New Dabaga/Ulangambi Forest Reserve

Management and Summary Report

FRONTIER TANZANIA
2001

Udzungwa Mountains Biodiversity Survey

New Dabaga/Ulangambi Forest Reserve

Management and Summary Report

Editors: KZ Doody, K M Howell & E Fanning.

Frontier Tanzania
University of Dar es Salaam
Society for Environmental Exploration

Royal Danish Embassy
MEMA **Udzungwa Mountains Forest Management and Biodiversity Conservation Component**

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Matumizi Endelevu ya Misitu ya Asili (MEMA)
Since 1999, MEMA based in Iringa, have been administering the Udzungwa Mountains Forest Management and Biodiversity Conservation Project (UMFM) and the Natural Woodlands Management Project (NWMP), funded by Danish International Development Assistance (DANIDA).

The University of Dar es Salaam (UDSM)
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.

The Society for Environmental Exploration (SEE)
The Society is a non-profit making company limited by guarantee and was formed in 1989. The Society's objectives are to advance field research into environmental issues and implement practical projects contributing to the conservation of natural resources. Projects organised by The Society are joint initiatives developed in collaboration with national research agencies in co-operating countries.

Frontier Tanzania (FT)
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).

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Foreword

The Udzungwa forests are unique. They represent a major part of the Eastern Arc forests, which are one of the 25 global biodiversity hotspots. Collectively, these 25 areas cover 1.4% of the planet's land area, but account for about 44% of all vascular plant species and 35% of four vertebrate groups.

The Eastern Arc Mountains have the highest levels of species endemism per unit area of remaining intact natural vegetation worldwide.

The Udzungwa Mountains contain the major part of the closed forests found in the group of Eastern Arc forests that cover an area from the Taita Hills in Kenya to Makambako in Southern Tanzania. The total area of closed natural forest in the Tanzanian part of the Eastern Arc is 1451km^2 or approximately 0.2% of the total area of the country. In a Tanzanian context the areas are extremely important, both for their biodiversity and water catchment values (for example 34% of all Tanzanian mammal species are found in the Eastern Arc forests).

The Udzungwa mountains have been legally protected with Forest Reserve status for many years due to their water catchment value. The water that drains from the mountains is of both local and national importance for domestic consumption, livestock, irrigated agriculture and hydroelectric power production.

The biodiversity values specific to the forests of Nyumbanitu/Ndundulu and New Dabaga/Ulangambi are described in the Udzungwa Mountains Biodiversity Survey Reports and represent the foundation for the development of the Udzungwa Forest Management Plans.

The Udzungwa Mountains Forest Management and Biodiversity Conservation Component of MEMA contracted the biodiversity surveys to Frontier Tanzania. MEMA is supporting the Forestry & Beekeeping Division and the Iringa District Council to develop and test models for Participatory Forest Management in the Udzungwa Mountains.

Participatory Forest Management is a new strategy that enhances the protection and sustainable utilisation of forests through the involvement of the communities neighbouring the forests. Communities living near the forests are hence able to monitor closely the activities in the forests while they at the same time often are the major users of the products that can be harvested in the forests. Indeed, the continued harvesting at planned and sustainable levels is a key to committed and responsible community involvement. Sometimes the term 'use-it-or-lose-it' is used to describe this strategy.

The central and local governments have accepted that community participation is the way forward. The Ministry and the local Council fully support the communities being active forest managers.

The great challenge now to all foresters, other professionals and local leaders involved in participatory forest management in the Udzungwas is to ensure that the communities are aware of the unique biodiversity values of their forests. That will hopefully lead to comprehensive, but locally manageable, joint forest management agreements between the

Forestry & Beekeeping Division, Iringa District Council and the communities surrounding the forests.

These reports are the result of the enduring effort by Frontier researchers, volunteers and villagers during almost two years of biodiversity surveys on the steep and wet slopes of the Udzungwa Mountains. The task has strained the human and material resources to their maximum capacity, so I am happy to see that the surveys are safely accomplished. I admire the spirit of the team and their ability to pursue the goal under challenging conditions. Their work is highly appreciated and the output constitutes a valuable and essential part of the framework needed to ensure that the unique Udzungwa forest ecosystems are maintained to the benefit of present and future generations of the Wazungwa people and all the rest of us.

Iringa, March 5th 2001

Henrik Lerdorf
Technical Advisor
MEMA

1.0 Contents

2.0 Acknowledgements

This report is a culmination of the hard work, co-operation, expertise and advice of many people without whom it would not have been possible. The contributions have been many and varied; we would like to thank everyone listed for their contribution to the Udzungwa Mountains Biodiversity Survey.

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Finally we would like to sincerely thank the Chairmen, Village Governments and people of Udekwa, Ifuwa, Ilamba and Kidabaga.

Kathryn Doody
KM Howell
Eibleis Fanning

30th April 2001

3.0 Introduction

3.1 Frontier Tanzania

Frontier Tanzania (FT) is a collaborative project first formed in 1989 between the University of Dar es Salaam (UDSM) and the Society for Environmental Exploration (SEE). SEE is a non-profit making company limited by guarantee. Its principal activity is the promotion and organisation of practical research and conservation projects manned by volunteers that will assist national authorities in host countries to develop, maintain or improve the environment and promote the sustainable use of natural resources. UDSM is an institution of higher learning where training and research are conducted. It also provides consultancy to government institutions, parastatals and individuals. The resulting organisation from the collaboration between these two institutions is known as Frontier Tanzania.

Since 1989 the aims of the Frontier Tanzania Forest Research Programme (FT FRP) have been to provide baseline information on the biological values of strategically selected forests as a basis for management planning and long-term monitoring, as well as training Tanzanian personnel and overseas students in the use of biological inventory techniques. The FT FRP worked in the Tanzanian Coastal Forests between 1989 and 1994, then moved to the East Usambaras where baseline biodiversity surveys are still being undertaken.

3.2 Matumizi Endelevu ya Misitu ya Asili (MEMA)

Since 1999, MEMA based in Iringa, has been administering two projects, the: Udzungwa Mountains Forest Management and Biodiversity Conservation Project (UMFM) and the Natural Woodlands Management Project (NWMP). It is the UMFM project funded by Danish International Development Assistance (DANIDA) that contracted Frontier Tanzania to undertake this survey.

This report is the culmination of work begun by FT in January 1999 working with the Udzungwa Mountains Joint Forest Management and Biodiversity Conservation Project (MEMA) funded by DANIDA, providing baseline biodiversity data. The biological data provided, together with separate MEMA socio-economic surveys will be used to draw up joint forest management plans.

3.3 Data Citation

Any publication that uses this data must acknowledge all collaborating parties (UDSM, FBD, MEMA, DANIDA, SEE and FT FRP). It should contain the following sentence:

“This publication uses material collected during the Udzungwa Mountains Biodiversity Surveys; a collaborative venture between the Society for Environmental Exploration and the University of Dar es Salaam (through the Frontier Tanzania Forest Research Programme), and the Udzungwa Mountains Forest Management and Biodiversity Conservation Component, MEMA, supported by the Danish Government through DANIDA.’’

3.4 Survey Period and Personnel

The survey of West Kilombero Scarp Forest Reserve was conducted between July to December 1999, and July to September and November to December 2000.

The survey was conducted by Frontier Tanzania staff, volunteers and local people from Udekwa and Ifuwa villages.

3.5 How to Use This Report

3.5.1 UMBS Reports

This report is one of a series of seven completed by Frontier Tanzania researchers. The reports are the culmination of the two year long Udzungwa Mountains Biodiversity Survey.

The overall aim of the report series is to provide detailed information on the survey findings in the two target reserves, with emphasis on the importance of the forested areas for the conservation of biodiversity. In order to achieve this, a **Botanical and Forest Use Report** and a **Zoological Report** have been written for each reserve, which are broken down into sections tackling each of the survey methods in turn. Each section has been written to give the reader enough detail to understand the findings without extensive reference to other reports in the series. In an attempt to make each section understandable without reference to other reports there is some repetition between sections, this is due to the similar needs of most forest dependent taxa, and the inevitable overlap of some surveys.

To minimise extensive repetition between sections, all recommendations for management and monitoring of the forests arising from the surveys are discussed in more detail in this **Management and Summary Report** for each of the two reserves. Also within this report, the key findings from all surveys are summarised in the executive summary, which is also included in both the Botanical and Forest Use and Zoological Reports. The purpose of this report is to give a brief overview of the UMBS project for use by managers, MEMA and the Forestry and Beekeeping Division of Iringa.

Detailed explanation of the methods used can be found in a **Methods Manual**. This gives methods for all surveys plus a bibliography of texts from which the methods have been derived. This also lists the animal and plant identification guides that were used in the field.

3.5.2 Database

The other major output of UMBS is a Microsoft Excell database. All zoological data will also be added to the National Biodiversity Database at the Department of Zoology and Marine Biology, University of Dar es Salaam. The UMBS database will include all data collected from the surveys in NDUFR and WKSFR and will include details on taxonomic identification, habitat details, current location of all specimens, collection localities and dates.

The Frontier Tanzania team has made every effort to ensure that this database can be understood by anyone who should wish to use it. For information regarding this, contact MEMA at the address given at the front of this report.

Hard copies of all original data sheets are stored at Frontier Tanzania and MEMA.

Please contact MEMA for information regarding the data.

3.5.3 Reports in This Series

Frontier Tanzania (2001a). New Dabaga/Ulangambi Forest Reserve – Management and Summary Report. *Report for the Udzungwa Mountains Forest Management and Biodiversity Conservation Project, MEMA, Iringa, Tanzania.*1-77 pp

Frontier Tanzania (2001b). West Kilombero Scarp Forest Reserve – Management and Summary Report. *Report for the Udzungwa Mountains Forest Management and Biodiversity Conservation Project, MEMA, Iringa, Tanzania.* 1-78 pp.

Frontier Tanzania (2001c). New Dabaga/Ulangambi Forest Reserve – Botanical and Forest Use Report. *Report for the Udzungwa Mountains Forest Management and Biodiversity Conservation Project, MEMA, Iringa, Tanzania.* 1-117 pp.

Frontier Tanzania (2001d). West Kilombero Scarp Forest Reserve – Botanical and Forest Use Report. *Report for the Udzungwa Mountains Forest Management and Biodiversity Conservation Project, MEMA, Iringa, Tanzania.*1-145 pp.

Frontier Tanzania (2001e). New Dabaga/Ulangambi Forest Reserve – Zoological Report. *Report for the Udzungwa Mountains Forest Management and Biodiversity Conservation Project, MEMA, Iringa, Tanzania.* 1-160 pp.

Frontier Tanzania (2001f). West Kilombero Scarp Forest Reserve – Zoological Report. *Report for the Udzungwa Mountains Forest Management and Biodiversity Conservation Project, MEMA, Iringa, Tanzania.* 1-191 pp.

Frontier Tanzania (2001g). Methods Manual. Report for the Udzungwa Mountains Forest Management and Biodiversity Conservation Project, MEMA, Iringa, Tanzania.

4.0 Executive Summary – New Dabaga/Ulangambi Forest Reserve

4.1 Introduction

Three reports present management recommendations and the results of forest use, botanical and zoological surveys of New Dabaga/Ulangambi Forest Reserve (NDUFR) in Iringa region, south-central Tanzania. Fieldwork was carried out by Frontier Tanzania as part of its "Udzungwa Mountains Biodiversity Survey". The findings are intended for use by Danida's MEMA project "Udzungwa Mountains Forest Management and Conservation" in the preparation of Joint Forest Management Plans.

New Dabaga/Ulangambi Forest Reserve is a montane forest fragment of 37km^2, at altitudes of 1740-2100m. It is set in a human dominated landscape with six villages nearby. Farmland, grassland and plantation forests occur right up to the Forest Reserve boundary.

Fieldwork was divided into forest use and botanical surveys from July to September 1999 and zoological surveys from October to November 2000. The following summary provides information on all of these surveys and suggested input to Joint Forest Management plans. Detailed findings of the surveys are presented in separate reports (Frontier Tanzania, 2001e).

4.2 Forest-Use Surveys

From transect surveys of human disturbance, NDUFR shows signs of a high level of natural resource extraction. The Forest Reserve is surrounded by human settlements whose inhabitants have extracted natural resources from the forest for generations. Commercial logging has been intense in the past, but the establishment of exotic tree plantation early this century and recent management initiatives (e.g. cessation of commercial logging within the reserve and the planting of more exotic tree plantations outside the reserve) have reduced the pressure on the Forest Reserve's wood resources, despite the growing human population. The most often encountered forms of disturbance were pit-saw logging and pole harvesting. Poles and timber have been extracted at a higher level in the western part of the reserve where settlements are more abundant. However, current timber and pole extraction is low.

