 54' 17.3"	037 42' 20.5"	357000	9236650	1400
24	UN-T12	0-50m along T12	27/01/2005	06 53' 52.8"	037 42' 31.6"	357339	9237403	1450
25	UN-V25	Further up the ridge path from V24, about 300m	27/01/2005	06 53' 43.1"	037 42' 31.7"	357339	9237703	1550
26	UN-T13	0-50m along T13	30/01/2005	06 49' 52.4"	037 42' 06.3"	356541	9244784	720
27	UN-V27	350-400m along T13	30/01/2005	06 50' 02.2"	037 42' 06.3"	356541	924484	800
28	UN-V28	200-250m along T14	02/02/2005	06 59' 55.4"	037 37' 32.3"	348182	9226242	1860
29	UN-T15	0-50m along T15	08/02/2005	06 53' 33.2"	037 40' 14.9"	353140	9237993	1540
30	UN-V30	450-500m along T15	08/02/2005	06 53' 47.9"	037 40' 14.9"	353140	9237543	1700
31	UN-T16	0-50m along T16	09/02/2005	06 53' 31.3"	037 40' 54.3"	354350	9238056	1500
32	UN-V32	400-450m of T16	09/02/2005	06 53' 44.3"	037 40' 54.3"	354350	9237656	1620
33	UN-V33	Up path from BC2 (west)	11/02/2005	06 53' 34.9"	037 39' 50.7"	352674	9237940	1550
34	UN-V34	By BC2	11/02/2005	06 53' 32.0"	037 40' 02.8"	352768	9238028	1500
35	UN-V35	550-600m along T17	14/02/2005	06 53' 30.7"	037 40' 10.9"	353018	9238071	1660
36	UN-V36	850-900m along of T17	14/02/2005	06 53' 30.7"	037 40' 20.7"	353318	9238071	1790

Appendix 5: Summary of transecting data

Each transect is 900m length x 10m width = 9000m², apart from transect 4 which was 750m in length due to impassable terrain.

Transect no.	Total Live pole (LP)	Average LP per 50m	Total Dead pole (DP)	Average DP per 50m	Total Old cut pole (OCP)	Average OCP per 50m	Total New cut pole (NCP)	Average NCP per 50m	Total Live timber (LT)	Average LT per 50m	Total Dead timber (DT)	Average DT per 50m	Total Old cut timber (OCT)	Average OCT per 50m	Total New cut timber (NCT)	Average NCT per 50m
1	468	26.00	57	3.17	62	3.44	0	0.00	423	23.50	146	8.08	9	0.51	6	0.32
2	160	8.89	4	0.22	0	0.00	0	0.00	160	8.89	18	1.00	0	0.00	0	0.00
3	295	16.39	21	1.17	13	0.72	0	0.00	246	13.67	13	0.72	3	0.17	0	0.00
4	90	6.00	1	0.07	0	0.00	0	0.00	111	7.40	6	0.40	0	0.00	0	0.00
5	88	4.89	2	0.11	6	0.33	1	0.06	105	5.83	17	0.94	9	0.50	5	0.28
6	276	15.33	8	0.44	10	0.56	1	0.06	278	15.44	19	1.06	2	0.11	0	0.00
7	331	18.39	4	0.22	2	0.11	0	0.00	266	14.78	18	1.00	0	0.00	0	0.00
8	145	8.06	1	0.06	0	0.00	0	0.00	181	10.06	21	1.17	0	0.00	0	0.00
9	353	19.61	10	0.56	20	1.11	0	0.00	262	14.56	15	0.83	2	0.11	0	0.00
10	100	5.56	0	0.00	0	0.00	0	0.00	123	6.83	20	1.11	0	0.00	0	0.00
11	194	10.78	22	1.22	0	0.00	0	0.00	199	11.06	32	1.78	1	0.06	1	0.06
12	264	14.67	8	0.44	0	0.00	0	0.00	236	13.11	25	1.39	0	0.00	0	0.00
13	324	18.00	21	1.17	85	4.72	6	0.33	118	6.56	17	0.94	48	2.67	0	0.00
14	131	7.28	5	0.28	1	0.06	2	0.11	155	8.61	12	0.67	1	0.06	0	0.00
15	212	11.78	9	0.50	11	0.61	3	0.17	156	8.67	40	2.22	3	0.17	0	0.00
16	84	4.67	0	0.00	0	0.00	2	0.11	125	6.94	21	1.17	0	0.00	0	0.00
17	130	7.22	2	0.11	8	0.44	6	0.33	111	6.17	21	1.17	1	0.06	1	0.06
Total	3645	203.50	175	9.74	218	12.11	21	1.17	3255	182.07	461	25.65	79	4.40	13	0.70

Appendix 6: Vegetation plot descriptions

Plot ID	Topo-graphy	Altitude (m asl)	Slope (deg)	Aspect	Vegetation Type	Canopy height (m)	Canopy Cover (%)	Disturbance Category	Feature of Interest	No. Indivs	No. species	Dominant species
1	SMS	1700	45	S	MF	10-20	10-50	Forest edge disturbed		34	15	<i>Maytenus spinosa</i>
2	SMS	1700	50	ESE	MF	10-20	10-50	Forest edge disturbed		23	13	<i>Cussonia spicata</i> ,
3	GMS	1300	15	S	SMF	>30	>50		Paths	34	8	<i>Drypetes sp</i> <i>Leptonychia usambarensis</i>
4	SLS	1220	25	E	SMF	>30	>50	Burning	Paths	49	26	<i>Myrianthus holstii</i>
5	SUS	1420	40	NE	MF	20-30	10-50	Natural Tree Fall		26	12	<i>Leptonychia usambarensis</i>
6	GLS	1370	15	E	SMF	>30	>50			63	23	<i>Leptonychia usambarensis</i>
7	SUS	1270	30	W	SMF	>30	>50			68	29	<i>Clausena sp</i>
8	GUS	1270	5	NE	SMF	>30	>50			54	20	<i>Leptonychia usambarensis</i> ,
9	SMS	1260	25	N	SMF	>30	>50			46	15	<i>Myrianthus holstii</i> <i>Leptonychia usambarensis</i> , <i>Morus mesozygia</i>
10	SMS	1260	25	NE	SMF	>30	>50			41	14	<i>Leptonychia usambarensis</i>
11	SMS	1280	25	SW	SMF	>30	>50		Path	42	17	<i>Leptonychia usambarensis</i> ,
12	SLS	1000	25	SE	SMF	10-20	10-50	Old cutting	Path	44	18	<i>Myrianthus holstii</i> <i>Apodytes dimidiata</i>
13	GMS	980	10-15	S	SMF	>30	>50		Paths	32	15	<i>Myrianthus holstii</i> , <i>Rawsonia lucida</i>
14	SMS	1350	35	E	SMF	>30	>50			46	18	<i>Trilepisium madagascariense</i>
15	GMS	1400	35	SE	SMF	20-30	>50			65	32	<i>Trilepisium madagascariense</i>
16	SUS	1450	35	E	SMF	20-30	>50			39	17	
17	SUS	1500	40	W	MF	20-30	>50			64	35	<i>Garcinia buchananii</i>
18	GMS	1100	10	S	SMF	10-20	10-50			48	23	<i>Ochna holstii</i>
19	GMS	1100	5		SMF	20-30	>50			52	21	<i>Khaya nyasica</i>

Plot ID	Topo-graphy	Altitude (m asl)	Slope (deg)	Aspect	Vegetation Type	Canopy height (m)	Canopy Cover (%)	Disturbance Category	Feature of Interest	No. Indivs	No. species	Dominant species
20	GMS	1300	20	E	SMF	>30	>50	Cutting		25	11	<i>Leptonychia usambarensis</i>
21	GMS	1300	0	E	SMF	20-30	10-50			46	24	<i>Leptonychia usambarensis</i>
22	GUS	1550	15-20	E	MF	20-30	>50	Cutting	Roads & tracks	56	27	<i>Leptonychia usambarensis</i>
23	GMS	1400	15	E	SMF	>30	>50		Path to Morogoro	45	25	<i>Leptonychia usambarensis</i>
24	SUS	1450	40	W	SMF	20-30	>50		Path	81	51	<i>Memecylon sp, Parinari excelsa</i>
25	GMS	1550	30	NW	MF	20-30	>50			66	34	<i>Leptonychia usambarensis</i>
26	GLS, VB	720	10	S	LF	20-30	>50	Cutting		23	14	
27	GMS	800	10	S	LF	10-20	>50	Cutting		34	14	<i>Albizia gummifera</i>
28	GUS	1810	5	S	MF	20-30	>50		Paths	22	7	<i>Syzygium parvulum</i>
29	GMS	1540	25	E	MF	>30	>50	Cutting	Paths	37	11	<i>Cussonia spicata</i>
30	SMS	1700	45	N	MF	20-30	10-50	Cutting	Old road to radio tower	16	7	<i>Cussonia spicata</i>
31	GMS	1620	25	N	MF	20-30	>50	Cutting & cultivation	Paths	25	10	
32	GUS	1620	25	N	MF	10-20	10-50	Cutting		37	17	<i>Macaranga capensis</i>
33	SLS	1570	25	E	MF	>30	>50	Cutting	Tracks	23	15	<i>Drypetes gerrardii</i>
34	SLS	1500	30	SE	MF	>30	<50	Cutting	Tracks	26	13	<i>Newtonia buchananii</i>
35	SUS	1660	30	N	MF	10-20	10-50	Cutting		19	14	
36	GUS	1790	20	E	MF	10-20	10-50		Paths	37	15	<i>Aphloia theiformis</i>

Key: Topography G = gentle, S = steep, LS = lower slope, MS = Mid slope, US = Upper slope, VB = Valley bottom; Vegetation LF = Lowland forest, SMF = Submontane forest, MF = Montane forest

Appendix 7: Regeneration plot descriptions

Regen Plot ID	Cover (%)				Dominance (%)				Soil Texture	Soil Colour	No. Indivs	No. Species
	Herbs	Bare soil	Litter	Rocks	Grasses	Forbs	Mosses/ lichens	Ferns				
1	90	0	80	5	0	0	0	30	Sandy clay	Light grey	34	7
2	60	0	60	5	0	0	0	30	Sandy clay	Light grey	44	8
3	60	10	30	5	0	0	10	40	Sandy clay	Red brown	79	10
4	40	20	30	0	0	0	20	20	Sandy clay	Light grey	49	9
5	40	5	30	5	0	0	0	20	Sandy clay	Light grey	60	8
6	80	0	60	0	0	0	0	30	Sandy clay	Dark grey	>92	9
7	30	0	40	0	0	0	0	40	Sandy clay	Dark grey	142	11
8	40	0	50	<5	0	0	0	10	Sandy clay	Dark grey	34	6
9	30	<2	40	<2	0	0	0	20	Sandy clay	Light grey	42	9
10	<20	10	40	5	0	0	0	15	Sandy clay	Dark grey	>68	7
11	50	<5	40	0	0	0	0	5	Sandy clay	Dark grey	>42	9
12	40	0	40	5	0	0	0	40	Sandy loam	Dark grey	53	11
13	40	0	50	0	0	0	0	10	Loamy clay	Dark grey	>71	8
14	30	5	50	10	0	0	0	5	Sandy loam	Red brown	64	9
15	40	5	50	5	0	0	0	5	Loamy clay	Dark grey	35	6
16	40	<5	35	10	0	0	0	5	Loamy clay	Dark grey	>74	10
17	40	0	50	5	0	0	0	5	Loamy clay	Dark grey	36	5
18	50	0	40	0	0	0	0	10	Sandy loam	Light grey	>46	9
19	50	10	30	5	0	0	0	5	Loamy clay	Light grey	>67	11
20	60	0	60	5	0	0	0	5	Loamy clay	Light grey	>74	12
21	30	0	60	5	0	0	0	5	Loamy clay	Dark grey	>45	7
22	50	0	60	0	0	0	0	10	Loamy clay	Red brown	>42	7
23	40	5	50	5	0	0	0	10	Loamy clay	Red brown	67	12
24	50	0	40	5	0	0	0	5	Loam	Light grey	>76	13
25	60	5	40	0	0	0	0	0	Loamy clay	Red brown	62	12
26	30	5	50	10	0	0	0	0	Loam	Dark brown	>54	6
27	30	25	40	15	10	0	0	0	Loam	Dark brown	35	7
28	60	0	50	0	0	0	0	5	Loam	Brown		
29	60	0	30	5	0	0	0	5	Loamy clay	Dark grey	38	8
30	60	0	40	5	0	0	0	5	Loamy clay	Dark grey	19	4
31	70	0	80	5	0	0	0	5	Loam	Dark brown	34	9

Regen Plot ID	Cover (%)				Dominance (%)				Soil Texture	Soil Colour	No. Indivs	No. Species
	Herbs	Bare soil	Litter	Rocks	Grasses	Forbs	Mosses/ lichens	Ferns				
32	60	0	60	10	0	0	0	10	Loamy clay	Light grey	>42	7
33	<20	30	40	10	0	0	0	0	Loamy clay	Light grey	61	10
34	<10	10	40	10	0	0	0	5	Loamy clay	Light grey	>69	10
35	50	5	30	5	0	0	0	5	Loam	Light grey	37	9
36	<20	40	<30	10	0	0	0	<5	Loam	Light grey	>79	12
MEAN	43.33	5.28	44.86	4.72	0.28	0.00	0.83	11.67			28.47	8.53

Appendix 8: Vegetative data

Plant species recorded by UCBS, including vegetation plots, regeneration plots and casual collections. Preliminary identifications have been conducted at Herbarium of University of Dar es Salaam by Mr. G. Sangu and Mr. F. Mbago.

