FRONTIER-TANZANIA Technical Report No. 16

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COASTAL FOREST RESEARCH PROGRAMME

STATUS REPORTS FOR 7 COASTAL FORESTS IN COAST REGION, TANZANIA

G.P CLARKE & L.K. STUBBLEFIELD

AUGUST 1995

THE SOCIETY FOR ENVIRONMENTAL EXPLORATION
AND
THE UNIVERSITY OF DAR ES SALAAM

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The Society for Environmental Exploration
The Society is a non-profit making company limited by guarentee 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 cooperating countries.

The University of Dar es Salaam
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 FRONTIER-TANZANIA Project and Series of Reports
The Society and the University have been conducting collaborative research into environmental issues since July 1989, under the title of the Frontier-Tanzania Project. The Project has to-date involved over 500 people from both Tanzania and overseas. Field research is being undertaken on a variety of habitats in Tanzania's coastal zone, chosen for their high biological interest and conservation value. Habitats under study include mangroves, coral reefs and Coastal Forests. The projects have been developed with the assistance and collaboration of Regional and District Authorities and of The Ministry of Tourism, Natural Resources and Environment. The findings of the Project are summarised in a series of reports published jointly by the University of Dar es Salaam and the Society. More formal scientific papers resulting from research are published in appropriate journals, thus ensuring wide dissemination of the information.

The Coastal Forest Research Programme
The Coastal Forests of Tanzania comprise small and geographically isolated forest remnants supporting large numbers of endemic and near-endemic plants and animals. The forests were once extensive but have been largely removed for farmland. Their status, distribution and biological character were extremely poorly known prior to 1989 when the Frontier-Tanzania Coastal Forest Research Programme was formed with the aim of surveying these forest and describing their conservation importance. To date over 70 sites have been identified of which 15 have been studied in depth. For each study site the project produces vegetation maps, and collects plants, vertebrates and invertebrates with studies of the ecology of key species. It is intended that this information be used by conservationists and foresters to secure a sustainable long-term development of Tanzania's Coastal Forests.

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Foreword to the Frontier Tanzania series of reports.

Global concern over the conservation of the world's biological diversity reached a new peak in June 1992, when many of the world's Heads of State signed the Biodiversity Convention in Rio de Janeiro at the Earth Summit (UNCED).

However, an accurate knowledge of the earth's biological richness is lacking in many countries. Without detailed information on the flora and fauna of a region its importance for the conservation of biological diversity remain undefined.

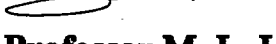
In Africa there are many areas of exceptional biological richness which have scarcely been studied. Even basic data on the status of resources may be lacking or outdated.

The Frontier-Tanzania project, a collaborative venture of the Society for Environmental Exploration and the Faculty of Science of the University of Dar es Salaam is tackling this problem head on.

In 1989 Tanzanian scientists identified ecosystems in coastal Tanzania which were in particular need of study because of their biological richness and importance. Since that time, the Frontier-Tanzania project has provided the means and the man-power to investigate these sites, catalogue their importance and suggest management strategies for their conservation. Coastal monsoon forests, the coral reefs of Mafia Island, the mangroves and sediments of the Rufiji Delta, and the vegetation of the Mikumi National Park have been investigated over the past three years.

All of these projects have generated large quantities of new data on the biological importance of the sites and their place alongside similar systems elsewhere in Africa. This research has allowed biological-diversity priorities to be better determined and management actions to be suggested. Many of the recommendations are under consideration by the Tanzanian Government.

This report series forms a contribution to the Frontier-Tanzania project and to the knowledge of the biological diversity of Tanzania. We warmly endorse its publication and hope that many more reports and papers result from this collaborative project, and that they help to assure that the future of the biological heritage of these strategic sites is conserved.