Animals in the forest are subjected to a severe hunting level, with a minimum of 33 set traps per km^2. Evidence was also found of honey collection. Other forest products taken from the Forest Reserve include plants for medicinal purposes and construction material for mats and thatched roofs.

Fires had recently swept in to the northern part of the Forest Reserve destroying forested habitat (estimated at 25ha) and maintaining areas of grassland (estimated at 3ha).

4.3 Botanical Surveys

Botanical survey was based primarily around 20m×50m vegetation plots, in which all trees above 10cm dbh* were measured and identified. Regenerating trees and shrubs were sampled within 3m×3m plots at the centre of the larger vegetation plots. Fertile specimens of plants encountered opportunistically were also collected. Furthermore, five indicator plant species were selected for a detailed assessment of their populations.

Trees over 10cm dbh were identified from 32 families, 55 genera and 71 species. Another 122 plant species were recorded by opportunistic collections. At least seven of the species recorded were found to be endemic to Tanzania.

The high level of past human disturbance has had a marked effect on the forest structure and tree species composition. This is evident from comparison with the less disturbed West Kilombero Scarp Forest Reserve. Statistical tests indicated a significantly higher number of regenerating trees and a much higher number of secondary trees recorded in plots at NDUFR. Furthermore, the forest tree community was found to be largely undifferentiated. The five most dominant trees (*Macaranga kilimandscharica, Cassipourea gummiflua, Aphloia theiformis, Nuxia floribunda* and *Rapanea melanophloeos*) accounted for 48% of all trees recorded in the vegetation plots, with the secondary tree species *M. kilimandscharica* being superdominant (20% of all trees recorded). In addition, formerly logged areas tended to have a broken/open canopy and were often dominated by a dense shrub layer.

Three plots were set up outside of the Forest Reserve in exotic plantation forests (pine and black wattle) and in a 6 hectare village government forest fragment. The 6 hectare indigenous forest fragment, despite having a monodominant (*Parinari*) canopy, had a higher number of regenerating forest species than many forest reserve plots, probably due to the presence of a closed canopy.

The five indicator species subjected to detailed assessment are forest dependent or canopy trees in NDUFR and at the same time used by the people in the nearby villages. Four of the five indicator species showed a distribution that was dependent on a minimum 40 % canopy cover. If the canopy continues to be degraded, low density species dependent on a closed canopy may be lost, resulting in a loss of biodiversity. In ecological terms, the potential for the sustainable utilisation of non-timber forest products form the five species was low.

4.4 Zoological Survey

The fauna of NDUFR were sampled through a combination of live trapping, timed area searches, and observations along linear transects. Seven taxonomic groups were selected for detailed study (see **Table 4A**).

Five trapsites within the Forest Reserve were sampled for eight days. The trapsites were selected to sample a maximum diversity of habitats, and therefore also species. This was achieved by using information gained about plant communities and habitat structure from the earlier vegetation surveys. For comparison with the five forest trapsites, four trapsites were placed outside of the Forest Reserve. These trapsites were sampled for four days.

* dbh: diameter at breast height, measured 130cm above ground.

A summary of the fauna recorded from NDUFR is presented in **Table 4A**. In total this list comprises 195 species identified by taxonomists and Frontier Tanzania researchers. **Table 4A** also shows the high number of forest dependent (82) and restricted range (43) species recorded at NDUFR. This is especially encouraging due to the disturbed state of the Forest Reserve, and also highlights the importance of maintaining and restoring the forest habitat to improve conditions for these forest dependent species.

Taxonomic identification was however not available for all specimens at the time of writing. This is particularly true of taxa that require extensive comparison with museum collections and expert knowledge (e.g. shrews, millipedes and molluscs). The incomplete nature of current identifications combined with the likelihood that there are species missed by this survey, as highlighted by the species accumulation curves, suggests that there are more species to add to the NDUFR species list.

Table 4A. Summary of conservationally important animal species recorded from New Dabaga/ Ulangambi Forest Reserve[+]. Sources of information for forest dependence and range restriction can be found in the relevant sections of the Zoological Report.

Taxonomic group	Total no. of species	Forest dependent	Restricted range[~]	IUCN conservation concern
Butterflies	50	29	17	0
Millipedes	13*	-	-	-
Molluscs	21*	-	-	-
Amphibians	18	4	6	6
Reptiles	8	3	3	0
Birds	84	36	12	2
Mammals	35	10	5	4

+ Includes species from four trapsites placed outside the Forest Reserve (all less than 1km from the Forest Reserve).
* Identification of millipede and mollusc specimens was not available at the time of writng. Instead the number of "morpho-species" classified by Frontier Tanzania researchers are indicated.
~ Restricted range: Eastern Arc Mountains, Tanzania and northern Malawi.

Certain forest dependent and/or restricted range species (e.g. Abbot's duiker and Udzungwa red colobus) are present within the reserve at low numbers. This is thought to be due to the high levels of hunting and/or habitat degradation within the Forest Reserve, and requires active management.

Of note was the high number of forest dependent species recorded within the 6 hectare village government forest fragment. Two particularly noteworthy records, both from this forest fragment, are the first capture of a male *Galagoides orinus* and the first record in the Udzungwa Mountains of the amphibian *Leptopelis vermiculatus* (both species are forest dependent).

4.5 Management Recommendations

The high biodiversity value, the presence of numerous forest dependent species, and several IUCN species of conservation concern highlight the need for a precautionary approach to management of NDUFR. The following management recommendations are proposed from a biodiversity prospective, and further investigation is advised prior to implementation of these recommendations.

Being heavily exploited for timber in the past, the forest in NDUFR needs time to recover. Management activities should therefore seek to re-establish forest cover, thereby improving conditions for forest dependent species and biodiversity in general. It is therefore proposed that logging, tree felling, polecutting, and honey extraction should be avoided. Possibilities of sustainable medicinal plant extraction should be investigated further. Access to the Forest Reserve should be allowed for people on foot crossing from villages to cultivated areas.

The high level of hunting threatens the populations of larger mammals (e.g. Abbot's duiker, Harvey's duiker, suni and bush pig). These larger mammals are present in the reserve at low numbers; therefore hunting of these animals should be drastically reduced or stopped.

Furthermore, establishment of additional plantations outside the Forest Reserve using indigenous and exotic species should be encouraged to supply the community with a required wood source. Identification of income generating activities outside the forest reserve is also needed (e.g. fruit processing).

A forest buffer zone is recommended around the outside of the Forest Reserve. The buffer zone would minimise the risk of fires entering the Forest Reserve, by serving as a focal point for certain income generating schemes (e.g. timber and pole extraction, honey production, medicinal plant harvesting). The zone should consist of indigenous tree species (e.g. *Albizia* spp.).

Nearby village government forests containing indigenous species should be supported and incorporated into the management plan. These forest fragments have been managed in a sustainable manner and they should be an integral part of an overall Joint Forest Management strategy. These forest fragments have also been shown to support forest dependent fauna and flora, and therefore these fragments could form an integral part of a system of corridors or stepping stones for dispersal of forest dependent species.

5.0 Aims

- **To conduct baseline forest and biodiversity surveys.**
  Based on systematic surveys, field observations, and casual collections.

- **To collate and disseminate baseline biodiversity information.**
  Through the production of reports.

- **To provide information on the biological value and use of the forests to assist in the development of Joint Forest Management plans.**
  Based on systematic surveys of forest use/human impact, field observations of forest use/human impact, and Participatory Rural Appraisal technique. Management recommendations and monitoring schemes will be suggested, based on baseline forest/biodiversity data and forest use/ human impact data.

6.0 Study Area

6.1 The Eastern Arc Mountains

Thomas Lehmberg, Lars Dinesen

The Eastern Arc Mountains (**Figure 6A**) are defined as the broken mountain chain stretching from Taita Hills in south-eastern Kenya and extending down to the south-western part of Tanzania, with the Udzungwa Mountains being the last in the chain (Lovett & Wasser, 1993). Each mountain range is separated from the next by drier woodland and savanna vegetation, although they all share a common geological history which dates back to at least the Miocene (Griffiths, 1993). Evidence shows that each mountain range is a block-fault mountain, shaped by periods of repeated uplift and vertical movements followed by longer periods of stability and erosion (Griffiths, 1993). The high proportion of endemic forest-dwelling organisms in the Eastern Arc is ascribed to the long presence of a humid forest cover fostered by a seasonal, but highly predictable rainfall pattern (Lovett 1993). This precipitation arises from moisture evaporating from the Indian Ocean, being subsequently carried towards the East African coast and discharged (Lovett, 1990 & 1993).

The Udzungwa Mountains, the largest of the Eastern Arc Mountain blocks, comprise a number of highly fragmented forest patches of varying sizes and composition (**Figure 6B**). The Mwanihana forest on a southeast-facing escarpment is the easternmost, with a long altitudinal gradient of continuous forest cover, whereas the westernmost forest fragments are smaller and drier, mainly situated on the highland plateau. Extensive forest areas are still present further down the escarpment as well. The large Luhombero forest on the plateau, has the highest peak in the Udzungwas reaching 2576m and forest cover extending up to around 2400m. There is still some uncertainty about the total forest cover in the Udzungwas. Rodgers and Homewood (1982) estimate 450 km^2 of evergreen forest, whereas Dinesen *et al.* (2001) has an estimate of 1800 km^2, including secondary forest, bamboo and groundwater dependent forest. The large majority of forests are situated in Catchment Forest Reserves designated because of their recognised importance as water cathment areas both locally and nationally. The Udzungwa Mountains National Park gazetted in 1992 covers almost 2000 km^2 of the eastern part of the Udzungwas (**Figure 6B**) and encompasses the entire Mwanihana forest, large parts of the Luhombero and Matundu forests as well as smaller fragments.

Whereas the Usambara and Uluguru Mountains have been subject to biological studies for more than 70 years, it is only quite recently that the attention has been focused on the Udzungwa Mountains. During the last three decades, the Udzungwa Mountains have received ever-increasing interest from biologists due to the continued discovery of taxa new to science. The taxonomic groups that have received most attention are primates and birds, whereas other larger mammals, spiders, plants, and frogs have been subject to few studies. Other groups have hardly been studied, and due to the very fragmented nature of the forests, basic distribution data is lacking for the majority of groups. For a review of biological studies see Lovett and Wasser (1993) and Dinesen *et al.* (*2001*).

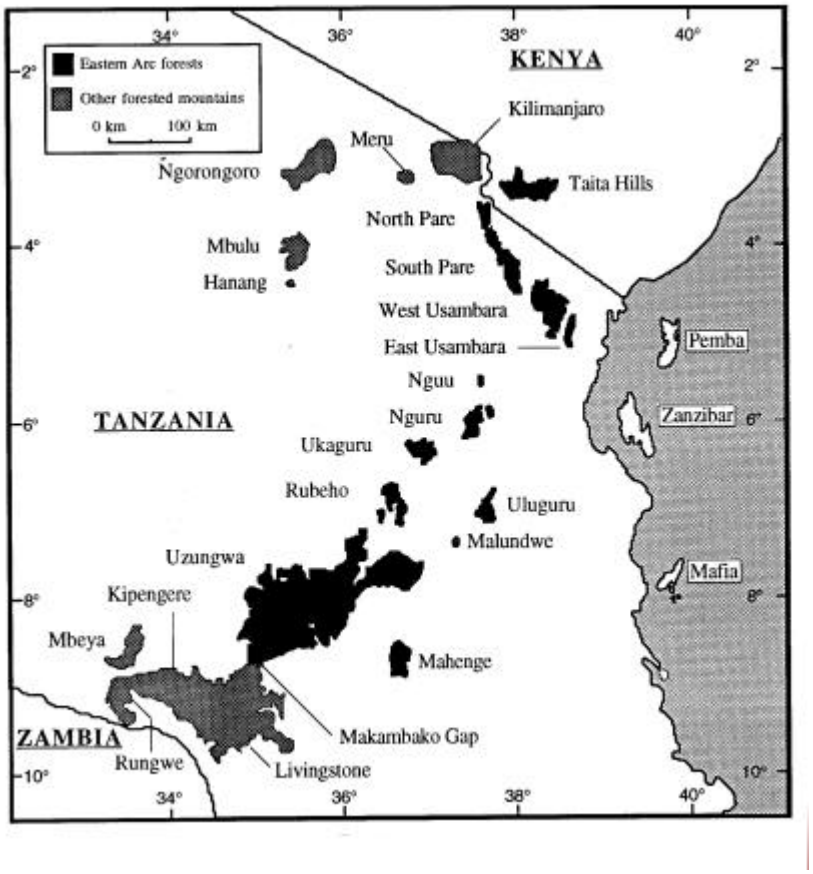

Figure 6A. Mountains of eastern Tanzania and southern Kenya that support moist forest. Eastern Arc Forests shown in black. From Lovett (1993).