Species	Author species	Altitudinal range (m asl)	Distribution	Life form	Endemic status	Status of Threat	Habitat	Data source	Notes
ACANTHACEAE									
<i>Isoglossa lactea</i>	Lindau	250 - 800	T6;	Herb	N		Forest	LEAP (East African Herbarium)	
<i>Justicia beloperonoides</i>				Herb	E				
<i>Justicia interrupta</i>	(Lindau) C. B. Clarke	810-1530	T2,6;	Herb	N		Montane forest	LEAP (East African Herbarium)	
<i>Justicia tenella</i>	(Nes) T. Anderson		T6; P; Zaire; W. Africa	Herb				LEAP (East African Herbarium)	
ADIANTACEAE									
<i>Adiantum lunulatum</i>	Burm. F.			Herb					Not in LEAP
ANACARDIACEAE									
<i>Sorindeia madagascariensis</i>	Thouars ex DC.	1 - 1830	K4,7; T2,3,5-8; P;Z; Malawi, Mozambique and Mascarene Islands	Evergreen tree	N		Riverine, coastal and upland forest, often in wet or seasonally flooded places.	FTEA	
ANISOPHYLLACEAE									
<i>Anisophylea abyssinica</i>	R. Br. ex SabiN			Tree					
ANNONACEAE									
<i>Annona sengalensis</i>	Pers	300-1500	Widespread	Tree					
<i>Monanthotaxis buchananii</i>	(Engl.) Verdc.		Africa and Madagascar	Tree or shrub					
<i>Uvariadendron usambarense</i>	R.E.Fr.	1230-2100		Tree	N	Vu	Moist forest or forest margins	LEAP	

Species	Author species	Altitudinal range (m asl)	Distribution	Life form	Endemic status	Status of Threat	Habitat	Data source	Notes
<i>Uvaria</i> sp		1300 - 1900		Tree				LEAP	
APOCYNACEAE									
<i>Diplorhynchus</i> sp	Welw. Ex Ficalho & Hiern			Shrub					
<i>Landolphia buchananii</i>		200- 2300		Woody climber				FTEA	
<i>Rauvolfia mombasiana</i>	Stapf	300 - 2440	U2; K4,7; T2,3,6-8; Burundi, Rwanda and Zaire	Tree				LEAP (East African Herbarium)	
<i>Rauvolfia volkensii</i>				Tree					
<i>Schizozygia coffoides</i>	(Boj.) Baill.	0 - 500	K7;	Shrub				LEAP (East African Herbarium)	
AQUIFOLIACEAE									
<i>Ilex mitis</i> var <i>schliebenii</i>	(L.) Radlk.	2400		Shrub	E	Vu	Montane rain forest		
ARACEAE									
<i>Amorphophallus stuhlmannii</i>	(Engl.) Engl. & Gehrm.	0 - 1400 m	T3, 6; not known elsewhere.	Plant robust	N		Evergreen forest, often on limestone.	FTEA	
ARALIACEAE									
<i>Cussonia spicata</i>	Thunb.	530-2150		Tree			Moist forest or forest margins	FTEA	
<i>Polyscias fulva</i>	(Hiern) Harms	1180 - 2160	U2-4; K5; T1-4,6,7; W. Africa, Malawi, Zambia, Zimbabwe, Angola	Tree			Upland and lowland rain-forest, riverine forest, also upland grassland.	FTEA	
<i>Polyscias</i> sp	Forster & forster			Tree					
<i>Schefflera lukwangulensis</i>		1400 - 2600		Tree	E	Vu	Uppermontane forest	LEAP	
<i>Schefflera spicata</i>		1400 - 2100		Tree			Uppermontane forest	LEAP	

Species	Author species	Altitudinal range (m asl)	Distribution	Life form	Endemic status	Status of Threat	Habitat	Data source	Notes
<i>Schefflera umbellifera</i>		1400 - 2300		Woody climber			Moist forest or forest margins	FTEA	
ASTERACEAE									
<i>Conyza attenuata</i>	DC.			Herb				FTEA	FTEA not ready. Listed in LEAP but no data
<i>Crassocephalum crepidioides</i>	(Benth.) S. Moore		U1-4; K1,3-7; T1-8;	Herb				FTEA	FTEA not ready
<i>Helichrysum odoratissimum</i>	(L.) Sweet	1700 - 3700	U1-3; K3,5; T2,4,7; Zimbabwe, Malawi, Mozambique, S. Africa	Herb					
<i>Helichrysum traversii</i>	Chiov.	1850 - 3000	K2,3,5; T2,3,7; Ethiopia	Herb				FTEA	
<i>Vernonia bruceae</i>	C. Jeffrey	1000 - 1200	T6,7 border; not known elsewhere.	Shrub, climber or small tree			Moist forest or forest margins	FTEA	NW Uluguru Mts and Mwanihana FR
<i>Vernonia holstii</i>	O. Hoffm.	900 - 2100	K3,4,6,7; T2-7; Cameroon, Congo, Rwanda, Zambia, Malawi, Mozambique, Zimbabwe	Woody herb or shrub			Margins of and clearings in dry evergreen forest, secondary bushland, maybe locally common	FTEA	
<i>Vernonia lasiopis</i>	O. Hoffm.	1050 - 2650	U2-4; K3,4,6,7; T1-3,5,6; Rwanda Sudan and Ethiopia	Woody herb or shrub			Forest clearings, forest margins, secondary bush derived from forest, riverine thicket, secondary grassland in forest or dry bush zone, roadsides, maybe abundant in abandoned cultivation		

Species	Author species	Altitudinal range (m asl)	Distribution	Life form	Endemic status	Status of Threat	Habitat	Data source	Notes
BALSAMINACEAE									
<i>Impatiens hamata</i>		1350-2200		Herb	N		Montane rain forest		
<i>Impatiens lukwangulensis</i>		1650-2250		Herb	E		Montane rain forest in moist and shaded areas		
<i>Impatiens serpens</i>		1550 - 2350		Herb	E		Moist forest or forest margins	FTEA	
<i>Impatiens uluguruensis</i>		1600-2550		Herb	E		Montane rain forest among mosses and shaded areas		
<i>Impatiens walleriana</i>	Hook. f.	0-2000	K7; T2,3,6; Z, P; Mozambique, S. Malawi, E. Zimbabwe	Succulent perennial			In damp often shaded, places in upland and coastal rain-forest, particularly in riverine thickets, gullies and damp rocky places	FTEA	
<i>Impatiens whitii</i>				Herb					
BEGONIACEAE									
<i>Begonia oxyloba</i>	Welw.	1100	K5; T3,7; Burundi, Zaire, W. Africa	Herb				LEAP	
<i>Begonia oxylobata</i>		1550 - 2600		Herb				FTEA	
CAESALPINIACEAE									
<i>Zenkerella sp</i>		Unknown		Shrub to tree			Moist forest or forest margins	Not in LEAP	
CELASTRACEAE									
<i>Maytenus accuminata</i>	(L.F.)Los.			Tree					
<i>Maytenus undata</i>	(Thunb.) Blakelock	0 - 3150	U1-4; K1-7; T1-4,6,7; Z; W. Afr, Madagascar, Sudan, Somalia, Yemen	Shrub			Forest, riverine forest, woodland, evergreen and coastal bushland		
CHRYSOBALANACEAE									

Species	Author species	Altitudinal range (m asl)	Distribution	Life form	Endemic status	Status of Threat	Habitat	Data source	Notes
<i>Parinari excelsa</i>	Sabine	1300 -1900		Tree			Montane forest	LEAP	
CYATHACEAE									
<i>Cyathea manniana</i>	Hook.			Herb					
CYPERACEAE									
<i>Cyperus cyperoides</i>	(L.) O. Ktze.	150 - 2150	U3,4; K1-4,6,7; T1-8; Ethiopia, Zaire, Burundi, S.Africa, Somalia	Herb				LEAP	
<i>Scleria lithosperma</i>	(L.) Sw.	80 - 500	K7; T3,6;	Herb				LEAP	
<i>Scleria racemosa</i>	Poir.		U1; K5,7; T3,4; Z; Ethiopia, Zimbabwe	Herb				LEAP	
DRACAENACEAE									
<i>Dracaena afromontana</i>	(L.) Ker-Gawl		U2-4; K5; T1,3,4,6; Zaire, S. Africa	Tree				LEAP	
EBENACEAE									
<i>Diospyras sp</i>		1500-1900		Tree	N		Moist forest or forest margins		
<i>Euclea natalensis</i>	Hiern			Tree or shrub					
EUPHORBIACEAE									
<i>Acalypha fruticosa</i>	Forssk	0 - 1890	U1-3; K1-7; T1-3, 6, 7, ?8; Z; Sudan to Somalia and south to Burundi with outlying stations in Namibia, S. Malawi and C. Mozambique, So. Arabia, S. india, Ceylon, Burma	Shrub or small tree			Coastal and deciduous bushland and thicket, wooded grassland, often riverine, on rocky shores or outcrops, and in other places with local water catchment and less grass competition becoming common in orver grazed places	FTEA	

Species	Author species	Altitudinal range (m asl)	Distribution	Life form	Endemic status	Status of Threat	Habitat	Data source	Notes
<i>Brideria micrantha</i>		580 - 1800		Tree			Forest, clearings and margins	FTEA	
<i>Drypetes gerrardii</i>	Pax	0 - 500 (1800)	K?1, 7; T3, 6-8; Z; Somalia, Mozambique, Zimbabwe, South Africa	Shrub or slender tree.			Evergreen forest and thicket, often riverine or in rocky places.		
<i>Drypetes gerrardinoides</i>		1500-2100		Shrub		Vu		FTEA	
<i>Drypetes natalensis</i>	(Harv.) Hutch.	15 - 1500	K4,7; T2-6,8; Z; Sudan, Mozambique, Malawi, Zambia, S.Africa	Shrub		Vu	Forest	LEAP	
<i>Macaranga capensis</i>	(Baill.) Sim	1500-2100		Tree				LEAP	
<i>Macaranga kilimandoscharicus</i>	Pax	200-2100		Tree				Not in LEAP	
<i>Phyllanthus nummulariifolius</i>	Por.	0 - 2450	U1 - 4; K1-5; T1-8; Z; P; from Sierra Leone to Sudan and south to South Africa; also in Madagascar, Mascarene Islands and Seychelles	Woody herb or shrub			Woodland, wooded grassland and forest edges, extending to upland grassland and bushland, often in seasonally wet and disturbed places.	FTEA	
<i>Suregada zanzibariensis</i>	Baill.	0 - 1600	K7; T3,6,8; Z; P. Somalia, Mozambique, Zimbabwe, Madagascar and South Africa	Shrub or small to large tree.			Coastal forest, woodland and bushland, common in places, occasionally found in similar places inland and at much higher altitudes.	FTEA	
FABACEAE									

Species	Author species	Altitudinal range (m asl)	Distribution	Life form	Endemic status	Status of Threat	Habitat	Data source	Notes
<i>Crotalaria vasulosa</i>	Benth.	0 - 1650	U4; K5,7; T1-3, 5,6,8; Z; Mozambique, Malawi, Zimbabwe and South Africa.	Annual			Grassland and <i>Brachystegia</i> woodland, often on sandy soil, also persisting on roadsides and cultivated ground.	FTEA	
<i>Desmodium tortuosum</i>	(Sw.) DC.	0 - 1100	U4; T1-4, 6,8; throughout tropical and subtropical areas of America; introduced and naturalised throughout the tropics of the old world.	Herbaceous from a woody base.			Roadsides, grassy places, abandoned plantations.	FTEA	
<i>Dialium holtzii</i>	Harms	10 - 460	T3, 6-8; Mozambique	Tree			Lowland dry evergreen forest, riverine and swamp-forest, woodland; perhaps also in lowland forest.	FTEA	
<i>Indigofera mildbraediana</i>	Gillett	400	T6; Nigeria, Gabon, Congo, Central Africa Republic Sudan, Angola	Semi-woody branching herb.			Scattered tree grassland.		
<i>Indigofera rhynochocarpa</i>	Bak.	500 - 2150	T1-8; Central African Republic, Congo, Rwanda, Burundi, Mozambique, Malawi, Zambia, Zimbabwe and Angola	Shrub			<i>Brachystegia</i> woodland	FTEA	