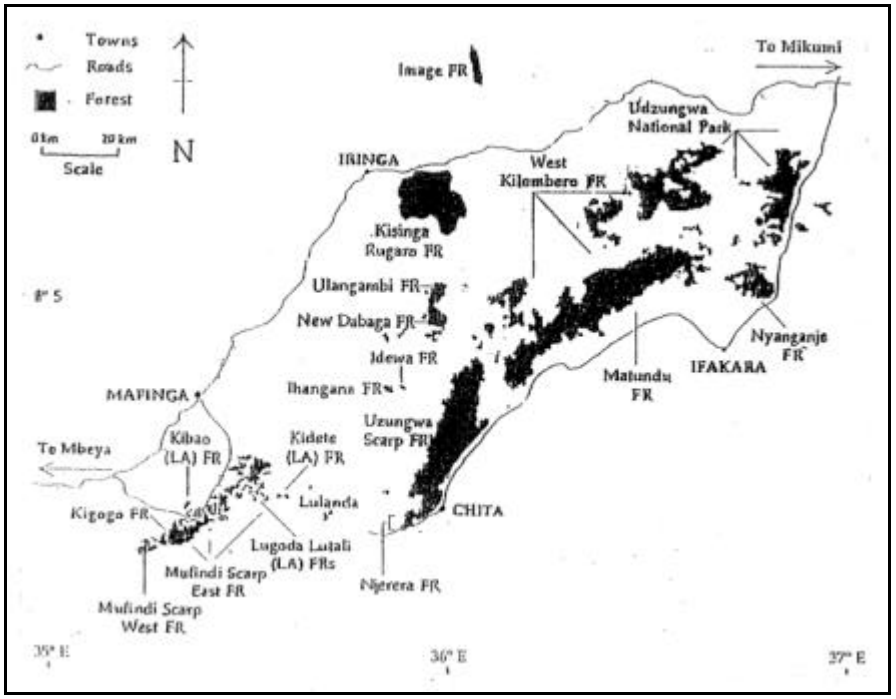

Figure 6B. Forest Reserves of the Udzungwa Mountains. From Moyer (1992).

6.2 Description of Reserve

6.2.1 General Description

Name: New Dabaga/Ulangambi Forest Reserve
Iringa District, Iringa Region, Tanzania.

Area: 3728 ha; 37.3 km^2

Boundary: Length 40 km. Clearly marked with eucalyptus trees, except along parts of the northwestern boundary. New Dabaga is continuous with Ulangambi Forest Reserve in the North.

Status: Catchment Forest Reserve. Ulangambi Forest Reserve gazetted in 1930. New Dabaga Forest Reserve gazetted in 1932.

Maps: Ordnance Survey topographic maps 1:50,000 Series Y742 Sheet 233/2. Forest reserve boundary correctly marked on Ordnance Survey Map. Aerial photographs available from the MEMA project for 1956, 1978 and 1999. Special map: New Dabaga/Ulangambi Forest Reserve Cover Type Map HIMA/DANIDA 1990 Forest Inventory Project. One sheet (1:25,000) 1990.

6.2.2 Location

Grid Reference: 35°54'E - 35°57'E, 8°01'S - 8°06'S

Elevation: 1740 – 2100 m a.s.l.

New Dabaga/Ulangambi Forest Reserve is located 45km southeast of Iringa. It is bordered by Kidabaga village (southwestern border). Other nearby villages include Ilamba, Lusinga, Magome, and to a lesser extent Isele and Lulanzi (see **Figure 6.2A**). There are numerous roads around the reserve (especially on the western side of the reserve). These roads are made up of old logging roads, roads linking the various villages, and roads linking plantations to the main Kidabaga-Iringa road. There is a twice-daily bus service linking Kidabaga to Iringa.

The forest is surrounded by grassland, fields, small patches of black wattle (*Acacia mearnsii*) and Pine (*Pinus sp.*) plantations, tea plantations and patches of *Parinari excelsa* village government forest. Farmland/grassland occurs right up to the forest edge.

6.2.3 Soils

Soils are brown sandy loams over crystalline gneiss with areas of clay with stones.

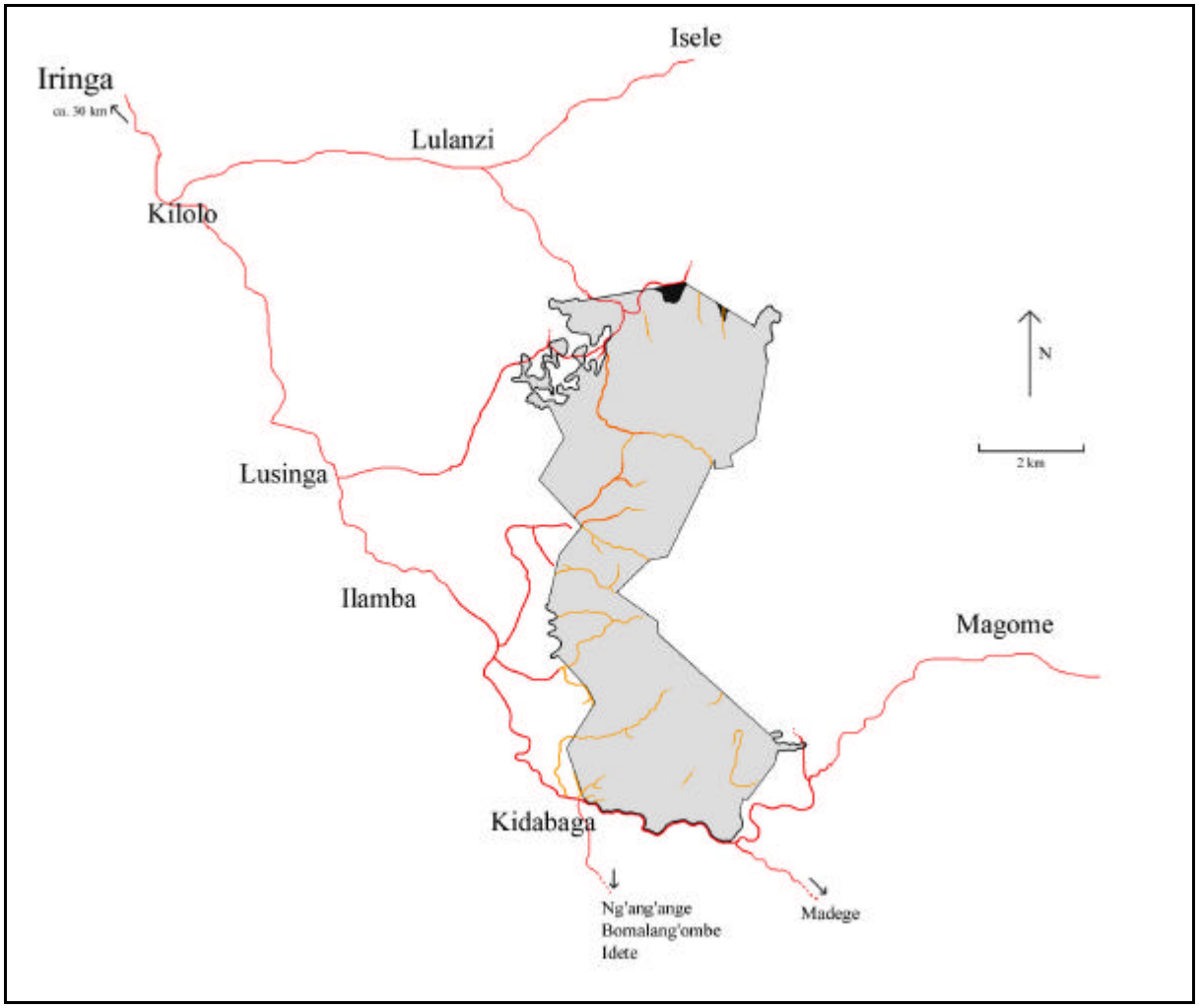

Figure 6.2A. Map of New Dabaga/Ulangambi Forest Reserve including villages and roads.

6.2.4 Climate

Climate is that of oceanic rainfall with oceanic/continental temperatures. The nearest rainfall station is at Iringa. However, the nearest station with comparable results is at the Brooke Bond Tea Estates to the south. Estimated rainfall is between 1500-2000 mm/yr. Estimated mean temperature is ~20°C max. (December), ~15°C min. (July). The dry season is between June and November.

6.2.5 Vegetation

The forests of New Dabaga/Ulangambi are a mosaic of upper montane and montane forests, with patches of bamboo. Species more typical of montane forests occur in the valleys with upper montane species occurring on upper slopes. The forest has been heavily disturbed by logging and fires, resulting in a broken canopy with tangled vegetation in many areas. Aerial photo interpretation (HIMA, 1990) gave the following areas: forested, 3296 ha; bush heathland, 308 ha; and grassland, 96 ha.

Montane Forest: Canopy height up to 25 m in the valleys. Trees include: *Albizia gummifera, Bridelia micrantha, Cassipourea gummiflua, Chrysophyllum gorungosanum, Ochna holstii, Ocotea usambarensis, Polyscias fulva, Schrebera alata, Syzygium guineense,* and *Zanthoxylum gilletii*.

Upper Montane Forest: Canopy height 10-15 m on the upper slopes. Trees include: *Albizia gummifera, Aphloia theiformis, Bersama abyssinica, Diospyros whyteana, Macaranga kilimandscharica,* and *Prunus africana.*

Interviews with elderly members of the local community established that the original canopy (prior to logging) of the Forest Reserve was dominated by *Ocotea usambarensis, Parinari excelsa, Cassipourea gummiflua, Chrysophyllum gorungosanum,* and *Polyscias fulva.*

6.2.6 Catchment Value

There are no major rivers that originate from the reserve. However, there are numerous small streams with their origins in the reserve; in the Ulangambi part of the reserve 13 streams cross the forest reserve boundary. These streams are used locally for crop irrigation and general water supply.

Frontier Tanzania Udzungwa Mountains Biodiversity Survey

New Dabaga/Ulangambi Forest Reserve

7 Biodiversity & Forest Use Survey Summaries

7.0 Biodiversity and Forest Use Survey Summaries

7.1 Introduction

This section is a compilation of the summaries of each section in the Botanical and Forest Use Report and Zoological reports for New Dabaga/Ulangambi Forest Reserve. For further information regarding the surveys' aims, methods and results please refer to botanical or zoological report as appropriate (Frontier Tanzania, 2001c & Frontier Tanzania, 2001e).

7.2 Tree Communities and Diversity in New Dabaga/ Ulangambi Forest Reserve

(section 7.2 in Frontier Tanzania, 2001c)

Andrew R. Marshall, Ioan Fazey, J. Elmer Topp-Jørgensen & Henry Brink

7.2.1 Summary and Recommendations

The following section looks at the mature tree species composition in the New Dabaga/ Ulangambi Forest Reserve (NDUFR). Large trees were measured and identified within 34 systematically arranged sample plots. Ecological and topographical data were collected and subsequently used to explain the variation in tree composition.

Trees were tentatively identified from 32 families, 55 genera and 71 species. The dominant species were *Macaranga kilimandscharica*, *Cassipourea gummiflua*, *Aphloia theiformis*, *Nuxia floribunda* and *Rapanea melanophloeos*. Of these, *M. kilimandscharica* was superdominant, being found in 33 out of 34 sample plots.

The forest was found to be largely undifferentiated. Two communities were noted including *Macaranga/Cassipourea/Garcinia* spp. and *Macaranga/Aphloia* spp. These communities were however very indistinct and no differences could be seen in terms of biodiversity value. Altitudinal range in NDUFR is relatively low and could not explain changes in tree composition. A relationship was however seen between the proportion of "rare" species and distance to forest edge. This may reflect an increase of rare species in more inaccessible areas.

The forest has low diversity in relation to other Eastern Arc forests. Particularly, there is a high dominance of a few species, a large number of secondary species and a low number of endemics. This is highlighted by comparison with the less exploited West Kilombero Scarp Forest Reserve.

Human pressure on NDUFR is high. This has had a marked effect on the forest structure and tree species composition. Since large-scale logging was ceased in the early 1990s pressure on the forest has apparently decreased. However, comparison with one survey from around this time suggests that the forest has not recovered from this disturbance.

Action is therefore needed to restore the canopy and therefore to assist rare forest dependent populations in NDUFR. Management aims should primarily be to actively assist the regeneration of forest canopy trees.

7.3 Tree Regeneration in New Dabaga/Ulangambi Forest Reserve

(section 7.3 in Frontier Tanzania, 2001c)

Andrew R. Marshall, Henry Brink, J. Elmer Topp-Jørgensen

7.3.1 Summary and Recommendations

3m×3m sample plots were established at 37 sites in and around New Dabaga/Ulangambi Forest Reserve (NDUFR). Within these, young trees below 10cm dbh were then identified to determine the regenerating species content of the reserve.

Regeneration was compared with the less disturbed West Kilombero Scarp Forest Reserve. Tests revealed a significantly higher number of regenerating trees in NDUFR. There is also a threefold increase in the mean number of regenerating trees. No significant difference in genus richness was seen. This may have been due to a low sampling intensity and to small plot size.

A high number of secondary trees occurred in the NDUFR plots. This, together with the large frequency of regenerating trees, is a result of human influences.

Furthermore, three plots were set up outside of the reserve: two in exotic plantation forest and one in an isolated village government forest fragment. The plots in plantation were clearly monodominant. The forest fragment however, despite having a monodominant (*Parinari*) canopy, had higher regenerating forest species content than many forest reserve plots. More forest species may have been encouraged to grow by the presence of a closed canopy. In contrast, several plots within the reserve did not have a continuous canopy.

Commercial extraction by logging companies in some areas of the reserve has affected regeneration by clear felling areas and thus encouraging the growth of scrubby habitat. The occurrence of seedlings is however high and there is clearly potential for the re-establishment of a closed canopy in much of the reserve with active assistance to remove vegetation which may be restricting growth. It is also suggested that all forest use is monitored closely to ensure that all damaging activities are stopped to assist regeneration. It is especially important that all pole cutting is ceased as this will prevent the regenerating trees from reaching maturity.

7.4 Target Species Survey

(section 7.4 in Frontier Tanzania, 2001c)

Henry Brink, Andrew R. Marshall, J. Elmer Topp-Jørgensen, Ioan Fazey

7.4.1 Summary

The following species were selected for a detailed assessment of their populations in New Dabaga/Ulangambi Forest Reserve: *Zanthoxylum gillettii, Prunus africana, Maytenus acuminata, Albizia gummifera* and *Ocotea usambarensis.* The five selected species have both a potential sustainable use as well as the potential to act as canopy indicators. Populations were surveyed on six east-west transects covering a total of 19,440m of transect; which is a total surveyed area of 11.66ha.

Zanthoxylum gillettii had the highest population of young trees (120 individuals), but low seedling recruitment. *P. africana* had a high proportion (71%) of its total population in the seedling size class (i.e. <1cm dbh), however, its overall numbers in the reserve were very low (64 individuals). *M. acuminata,* a shrub, showed good regeneration in areas where it was abundant. *A. gummifera* had the highest overall population of the tree species (554 individuals) and good regeneration in the reserve (68% of population below <1cm dbh). *O. usambarensis* had very low regeneration in the reserve. Based on the number of individuals of each species recorded in the different size classes, the following observations were made: *A. gummifera* and *M. acuminata* appeared to have stable self-maintaining populations; *P. africana's* population had irregular seedling establishment; *Z. gillettii* and *O. usambarensis* regeneration appeared to be limited for some reason.

Four of the five target species (*O. usambarensis, M. acuminata, Z. gillettii,* and *P. africana*) showed a distribution that was dependent on over 40% cover. If the canopy continues to be degraded, then species such as these (and probably many more) may be lost, resulting in a loss of biodiversity. The disturbed state of the forest reserve was highlighted; *O. usambarensis* was present at a level of five mature trees per hectare (in an undisturbed forest of this type, *O. usambarensis* should be present at a level of 25-50 mature trees per hectare).

In ecological terms, the potential for the sustainable utilisation of the five species was generally low. *M. acuminata* and *A. gummifera* had some potential for non-timber forest product utilisation. The detailed study of the five species provides baseline data that may be used in future monitoring efforts.

7.5 Opportunistic Botanical Collections

(section 7.5 in Frontier Tanzania, 2001c)

Henry Brink, Dominic Price, J. Elmer Topp-Jørgensen, Andrew R. Marshall, Kathryn Doody

7.5.1 Summary

171 fertile plant specimens were collected from New Dabaga/Ulangambi Forest Reserve. To date, 171 specimens have been identified to family level, 170 to genus level, and 167 to species level. The collection comprises 51 families, 102 genera and 128 species. Three specimens were identified as endemic to Tanzania, and 17 specimens as not previously recorded in the Udzungwas. Final verification and identification of the collection by Kaj Vollesen (Royal Botanical Gardens, Kew) has been completed leaving 7 specimens to be verified.

7.6 Ethno-Ecological Survey

(section 8.2 in Frontier Tanzania, 2001c)

J. Elmer Topp-Jørgensen, Henry Brink and Andrew R. Marshall.

7.6.1 Summary

Ethno-ecological interviews were conducted in three villages neighbouring New Dabaga/ Ulangambi Forest Reserve. The Participatory Rural Appraisal technique and informal interviews with key informants were made with traditional healers, elder men and randomly chosen people. Casual observations and aerial photographs were also used to record information regarding human uses of natural resources.

New Dabaga/Ulangambi Forest Reserve is surrounded by human settlements whose inhabitants have extracted natural resources from the forest for generations. A growing population has led to an increase in the demand for land and products from the forest. Timber harvests have been intense in the past, but the establishment of exotic tree plantation early this century and recent management initiatives have greatly reduced the pressure on the forest wood resources, despite the growing population. There is however evidence that timber extraction has had an implication on the habitat structure and tree species composition.

Pole and firewood extraction has also been reduced. Currently, high levels of pole extraction are limited to an area near Kidabaga. This has a pronounced effect on canopy renewal and composition in a small area near the village of Kidabaga.

Minor forest products taken from the forest reserve were said to include plants for medicinal purposes, construction material for mats, thatched roofs and to a lesser degree firewood and fruits. Due to the natural renewal and fast regeneration, the harvest of these minor forest products seems to be sustainable under the present extraction level, but further studies are recommended to verify this.

Fires have entered the reserve along the northern boundary where they maintain areas of grassland. These fires are entering the reserve from the clearing of pastures, while the fires that have swept through large areas inside the northern half of the forest reserve might originate from small fires lit to facilitate honey collection or hunting.

The hunting level in the forest is severe and many of the larger mammals are very low in numbers, some even threatened with extinction.

7.7 Assessment of the Impact of Human Forest Use in New Dabaga/Ulangambi Forest Reserve

(section 8.3 in Frontier Tanzania, 2001c)

J. Elmer Topp-Jørgensen, Andrew R. Marshall and Henry Brink.

7.7.1 Summary

The disturbance survey was carried out along seven transects in New Dabaga/Ulangambi Forest Reserve. All evidence of human activities were recorded within 5m of the transects. The number of live and naturally dead poles and trees were likewise recorded.

The data revealed signs of a very high level of human disturbance. The most often encountered forms of disturbance were logging and pole harvesting. Hunting, honey harvesting and fires were also recorded.

The reserve has also been heavily exploited for timber, and shows a higher extraction level than three other exploited forest reserves surveyed by Frontier Tanzania in the East Usambara Mountains. Although timber extraction was reduced when commercial logging was stopped by government restrictions, logging still takes place in the reserve, targeting *Ocotea usambarensis*, and to a lesser degree *Zanthoxylum gillettii* and *Parinari excelsa*.

Pole extraction is relatively low for NDUFR, when compared to forest reserves surveyed in the East Usambaras. This can probably be accredited to the establishment of plantation forests outside the reserve, which provide the local community with a pole resource. Nevertheless the extraction level is still a concern and an alternative source outside the reserve should be sought.

Both poles and timber have been extracted at a higher level in the western part of the reserve where settlements are more abundant.

Animals in the forest are subjected to a severe hunting level with as many as 85 traps per km^2. This is believed to have seriously affected populations of most of the larger mammalian species in the reserve. Evidence was also found of honey collection. Fires have recently swept through the northern part of the reserve destroying forested habitat and maintaining areas of grassland.

7.8 The Small Mammal Fauna of New Dabaga/Ulangambi Forest Reserve

(section 7.2 in Frontier Tanzania, 2001e)

J. Elmer Topp-Jørgensen, Henry Brink and Andrew R. Marshall.

7.8.1 Summary and Recommendations

The small mammal fauna of New Dabaga/Ulangambi Forest Reserve (NDUFR) was surveyed during the months October and November 2000, using a combination of bucket pitfalls and Sherman traps. Five trapsites were positioned inside the forest reserve and four in other habitats. Other habitats included a Village Government forest, black wattle (*Acacia mearnsii*) plantation, pine (*Pinus caribaea*) plantation and a fallow field. Forest reserve sites were trapped for eight days, other habitats for four days.

The term "small mammals" refers in this study to members of the family Soricidae and the orders Macroscelidea and Rodentia. "Small rodents" refers to species of the family Rodentia caught in Sherman traps and bucket pitfalls (*Beamys hindei* and *Tatera* sp. being the largest species).

The list of small mammals recorded from natural forest in NDUFR includes 12 species of rodents, one species of Macroscelidae and a minimum of two species of shrew. In addition two species were recorded only outside natural forest (*Otomys* sp. and *Rhabdomys pumilio*). Two species are listed as "Vulnerable" according to IUCN (*Rhynchocyon cirnei* and *B. hindei*) while data is deficient for two species. Of the species identified to date, four species are forest dependent and only one subspecies (*Paraxerus lucifer lucifer*) is restricted to forested areas in Tanzania. It is however likely that this number will increase when identifications of collected shrews are finalised.

Eleven species were captured in Sherman traps and bucket pitfalls in and around NDUFR. Ten species were caught in natural forest and eight in non-natural forest habitat. Species unique to natural forests in this study are *Graphiurus* sp., *Dasymys incomptus* and *Tatera* sp.. All three of these species have not previously been recorded from the Udzungwa Mountains, and the two latter are first records from forested areas in the Arc. Neither of the species are however typical forest species, but are found in a variety of habitats.

The identification of *Graphiurus* sp., *D. incomptus* and *Tatera* sp. from forested areas in NDUFR, combined with Frontier Tanzania surveys in West Kilombero Scarp Forest Reserve and data from Stanley *et al.* (1998), increases the number of small rodent species known from forested areas in the Udzungwa Mountains to 16. This is the highest number recorded for an Eastern Arc forest, thus highlighting the great biodiversity value of this mountain region.

Although many species were found outside natural forest habitat, several rodent species depend on forests for their survival. Management activities should therefore focus on maintaining/improving forest quality.

7.9 Bats of New Dabaga/Ulangambi Forest Reserve

(Section 7.3 in Frontier Tanzania 2001e)

Henry Brink, J. Elmer Topp-Jørgensen, Andrew R. Marshall

7.9.1 Summary

Bats of New Dabaga/Ulangambi Forest Reserve (NDUFR) were sampled during the period October to November 2000. Sampling was carried out using mist nets. Bats encountered opportunistically (e.g. roosting) were also collected. A total of 61 hours were spent mist netting. Fourteen bats were caught, representing two families and three genera. Only one individual was identified to species level, thereby making any interpretation of results difficult. The small sample size and few genera recorded compared to other areas (e.g. West Kilombero Scarp Forest Reserve), makes it doubtful that a representative species list has been compiled.

7.10 Eastern Tree Hyrax (*Dendrohyrax validus*) in New Dabaga/ Ulangambi Forest Reserve

(Section 7.4 in Frontier Tanzania 2001e)

J. Elmer Topp-Jørgensen, Henry Brink and Andrew R. Marshall.

7.10.1Summary and Recommendations

Knowledge of the basic ecology of the tree hyrax is extremely limited. A lack of research into the needs of tree hyraxes is regrettable because their uneven abundance and patchy distribution will need to be understood before practical conservation plans can be attempted. This study aims to assess the influence of habitat degradation and hunting on the hyrax population in New Dabaga/Ulangambi Forest Reserve.

No systematic survey was carried out of the eastern tree hyrax population in New Dabaga/Ulangambi Forest Reserve due to the low number of calling individuals. Calls were, however, instead recorded during a stay in the forest in August 1999 and during bat-netting activities in October and November 2000.

Two species of hyrax are present in NDUFR, based on vocalisations of *Dendrohyrax validus* and a skull collected from *Heterohyrax brucei*. No calls were heard of *H. brucei* during the fieldwork, and hence the abundance of this species could not be assessed by the employed method. This study therefore focuses on the near endemic *D. validus*, which is listed as "Vulnerable" by IUCN.

The abundance of *D. validus* in NDUFR is very low compared to undisturbed areas in the Udzungwa Mountains. Notably the high level of ground snaring coupled with logging seems to have reduced *D. validus* density. Indirectly, extensive logging, which has taken place throughout the reserve, may have affected the hyrax population as it has removed potential nesting trees and reduced arboreal pathways. The reduction of arboreal pathways has forced the animal into moving on the ground to get from one tree to another, thus becoming more vulnerable to ground snaring.

The low abundance of *D. validus* may also be a result of competition with *H. brucei* for food or shelter. The method employed in the study may have underestimated *D. validus* abundance if a change in behaviour has been induced by hunting, e.g. animals remain quiet throughout the night in order not to reveal their presence, and therefore cannot be heard calling. Nevertheless, the population of *D. validus* has been adversely affected by the history of human forest use. Management initiatives should therefore focus on improving conditions for this near endemic species, through improvement of forest quality and a regulation of the hunting level.