Species	Author species	Altitudinal range (m asl)	Distribution	Life form	Endemic status	Status of Threat	Habitat	Data source	Notes
<i>Senna alba</i>	(L) Irwin & BarNby	550 - 1220	U4; T3,6; originally from tropical America, but now established in various parts of the Old World tropics.	Shrubby herb			A naturalised weed of plantations and cultivated ground in lowland rain forest areas; said to be v. common in the old cultivation in Kimboza Forest Reserve.	FTEA	
<i>Senna petersiana</i>	(Bolle) J. M. Lock	12 - 2130	U1-4; K3,5; T1,4,6-8; Z; eastern Africa from Ethiopia and the Sudan Republic southwards to Mozambique and the Transvaal, extending westwards to Central African Republic and Cameroon Republic; also in Madagascar.	Shrub or tree			In or on edge of rain-forest, riverine forest, deciduous woodland, coastal evergreen bushland and wooded grassland.	FTEA	
<i>Vigna fischeri</i>	Harms	1000 - 2250	K4,5; T2,3,6-8; Cameroon, Burundi, Ethiopia, Malawi and Zambia	Perennial herb			Swampy grassland with scattered shrubs, upland grassland with scattered trees, forest edges, old cultivations.	FTEA	
<i>Vigna reticulata</i>	Hook. f.	0 - 2460	U1-4; K3,7; T1,3,4,6-8; Z; widespread in tropical Africa from Sierra Leone to Angola, Ethiopia, Mozambique and Zimbabwe, also in Madagascar.	Climbing herb			Grassland, bushland or grassland with scattered trees, usually on damp or swampy ground.	FTEA	

Species	Author species	Altitudinal range (m asl)	Distribution	Life form	Endemic status	Status of Threat	Habitat	Data source	Notes
FLACOURTIACEAE									
<i>Aphloia theiformis</i>	(Vahl) Benn.	750 - 2300		Tree			Moist forest or forest margins	LEAP	
<i>Dovyalis abyssinica</i>				Tree				FTEA	
<i>Flacourtia indica</i>	(Burm. f.) Merr.	0 - 2400	U1,3,4; K2-5, 7; T1-8; Z; widespread in tropical and subtropical Africa, Madagascar, Mascarens and Seychelles, also in Asia and Malesia, sometimes cultivated for its edible fruits.	Shrub or tree			Woodland, wooded grassland and bushland. Often riparian.	FTEA	
<i>Flacourtia sp</i>		Unknown		Tree				Not in LEAP	
<i>Oncoba welwitschii</i>	Oliv.	800 - 1900	T3,6-8; Nigeria to Zaire and Angola also in Malawi and Mozambique	Shrub or tree			Lower storey of rain forest, dry evergreen forest and riverine forest, also in secondary growth.	FTEA	
<i>Rauvolfia sp</i>		Unknown		Shrub to tree				Not in LEAP	
<i>Rawsonia lucida</i>	Harv.& Sond.	50 - 1900	U2,3; K4-7; T1-3, 6-8; P; Somali Republic, Sudan, Angola, Zaire, Malawi, Zambia, Zimbabwe, Mozambique, Swaziland, South Africa	Shrub or tree			Understorey and shrub layer of lowland and upland rain forest, dry evergreen forest ,semi-swamp and riverine forest.	FTEA	
GESNRIACEAE									

Species	Author species	Altitudinal range (m asl)	Distribution	Life form	Endemic status	Status of Threat	Habitat	Data source	Notes
<i>Saintpaulia goetzeana</i>	H. Wendl			Herb	E				
<i>Saintpaulia incospicua</i>	H. Wendl			Herb	E				
<i>Streptocarpus glandulosissimus</i>	Engl.	2700	U2; K1,4,7; T2,3,6,7; Rwanda, Burundi	Herb	E			FTEA	
<i>Streptocarpus sp</i>	Lindl.			Herb	E			FTEA	
GRAMINAE									
<i>Sinarundinaria alpina</i>	Schumann		Tropical East African mountains	Shrub					
GUTTIFERAE									
<i>Allanblackia stuhlmannii</i>	(Engl.) Engl.	540-2100	T6, T7	Tree	N	Vu	Forest species	Not in LEAP	
<i>Allanblackia uluguruensis</i>	(Vahl) Bennett.	750-2300	T3,T7	Tree	N	Vu	Moist forest or forest margins	Not in LEAP	
<i>Garcinia buchananii</i>	Bak.	1230- 1900		Tree			dry forest	FTEA not ready yet	
<i>Garcinia kingaensis</i>		1600- 2350		Tree			Moist forest or forest margins	LEAP	
<i>Garcinia volkensii</i>	Engl.	1200- 2400		Tree			Moist forest or forest margins	LEAP	
<i>Harungana sp</i>	Lam.			Tree					
<i>Symphonia globulifera</i>		750-2300		Tree			Montane forest	LEAP	
HYDROCALYTACEAE									
Unknown specimen				shrub				Not in LEAP	
ICACENACEAE									
<i>Apodytes dimidiata</i>	Arn.	580-2100		Tree			Moist forest or forest margins	FTEA	
IRIDACEAE									
<i>Gladiolus bussei</i>		1900 -2600		Herb				FTEA	
LABIATAE									
<i>Hoslundia opposita</i>	Vahl		U2,3; K1-6; T2-4, 6; Burundi, Somalia, Eritrea,	Tree				FTEA	

Sudan.

<i>Plectranthus laxiflorus</i>	Benth.			Shrub				FTEA	Not in LEAP
LAURACEAE									
<i>Cryptocarya</i> sp		1350-1800		Shrub layer			Moist forest or forest margins	FTEA	
<i>Ocotea usambarensis</i>	Engl.	1400 - 2000		Tree			Moist forest or forest margins	LEAP	
LEGUMINOSAE									
<i>Albizia gummifera</i>	(J.F. Gmel.) C.A. Sm.	300-2000	Widespread	Tree			Moist forest, secondary forest, forest margins		
<i>Brachystegia spiciformis</i>	Benth.	300-1500		Tree					
<i>Cyanometra</i> sp	L.			Tree	N				
<i>Lonchocarpus carpusa</i>	Kunth			Tree					
<i>Millettia dura</i>	Dunn			Tree					
<i>Newtonia buchananii</i>	(Baker) Gilb. & Bout.	800-2000		Tree				Lovett Guide Not ready yet	
<i>Pterocarpus tinctorius</i>	Welw.	300-1000		Tree					
<i>Schefflerodendron usambarense</i>	Harms	1400 -1900		Tree			Moist forest or forest margins	FTEA	
<i>Tamarindus indica</i>	L.			Tree					
LILIACEAE									
<i>Aloe bussei</i>	A. Berger	580 - 1500	T5-7;	Herb	N	CITES II	Rocky outcrops	FTEA	
<i>Asparagus asparagoides</i>	(L.) Druce		K4,7; T7; Burundi, Zaire, S. Africa	Herb				FTEA	
LOBELIACEAE									
<i>Lobelia graniticola</i>				Herb	E			FTEA	
<i>Lobelia lukwangulensis</i>	Thunb.	0 - 1780	K1, 4, 7; T1,3,4,6-8; Z; P; Ethiopia, Zimbabwe, Mozambique, Comoro Isl, Madagascar, Reunion, Brazil.	Perennial herb	E		Grassland, forest margins, roadsides, streamsides or on coastal sand, often in damp places.	FTEA	
LOGANIACEAE									

Species	Author species	Altitudinal range (m asl)	Distribution	Life form	Endemic status	Status of Threat	Habitat	Data source	Notes
<i>Nuxia congesta</i>	Fresen.	1500 - 2100		Tree				LEAP	
MALIACEAE									
<i>Celtis whitii</i>		1700		Tree			Moist forest or forest margins	FTEA	
MALVACEAE									
<i>Hibiscus faulknerae</i>	Vollesen		K7; T6,8;	Herb				FTEA	
<i>Hibiscus surattensis</i>	L.	1450	U1-4; K3,7; T1,3,4,6,8; Mozambique, Malawi, Zambia, Burundi, Zaire.	Herb				FTEA	
<i>Sida javensis</i>	Cav.	50 - 1750	U1,2,3,4; K1-7; T7,8; Z; P; Zaire, Sudan, Ethiopia, Eritrea	Shrub				FTEA	
<i>Sida rhombifolia</i>	L.			Shrub				FTEA	
MELASTOMATACEAE									
<i>Dissotis rotundifolia</i>	(Sm.) Triana	0 - 1900	U2-4; K7; T1,3,4, 6-8; Z; P; widespread in tropical Africa from Sierra Leone southwards to Angola and extending eastwards through Zaire and E. Africa to Zimbabwe and Mozambique; introduced to Malaysia	Herb			Margins of rain-forest, riverine forest, flood plains and valley grassland, swamps, upland grassland in moist places.	FTEA	
<i>Memecylon cogniauxii</i>	750-1800			Tree	N		Rain forest	FTEA	
<i>Memecylon jasminoides</i>	L.			Tree					

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<i>Memecylon sp</i>				Shrub				LEAP	
MELIACEAE									
<i>Khaya anthoeceaca</i>	(Welw.) C.DC.	1200 - 1900		Tree				FTEA	
<i>Trichilia emetica</i>	Vahl	10 - 1300	U1-3; K1, 3-7; T 1-8; Z	Tree			Coastal forest, drier types of riparian forest and riparian woodland; more rarely in rocky outcrops or in wooded grassland.		
<i>Turraea holstii</i>	Gurke	300 - 450	T6; not known elsewhere.	Treelet			Lowland (groundwater) rain-forest on limestone	LEAP	Kimboza F.R.
MONIMIACEAE									
<i>Xymalos monospora</i>	(Harv.) Baill. ex Warb.	900 - 2700	U1-4; K1, ?2; 3-7; T1-4, 6, 7; eastern Africa from Sudan Republic and eastern Congo Republic to South Africa, also Cameroon Highlands and Fernando Po.	Shrub or small tree			Lowland and upland rain forest, often a co-dominant in forests on isolated mountain-tops in dry country		
MORACEAE									
<i>Dorstenia schliebenii</i>	Mildbr.	300 - 2000	T 6-8; Malawi	Herb	N		Rain-forest, often among rocks.	LEAP	
<i>Ficus bussei</i>	Mildbr. & Burret	0 - 550	K7, T3, 5, 6, 8; Somalia, Mozambique, Malawi, Zambia, Zimbabwe.	Tree			Lowland forest, riverine, swamp forest and flood plains.	LEAP	

Species	Author species	Altitudinal range (m asl)	Distribution	Life form	Endemic status	Status of Threat	Habitat	Data source	Notes
<i>Ficus sur</i>	Forssk	0 - 2300	U1-4; K1,3-7; T1-8; Z; P; extending to Yemen, Cape Verde Isl. Angola and South Africa.	Tree			Forest, riverine, wooded grassland, often left in cleared places.	LEAP	
<i>Ficus thonningii</i>	Blume	350 - 2500	U1-4; K1-7; T1-8; extending to Cape Verde Isl, Angola, Ethiopia and South Africa.	Tree			Forest, woodland, bushland and wooded grassland, sometimes along rivers and lakes or among rocks, planted for ornament and bark cloth.	LEAP	
<i>Ficus vallis-choudae</i>	Del.	450 - 1800	U1,2,4; K1-7; T 2-7	Tree			Riverine, lakesides, ground water forest.	LEAP	
<i>Mesogyne insignis</i>	Engl.	500 - 1300	T3,6; S. Tome	Shrubs or trees.	N	Vu	Rain-forest;		
<i>Morus mesozygia</i>	L.			Tree					
<i>Myrianthus holstii</i>	Engl.	1200 - 2000		Tree				LEAP	
<i>Trilepisium madagascariense</i>	DC.			Tree					
MYRICACEAE									
<i>Agaurea salicifolia</i>	(Comm. Ex. Lam.) Hook.f.ex. Oliv.	1400- 2600		Shrub to tree			Uppermontane forest	FTEA	
<i>Myrica salicifolia</i>		1900 - 2600		Tree			Moist forest or forest margins	LEAP	
MYRSINACEAE									
<i>Maesa lanceolata</i>		1600 - 2000		Tree			Moist forest or forest margins	LEAP	
<i>Myrsine sp</i>		1500 - 2200		Tree				FTEA	