7.11 Large Mammals in New Dabaga/Ulangambi Forest Reserve

(Section 7.5 in Frontier Tanzania 2001e)

J. Elmer Topp-Jørgensen, Henry Brink and Andrew R. Marshall.

7.11.1Summary and Recommendations

Large mammals are here defined as mammals, which generally are too large to be caught in bucket pitfalls and Sherman traps used in the survey of the small mammal fauna (section 7.2). The large mammals therefore include bushbabies (Galagoides), elephant shrews (Rhynchocyonidae), squirrels (Sciuridae), cane rat (Thryonomyidae), giant pouched rat (*Cricetomys gambianus*) and species of larger size than these.

A list of large mammals of New Dabaga/Ulangambi Forest Reserve (NDUFR) was compiled through casual and systematic observations of animals and their spoors[*]. A systematic survey of spoors was carried out along five different transects in NDUFR. Along these transects, burrows within 5m of the transect were recorded, dung within 2m, and paths intersecting the transect line were recorded if they could be assigned to a species. In total 4.65km of transect were surveyed. Throughout fieldwork, notes were also taken on all encountered large mammals or their spoors.

A total of 17 species of large mammals were recorded from NDUFR and surrounding areas. Sixteen species were recorded from natural forest areas, while only one species was observed in black wattle (*Acacia mearnsii*) plantations. Seven species were forest dependent, and five were listed as "Vulnerable" or "Lower risk" by IUCN. Further highlighting the importance of forested areas are records of five near endemic species and subspecies of which four are dependent on natural forests.

The largest species of mammals disappeared from the area a long time ago, probably several decades before the establishment of the reserve in the early 1930s. This is thought to be due to the relatively small size of NDUFR, its long-term isolation in a landscape dominated by humans, as well as a substantial hunting level over most of the reserve. The relative abundance survey showed a significant reduction in the abundance of all three forest antelopes and bush pig. Of these, Abbot's duiker and Harvey's duiker are of conservation concern. Many of the species, which are of priority for management are low in numbers due to extensive hunting and/or forest degradation resulting from logging (this study; sections 7.4 and 7.6). In particular Abbot's duiker (*Cephalophus spadix*) is very sensitive to hunting therefore it is imperative that all hunting of this species is stopped in order to ensure a continued presence in NDUFR of this IUCN "Vulnerable" species restricted to the Eastern Arc.

Species such as the two smallest forest antelopes, Harvey's duiker (*Cephalophus harveyi*) and suni (*Neotragus moschatus*), seem to have been reduced in numbers compared to the undisturbed forest areas in WKSFR. On the other hand, smaller species such as giant

[*] *In this study the term "Spoor" refers to all signs produced by animals.*

pouched rat (*Cricetomys gambianus*) and chequered elephant shrew (*Rhynchocyon cirnei*) probably are little affected by the severe hunting level in the reserve. It is also noted that these observations are a snapshot in time, and that future monitoring would reveal more detailed information on population trends.

In order to ensure the presence of the large mammal species of conservation concern in NDUFR, it is suggested that management should focus on improvement of forest quality and seek to reduce the level of hunting. Large species in particular would also benefit from establishment of corridors or stepping-stones for dispersal. Nearby forest fragments (trapsite A: Village Government Forest) show potential for incorporation in such a venture.

7.12 Priorities for the Conservation of Monkeys in New Dabaga/ Ulangambi Forest Reserve Based on Comparison of Group Density and Socioecology with West Kilombero Scarp Forest Reserve

(Section 7.6 in Frontier Tanzania 2001e)

Andrew R. Marshall, Henry Brink, J. Elmer Topp-Jørgensen

7.12.1Summary and Recommendations

Ten species of primate are known from the Udzungwa Mountains, making it one of the most important areas for primate conservation in East Africa. Amongst these are four forest dwelling monkey species, (Udzungwa red colobus, *Procolobus gordonorum*, Sanje crested mangabey, *Cercocebus galleritus sanjei*, Angolan black and white colobus, *Colobus angolensis palliatus* and Sykes' monkey, *Cercopithecus mitis* (subsp.). The former two of these are of restricted range and of considerable conservation concern (IUCN vulnerable and endangered respectively).

There has been little previous study of Udzungwa primates in most forest fragments beyond details of presence/absence and not even that information is available for some forests. Prior to this survey, no detailed monkey census had been carried out in New Dabaga/Ulangambi Forest Reserve (NDUFR). This is most notable from the Udzungwa red colobus not being recorded from the area since 1951.

Twenty-one census transect walks made along two transect routes recorded the presence of black and white colobus, Sykes' monkey and the Udzungwa red colobus. Of these, most visual records were of the red colobus, whereas Sykes' monkey vocalisations were heard most often. It was apparent however that the transect lines surveyed were located in two of the most intact areas of forest and thus are likely to represent some of the highest monkey densities in NDUFR. This was highlighted by a single census walk in the north of the reserve, where the forest canopy is heavily degraded and very few monkeys were seen. A low frequency of casual observations in other heavily disturbed areas of the reserve during the five months of fieldwork further emphasises a lower abundance outside of areas of intact canopy.

Encouragingly, red colobus group density on one of the transect lines in NDUFR is comparable to that seen using identical methods in Ndundulu forest in West Kilombero Scarp Forest Reserve. Further comparison with Ndundulu forest and other forests in the Udzungwas however stresses the generally low monkey density of NDUFR. There is also a considerable reduction in group size and in associations between different species. From the elimination of other factors and from previous studies in Tanzania and elsewhere, the observed differences are likely to be due to two major factors. Most importantly for conservation, habitat quality appears to be having the highest impact on both primate density and group size. Also important however are differences in predation between the two reserves, which have probably resulted in the lack of interspecific associations in NDUFR, where there are few or no predators. Comparison between transect lines within the

two reserves also appears to support these suggestions. Hunting may also be having an effect, primarily on Sykes' monkeys, which are persecuted as pests.
Observed changes in monkey ecology with habitat quality provide just one example of how human impacts on forested areas can affect wildlife. Such changes are indicative of monkey populations under environmental stress and thus the ecology of many taxa are likely to be under similar pressures. It is therefore suggested that management priorities should aim to restore the degraded areas of forest (as described in Frontier Tanzania, 2001a) to allow the current patchy distribution of monkey groups to colonise other areas of forest within the reserve. In conjunction with this, the progress of forest recovery should be monitored closely to ensure that management activities are successful and that the forest is not further exploited.

Monkeys observed in small fragments of village government and privately owned forests outside of NDUFR also suggest there is potential for the protection/development of these areas to act as stepping stones or corridors to assist dispersal beyond the boundaries of the reserve.

7.13 Bird Observations from New Dabaga/Ulangambi Forest Reserve

(Section 7.7 in Frontier Tanzania 2001e)

Andrew R. Marshall, J. Elmer Topp-Jørgensen, Henry Brink

7.13.1 Summary and Recommendations

The Udzungwa Mountain range contains more restricted range birds than any other area in Eastern Arc Mountains. The Udzungwa avifauna is therefore a key factor in demonstrating the conservation value of the area.

In order to gain an overview of the bird species in the New Dabaga area, Elia Mulungu (WCS) spent three days in the field, carrying out bird surveys in three areas. This, coupled with observations made by the Frontier Tanzania research team is used to produce a list of species present along with some remarks on the influence of habitat quality.

Despite its isolation and high level of human impact, at least 34 forest dependent and 12 restricted range species were observed. This includes two species of IUCN conservation concern which were observed within the forest including the Kipengere seedeater, *Serinus melanochrous* (lower risk) and Usambara weaver, *Ploceus nicolli* (endangered). The forest of NDUFR should therefore be considered an important area for conservation. In addition to these, the blue swallow, *Hirundo atrocaerulea* (vulnerable migrant), was also seen in the area during 2000 fieldwork.

A number of the bird species recorded are montane forest dependent species and hence require natural forest habitat to survive. This also means that many are unlikely to be able to disperse far beyond the forest boundary. To assist this, investigation into the formation of forested corridors or stepping stones to other nearby forest fragments is suggested. An encouraging sign of the potential for this is the abundance of forest birds observed in a *Parinari excelsa* fragment surveyed in the Msonza area.

The isolated nature of NDUFR, which is over 10km from the nearest forest fragment of comparable size, means that forest dependent species are unlikely to be able to colonise or re-colonise from elsewhere. The conservation of the species that are already present can however be assisted by the improvement of canopy cover. This may require active assistance of tree growth by removal of restricting herbaceous vegetation.

7.14 Assessment of Reptile Collections from New Dabaga/ Ulangambi Forest Reserve

(Section 7.8 in Frontier Tanzania 2001e)

Andrew R. Marshall, J. Elmer Topp-Jørgensen, Henry Brink

7.14.1Summary and Recommendations

Since short surveys in the 1950s, the herpetofauna of the Udzungwa Mountains has been much neglected. In recent years, three areas of Udzungwa forests have been surveyed, although the reptilian inhabitants of several forests remain unstudied and undocumented. Much of the remainder of the Eastern Arc reptiles are also poorly known. In this respect, knowledge of East African reptiles lags behind other areas of the world. By contrast, the reptilian fauna of many countries (e.g. much of Asia, West Africa and America) has been inventoried and is currently undergoing detailed ecological study (Howell, 1993).

The reptiles of New Dabaga/Ulangambi Forest Reserve and surrounding area were surveyed using a combination of bucket-pitfall traps and opportunistic collections. From this, eight species from five families are listed. These include three near endemic forest dependent species.

In comparison to other Eastern Arc forests sampled using identical methodology, the reptilian diversity in NDUFR appears to be particularly low. Most notably, only six records of reptiles were made in the reserve itself. Low sampling intensity, the high altitude climate and habitat degradation may have affected this.

Montane forest reptile ecology is however very poorly known. In particular, there is little information about baseline diversity or population levels prior to habitat degradation. Management initiatives have been suggested to improve NDUFR habitat, such as active assistance of forest re-growth. Although not specifically designed with reptiles in mind, this may assist forest reptile populations. Without influx of species due to the isolated nature of the reserve, however, once forest-dependent species are lost, they are unlikely to return naturally. Further management initiatives to encourage the connection of NDUFR by forest corridors to adjacent forest fragments may assist this, and would also assist dispersal of those species already present.

Following and during implementation of management initiatives, there will be great potential for detailed studies of changes in reptile populations with habitat improvement. This would provide much needed information to assist with management and conservation of reptiles in montane forest.

7.15 Amphibians of New Dabaga/Ulangambi Forest Reserve

(Section 7.9 in Frontier Tanzania 2001e)

Henry Brink, Andrew R. Marshall, J. Elmer Topp-Jørgensen

7.15.1Summary and Recommendations

The amphibian fauna of New Dabaga/Ulangambi Forest Reserve (NDUFR) was sampled using a combination of bucket pitfall trapping and opportunistic collections. Five sites were sampled within the forest reserve (trapsite 1-5), and four trapsites were placed outside the reserve (trapsite A-D). Trapsites within the forest reserve were sampled for eight days, while those outside were for four days. Amphibian communities of NDUFR were surveyed from October to November 2000.

A total of 553 amphibians were caught of which 103 were retained for taxonomic purposes. Specimen identification is still preliminary. Within this amphibian collection, there are at least four families, ten genera and 14 species[*]. It is felt that this survey provides a sample of the majority of amphibian fauna of the area. The Udzungwa endemic, *Phlyctimantis keithae* (not forest dependent), was recorded on four occasions and three forest dependent species were recorded by this survey. All species listed as forest dependent are limited in range to the forests of eastern Tanzania.

Amphibian diversity varied between trapsites. Three factors were thought to be important in explaining this variation, namely; precipitation, distance to water and canopy cover. The proximity of water was shown to have a significant influence on the number of individuals recorded; more individuals were recorded near water.

Of note was the collection of *Leptopelis bocagii* (open habitat species) and *Leptopelis vermiculatus* (forest dependent species) during this survey, which represents the first record of both species in the Udzungwa Mountains. These range extensions emphasise the incomplete nature of current knowledge.

Open habitats and disturbed habitats, near irrigation ditches or streams (i.e. trapsite D and 1, respectively) may support a greater diversity of species than comparatively undisturbed forest habitats (e.g. trapsite 4). However, the species of these open/disturbed areas are generally adaptable and widespread. The forest dependent amphibian fauna (e.g. at trapsite 4) tends to have a limited distribution. Forested areas occupy a minute portion of the Tanzanian landscape (less than 3%), thereby stressing the importance of conserving these forest fragments (as highlighted in Howell, 1993; Schiøtz, 1981). NDUFR has been subjected to heavy past disturbance, therefore, management efforts should seek to maintain current forested areas and re-establish canopy cover in the degraded areas. Several limited range species were recorded within a 6ha village government forest (trapsite A), which suggests its potential within a system of forested corridors/stepping stones.

[*] Number of species used in the Executive Summary and Management Sections based on Table 7.9F; Frontier Tanzania, 2001e.

7.16 Mollusc Diversity in New Dabaga/Ulangambi Forest Reserve

(Section 7.10 in Frontier Tanzania 2001e)

J. Elmer Topp-Jørgensen, Andrew R. Marshall, Henry Brink.

7.16.1Summary and Recommendations

The mollusc fauna was sampled at nine trapsites using a combination of plot surveys, direct timed searching and casual collections. Five sites were within the forest reserve, one site in village government forest (site A), one site in a fallow field (D) and two sites in plantation forests (black wattle (*Acacia mearnsii*) (site C) and pine (*Pinus caribaea*) (site B)). For each site, collected molluscs have been counted and divided into morpho-species.

The mollusc fauna of New Dabaga/Ulangambi Forest Reserve (NDUFR) with 21 morpho-species is an average Eastern Arc forest in terms of species richness. West Kilombero Scarp Forest Reserve (WKSFR), also in the Udzungwas, is more diverse (54 morpho-species). This is probably due to a higher altitudinal span and the variety of habitats found in WKSFR compared to the similar ecological conditions found in NDUFR.

Within the forest reserve there were few differences between sites in species richness and diversity for reasons mentioned above. Comparisons between sites differing in disturbance level showed no apparent effect on the molluscan communities. Although not significant, the results indicate that mollusc diversity might be more dependent on whether or not the site is associated with a water source. The species accumulation curve suggest that the mollusc fauna is well represented in this study, but a increase in the number of plots is recommended in order to make any conclusions.

Forest reserve sites were more species rich and more diverse than sites outside the reserve. Site A in natural forest contained only species found in the reserve. The site was low in species and high in number of individuals probably due to the highly uniform *Parinari excelsa* habitat. Little overlap in species composition was observed between natural forest sites and trapsite D (fallow field). This indicates the presence of different molluscan communities in these habitats. Probably with forest dependent species in the natural forest and species adapted to more arid conditions in the fallow field. The plantation forests had the lowest abundance of molluscs.

The biggest threat to the mollusc fauna of NDUFR is destruction of habitat. The forest shows a uniform distribution of species with moist areas harbouring more diverse communities than drier areas. Essential for the conservation of molluscan diversity in the forest reserve is therefore that catchment areas are left undisturbed and that a management plan aims to protect against further destruction of natural forest.

7.17 Millipede Diversity and Distribution in New Dabaga/ Ulangambi Forest Reserve

(Section 7.11 in Frontier Tanzania 2001e)

Andrew R. Marshall, Henry Brink, J. Elmer Topp-Jørgensen

7.17.1 Summary and Recommendations

Knowledge of millipedes (class Diplopoda) is extremely limited, especially in the montane forests of Tanzania. Only about six of the eleven Tanzanian families are known in any detail and only one has been extensively documented. For this reason, most millipede collections made from Tanzania are likely to contain several undescribed species and even new genera. Hoffman (1993) estimates that only one in eight millipede species has been described.

Endemism in millipedes is extremely high and few species occur in more than one mountain range. The Udzungwa Mountain range has been surveyed by only one expedition, which concentrated on Mwanihana forest. This short study however found four endemic genera and eleven endemic species from the family Oxydesmidae (Hoffman, 1993). When compared to species endemism of this family in other Eastern Arc forests, this places the Udzungwas above all others. Much of the Udzungwas are however unexplored and given this high level of millipede endemism, there are clearly more discoveries to be made.

Millipedes from the previously unstudied populations of New Dabaga/Ulangambi Forest Reserve (NDUFR) were sampled using a combination of quadrats and timed casual searches. From these, 2,012 millipedes were collected. Taxonomic verification was however unavailable at the time of report writing, so these were classified into thirteen morpho-species in order to investigate diversity.

Comparison with millipedes collected from West Kilombero Scarp Forest Reserve (WKSFR) highlights the high level of endemism of forest millipedes. Most notably, only ten out of the thirty-eight morpho-species in WKSFR were also found in NDUFR. Furthermore, there are two morpho-species that were found in NDUFR and not in WKSFR.

The millipede fauna within the forest is also clearly more diverse than that outside. Notably, five out of the thirteen morpho-species (38.5%), were found only in the forest trapsites. Given the extremely low dispersal ability of millipedes beyond environmental boundaries, most of these “forest species” are likely to be restricted to and dependent on these forests for survival.

Differences in millipede diversity between and also within the two reserves are likely to be due to factors influencing desiccation. This is the primary limiting factor to millipede distribution (Hoffman, 1993). In particular, canopy fragmentation increases the exposure of the forest floor to drying out, and thus should be monitored to ensure that harmful activities are not threatening this. Improvement of forest canopy in NDUFR may therefore enhance the millipede fauna.

7.18 Butterfly Diversity of New Dabaga/Ulangambi Forest Reserve

(Section 7.12 in Frontier Tanzania 2001e)

Henry Brink, J. Elmer Topp-Jørgensen, Andrew R. Marshall

7.18.1 Summary and Recommendations

The butterfly community of New Dabaga/Ulangambi Forest Reserve (NDUFR) was sampled using a combination of butterfly traps, timed sweep netting, and casual collections. Five sites were sampled within the forest reserve (trapsite 1-5). Four trapsites (trapsites A-D) were placed outside the forest reserve; in a 6ha *Parinari excelsa* dominated village government forest, pine plantation, black wattle plantation, and fallow field. Butterflies were sampled from early October to late November 2000.

A total of 799 butterflies were caught in NDUFR. The butterflies came from eight families, 30 genera and 50 species. No species recorded by this survey was endemic to the Udzungwas. However, at the subspecies level, there were two Udzungwa endemics (*Henotesia ubenica uzungwa* and *Acraea alicia uzungwae*). There are a further 15 near-endemic species/subspecies.

Two factors were thought to be important in influencing butterfly diversity at the various trapsites. These were time of year and habitat heterogeneity. An increase in the numbers of individuals and species were noted towards the end of the survey period. This suggests more butterflies would be recorded had sampling continued into the warmest and wettest time of the year (December to April). Trapsite 5, located at the centre of the forest reserve by a stream with canopy gaps, had the highest butterfly diversity; with 22 species and 275 individuals recorded.

Of the near-endemic butterflies recorded, 70% were forest dependent. In the eastern half of Africa, forested areas are mainly restricted to mountains and surrounded by savanna or even semi-desert. The greatest threat to these forest dependent species is the widespread reduction in forest size and quality. Therefore, schemes that seek to maintain the existing forest habitat should be supported in NDUFR.

Frontier Tanzania Udzungwa Mountains Biodiversity Survey

New Dabaga/Ulangambi Forest Reserve

8 Input to Joint Forest Management

8.0 Discussion of Input to Joint Forest Management

J. Elmer Topp-Jørgensen, Henry Brink and Andrew R. Marshall.

8.1 Factors Important for Maintaining/Improving Forest Quality

Logging/Tree Felling Including Pole Cutting

Any logging in New Dabaga/Ulangambi Forest Reserve should be avoided. The canopy cover is greatly reduced in the forest reserve as a result of timber extractions and clearing of land for agricultural purposes. A dense herb and shrub layer together with an abundance of vines often renders forest regeneration difficult. Based on aerial photographs, it seems that some regeneration has occurred since 1956, but numerous patches of shrubby habitat still persist in the reserve. A closed canopy cover is vital to maintain forest ecosystem functions and protect many forest dependent species. The canopy might be able to re-establish itself if left undisturbed for a substantial amount of time (decades). To facilitate regeneration in certain areas it is suggested that the possibility of active management in the form of clearing shrub cover from around regenerating trees and replanting open areas with local forest trees (e.g. *Albizia gummifera*) is investigated and implemented.

Extractions of poles should be stopped to allow forest re-growth. Timber and pole extractions have been reduced since the termination of commercial logging activities in the reserve in the early 1990s and due to the creation of exotic tree plantations outside the reserve. Limited extraction however still occurs in the forest reserve for both timber and poles.

Villagers should be informed of the negative impact of logging and pole cutting, and encouraged to stop extraction from the forest immediately. Plantation establishment outside the forest reserve should also be encouraged in areas where wood resources are scarce. Emphasis should be put on the tree species composition of the plantations, which should seek to replace extractions for timber poles, kitchen utensils and firewood currently being taken from the natural forest. Negotiations with landowners should identify plantation species in demand. Preferably indigenous trees should be planted, but if no local fast growing trees exist, exotic species (black wattle *Acacia mearnsii*, pine *Pinus caribaea*, cypress *Cupressus* sp. or eucalyptus *Eucalyptus* sp.) can be considered. Elsewhere black wattle has become an invasive pest, but its importance as replacement for poles mean that its presence in the Dabaga area is still important for the protection of natural forests. Care should however be taken so that these species do not enter the reserve.

The task of facilitating forest re-growth by removing herbs, shrubs and vines from regenerating trees is very labour intensive and hence may be costly. The possibilities of actively facilitating tree growth should be investigated.

The Forest and Bee-keeping Division of Iringa District should select disturbed areas for management activities to actively assist forest regeneration based on the list below (see Frontier Tanzania, 2001c: Figure 8.2A for heavily disturbed areas and Figure 8.3H for plot locations):

- North-western part of the reserve along old logging road;
- Open areas along reserve boundary (incl. Plot 9, 26 and 26a);
- Hibiscus/Triumfetta area in plot 25 and along the path to plot 15;
- Fire disturbed area in plot 29 (and 33);
- Fire disturbed areas along northern boundary;
- Disturbed areas located on the 1999 aerial photographs.

Villagers could be employed periodically to remove tangled vegetation from and around regenerating trees until they have reached a size where they are no longer threatened by herb, shrub and vine strangulation. This task could be appointed to one or two persons from villages adjacent to the forest reserve. It would be natural to choose people who have been involved in the work carried out by Frontier Tanzania as they know about the project and have gained a thorough knowledge of the state of the forest reserve. They would therefore also be able to assist in the selection of sites for management activities in the field.

Forest Division staff should visit the sites quarterly to monitor possible improvements in the development of forest re-growth (see section 10). Management activities should be adjusted on the basis of their findings. If the method proves to be feasible for improving tree regeneration in formerly cleared areas, the initiative could be extended.

Village Government Forests (*Parinari* Forest Fragments)

Small patches of village government forests are found adjacent to the forest reserve. Such forests are protected and managed by the local community. It is a good example of a local initiative which has conserved forested areas. The canopy in these forest fragments consists primarily of *Parinari excelsa* but other forest species are also present. *P. excelsa* has multiple uses (e.g. medicinal uses and the fruits are eaten), and secondly its closed canopy allows forest species to regenerate. The regenerating trees constitute a potential wood source, including hardwood species used for tool handles, kitchen utensils etc.. *Macaranga kilimandscharica*, a preferred firewood species, is also abundant. No exotic plantation tree species in the area is useful for tool handles, whereas these natural forest fragments provides excellent opportunities for a future supply of non-timber forest resources. With the creation of more natural forest habitat composed of indigenous tree species outside the reserve (see suggestion below regarding buffer zone and stepping stones for dispersal) there might also be scope for limited timber extraction.

In addition these forests are important water catchment areas and they might function to a certain extent as stepping-stones for forest species.

This system of village government forests should be incorporated into the Joint Forest Management plan, and negotiations with locals should seek a way to increase the size and the number of these. Furthermore, an overall forest strategy for the area should include these fragments as well as the forest reserve.

Bush-Fires

Bush-fires should be prevented. At present cultivated land and grassland are found right next to the forest reserve boundary. This increases the risk of fire spreading into the reserve because no transitional zone between forest and more open habitat exists. Fires sweep regularly through areas inside the northern boundary of New Dabaga/Ulangambi Forest Reserve maintaining and probably also slowly expanding grassland areas. In these regularly burnt areas of about 3ha, fire-tolerant grasses are abundant with scattered individuals of the fire-resistant *Protea* sp.. Fires have recently burnt through large areas of forested habitat, killing most trees in an estimated area of 25ha inside the reserve. These former forested areas are now regenerating with pioneer or secondary shrub species, which are often widespread, opportunistic and non-forest dependent. They have only little value for biodiversity and human use. These regular fires lead to difficulties in re-establishing the canopy and hence are seen as areas where management should be carried out.

Awareness raising including information meetings and teaching environmental subjects in schools (A) and a buffer zone (B) of trees may counter the impact of fire. Furthermore, it could be used for honey production activities (see below) and contribute to the production of non-timber forest resources.