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<i>Rapana melanophloeos</i>		1100 - 2600		Tree			Uppermontane forest	LEAP	
MYRTACEAE									
<i>Syzygium cordatum</i>	Hochst. Ex. Krauss	200 - 2500		Shrub			Uppermontane forest	Lovett Guide Not ready yet	
<i>Syzygium cuminii</i>		1100 - 1900		Grass				FTEA	
<i>Syzygium guineense</i>	(Eilld.) DC.	1800 - 2600		Herbaceous climber			Uppermontane forest	Lovett Guide Not ready yet	
<i>Syzygium parvulum</i>		1100 - 2600		Shrub	E		Uppermontane forest	Lovett Guide Not ready yet	
<i>Syzygium sclerophyllum</i>	Brenan	1200 - 2600		Tree			Uppermontane forest	Lovett Guide Not ready yet	
OCHNACEAE									
<i>Ochna holstii</i>	Engl.	200 - 2300		Tree				LEAP	
OLACACEAE									
<i>Strombosia scheffleri</i>	Engl.	1500 -2600		Tree			Moist forest or forest margins	Lovett Guide Not ready yet	
ORCHIDACEAE									
<i>Bulbophyllum</i> spp	Thouars			Herb					
OXALIDACEAE									
<i>Oxalis corniculata</i>	L.	10 - 2950	U1-4; K2-7; T1-4, 6-8; Z; P; widespread in most tropical and many temperate countries	Herb			Weed in cultivation, disturbed ground, lawns and roadsides.	FTEA	
PASSIFLORACEAE									
<i>Adenia lindiensis</i>	Harms	0 - 1200	K7; T3,6,8; not known elsewhere	Climber			Shrub layer and edges of evergreen forest and associated bushland		

Species	Author species	Altitudinal range (m asl)	Distribution	Life form	Endemic status	Status of Threat	Habitat	Data source	Notes
<i>Passiflora edulis</i>	Sims	0 - 2500	U4; K4; T2,3,6,7; widely cultivated.	Climber			Often cultivated for the flavoured fruit and escaped in forest edges, thickets and disturbed places.		
PIPERACEAE									
<i>Peperomia blanda</i>	(Jacq.) Kunth	250 - 1800	U2,3; K4-7; T1-3, 6,7, from Yemen to South Africa west to Zaire, Madagascar, Mascarene Isl, India, Burma to South America	Erect plant			Bare bout often shady rocky places, evergreen scrub and 'dry' forest also margin of standing water and springs, often with Aloe and Aeollanthus or in riverine thickets, rarely an epiphyte	FTEA	
<i>Peperomia trifoliolate</i>				Epiphytic herb					
<i>Piper capense</i>	L. f.	650 - 2500	U2-4; K1,2,3-6,7; T1-4, 6-8; widespread in Africa from Sierra Leone to Cameroon, Rio Muni, Bioko, Sao Tome to Zaire, Rwanda, Burundi, Sudan and Ethiopia south to Mozambique, Zimbabwe, Malawi Swaziland and South Africa.	Shrub or subshrub			Forest undergrowth in wet places, swampy forest edges, mixed bamboo-forest, also upland scrub and thicket near streams , grassland and tree clumps.	FTEA	

Species	Author species	Altitudinal range (m asl)	Distribution	Life form	Endemic status	Status of Threat	Habitat	Data source	Notes
<i>Piper umbellatum</i>	L.	(0-)150 - 1800 (- 2100)	U2-4; K1,3,4,5; T2-5,6,7; Z; Guinea Bissau to Angola, Zaire, Sao Tome, Bioko, So. Sudan, Mozambique, Malawi, Zimbabwe, Seychelles, Madagascar, Mascarene is; pantropical	Shrub or woody herb			Evergreen forest undergrowth, swamp forest, elephant grass, river banks, old rubber plantations always in damp places	FTEA	
POACEAE									
<i>Andropogon contotus</i>		1100 - 2600		Grass				LEAP	
<i>Panicum hirtum</i>	Kam. (Syn. P. heterostachyum Hack.)			Grass					
PODOCARPACEAE									
<i>Podocarpus latifolius</i>	(Thunb.) R. Br. Ex Mirb.	1800 - 2600		Tree			Moist forest or forest margins	FTEA	
POLYGALACEAE									
<i>Polygala macrostigma</i>	Chodat	1200	T3,4,6,8;	Herb				FTEA	
<i>Polygala sphenoptera</i>	Fresen.	1000 - 2200	U3; K2,3,5-7; T1-8; Zaire, Cameroon, Zimbabwe, Zambia	Herb					
PROTEACEAE									
<i>Faurea saligna</i>	Harvey.			Tree					
RHAMNACEAE									
<i>Maeopsis eminii</i> (exotic)	Engl.	300-1500		Tree			Forest		
ROSACEAE									
<i>Rubus albata</i> (exotic)				Shrub					
<i>Rubus pinnatus</i> (exotic)	Willd.			Shrub					
<i>Rubus sp</i> (exotic)				Shrub					

Species	Author species	Altitudinal range (m asl)	Distribution	Life form	Endemic status	Status of Threat	Habitat	Data source	Notes
<i>Prunus africana</i>	(Hook. F.) Kalkm	1500 - 2600		Tree		CITES II		FTEA	
RUBIACEAE									
<i>Canthium nodulosa</i>				Shrub to tree				FTEA	
<i>Canthium oligocarpum captum</i>	Hiern	1350 - 2000	T3,6,7; Malawi and Mozambique (subsp range)	Shrub or tree			Forest	FTEA	
<i>Canthium sp1</i>		Unknown		Shrub				Not in LEAP	
<i>Canthium sp2</i>		Unknown		Shrub			Moist forest or forest margins	Not in LEAP	
<i>Catunaregam spinosa taylorii</i>	(Thunb.) Tirveng.	100 - 1915	T1-8; Zaire, Mozambique, Malawi, Zambia and Zimbabwe (sub-species range)	shrub or small tree			<i>Brachystegia</i> woodland, open bushland and scrub, grassland with scattered trees, sometimes on rocky ground.	FTEA	
<i>Chassalia discolor</i>		1200 -1900		Shrub	N		Moist forest or forest margins	FTEA	
<i>Chassalia partifolia</i>		1230 2100		Shrub			Moist forest or forest margins	FTEA	
<i>Coffea pseudozaguebarica</i>				Tree	N	Vu			
<i>Didymosalpinx norae</i>	(Swynn.) Keay	190 - 810	K7; T3,6,8; Mozambique, Zimbabwe.	Shrub or small tree			Evergreen forest, secondary forest, forest edges.	FTEA	
<i>Gardenia posoquerioides</i>	S. Moore	250 - 1000	K7; T6; Zimbabwe; also cultivated in Puerto Rico and Florida.	Glabrous shrub or small tree			Evergreen forest, <i>Brachystegia</i> woodland;	FTEA	
<i>Hallea robustipulata</i>		200- 1800		Shrub to tree			Moist forest or forest margins	LEAP	

Species	Author species	Altitudinal range (m asl)	Distribution	Life form	Endemic status	Status of Threat	Habitat	Data source	Notes
<i>Hedythyrus thamnoidea</i>		1230- 1900		Shrub			Differentiated forest	FTEA	
<i>Hymenodictyon floribundum</i>	Wallich			Tree					
<i>Lamprothamnus zanguebarica</i>	Hiern			Tree					
<i>Lasianthus grandiflorius</i>		1200 - 2040		Shrub	E	Vu	Montane rain forest shrub layer	LEAP	
<i>Lasianthus kilimandcharicus</i>	E.A.Bruce	1000-2300	T6; not known elsewhere.	Shrub	N		Shrub layer of rain forest.	FTEA, LEAP	Uluguru Mts
<i>Lasianthus macrocalyx</i>		1200 -2400		Shrub	E		Montane rain forest shrub layer	LEAP	
<i>Lasianthus microcalyx</i>		2100 - 2600		Shrub	E		Montane rain forest shrub layer	LEAP	
<i>Lasianthus wallacei</i>		1100 - 1900		Shrub	E	Vu	Montane rain forest shrub layer	FTEA	
<i>Lasianthus sp</i>		1600 - 2430		Shrub			Moist forest or forest margins	LEAP	
<i>Leptactina platyphylla</i>	(Hiern) Wernham	45 - 1650	U2,4; K5,7; T3,4,6,7,?8; Cameroon, Central African Republic, Zaire, Burundi, Rwanda, Sudan, Mozambique, Malawi	Shrub or small tree			Evergreen forest, woodland, secondary bushland.	FTEA	
<i>Oxyanthus speciosus stenocarpus</i>	DC.	750 - 2300	U1-3; K1, 3-7, T2,3,5-8; Rwanda, Ethiopia, Mozambique, Zimbabwe and South Africa	Shrub or small tree			Forest	FTEA	Details for sub-species

Species	Author species	Altitudinal range (m asl)	Distribution	Life form	Endemic status	Status of Threat	Habitat	Data source	Notes
<i>Pavetta aff. sparsipila</i>	Bremek			Shrub layer	E	Vu	Forest	FTEA	
<i>Pavetta crebilifolia</i> var <i>crebilifolia</i>		950- 1900		Shrub	N		Moist forest or forest margins	LEAP	
<i>Pavetta holstii</i>	Schumm.	600 - 2000	T3, 6; not known elsewhere.	Shrub, scrambling shrub or small tree			Evergreen forest.	FTEA	Lushoto District: E. Usambara Mts, Monga. Tanga District from Amani; Morogoro district: Nguru Mts, Manyangu Forest, Liwale Forest. E. Usambaras and Ulugurus
<i>Psychotria brucei</i>	Verdc.	300 - 1000	T3,6; not known elsewhere.	Herb	N	R	Rain forest		
<i>Psychotria megalopus</i>		1140 - 1850		Shrub some time tree	N	Vu	Evergreen forest; riverine forest	FTEA	
<i>Psychotria sp 3</i>	(Chiov.) Bridson	45 - 960	K7; T3,6,8; Somalia	Shrub or small tree			Thicket or sometimes forest	FTEA	
<i>Psychotria sp 4</i>		200-2500		shrub				LEAP	
<i>Rothmannia urcelliformis</i>	(Lindl.) Dandy	(700-) 1050 - 1675	U1,2,4; T7,8; throughout west tropical Africa, the Zaire basin, Sudan, Malawi, Zambia and Angola	Shrub or small tree			Forest	LEAP	
<i>Rytigynia bogoyensis</i>	(K. Schum.) Verdc. fortasse sp. nov.			Tree		Vu		LEAP	

Species	Author species	Altitudinal range (m asl)	Distribution	Life form	Endemic status	Status of Threat	Habitat	Data source	Notes
<i>Rytigynia lichenoxenos</i>	(K. Schumm.& K. Krause) Bullock	950 - 1830	K7; T3,6; not known elsewhere	Shrub or small tree	N	R, Vu	Open bushland in granite areas, submontane forest	FTEA	Taita Hills, E. Usambara Hills, W. Nguru Mountains above Maskati.
<i>Rytigynia uhligii</i>		1400- 2101		Shrub			Moist forest or forest margins	LEAP	
<i>Tricalysia ovalifolia</i>	Hiern	0 - 1000	K7; T3,6,8; Z; Madagascar, Somalia, Aldabra, Assumption, Comores, Madagascar	Shrub or small tree		Vu	Coastal evergreen or mixed formations, secondary vegetation, dry thickets, wooded grassland and evergreen forest		
<i>Tricalysia pallens</i>		1100 - 2600		Shrub				FTEA	
<i>Tricalysia pedicellata</i>	Robbr.	300 - 700	T6; not known elsewhere.	Shrub or small tree	N	Vu	Forest		Kilosa District; Mikumi National Park, Vuma Hills, Nguru Moutnains, Kimboza FR
Unknown				Shrub			Moist forest or forest margins	Not in LEAP	
Unknown				Shrub			Uppermontane forest	Not in LEAP	
RUTACEAE									
<i>Clausena anisata</i>		1300 -1800		Shrub to tree			Moist forest or forest margins	FTEA	
<i>Teclea simplicifolia</i>	(Engl.) Verdoorn	1100 - 2100		Shrub to tree				LEAP	
<i>Vepris trichocarpa</i>	(Kokwaro) Mziray			tree					Not in LEAP

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<i>Zanthoxylum gillettii</i>	(De Wild.) Waterm.	1700		woody climber		R	Moist forest or forest margins	FTEA	
SAPINDACEAE									
<i>Allophylus abyssinica</i>	Taub.	1000 - 2100	T 2,4,6,7; not known elsewhere.	Tree or shrub		R	Steep forested ravines, forest edges	FTEA	Notes for variety. Species more widespread
<i>Allophylus rubifolius</i>	(A.Rich.) Engl.	0 - 2250	U1-5; K1-7; T1-8; E. Zaire, Sudan, Ehtiopia and N. Somalia, south to South Africa.	Shrub or small tree			Grassland with scattered trees, rough grassland, thicket edges of cultivation, woodland sometimes riverine		
<i>Deinbollia borbonica</i>	Scheff.	0 - 1050	K4,7; T2,3,5-8; Z; P; S. Somalia, Malawi, Mozambique and Comoro Is.	Shrub or small tree			Riverine acacia thorn bush and evegreen thicket. Combretum - Acacia woodland, low evergreen forest on limestone outcrops		
SAPOTACEAE									
<i>Kiggelaria africana</i>	L.	1600- 2430		Tree				FTEA	
<i>Manilkara sp</i>				Tree					
<i>Mimusops schliebenii</i>	A. DC.	0 - 750	K7; T3,6,8; Z; P; Mozambique and Zimbabwe, also Comoro Is and Madagascar	Shrub or small tree			Lowland dry evergreen forest, riverine forest and coastal evergreen thickets.	FTEA	
Unknown		Unknown		Tree			Moist forest or forest margins	Not in LEAP	
SELAGINLLACEAE									
<i>Selaginella kraussiana</i>	(Kunze) A. Braun			Fern					
SOLANACEAE									

Species	Author species	Altitudinal range (m asl)	Distribution	Life form	Endemic status	Status of Threat	Habitat	Data source	Notes
<i>Solanum schumannianum</i>	Dammer, forma	1450 - 2320	K4,6,7; T2,3,6,7	Shrub				FTEA	
STERCULIACEAE									
<i>Cola clavata</i>	Cav.		T2,3,5;	Tree	N			FTEA	
<i>Cola greenwayi</i>	Forssk	1050 - 2300	U2,4; T3,4,8; Rwanda, Burundi	Tree	N			FTEA	
<i>Cola scheffleri</i>	Vatke	100 - 750	K7; T6,8; Z;	Tree	N			FTEA	
<i>Cola stelechantha</i>	Brenan	500 - 1500	K7; T6	Tree				FTEA	
<i>Cola usambarensis</i>				Tree	N			FTEA	
<i>Dombeya shupangae</i>	K. Schum.	600	T2,3,4; Madagascar	Tree	N			FTEA	
<i>Leptonychia usambarensis</i>	K. Schum.			Shrub to tree	N			FTEA	
<i>Nesogordonia holtzii</i>		1200 - 2600		Tree			Stunted forest	FTEA	
<i>Octolobus rubrostipulata</i>	Welw.			Tree					
<i>Octolobus spectabilis</i>		1210- 1900		Tree			Moist forest or forest margins	LEAP	
<i>Streblus usambarensis</i>		1300 -1900		Tree			Moist forest or forest margins	Lovett Guide Not ready yet	
THEACEAE									
<i>Balthasaria schliebenii</i>	(Melch.) Verdc.	1300- 1900		Tree		R	Moist forest or forest margins	FTEA	
TILIACEAE									
<i>Triumfetta cordifolia</i>	A. Rich.	1290	U2,3; T1,4; Zaire, Rwanda	Herb				FTEA	
<i>Triumfetta rhomboidea</i>	Jacq.		T1-8;	Herb					
UMBELLIFERAE									
<i>Embelia schimperi</i>		1500 -2400		Tree			Moist forest or forest margins	FTEA	
<i>Englerophytum natalense</i>		530 - 2150		Shrub to tree			Montane forest	LEAP	

Species	Author species	Altitudinal range (m asl)	Distribution	Life form	Endemic status	Status of Threat	Habitat	Data source	Notes
<i>Zanha golungensis</i>		1400 - 1900		Tree			Moist forest or forest margins	LEAP	
URTICACEAE									
<i>Elatostema paivae anum</i>	Wedd.	900 - 2100	T2,3,6,7; widespread in the wetter parts of tropical Africa, west to Guinea south to Malawi	Herb			Lowland rain forest or altitudinal transitional forest, in the moist ground cover, often along streams.		
VERBENACEAE									
<i>Vitex usambarensis</i>	L.	1200-2000		Tree			Forest, forest margins, secondary forest		
VIOLACEAE									
<i>Rinorea arborea</i>	(Thouars) Baill.	0 - 850	K7; T3,6,8; Z; Mozambique, Madagascar	Shrub or small tree			Lowland evergreen forest		
<i>Rinorea elliptica</i>	(Oliv.) Kuntze	50 - 600	K7; T2,3,6,8; Mozambique, Malawi	Shrub or small tree			Lowland evergreen rain forest	FTEA	
<i>Rinorea ilicifolia</i> var. <i>amplexicaulis</i>	Grey-Wilson	1150	T1,4,6 not known elsewhere.	Shrub or small tree			Evergreen forest	FTEA	Details for variety. Species widespread. Nguru, Uluguru, Utwani Forest, Lamu District.
<i>Rinorea squamosa kaessNri</i>	(Engl.) Grey-Wilson	30 - 450	K7; T6; not known elsewhere	Shrub or small tree			Evergreen lowland and submontane forest.		
VITACEAE									
<i>Cissus sciaphila</i>	Gilg.	0 - 450	K7; T3,6,8; Z; P; not known elsewhere	Climber			Lowland forest, riverine forest fringes, woodland slopes above river valleys.	FTEA	

Species	Author species	Altitudinal range (m asl)	Distribution	Life form	Endemic status	Status of Threat	Habitat	Data source	Notes
<i>Cyphostemma buchananii</i>	(Planch.) Wild & Drummond	0 - 1125	K7; T3-8;Z; Zaire, Malawi, Mozambique, Zambia, Zimbabwe, Botswana and South Africa.	Herb			Coastal thicket on old coral reefs, etc, bushland, wooded grassland, woodland, forest also in old cultivations.		
ZAMIACEAE									
<i>Encephalartos hildebrandtii</i>	A. Br. & Bouche	0 - 600	U2; K7; T3,6; Z;	Tree	N	CITES I		FTEA	

Plant species recorded in the vegetation plots in Uluguru North FR, following Mabberley (1997) and Palgrave (1996)

Key to Appendix 8

Author

Altitudinal range (m)

This refers to the known range of altitudes from which this species has been recorded.

Distribution

The distribution records are based on the geographical divisions used by the Flora of Tropical East Africa (available at <http://www.rbk.org.uk/herbarium/fta/geograph.html>.) e.g. T3, T6, T8 represent Tanzania and K7 represents Kenya. Names of countries are the same as those given in the FTEA. As this has been published over several decades it includes a number of country names which have subsequently been changed e.g. Nyassaland is now Malawi etc.

Where the subspecies or variety is listed, the distribution refers to the sub-species or variety not the species.

Endemic status (based on Iversen 1991b)

E = Endemic: Occuring within the Uluguru Mountains only

N = Near endemic: Species with limited ranges within the Eastern Arc mountains and / or East African lowland forests

W = Widespread distribution

Status of threat

Threat status IUCN:

VU = Vulnerable; high risk of extinction in the wild in the medium-term future (20% loss already in last 10 years or 3 generations)

Threat status CITES:

I = Threatened with extinction and excluded from commercial international trade

II = Not yet threatened with extinction, but may be so if trade is not regulated thus export permits are required

R = Rare, from Leap database, species found in less than two out of eight regions of Tanzania

Habitat

This describes the habitats in which this species is found.

Data source

Three data sources were used for information on the altitudinal range, distribution and habitat association.

FTEA: The Flora of Tropical East Africa was the preferred data source. The FTEA is a series published by the Royal Botanic Gardens, Kew. Descriptions are not yet available for all families.

LEAP: The List of East African Plants is published by the East African Herbarium.

TROPICOS provides new and improved access to the Missouri Botanical Garden's VAST nomenclatural database and associated authority files.

Generally this was only used in combination with either FTEA or LEAP

Appendix 9: Mammal data

9a Full list of mammals recorded in Uluguru North FR, updated from Doggart et al (2005) with UCBS 2005 data.

Taxonomy follows Kingdon (1997). Voucher specimens are currently undergoing formal taxonomic verification (Appendix 2). Highlighted are new records for Uluguru North FR collected by UCBS.

Species	Common name	Range	Habitat	Threat status IUCN	Threat status CITES	Most recent record
COLOBIDAE						
<i>Colobus angolensis</i>	Angola pied colobus	Widespread	FF	DD	II	UCBS 2005
CERCOPITHECIDAE						
<i>Cercopithecus mitis</i>	Gentle monkey	Widespread	F		II	UCBS 2005
GALAGONIDAE						
<i>Otolemur garnetti</i>	Small-eared galago	Coastal Forests and Eastern Arc	F		II	UCBS 2005
<i>Galagoides orinus</i>	Usambara galago	Eastern Arc	FF	DD	II	UCBS 2005
PTEROPODIDAE						
<i>Epomophorus labiatus</i>	Epauletted fruit bat	Widespread				UCBS 2005
<i>Stenonycteris lanosus</i>	Mountain fruit bat	Widespread	F			UCBS 2005
NYCTERIDAE						
<i>Nycteris thebaica</i>	Slit-faced bat	Widespread				Swynnerton and Hayman 1950
<i>Nycteris hispida</i>	Slit-faced bat	Widespread				Swynnerton and Hayman 1950
RHINOLOPHIDAE						
<i>Rhinolophus landeri lobatus</i>	Horseshoe bat	Widespread				Swynnerton and Hayman 1950
<i>Rhinolophus hildebrandti</i>	Horseshoe bat	Widespread				UCBS 2005
HIPPOSIDERIDAE						
<i>Hipposideros caffer caffer</i>	Leaf-nosed bat	Widespread				Swynnerton and Hayman 1950
VESPERTILIONIDAE						
<i>Eptesicus sp</i>	Serotine					UCBS 2005
<i>Myotis welwitschii venustus</i>	Hairy bat	Widespread				Swynnerton and Hayman 1950

Species	Common name	Range	Habitat	Threat status IUCN	Threat status CITES	Most recent record
<i>Kerivoula africana</i>	Woolly bat	Lowland E. Arc and Coastal Forests				Swynnerton and Hayman 1950
<i>Chalinolobus argentatus</i>	Butterfly bat	Widespread				Swynnerton and Hayman 1950
<i>Pipistrellus kuhlii fuscatus</i>	Pipistrelle	Widespread				Swynnerton and Hayman 1950
<i>Pipistrellus nanus nanus</i>	Pipistrelle	Widespread				UCBS 2005
<i>Scotoecus hirundo hindei</i>	Evening bat	Widespread				UCBS 2005
<i>Scotophilus viridis viridis</i>	House bat	Widespread				Swynnerton and Hayman 1950
<i>Miniopterus schreibersi</i>	Long-fingered bat	Widespread				Swynnerton and Hayman 1950
CHRYSOCHLORIDAE						
<i>Chrysochloris stuhlmanni tropicalis</i>	Stuhlmann's golden mole	Sub-species endemic to Uluguru				UCBS 2005
SORICIDAE						
<i>Crocidura cf hirta</i>	White-toothed shrew	Widespread				UCBS 2005
<i>Crocidura monax</i>	White-toothed shrew	Eastern Arc, Kilimanjaro and one other site.		VU		Stanley et al 1998
<i>Crocidura olivieri</i>	White-toothed shrew	Widespread				UCBS 2005
<i>Crocidura telfordi</i>	White-toothed shrew	Uluguru and Udzungwa	FF	CR		Stanley et al 1998
<i>Myosorex geata</i>	Mouse shrew	Uluguru	FF	EN		UCBS 2005
cf. <i>Sylvisorex howelli</i>	Climbing shrew	Usambara and Uluguru	FF	VU		UCBS 2005
cf. <i>Sylvisorex megalura</i>	Climbing shrew	Widespread				Stanley et al 1998
MACROSCOLIDINAE						
<i>Petrodromus tetradactylus</i>	Four toed elephant shrew	Widespread	F			Swynnerton and Hayman 1950
RHYNCHONCYONINAE						
<i>Rhynchocyon petersi</i>	Zanj elephant shrew	South Pare, Usambara, Uluguru, Nguru?, Coastal Forests	F	EN		UCBS 2005
SCIURIDAE						
<i>Paraxerus lucifer</i>	Tanganyika mountain squirrel	Widespread	FF			UCBS 2005
<i>Paraxerus palliatus</i>	Red-bellied coast squirrel	Widespread	F	VU		Swynnerton and Hayman 1950

Species	Common name	Range	Habitat	Threat status IUCN	Threat status CITES	Most recent record
<i>Paraxerus ochraceus</i>	Ochre bush squirrel	Widespread	F			Swynnerton and Hayman 1950
ANOMALURIDAE						
<i>Anomalurus derbianus</i>	Lord Derby's anomalure	Widespread	F			UCBS 2005
DENDROMURINAE						
<i>Dendromus mesomelas</i>	Climbing mouse	Widespread	O			Swynnerton and Hayman 1950
CRICETOMYINAE						
<i>Beamys hindei</i>	Lesser pouched rat	Usambara, Uluguru, Udzungwa, Nguru, Pare (and coastal forest)	F	VU		UCBS 2005
<i>Cricetomys gambianus</i>	Giant pouched rat	Widespread	F			Swynnerton and Hayman 1950
OTOMYINAE						
<i>Otomys denti</i>	Groove-toothed rat	Widespread	O			Swynnerton and Hayman 1950
MURIDAE						
<i>Hylomyscus denniae</i>	African wood mouse	Widespread	F			UCBS 2005
<i>Grammomys</i> spA 26104	Narrow-footed woodland mouse	?				UCBS 2005
<i>Grammomys</i> spB 26103	Narrow-footed woodland mouse	?				UCBS 2005
<i>Lophuromys sikapusi</i>	Brush-furred mouse	Widespread	F			Swynnerton and Hayman 1950
<i>Lophuromys flavopunctatus</i>	Brush-furred mouse	Widespread	F			UCBS 2005
<i>Praomys</i> sp.	Soft-furred rat	Widespread	F			UCBS 2005
<i>Mus minutoides</i>	Common mouse	Widespread				Swynnerton and Hayman 1950
<i>Dasymys incomtus</i>	Shaggy swamp rat	Widespread	O			Swynnerton and Hayman 1950
<i>Lemniscomys</i> sp.	Zebra mouse	Widespread	O			Swynnerton and Hayman 1950
<i>Pelomys fallax</i>	Creek rat	Widespread	O			Swynnerton and Hayman 1950
MYOXIDAE						
<i>Graphiurus murinus</i>	Dormouse	Widespread				UCBS 2005