A) Awareness Raising

Fire disturbed areas have been located and the cause of the fires should be discussed. Once the cause of the fire is known, villagers inhabiting the area around the reserve should be informed on a regular basis about the negative effects of fires, and ways and means of avoiding fires. They should be discouraged from lighting fires inside the reserve and to control their use of fire outside the reserve. The creation of a buffer zone of indigenous trees around the forest reserve is recommended (see below) and alternative ways of income from such a zone should be discussed. Fire activities in the New Dabaga/Ulangambi area should be monitored (see section 9). Such issues should also be taken up in schools to increase environmental awareness in future generations.

B) Buffer Zone

It is recommended that field owners adjacent to the forest reserve are encouraged to establish a forest wood zone between cultivated areas and the forest. The buffer zone should consist of indigenous species only. This buffer zone can be subject to non-timber forest resource extraction and beehives can be established. Negotiations with local people will reveal which tree species are in demand and hence should be planted. The use of exotic species should be avoided as it will act as a barrier to dispersion, they can have detrimental effect on soil conditions and e.g. fire is involved in the regeneration of black wattle.

The motivation for the landowners to establish a buffer zone on their land, is that it will provide them with non-timber forest resources and it is recommended that they receive technical and economic assistance for establishing income generating timber, pole or fruit plantations on land away from the forest reserve.

Landowners should be offered technical assistance to the establishment and further development of the buffer zone on their land, and they should be integrated partners involved in the management. As owners probably will not have the money to implement such activities, financial support for seedling purchase will be necessary for a successful implementation, unless a village based tree nursery can be

established. It should however be noted that similar efforts elsewhere have had problems with ensuring persistent interest from villagers. Therefore discussions with villagers should produce aims of buffer zone resource use and select the best possible means of ensuring the enduring efforts by the villagers. The owners should also receive training in nursing of seedlings to secure the survival of as many seedlings as possible. The buffer zone should preferably be established as a belt 50m wide along the forest reserve boundary. Along the southern edge of the forest, a road borders the reserve, so problems with creating a buffer zone in this area might arise.

8.2 Non-Timber/Pole Forest Resources

Honey Extraction

Honey collection in New Dabaga/Ulangambi Forest Reserve should be avoided. Honey is a highly favoured natural resource extracted from the forest. Signs of honey collection were seen in all forested parts of the forest reserve. During interviews honey was often mentioned as a favoured treat with medicinal effects. However, honey collection is accompanied by fire. By setting up beehives in forested areas outside the reserve and via information meetings, it is hoped that villagers can be persuaded not to collect honey from the forest, thus preventing the use of fire inside the reserve.

Villagers interested in honey production should receive technical assistance to the establishment of beehives in the forest buffer zone and other areas outside the forest reserve. They should be informed that it might take a significant amount of time before bees settle down in the hives and that it is unlikely that all hives will be occupied.

Extraction of Medicinal Plants

Management plans should focus on initiatives of extraction of medicinal plants outside the forest reserve. This is due to experiences elsewhere, where supposed sustainable extraction of natural resources has proved non-sustainable. Alternatives to harvests of medicinal plant parts could be identified. However, subject to further studies of plant species utilised for medicinal purposes, extractions of certain medicinal trees and shrubs may be allowed, where extraction does not threaten the survival of the affected individual. Extractions of some herb and liana species whose existence is not threatened could also be allowed, as these are often readily renewable and regenerate quickly.

Medicinal plant extractions can be intimately linked to conservation because many of these plants are found in habitats endangered by current land-use. However, before medicinal plant collections are allowed, assessment should be made of the utilised species and their suitability to sustainable extractions on the basis of abundance, renewability, rarity and ecological affinities. A list of utilised species should be produced including information of plant parts and the harvest method used. Based on this list, another list of species allowed for medicinal plant collection should be produced in close collaboration with the villagers and subsequently distributed to the relevant persons in the local communities. It is important that extractions are carried out for local consumption only to avoid unsustainable harvests. It should be noted that access to this resource is most important to the poorest people in the community, because they often cannot afford medicine sold from dispensaries.

Certified persons who possess knowledge of medicinal plant uses (e.g. traditional healers) should carry out the medicinal plant collections. Negotiations between Forest Division, village governments and local people should identify people to be issued with a certificate for medicinal plant extractions from the forest reserve.

Certified persons should be taught harvesting methods, so ring barking and other non-sustainable extraction methods are avoided. The certified persons should also keep a record of collected species and an estimate of the amount harvested. Forest Division staff should check these lists annually, and yearly walks through the forest with certified persons should be made to monitor and evaluate the sustainability of the extractions.

8.3 Access to the Forest Reserve

In general, all people on foot should have access to the forest reserve crossing from villages to cultivated areas. The village government should issue a certificate for these people. It is also recommended that separate access certificates could be provided to all sustainable users based on their personal record with respect to sustainable forest management. Certificates should be reviewed and renewed annually. The village government is responsible for keeping a record of persons issued with an access permit. Copies of these records should be provided to the Forest Division annually.

Only sustainable users with valid certificate should be allowed to collect resources permitted under the Joint Forest Management plan. If this system after a number of years has proven to be successful (i.e. illegal extraction is prevented) the use of a certificate system could cease. However, if illegal human activities continue or increase, the certificate system should continuously be applied or its use reviewed.

The hunting of hyraxes, bush pig (*Potamochoerus larvatus*) and forest antelopes is highly unsustainable at the current level. Hunting should therefore under no circumstances be allowed for these and other large mammals. The effect on smaller species is not known in detail and future research on the subject is essential. Using the precautionary principle therefore implies that hunting in the forest reserve should not be part of a joint forest management plan.

8.4 Suggested Income Generating Activities

Fruit Manufacturing

There is an abundance of fruit trees (pear, apple, peach and plum) around New Dabaga/Ulangambi Forest Reserve. In the fruiting season, fruits are exported to markets in Iringa and even as far away as Dar es Salaam. This production might hold potential for a fruit canning industry, thereby creating work and income to inhabitants of the area.

If found relevant under the project, assessment of the possibilities for processing of fruits could be investigated. The fruit production should be assessed and a market analysis carried out.

Other Income Generating Activities

The natural resources suggested for extraction from the reserve and the income generating activities suggested above were identified during the Frontier Tanzania studies. Further investigation of socio-economic aspects and marketing analysis may reveal other possible resources suitable for sustainable extraction (e.g. oils, seeds or genetic material to improve resistance in commercial crops).

8.5 Suggestions for Future Research Related to Joint Forest Management in and around New Dabaga/Ulangambi Forest Reserve

- Investigation of the possibilities for actively facilitating forest re-growth.
- Investigation of which forest plants used for medicine can be replaced by a resource from outside of the reserve.
- Assessment of medicinal plant harvest potential from the forest that cannot be replaced by extractions from habitats outside the reserve.
- Investigation of possibilities and potential for sustainable hunting compared to increased animal husbandry outside the reserve.
- Investigation of the possibility and feasibility of establishing a corridor/stepping stones for dispersal to neighbouring forests.
- Investigating the possibility and feasibility of establishing buffer zone of indigenous tree species around the reserve.
- Develop a rapid appraisal technique to assess changes in forest quality.

Furthermore, NDUFR and the small forest fragments found around the reserve and in the Udzungwas as a whole, offer excellent opportunities for studying the effect of habitat degradation and fragmentation on the areas plants and fauna.

Frontier Tanzania Udzungwa Mountains Biodiversity Survey

New Dabaga/Ulangambi Forest Reserve

9 Monitoring Recommendations

9.0 Recommendations for Monitoring of New Dabaga/ Ulangambi Forest Reserve

J. Elmer Topp-Jørgensen, Henry Brink and Andrew R. Marshall.

9.1 Summary of Monitoring Recommendations

Implicit in the rationale for monitoring is a recognition of potential for change. Monitoring creates an ongoing feedback that allows managing authorities to track the results of their actions. Incorporating the results from monitoring activities allows managers to remain flexible and adapt to uncertainty. Such an adaptive approach is considered to be vital for the successful implementation of a Joint Forest Management plan.

The disturbed state of New Dabaga/Ulangambi Forest Reserve has highlighted the need for management intervention. In order to evaluate the effect of the management interventions regular monitoring is recommended.

Monitoring activities should be carried out to measure forest regeneration as it is agreed in the Joint Forest Management plan. The most practical and cost-effective option is conduct casual walks with a local informer. During these walks, evidence of forest quality should be recorded, including human impact within the forest reserve.

A boundary walk is recommended for monitoring the impact of fire on forest edge areas. To further limit the disturbance caused by fire, a buffer zone of indigenous species should be established around the outside of the forest reserve. Monitoring of the buffer zone is recommended by using fixed-point photographs from known positions.

Following the intensive timber extraction from the reserve, the re-establishment of a closed canopy is seen as a key management issue for the Joint Forest Management plan. Fixed plots in and visits to management intervention sites should be carried out to monitor the facilitation of tree re-growth in heavily disturbed areas.

Extraction of medicinal plants and the establishment of beehives should also be monitored to follow the implementation of sustainable medicinal extraction and creation of an alternative source for honey.

Finally, it is also recommended that land use pattern is monitored using a combination of aerial photographs and fixed point photos from ground level. These initiatives are recommended to be carried out at long intervals to monitor the development of plantation establishment, creation of a buffer zone, maintenance and possible extension of *Parinari* forest patches and agricultural land use.

Involving monitoring of animal populations in evaluation of Joint Forest Management initiatives is not deemed essential for the MEMA project. It is often time consuming and requires experienced researchers. Furthermore, most of the forest dwelling, restricted range and threatened animal species found in NDUFR are believed to benefit from initiatives to increase forest quality which are better monitored in other ways. The area however offers excellent opportunities for ecological studies of animal population in relation to human forest disturbance. Examples of such studies can be found in the Zoological Report (Frontier Tanzania, 2001e), including assessment of human impact on hyraxes, large terrestrial mammals and monkeys through logging and hunting.

9.2 Justification, Activities and Outputs of Suggested Monitoring Activities

9.2.1 Monitoring of Forest Quality

Justification

The forest has been subject to a high level of exploitation in the past and in order to increase the biodiversity value of the reserve it is proposed that logging, pole-cutting and bush-fires are avoided to encourage the formation of a mature forest environment.

Actions

Casual walks should be carried out annually along existing paths and Frontier Tanzania transects in the forest. A local informer with knowledge about existing paths should be used. During the walks all signs of disturbance should be noted and their origins discussed with the local informer.

Outputs

For each casual walk, a list of the number and approximate location of all observed disturbance categories (i.e. traps, logging, pole cutting, fire, etc.) is produced. Lists should be kept by the Forest Division and compared with previously recorded lists.

9.2.2 Monitoring of Bush-Fires

Justification

Fire has swept inside the forest and along the northern boundary. They are maintaining areas of grassland and have resulted in large areas of dead forest. Therefore monitoring of the occurrence of fire is suggested.

Actions

A boundary walk should be made annually at the end of the dry season when most cultivation fires have occurred. With a sketch map of the forest reserve in hand, all signs of fires should be recorded during the boundary walk. Notes should be made on the extension of the fire, and whether it entered the reserve or not. If possible the causes of the fires should be noted.

Outputs

The number of observed fires and their extension should be recorded and used for comparison with previous boundary walks.

9.2.3 Monitoring of Forest Regeneration

Justification

The low rate of change over time in vegetation plots makes monitoring unnecessary in the short run. If it is felt necessary to repeat the Large Tree Survey in selected plots (e.g. to assess tree growth rates) new surveys could be carried out. A period of 5-10 years between re-surveys of selected plots is recommended. Maintenance of paths leading to selected plots will be necessary to relocate the plots. Experience suggests at least biannual clearance of transects is necessary in shrubby areas.

Ecological conditions will improve for forest species with the re-establishment of a more closed canopy. The cover would re-establish naturally if human resource use is sustainable or avoided, although it may take a significant amount of time. In the management recommendations it is therefore proposed that regeneration of heavily disturbed forest areas in the forest reserve should be facilitated. Degraded areas are abundant in the reserve, thus offering excellent opportunities for studying the effect of active management.

Actions

It is suggested that tree regeneration should be monitored in three managed areas and one area without management. If regeneration facilitation is undertaken in additional areas, yearly visits are suggested to these sites.

A) Monitoring of regeneration plots:

Four 20 x 50m plots are suggested for monitoring forest regeneration. Vegetation plots number 25, 26 and 29 (see Frontier Tanzania, 2001c: section 8.3 for position of these plots) would be valuable to monitor. It is suggested that all trees above 5cm dbh are marked and measured. Large species of shrub like *Vernonia subuligera* should be excluded from the survey, as this species is not capable of establishing a canopy. In addition, a plot without active regeneration management should be monitored for comparison.

B) Visits to other regeneration sites (not plots):

The person involved should facilitate a yearly visit to all regeneration management sites. Progress should be discussed and the effect evaluated. The management strategy should be revised accordingly to optimise tree regeneration conditions.