Species	Common name	Range	Habitat	Threat status IUCN	Threat status CITES	Most recent record
MUSTELIDAE						
<i>Aonyx capensis</i>	African clawless otter	Widespread	F		II	Swynnerton and Hayman 1950
HERPESTIDAE						
<i>Atilax paludinosus</i>	Water mongoose	Widespread	O			UCBS 2005
<i>Herpestes sanguinea</i>	Slender mongoose	Widespread	O			UCBS 2005
HYSTRICINAE						
<i>Hystrix cristata</i>	Crested porcupine	Widespread	O			UCBS 2005
VIVERRIDAE						
<i>Genetta tigrina</i>	Blotched genet	Widespread	F			Swynnerton and Hayman 1950
<i>Civettictis civetta</i>	African civet	Widespread	F			Swynnerton and Hayman 1950
<i>Leptailurus serval</i>	Serval cat	Widespread	O		II	Swynnerton and Hayman 1950
NANDININAE						
<i>Nandinia binotata</i>	African palm civet	Widespread	F			Swynnerton and Hayman 1950
FELIDAE						
<i>Panthera pardus</i>	Leopard	Widespread	F		I	Swynnerton and Hayman 1950
PROCAVIDAE						
<i>Dendrohyrax validus</i>	Tree hyrax		F	VU		UCBS 2005
SUIDAE						
<i>Potamochoerus larvatus</i>	Bush pig	Widespread	F			UCBS 2005
BOVIDAE						
<i>Tragelaphus scriptus</i>	Bushbuck	Widespread	F			Swynnerton and Hayman 1950
<i>Cephalophus monticola</i>	Blue duiker	Widespread	FF		II	UCBS 2005
<i>Cephalophus harveyi</i>	Harvey's duiker	Widespread	FF			Swynnerton and Hayman 1950
<i>Cephalophus spadix</i>	Abbot's duiker	Udzungwa, Usambara?, Uluguru, Udzungwa, Rungwe and Kilimanjaro	FF	VU		Swynnerton and Hayman 1950

Species	Common name	Range	Habitat	Threat status IUCN	Threat status CITES	Most recent record
<i>Neotragus moschatus</i>	Suni	Widespread	F			Swynnerton and Hayman 1950

Key to Appendix 9

The habitat preference of each species is described in the habitat column as:

FF = Species dependent on primary forest only. It does not include forest edge or secondary forest species;

F = Forest dwelling but not dependent on primary forest: species occurring in primary forest as defined above as well as other vegetation types. It should be emphasised that many of these species are still dependent on a forest habitat albeit forest edge or disturbed forest. Most species in this category will still be adversely affected by forest destruction.

O = These are species that do not normally occur in primary or secondary forest or forest edge.

IUCN threat status:

CR = Critically endangered; *extremely* high risk of extinction in the wild

EN = Endangered; *very* high risk of extinction in the wild

VU = Vulnerable; high risk of extinction in the wild

DD = Data deficient

CITES threat status:

I = Threatened with extinction and excluded from commercial international trade

II = Not yet threatened with extinction, but may be so if trade is not regulated, thus export permits are required

9b Small mammal numbers recorded from the UCBS zoological trapsites in Uluguru North FR. Taxonomy following Kingdon (1997). Voucher specimens are currently undergoing formal taxonomic verification (Appendix 2).

Species	Common name	Numbers of individuals per trapsite (recaptures)				KMH No.s
		Main 1	Main 2	Sat camp 3	Sat camp 4	
SORICIDAE						
<i>Crocidura hirta</i>	White-toothed shrew	2 (0)	5 (0)	0	0	26450, 26453, 26455
<i>Crocidura oliveri</i>	White-toothed shrew	1 (0)	2 (0)	0	0	26448, 26456
<i>Crocidura nana/elongius</i>	White-toothed shrew	0	1 (0)	0	0	26454
<i>Myosorex geata</i>	Mouse shrew	1 (0)	0	0	0	26451
<i>Sylvisorex howelli</i>	Climbing shrew	14 (0)	12 (0)	0	0	26446, 26447, 26452, 26457
CRICETOMYINAE						
<i>Beamys hindei</i>	Lesser pouched rat	0	1 (0)	0	0	26102
MURIDAE						
<i>Grammomys sp A</i>	Narrow footed woodland mouse	0	1 (0)	0	0	26104
<i>Grammomys sp B</i>	Narrow footed woodland mouse	0	1 (0)	0	0	26103
<i>Lophuromys flavopunctatus</i>	Brush-furred mouse	6 (0)	1 (0)	0	0	26094, 26097, 26098, 26106
<i>Praomys sp</i>	Soft-furred rat	39 (22)	37 (44)	5 (0)	8 (1)	26095, 26099, 26101
<i>Hylomyscus denniae</i>	African wood mouse	24 (24)	27 (11)	3 (0)	5 (0)	26096, 26100
MYOXIDAE						
<i>Graphiurus murinus</i>	African Dormouse	0	2 (0)	0	0	26105
		87 (46)	87 (55)	8 (0)	14 (1)	

Main zoo site contained bucket pitfall and sherman traps

Sat camp zoo site contained 20 sherman traps only

Appendix 10: Bird data

10a Bird survey summary

Surveyed site	Coordinates	Altitude m asl	Habitat description	Duration of survey	Amount of time misnetting net-metre - hrs	Net - metres
Sat Camp 1 Kinole	06°52'36.4", 037°44' '15.8"	980	Sub montane forest	19/01/2005 - 24/01/2005	3888	162m
Sat Camp 2 Bagilo	06°54 '19.7", 037°42'33.1"	1300	Sub montane forest	25/01/2005 - 29/01/2005	3982	181 m
Sat Camp 2 (1) Ngong'olo area	No coordinates obtained	1700	Montane forest	30/01/2005 - 03/02/2005	6030	201m
Base Camp 2 (Two different net rides) Morningside	06°53'34.7", 037°40'04.5"	1480	Sub montane forest	06/02/2005 - 15/02/2005	14,688	306m

10b Forest birds species recorded within Uluguru North FR, updated from Doggart et al (2005) with UCBS data. Recordings following Stevenson & Fanshawe (2002). Highlighted are those new records for Uluguru North FR collected by UCBS.

Species	Common name	Range	Habitat	Threat status IUCN	Threat status CITES	Most recent record
ACCIPITRIDAE						
<i>Accipiter tachiro</i>	African goshawk	Widespread	F		II	UCBS 2005
<i>Polyboroides typus</i>	African harrier hawk	Widespread	F		II	UCBS 2005
<i>Buteo oreophilus</i>	Mountain buzzard	Widespread in highlands of eastern half of the continent	F/FF		II	UCBS 2005
<i>Stephanoaetus coronatus</i>	African crowned eagle	Widespread	FF		II	UCBS 2005
NUMIDIDAE						
<i>Guttera pucherani</i>	Crested guineafowl	Widespread	F/O/FF			UCBS 2005
COLUMBIDAE						
<i>Turtur tympanistria</i>	Tambourine dove	Widespread	F/FF			UCBS 2005
<i>Columba delegorguei</i>	Eastern bronze-naped pigeon	Localised in eastern half of the continent	FF/F			UCBS 2005
<i>Columba arquatrix</i>	Olive pigeon	Widespread in highlands	FF/F			UCBS 2005
<i>Aplopelia larvata</i>	Lemon dove	Widespread	FF/F			UCBS 2005
MUSOPHAGIDAE						
<i>Tauraco livingstonii</i>	Livingstone's turaco	Widespread from C Kenya via Tanzania to E Zambia, Malawi to S Mozambique	FF		II	UCBS 2005
CUCULIDAE						
<i>Cercococcyx montanus</i>	Barred long-tailed cuckoo	Widespread	FF/F			UCBS 2005
<i>Chrysococcyx klaas</i>	Klaas's cuckoo	Widespread	F			UCBS 2005
<i>Chrysococcyx cupreus</i>	African Emerald cuckoo	Widespread	F/FF			UCBS 2005
STRIGIDAE						
<i>Bubo vosseleri</i>	Usambara eagle-owl	E. Usam., Ulug. & Udz.	FF	VU	II	UMBCP 2000
<i>Strix woodfordii</i>	African wood owl	Widespread	F/FF		II	UCBS 2005
APODIDAE						
<i>Schoutedenapus myoptilus</i>	Scarce swift	Wide range but localised in highlands	F/FF			Svendsen and Hansen 1995
TROGONIDAE						

Species	Common name	Range	Habitat	Threat status IUCN	Threat status CITES	Most recent record
<i>Apaloderma vittatum</i>	Bar-tailed trogon	Eastern Africa, Albertine Rift & Cameroon Mts	FF			Svendsen and Hansen 1995
BUCEROTIDAE						
<i>Tockus alboterminatus</i>	Crowned hornbill	Widespread	F/FF			UCBS 2005
<i>Bycanistes bucinator</i>	Trumpeter hornbill	Widespread	F/FF			UCBS 2005
<i>Bycanistes brevis</i>	Silvery-cheeked hornbill	Widespread in eastern half of the continent	F/FF			Svendsen and Hansen 1995
CAPITONIDAE						
<i>Stactolaema olivacea</i>	Green barbet	Very localised in a few coastal forests and mountains from SE Kenya, Tanz., N&S Malawi, N Moz. and Ngoye Forest in NE S. Africa	FF			UCBS 2005
<i>Pogoniulus leucomystax</i>	Moustached green tinkerbird	Localised in highlands from C Kenya, Tanz. to S Malawi	FF			UCBS 2005
<i>Pogoniulus bilineatus</i>	Yellow-rumped tinkerbird	Widespread	FF/F			UCBS 2005
INDICATORIDAE						
<i>Indicator variegatus</i>	Scaly-throated honeyguide	Widespread	FF/F			UCBS 2005
PICIDAE						
<i>Dendropicos griseocephalus</i>	Olive woodpecker	Widespread	FF			UCBS 2005
EURYLAIMIDAE						
<i>Smithornis capensis</i>	African broadbill	Widespread	FF			UCBS 2005
MOTACILLIDAE						
<i>Motacilla clara</i>	Montane wagtail	Widespread palearctic migrant	O			UCBS 2005
PYCNONOTIDAE						
<i>Andropadus virens</i>	Little greenbul	Widespread	FF/F			UCBS 2005
<i>Andropadus masukuensis</i>	Shelley's greenbul	Widespread	FF			UCBS 2005
<i>Andropadus neumanni</i>	Uluguru mountain greenbul	Widespread	FF			UCBS 2005
<i>Andropadus milanjensis</i>	Stripe-cheeked greenbul	Widespread	FF			UCBS 2005
<i>Phyllastrephus flavostriatus</i>	Yellow-streaked greenbul	Patchy distribution in eastern half of the continent incl. Albertine Rift	FF			UCBS 2005
<i>Phyllostrephus cabanisi</i>	Cabanis' Greenbul	Widespread	FF			UCBS 2005
TIMALIIDAE						
<i>Pseudoalcippe abyssinica</i>	African hill babbler	Localised in eastern half of of the continent & a isolated population in C Angola	FF			UCBS 2005

Species	Common name	Range	Habitat	Threat status IUCN	Threat status CITES	Most recent record
<i>Modulatrix stictigula</i> TURDIDAE	Spot-throat	Eastern Arc & Mt Rungwe	FF			UCBS 2005
<i>Pogonocichla stellata</i>	White-starred robin	Widespread	FF/F			UCBS 2005
<i>Sheppardia sharpei bangsi</i>	Sharpe's akalat	Usam., Ukaguru, Ulug., Udz., Nguus & Mt Rungwe. Uluguru endemic subspecies	FF			UCBS 2005
<i>Cossypha anomala</i>	Olive-flanked robin-chat	N Tanz. & C&S Eastern Arc, Southern highlands and S Malawi and N Moz.	FF			UCBS 2005
<i>Cossypha natalensis</i>	Red-capped robin-chat	Widespread	F/FF			UMBCP 2000
<i>Alethe fuelleborni</i>	White-chested alethe	Widespread	FF			UCBS 2005
<i>Zoothera gurneyi</i>	Orange ground thrush	Wide range but localised	FF			UCBS 2005
<i>Turdus olivaceus</i> MUSCICAPIDAE	Olive thrush	Widespread	FF			UCBS 2005
<i>Muscicapa adusta</i> SYLVIIDAE	African dusky flycatcher	Widespread	FF/F			UCBS 2005
<i>Camaroptera brachyura</i>	Grey-backed camaroptera	Widespread	F/O			UCBS 2005
<i>Chloropeta similis</i>	Mountain yellow warbler	Widespread	FF			UCBS 2005
<i>Bathmocercus winifredae</i>	Mrs Moreau's warbler	Ukaguru, Ulug., Udz. & Rubeho Mts	FF	VU		UCBS 2005
<i>Phylloscopus umbrovirens fugglescouchmani</i>	Brown woodland warbler	Widespread, however very uncommon in the Eastern Arc's montane forests. Uluguru endemic subspecies	FF			UCBS 2005
<i>Phylloscopus ruficapillus</i>	Yellow-throated woodland warbler	Extreme S Kenya via Tanz., Malawi, E Zim. to S South Africa	FF			UCBS 2005
<i>Bradypterus mariae</i>	Evergreen forest warbler	Widespread	FF			UCBS 2005
<i>Apalis melanocephala</i>	Black-headed apalis	Mainly highlands from S Somalia, via Tanz. & Malawi to SC Moz.	FF			UCBS 2005
<i>Apalis chariessa</i>	White-winged apalis	Very localised, Coastal S Kenya, Eastern Arc highlands & S Malawi	FF	VU		UCBS 2005
<i>Apalis thoracica uluguru</i>	(Uluguru) Bar-throated apalis	Widespread. Uluguru endemic subspecies	FF			UCBS 2005
<i>Apalis chapini</i>	Chestnut-headed apalis	Highlands in Tanz. & Malawi	FF			UCBS 2005
<i>Orthotomus metopias altus</i>	Red-capped forest warbler / African tailorbird	Usam., Nguru, Ukaguru, Ulug., Udz., Matego Highlands & Njesi Plateau. Uluguru endemic subspecies	FF			UCBS 2005
ZOSTEROPIDAE						
<i>Xosterops senegalensis</i>	Yellow white-eye	Widespread	FF/F			UCBS 2005

Species	Common name	Range	Habitat	Threat status IUCN	Threat status CITES	Most recent record
MONARCHIDAE						
<i>Trochocercus albonotatus</i>	White-tailed crested flycatcher	Widespread in eastern half of the continent incl. Albertine Rift	FF			UCBS 2005
<i>Terpsiphone viridis</i>	African paradise flycatcher	Widespread	FF/F			UCBS 2005
PLATYSTEIRIDAE						
<i>Batis mixta</i>	Forest batis	Eastern Arc & Coastal forests	FF			UCBS 2005
MALACONOTIDAE						
<i>Telophorus nigrifrons</i>	Black-fronted bush-shrike	Widespread	FF			UCBS 2005
<i>Telophorus quadricolor</i>	Four-coloured bush-shrike	Widespread in two large areas: Kenya-Tanz. and S Moz.-South Africa & Zimbabwe	F			Rodgers et al 1983
<i>Malaconotus alius</i>	Uluguru bush-shrike	Uluguru endemic and very localised	FF	EN		UCBS 2005
<i>Laniarius fuelleborni</i>	Fulleborn's black boubou	Eastern Arc and highlands of N Malawi	FF			UCBS 2005
<i>Dryoscopus cubla</i>	Black-backed puffback	Widespread	O/F			UCBS 2005
CAMPEPHAGIDAE						
<i>Coracina caesia</i>	Grey cuckoo-shrike	Highlands of eastern half of the continent and Cameroon Mts	FF			UCBS 2005
DICRURIDAE						
<i>Dicrurus ludwigii</i>	Square-tailed drongo	Widespread	FF			UCBS 2005
ORIOIDAE						
<i>Oriolus chlorocephalus</i>	Green-headed oriole	Very localised and disjunct pop from S Kenya via Tanz. to S Malawi & C Moz.	FF			UCBS 2005
CORVIDAE						
<i>Corvus albicollis</i>	White-naped raven**	Widespread	O			UCBS 2005
STURNIDAE						
<i>Poeoptera kenricki</i>	Kenrick's starling	Kenya C highlands through E Arc to S Tanz.	FF			UCBS 2005
<i>Onychognathus walleri</i>	Waller's starling	Eastern Africa, Albertine Rift & Cameroon Mts	FF			UCBS 2005
NECTARINIIDAE						
<i>Nectarinia olivacea</i>	Olive sunbird	Widespread	F/FF			UCBS 2005
<i>Nectarinia loveridgei</i>	Loveridge's sunbird	Uluguru endemic	FF	NT		UCBS 2005
<i>Anthreptes collaris</i> *	Collared sunbird	Widespread	O/F			UCBS 2005
PLOCEIDAE						

Species	Common name	Range	Habitat	Threat status IUCN	Threat status CITES	Most recent record
<i>Ploceus bicolor</i> ESTRILDIDAE	Dark-backed weaver	Widespread	FF/F			UCBS 2005
<i>Estrilda quartinia</i>	Yellow-bellied waxbill	Widespread	O			UCBS 2005
<i>Mandingoa nitidula</i>	Green-backed twinspot	Widespread	FF			UCBS 2005
<i>Cryptospiza reichenovii</i>	Red-faced crimsonwing	Localised in highlands of Tanz., Malawi, N Moz., E Zimbabwe, Albertine Rift, C Angola and Cameroon	FF			UCBS 2005
FRINGILLIDAE						
<i>Linurgus olivaceus</i>	Oriole finch	Eastern Arc and few highlands, S Somalia, N Malawi, Albertine Rift & Cameroon	FF			UCBS 2005

*Casual observations by field team, not ornithologist

** Although not a forest dependent bird, the White-naped raven was recorded in the forest, as it is attracted to human activity, for instance UCBS basecamp

10c Non-forest bird species, those recorded at forest edge or in the immediate surroundings.
Recordings following Stevenson & Fanshawe (2002).

Species	Common name	Range	Habitat	Threat status IUCN	Threat status CITES	Area Observed
ACCIPITRIDAE						
<i>Circaetus cinerascens</i>	Brown snake eagle					Above Kinole village in a coconut shamba
<i>Gypohierax angolensis</i>	Palm-nut vulture	Widespread	O/F			Outside of the forest near Semeni village
<i>Buteo augur</i>	Augur buzzard	Widespread	O		II	Forest edge and adjacent shamba in all surveyed localities
<i>Falco biarmicus</i>	Lanner falcon	Widespread	O			Above Kinole and Bagilo villages
<i>Falco cuvieri</i>	African hobby	Widespread	O		II	At the rocks above Morningside and at the forest edge above Semeni village
PHASIANIDAE						
<i>Francolinus hildebrandti</i>	Hildebrandt's francolin	Widespread	O			At shamba above Morningside
CUCULIDAE						
<i>Cuculus solitaruis</i>	Red-chested cuckoo	Widespread	O/F			Forest edge in all surveyed localities
APODIDAE						
<i>Apus affinis</i>	Little swift	Widespread	O			Outside the forest and flying above it in all surveyed localities
<i>Apus caffer</i>	White-rumped swift	Widespread	O			Outside the forest and flying above it in all surveyed localities
<i>Neafrapus boehmi</i>	Bohm's spintail	Widespread	O/F/FF			Above Kinole, Bagilo anf Morningside
COLIIDAE						
<i>Colius striatus</i>	Speckled mousebird	Widespread	O			Shamba above Kinole and Morningside
MEROPIDAE						
<i>Merops nubicus</i>	Northern carmine beeater	Widespread, visitors in East Tanz. from Sept -Apr	O			Flock recorded at shambas above Kinole village
HIRUNDINIDAE						
<i>Hirundo senegalensis</i>	Mosque swallow	Widespread	O			Forest edge above Morningside
<i>Hirundo fuligula</i>	African rock martin	Widespread	O			Outside the forest and flying above it in all surveyed localities
<i>Psalidoprocne holomelas</i>	Black saw-wing	Widespread	O/F			Outside the forest and flying above it in all surveyed localities
<i>Psalidoprocne albiceps</i> *	White-headed saw-wing	Widespread	O/F			Above Morningside
PYCNONOTIDAE						

Species	Common name	Range	Habitat	Threat status IUCN	Threat status CITES	Area Observed
<i>Pycnonotus barbatus</i>	Common bulbul	Widespread	O/F			Very common, recorded outside the forest in all surveyed localities
SYLVIIDAE						
<i>Melocichla mentalis</i>	African moustached warbler	Widespread	O/F			At old coffee shamba near river at satellite camp two
<i>Schoenicola brevirostris</i>	Broad-tailed warbler	Widespread	O			Shamba just outside forest at basecamp two
<i>Cisticola chiniana</i>	Rattling cisticola	Widespread	O			Outside forest mostly in shamba in all surveyed localities
MALACONOTIDAE						
<i>Tchagra minuta</i>	Marsh tchagra	Widespread	O			Rank growth with bracken at forest edge in basecamp two
STURNIDAE						
<i>Onychognathus morio</i>	Red-winged starling	Widespread	O/F/FF			Outside the forest in all surveyed localities
NECTARINIIDAE						
<i>Chalcomitra amethystine</i>	Amethyst sunbird	Widespread	O/F			Banana shamba above Kinole village
ESTRILDIDAE						
<i>Lonchura bicolor</i>	Black and white mannikin	Widespread	O			Forest edge and shambas in all surveyed localities

Key to Appendix 10

The habitat preference of each species is described in the habitat column as:

FF = Species dependent on primary forest only. It does not include forest edge or secondary forest species;

F = Forest dwelling but not dependent on primary forest: species occurring in primary forest as defined above as well as other vegetation types. It should be emphasised that many of these species are still dependent on a forest habitat albeit forest edge or disturbed forest. Most species in this category will still be adversely affected by forest destruction.

O = These are species that do not normally occur in primary or secondary forest or forest edge.

IUCN threat status:

CR = Critically endangered; *extremely* high risk of extinction in the wild

EN = Endangered; *very* high risk of extinction in the wild

VU = Vulnerable; high risk of extinction in the wild

NT = Near threatened; Taxa that do not qualify as Critically Endangered, Endangered or Vulnerable now, but is close to qualifying for or is likely to qualify for a threatened category in the near future

CITES threat status:

I = Threatened with extinction and excluded from commercial international trade

II = Not yet threatened with extinction, but may be so if trade is not regulated, thus export permits are required

10d Bird specimens collected from Uluguru North FR by UCBS.

Species	Skin	DNA Samples
<i>Cercococcyx montanus</i>		1
<i>Turtur tympanistria</i>		1
<i>Andropadus virens</i>		4
<i>Andropadus masukuensis</i>		10
<i>Andropadus milanjensis</i>	1	6
<i>Phyllastrephus cabanis</i>		10
<i>Pogonocichla stellata</i>		4
<i>Sheppardia sharpei</i>	2	7
<i>Alethe fuelleborni</i>		6
<i>Turdus olivaceus</i>		2
<i>Zoothera gurneyi</i>	1	1
<i>Modulatrix stictigula</i>		8
<i>Bradypterus lopezi</i>		1
<i>Phylloscopus ruficapillus</i>		3
<i>Orthotomus metopias</i>		2
<i>Apalis thoracica</i>		1
<i>Batis mixta</i>		5
<i>Laniarius fuelleborni</i>		2
<i>Nectarinia olivacea</i>	1	4
<i>Nectarinia loveridgei</i>		2
<i>Stactolaema olivacea</i>		5
<i>Zosterops senegansis</i>		1
<i>Terpsiphone viridis</i>		2
<i>Apaloderma vittatum</i>	1	1
<i>Cryptospiza reichenovii</i>	1	2
Total	7	91

10e Numbers of individuals netted in each surveyed locality within Uluguru North FR

Species	Sat camp 1	Sat camp 2	Ngong'olo Camp	Base Camp 2
Net metre hours	3,888	3,982	6,030	14,688
<i>Turtur tympanistria</i>	1	0	0	0
<i>Cercococcyx montanus</i>	0	0	0	1
<i>Apaloderma vittatum</i>	0	0	1	0
<i>Pogoniulus leucomystax</i>	0	0	0	2
<i>Stactolaema olivacea</i>	0	3	0	1
<i>Smithornis capensis</i>	1	1	0	0
<i>Andropadus virens</i>	4	0	0	9
<i>Andropadus masukuensis</i>	0	14	4	9
<i>Andropadus milanjensis</i>	0	6	0	2
<i>Phyllastrephus flavostriatus</i>	0	1	0	0
<i>Pogonocichla stellata</i>	0	3	1	10
<i>Sheppardia sharpei</i>	1	5	1	4
<i>Alethe fuelleborni</i>	5	0	1	4
<i>Turdus olivaceus</i>	0	1	0	1
<i>Zoothera gurneyi</i>	0	1	0	0
<i>Modulatrix stictigula</i>	0	4	3	1
<i>Bradypterus lopezi</i>	0	0	1	2
<i>Phylloscopus ruficapillus</i>	0	0	1	2
<i>Orthomus metopias</i>	0	5	1	0
<i>Apalis thoracica</i>	0	0	3	1
<i>Muscicapa adusta</i>	0	0	0	1
<i>Batis mixta</i>	0	4	4	1
<i>Terpsiphone viridis</i>	0	1	1	0
<i>Trochocercus albonotatus</i>	0	1	2	2
<i>Pseudoalcippe abyssinica</i>	0	0	1	0
<i>Zosterops senegalensis</i>	0	0	1	0
<i>Nectarinia loveridgei</i>	2	10	10	0
<i>Nectarinia olivacea</i>	21	19	0	11
<i>Laniarius fuelleborni</i>	0	1	0	1
<i>Cryptospiza reichenovii</i>	3	13	0	21
Total	37	93	36	86

Appendix 11: Reptile data

11a Reptile species recorded within Uluguru North FR, updated from Doggart et al (2005) with UCBS data.