Management activities to facilitate tree regeneration should be monitored yearly until trees have reached a size where they are not threatened by shrub strangulation and enough trees are present to constitute a canopy when trees have matured.

Outputs

The number of trees and the mean diameter at breast height (dbh) will act as a measure of tree re-growth. Results can then be compared with previous surveys.

9.2.4 Monitoring of Buffer Zone Management

Justification

The establishment of a forest buffer zone of plantation trees around the reserve will reduce the impact of fire and other human pressure. It may also reduce the influence of gust winds and dry air, and at least theoretically act as a barrier to invasive exotic plant species. The creation of the buffer zone should therefore be supervised to reduce loss of seedlings and optimise the tree growth. Fixed point photographs is recommended as a mean for monitoring.

Actions

Visits should be made to 4 different sites along the forest reserve border to assess the tree growth in the buffer zone. These should be suitable sites for taking fixed-point photographs to be taken of the proposed buffer zone. The sites could be visited in conjunction with other monitoring or management activities. Photographs should be taken annually to monitor the development of the tree growth. Every year, photos should be taken from the exact same spot and in the same direction.

Ad libitum notes on tree growth in the buffer zone should be recorded annually in conjunction with the fire boundary walk.

Outputs

Fixed point photographs of the buffer zone should be used to monitor the development of tree growth. Photographs should then be compared to previously taken photos from the same point.

9.2.5 Monitoring of Honey Production in the Buffer Zone

Justification

As an alternative to collection of wild honey, establishment of beehives is suggested in the buffer zone and other habitats outside the forest reserve. This will presumably minimise the use of fire within the reserve boundary and create a safe zone for bees in the forest.

Actions

A bee-keeping expert should visit beehives in the area annually to evaluate the progress. Villagers interested in honey production should have the opportunity to seek advice for their production efforts.

Outputs

The total number of established beehives and the number of hives inhabited by bees should be recorded for both the buffer zone and plantation forests. These numbers can then be compared with previous recordings.

9.2.6 Monitoring of Medicinal Plant Collections

Justification

Harvests of certain medicinal plants are the only resource proposed useful for sustainable extraction from the forest reserve. Collections from certain trees and large shrubs seem not to damage the affected individuals and certain herbs, shrubs and climbers are readily renewable. It is important that the extractions are planned carefully and monitored closely to assess whether harvests are sustainable. Should the monitoring show that some extractions are not sustainable, collections of the particular species should be reduced or avoided.

Actions

The lists of collected species produced by the licensed medicinal plant collectors should be checked annually by Forest Division staff, and a plan for monitoring the extraction should be produced. The simplest and most practical method for this would be yearly walks through the forest with certified persons informing on the availability of all species on the legal extraction list. On the other end of the effort scale would be more detailed population studies to monitor the sustainability of the extractions of all or some of the rarer plant species found in the reserve. Investigations should be carried out in areas along the boundary where settlements are abundant and the extractions are occurring. Monitoring should continue as long as medicinal plant extractions are allowed.

Outputs

The output of this activity will depend on the method chosen for monitoring. The most straightforward would be the comparison of extractions recorded by certified collectors. Compared with previous recordings this could indicate population trends for harvested species. Alternatively harvest yield surveys could be carried out. In similar habitat, plots could be established in harvested and untouched sites. Comparing results with previous recordings could then monitor the abundance and regeneration of harvested species.

9.2.7 Monitoring of Land Use Patterns

Justification

New Dabaga/Ulangambi Forest Reserve is surrounded on all sides by habitats influenced by people. Monitoring of land use patterns is therefore recommended to investigate the influence of Joint Forest Management activities. This should be used to monitor the extension of natural forest areas, the development of plantation, creation of a buffer zone, extension of *Parinari* forest patches (Village Government Forests) and agricultural development.

Actions

Preferably aerial photographs should be taken every 10^{th}-20^{th} year if means are available. These photos can be used in combination with fixed point photos taken from ground level every 3^{rd} year. A number of fixed points should be chosen on the basis of suitability for monitoring of forest expansion/reduction. Fixed point photos should be taken from the exact same spot in the same direction. The points should also be easily recognisable. To facilitate this a GPS reading should be recorded together with a description of how to find the point.

Output

Aerial photos: The size of the forest reserve and all public forest fragments should be measured on the basis of aerial photographs.

Fixed point photos: Fixed point photographs of the forest reserve, buffer zone, plantations and village government forests can be used to monitor the development of tree growth. Photographs can then be compared to previously taken photos from the same point.

9.3 Summary Table of Monitoring Activities

Monitoring category	Activities	Replications	Outputs	Costs Estimated person days
Human impact	Casual disturbance observation walks.	Annually	Number of disturbance observations.	3
Forest regeneration	20 x 50m plot surveys. Visits to other regeneration facilitation sites.	Annually Annually	Number and mean dbh of trees >5cm dbh.	3
Maintenance of paths to monitoring sites	Re-cutting of paths.	Biannually	-	4
Fire	Boundary walk.	Annually	Number of fires outside and inside Forest Reserve.	4
Buffer zone	Fixed point photographs. Visits to buffer zone sites.	Annually Annually	Fixed point photos of buffer zone.	2.5
Honey production	Visits to honey production sites. Advice for beehive owners.	Annually As appropriate	Total number of beehives and number of inhabited hives.	2.5
Medicinal plant collection	Visits to certified medicinal plant collectors. Assessment of medicinal plant availability.	Annually Annually	Species and amount extracted recorded by extractor or yield surveys in plots.	4
Land use pattern	Aerial Photographs. Fixed point photographs.	Preferably every 20th year Every 3rd year	Aerial and fixed point photographs.	-

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11.0 Appendices

Appendix 8A. Lists of animals considered important for conservation in New Dabaga/Ulangambi Forest Reserve. Lists are presented for each taxonomic group and include forest dependent species, species of restricted range, species considered threatened by IUCN or CITES and species not currently described. Definitions of the presented categories can be found at the end of the tables, while the sources used for these categories can be found in the relevant sections.

Butterflies

Species	Ecological type	Conservation status	Endemism
ACRAEIDAE			
Acraea acuta acuta	×		(NE)
Acraea alicia cf uzungwae	×		(E)
Acraea cf goetzei	×		NE
DANAIDAE			
Amauris cf echeria	F		
Amauris ellioti	F		
HESPERIIDAE			
Metisella cf medea medea	F		
Metisella cf orientalis	F		
LYCAENIDAE			
Cf Anthene hobleyi	F		
Lycaena cf abboti	F		
Tuxentius cf ertli	F		NE
Uranothauma antinorii felthami	F		
Uranothauma cf delatorum	F		
Uranothauma cf heretsia virgo	F		(NE)
NYMPHALIDAE			
Antanartia dimorphica dimorphica	F		
Antanartia schaeneia dubia	F		
Charaxes acuminatus cf acuminatus	F		
Charaxes congdoni	F		NE
Issoria baumanni orientalis	×		(NE)
Neptis aurivilli cf aurivilli	F		NE
Neptis saclava marpessa	F		
Precis tugela	F		
PAPILIONIDAE			
Graphium policenes	F		
Papilio cf bromius	F		
Papilio chrapkowskii	F		
Papilio cf desmondi usambarensis	F		NE
Papilio echerioides	F		
Papilio cf fulleborni fulleborni	F		NE
Papilio pelodurus cf vesper	F		NE
Papilio phorcas cf nyikanus	F		(NE)
Papilio thuraui	F		NE
PIERIDAE			
Mylothris cf sagala	F		
SATYRIDAE			
Aphysoneura pigmentaria uzungwae	F		(NE)
Bicyclus danckelmani	F		NE
Bicyclus simulacris	F		NE
Henotesia ubenica uzungwa	O		(E)

Appendix 8A (continued)
Birds

Common name	Latin name	Ecological type	Conservation Status	Endemism
FALCONIFORMES				
Mountain buzzard	*Buteo oreophilus*	F	II	
COLUMBIFORMES				
Olive pigeon	*Columba arquatrix*	F		
Lemon (or cinnamon) dove	*Aplopelia larvata*	F		
CUCULIFORMES				
Barred long-tailed cuckoo	*Cercococcyx montanus*	F		
TROGONIFORMES				
Bar-tailed trogon	*Apaloderma vittatum*	F		
PICIFORMES				
Moustached green-tinkerbird	*Pogoniulus leucomystax*	F		
Olive woodpecker	*Dendropicos griseocephalus*	F		
PASSERIFORMES				
Blue swallow	*Hirundo atrocaerulea*	O	VU	
Green-throated (mountain) greenbul	*Andropadus chlorigula*	F		NE
Stripe-cheeked greenbul	*Andropadus milanjensis*	F		
Shelley's greenbul	*Andropadus masukuensis*	F		
Placid greenbul (=olive mountain greenbul)	*Phyllastrephus cabanisi placidus*	F		
African hill babbler	*Pseudoalcippe abyssinica*	F		
Olive-flanked robin-chat (=olive-flanked ground-robin)	*Cossypha anomala*	F		NE
(Northern) olive thrush	*Turdus olivaceus abyssinicus*	F		
Orange ground thrush	*Zoothera gurneyi*	F		
Sharpe's akalat	*Sheppardia sharpei*	F		NE
Spot-throat	*Modulatrix stictigula*	F		NE
White-chested alethe	*Alethe fuelleborni*	F		NE
White-starred robin	*Pogonocichla stellata*	F		
African dusky flycatcher	*Muscicapa adusta*	F		
Yellow-throated woodland warbler	*Phylloscopus ruficapillus*	F		
Red-capped forest warbler	*Orthotomus metopias*	F		NE
Bar-throated apalis	*Apalis thoracica*	F		
Chapin's apalis	*Apalis chapini*	F		NE
Black-lored cisticola	*Cisticola nigriloris*	×		NE
Evergreen forest warbler	*Bradypterus lopezi mariae*	F		
White-tailed crested flycatcher	*Trochocercus albonotatus*	F		
Fülleborn's (black) boubou	*Laniarius fuelleborni*	F		NE
Grey cuckoo-shrike	*Coracina caesia*	F		
Waller's starling	*Onychognathus walleri*	F		
Usambara weaver	*Ploceus nicolli*	F	EN	NE
Eastern double-collared sunbird/ Moreau's sunbird	*Nectarinia mediocris/ moreaui*	F	LR	NE
Red-faced crimsonwing	*Cryptospiza reichenovii*	F		
(Yellow-browed) streaky seed-eater	*Serinus striolatus whytii*	×		NE
Kipengere seedeater	*Serinus melanochrous*	F	LR	NE
Oriole finch	*Linurgus olivaceus*	F		

Appendix 8A (continued)

Reptiles

Species	Ecologican type	Copnservation status	Endemism
CHAMAELEONIDAE			
Chamaeleo werneri	F	II	NE
Chamaeleo tempeli	F	II	NE
Bradypodion oxyrhinum (?)	F	II	NE

Amphibians

Species	Ecological type	IUCN Status	Endemism
ARTHROLEPTIDAE			
Arthroleptis affinis	F	VU	NE
Arthroleptis xenodactylus	F	VU	NE
BUFONIDAE			
Bufo sp. nov.			
Nectophrynoides viviparus	F	VU + I	NE
HYPEROLIIDAE			
Afrixalus morerei	O	VU	E
Leptopelis vermiculatus	F	LR/nt	**NE**
Phlyctimantis keithae	×	EN	**E**

Mammals

Order and family	Species	Ecological type	Conservation status	Endemism
PRIMATES				
Colobidae	*Procolobus gordonorum*	F	VU	NE
	Colobus angolensis palliatus	F	DD	
Cercopithecidae	*Cercopithecus mitis*	F		
Galagonidae	*Galagoides orinus*	F	DD	NE
MACROSCELIDAE				
Macroscelididae	*Rhynchocyon cirnei*	O	VU	
RODENTIA				
Sciuridae	*Paraxerus lucifer lucifer*	F		(NE)
Cricetidae	*Beamys hindei*	F		
Muridae	*Lophuromys flavopunctatus*	F		
	Praomys delectorum	F		
HYRACOIDEA				
Procavidae	*Dendrohyrax validus*	×	VU	NE
ARTIODACTYLA				
Bovidae	*Cephalophus harveyi*	F		
	Cephalophus spadix	F	VU	NE
	Neotragus moschatus	×	LR/cd	

Ecological type: F = Forest dependent, × = found in forests and also other habitats, O = normally regarded as a non-forest species.
Conservation status according to IUCN (Hilton-Taylor, 2000): VU = vulnerable; LR/cd = lower risk, conservation dependent; LR/nt = lower risk, near threatened; DD = data deficient; I = CITES appendix I; II = CITES appendix II.
Endemism: E = Endemic: occurs only within the Udzungwa Mountains; NE = near endemic, distribution limited to the Eastern Arc, Tanzania and northern Malawi.
Letters in brackets refer to subspecies.