Recordings follow Spawls et al (2002). Highlighted are those new records for Uluguru North FR collected by UCBS. Voucher specimens for snakes have been verified by Dr. Don. Boradley and the remaining specimens are currently undergoing taxonomic verification (Appendix 2).

Species	Common name	Range	Habitat	Threat status IUCN	Threat status CITES	Most recent record
CHAMAELEONIDAE						
<i>Bradypodion fischeri fischeri</i>	Usambara two-horned chameleon	Tanzania endemic, known from Usambara and Nguru only, new record for Uluguru	FF		II	UCBS 2005
<i>Chamaeleo cf. wernerii</i>	Werner's three-horned chameleon	Tanzania endemic, Uluguru & Udzungwa	FF		II	UCBS 2005
<i>Rhampholeon brevicaudatus</i>	Bearded pigmy chameleon	Tanzania endemic; Coastal Tanzania and Eastern Arc	FF			UCBS 2005
<i>Rhampholeon uluguruensis</i>	Uluguru pigmy chameleon	Uluguru & Ukaguru endemic	FF			Howell 1985
SCINCIDAE						
<i>Scelotes uluguruensis</i>	Uluguru fossorial skink	Tanzania endemic, Usambara, Uluguru & Nguru	FF			UCBS 2005
TYPHLOPIDAE						
<i>Rhinotyphlops lineolatus</i>	Blind snake	Widespread throughout sub Saharan Africa	O/F			UCBS 2005
VIPERIDAE						
<i>Atheris ceratophorus</i>	Horned bush-viper	Tanzania endemic, Usambara, Uluguru & Udzungwa	F			UCBS 2005
ATRACTASPIDAE						
<i>Atractaspis aterrima</i>	Western forest stiletto-snake	Widespread in W Africa with "peculiar" isolated records in Tanz. Eastern Arc.	F/FF			UCBS 2005
ELAPIDAE						
<i>Elapsoidea nigra</i>	Usambara garter-snake	Tanzania endemic, N Tanz., Usambara & Uluguru	FF			UCBS 2005
COLUBRIDAE						

Species	Common name	Range	Habitat	Threat status IUCN	Threat status CITES	Most recent record
<i>Philothamnus battersbyi</i>	Battersby green snake	Widespread from Sudan to NE Tanzania	O/F			UCBS 2005
<i>Philothamnus hoplogaster</i>	South-eastern green snake	South-eastern Tanzania; other isolated records in West Africa	O/F			UCBS 2005
<i>Crotaphopeltis tornieri</i>	Tornier's cat snake	Tanz. Eastern Arc & coastal forest plateau, S. Highlands and N Malawi	FF			UCBS 2005
<i>Thelotornis mossambicanus</i>	Vine snake	Widespread from S. Somalia to Mozambique	O/F			UCBS 2005
<i>Thelotornis kirtlandii</i>	Forest vine snake	Two isolated Tanz. records, Mahale peninsula & Udzungwa escarpment forest	F			UCBS 2005

11b Reptile numbers recorded from the UCBS zoological trapsites, herpetological searches and casual collections in Uluguru North FR. Voucher specimens are currently undergoing formal taxonomic verification (Appendix 2).

Species	Common name	Numbers of individuals caught per zoo site * (casual)				KMh No.s
		Main site 1	Main site 2	Sat camp 1	Sat camp 2	
CHAMAELEONIDAE						
<i>Bradypodion fischeri fischeri</i>	Usambara two-horned chameleon	0 (1)	0	0	0	26224
<i>Chamaeleo</i> cf. <i>werneri</i>	Werner's three-horned chameleon		0 (1)			
<i>Rhampholeon brevicaudatus</i>	Bearded pigmy chameleon	0 (1)	0	0 (2)	0	26221, 26226, 26227
SCINCIDAE						
<i>Scelotes uluguruensis</i>	Uluguru fossorial skink	0	0	0	0 (1)	26231
TYPHLOPIDAE						
<i>Rhinotyphlops lineolatus</i>	Blind snake	0	0	0	0 (1)	26232
VIPERIDAE						
<i>Atheris ceratophorus</i>	Horned bush-viper	0	0	0	0 (2)	26230, 26631

Species	Common name	Numbers of individuals caught per zoo site * (casual)				KMH No.s
		Main site 1	Main site 2	Sat camp 1	Sat camp 2	
ATRACTASPIDAE						
<i>Atractaspis aterrima</i>	Western forest stiletto-snake	0	0	0	1	26223
ELAPIDAE						
<i>Elapsoidea nigra</i>	Usambara garter-snake	0	0	0 (1)	0	
COLUBRIDAE						
<i>Philothamnus battersbyi</i>	Usambara green snake	0 (1)	0	0	0	26222
<i>Philothamnus hoplogaster</i>	South-eastern green snake	0	0	0 (1)	0	26225
<i>Crotaphopeltis tornieri</i>	Tornier's cat snake	1	0	0	0	26220
<i>Thelotornis mossambicanus</i>	Vine snake	0	0	0 (1)	0	26228
<i>Thelotornis kirtlandii</i>	Forest vine snake	0	0	1	0	26229
		1 (3)	0	1 (5)	1 (4)	

* This includes captures from bucket pitfall traps and herpetological searches

Appendix 12: Amphibian data

12a Amphibian species recorded within Uluguru North FR, updated from Doggart et al (2005) with UCBS data.

Recordings follow Spawls et al (2002). Highlighted are those new records for Uluguru North FR collected by UCBS. Voucher specimens are currently undergoing taxonomic verification (Appendix 2).

Species	Range	Habitat	Threat status IUCN	Threat status CITES	Most recent record
ARTHROLEPTIDAE					
<i>Arthroleptis cf affinis</i>	Tanzania endemic, few coastal forests and Eastern Arc Mts	F/FF			UMBCP 2000
<i>Arthroleptis cf affinis/reichei</i>		FF			UCBS 2005
<i>Arthroleptis xenodactylus</i>	Usambara and Uluguru endemic	F			Channing 2000
<i>Arthroleptis xenodactyloides</i>	N. Tanz. through Malawi, N & C Mozambique to E Zimbabwe	F			UCBS 2005
<i>Arthroleptis cf xenodactyloides</i>		F			UCBS 2005
<i>Arthroleptis</i> sp					UCBS 2005
BUFONIDAE					
<i>Nectophrynoides cryptus</i>	Uluguru endemic	FF	EN	I	Howell 1993
<i>Nectophrynoides minutus</i>	Uluguru & Rubeho endemic	FF	EN	I	Howell 1993
<i>Nectophrynoides tornieri</i>	Tanzania endemic, East Usambaras, Ulugurus, Udzungwas & Southern Rift	FF			?
<i>Nectophrynoides viviparus</i>	Tanzania endemic, Uluguru, Udzungwa & Mt Rungwe	F	VU	I	UCBS 2005
<i>Nectophrynoides viviparus group</i>					UCBS 2005
<i>Nectophrynoides pseudotornieri</i>	Uluguru endemic	FF			UMBCP 2000
<i>Nectophrynoides</i> sp B					UCBS 2005
<i>Nectophrynoides</i> sp F					UCBS 2005
HYPEROLIDAE					
<i>Hyperolius puncticulatus</i>	Localised from N Tanz. through the Eastern Arc to S Malawi	F			Channing 2000
<i>Hyperolius spinigularis</i>	Localised from N Tanz. through the Eastern Arc to S Malawi	F			Channing 2000
<i>Hyperolius mitchelli</i>	Widespread, N Tanz. via Malawi to C Mozambique	O			Mariaux 2000

Species	Range	Habitat	Threat status IUCN	Threat status CITES	Most recent record
<i>Afrivalus fornasini</i>	Widespread in eastern half of the continent and W Zimbabwe	O			Channing 2000
<i>Leptopelis flavomaculatus</i>	Eastern half of the continent, S Kenya, through Tanz, N Mozambique & Malawi to C Moz and E Zimbabwe	F/FF			UCBS 2005
<i>Leptopelis parkeri</i>	Tanzania endemic, Eastern Arc Usambara, Uluguru, & Udzungwa	FF	VU		UCBS 2005
<i>Leptopelis vermiculatus</i>	West & East Usambaras, Nguu, Udzungwa, Southern rift	FF	VU		UCBS 2005
<i>Leptopelis uluguruensis</i>	Uluguru and Usambara endemic	FF	VU		UCBS 2005
MICROHYLIDAE					
<i>Probreviceps macrodactylus loveridgei</i>	Uluguru and Udzungwa endemic	FF	VU		UCBS 2005
RANIDAE					
<i>Arthroleptides yakusini</i>	Uluguru, Mahenge and Udzungwa endemic	FF	EN		UCBS 2005
<i>Phrynobatrachus natalensis</i>	Widespread	F			Channing 2000
<i>Phrynobatrachus acridoides</i>	Eastern half of the continent, S Somalia, S Kenya, through Tanz., Malawi, and throughout Mozambique to NE S Africa	F			UMBCP 2000
<i>Phrynobatrachus udzungwensis</i>	Uluguru, Nguru & Udzungwas endemic		EN		UCBS 2005
<i>Afrana sp</i>					Mariaux 2000
CAECILIIDAE					
<i>Scolecophorus uluguruensis</i>	Uluguru endemic	FF			UCBS 2005
<i>Scolecophorus kirkii</i>	Eastern Arc and Southern Rift	FF			UCBS 2005

12b Amphibian numbers recorded from the UCBS trapsites, herpetological searches and casual collections in Uluguru North FR. Voucher specimens are currently under going formal taxonomic verification (Appendix 2).

Species	Numbers of individuals per trapsite * (casual)				KMH No.s
	Main 1	Main 2	Sat camp 1	Sat camp 2	
ARTHROLEPTIDAE					
<i>Arthroleptis cf affinis</i>	0	0	2	0	26542, 26557, 26559
<i>Arthroleptis xenodactyloides</i>	0	1	1	0 (1)	26554, 26562, 26575
<i>Arthroleptis</i> sp	0	1 (2)	0 (1)	0 (1)	26107, 26558, 26570, 26579
BUFONIDAE					
<i>Nectophrynoides viviparus</i>	0 (1)	2	0 (1)	1	26544, 26556, 26565, 26567, 26578
<i>Nectophrynoides viviparus</i> group	0	2	0	0	26569, 26580
<i>Nectophrynoides</i> sp B	3	0	0	0	26547, 26548, 26549, 26550
<i>Nectophrynoides</i> sp F	0	5 (1)	0	0	26574
HYPEROLIDAE					
<i>Leptopelis flavomaculatus</i>	0	0	0	0 (1)	26568
<i>Leptopelis parkeri</i>	0 (1)	5	0	0	26543, 26571, 26572, 26573, 26576, 26577, 26581
<i>Leptopelis uluguruensis</i>	1 (2)	6 (2)	11 (1)	0	26540, 26541, 26545, 26551, 26553, 26564, 26566
MICROHYLIDAE					
<i>Probreviceps macrodactylus loveridgei</i>	24	0	0 (1)	0 (1)	26536, 26546, 26555, 26560,
RANIDAE					
<i>Arthroleptides yakusini</i>	0	0	1 (1)	0	26552, 26561
<i>Phrynobatrachus udzunwensis</i>	0	0	0	1	26563
CAECILIIDAE					
<i>Scolecophorus uluguruensis</i>	0	1 (1)	0	0	26412, 26413
<i>Scolecophorus kirkii</i>	3	0	0	0 (1)	26408, 26409, 26410, 26411
	31 (4)	18 (6)	15 (5)	2 (5)	

* This includes captures from bucket pitfall traps and herpetological searches

Key to Appendix 11 and 12

The habitat preference of each species is described in the habitat column as:

FF = Species dependent on primary forest only. It does not include forest edge or secondary forest species;

F = Forest dwelling but not dependent on primary forest: species occurring in primary forest as defined above as well as other vegetation types. It should be emphasised that many of these species are still dependent on a forest habitat albeit forest edge or disturbed forest. Most species in this category will still be adversely affected by forest destruction.

O = These are species that do not normally occur in primary or secondary forest or forest edge.

Threat status IUCN:

CR = Critically endangered; *extremely* high risk of extinction in the wild

EN = Endangered; *very* high risk of extinction in the wild

VU = Vulnerable; high risk of extinction in the wild

Threat status CITES:

I = Threatened with extinction and excluded from commercial international trade

II = Not yet threatened with extinction, but may be so if trade is not regulated thus export permits are required