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Vice Chancellor
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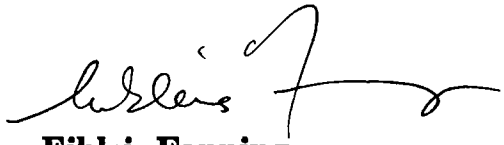

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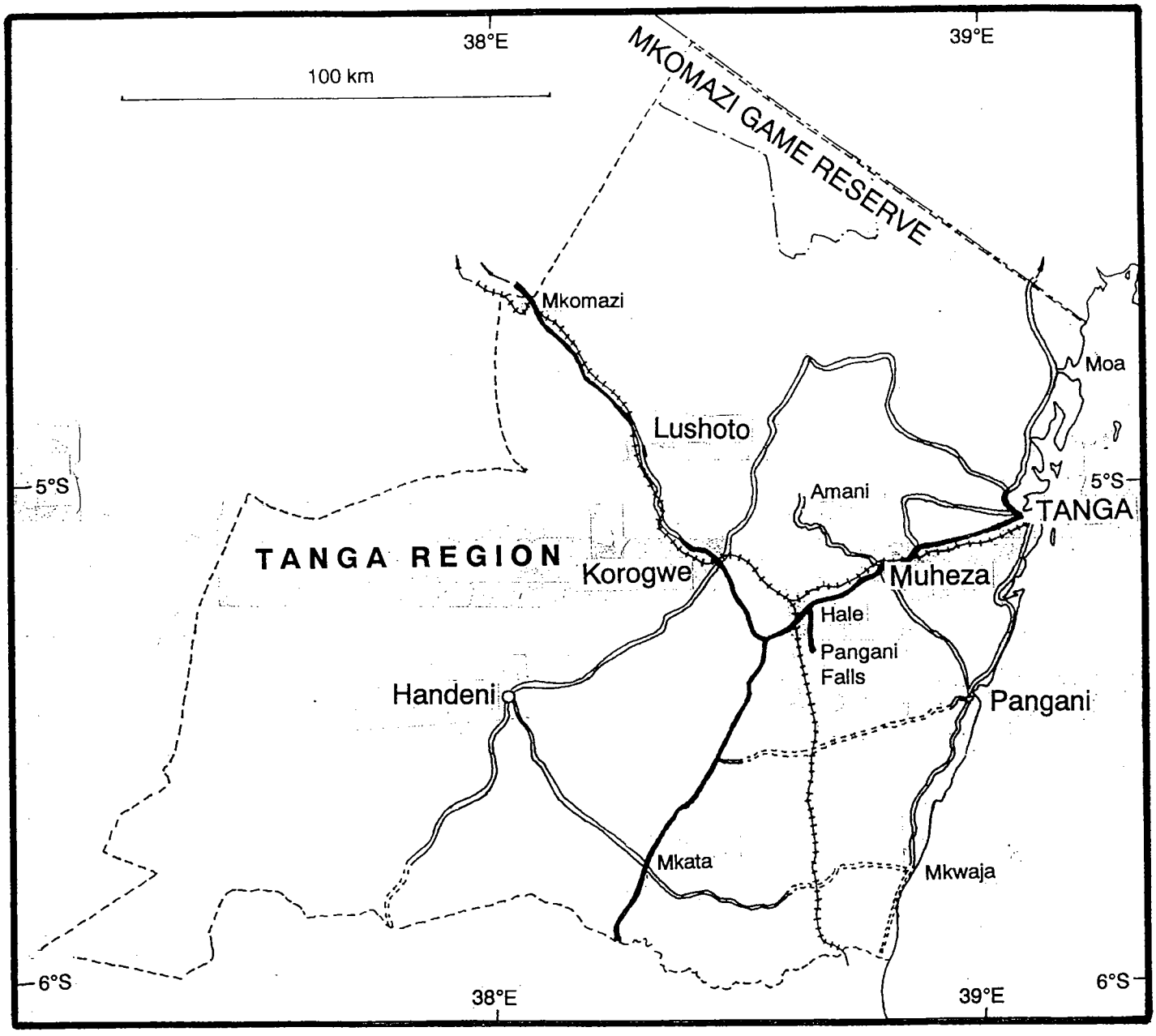
38°E
39°E
100 km
MKOMAZI GAME RESERVE
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Moa
Lushoto
5°S
Amani
TANGA
TANGA REGION
Korogwe
Muheza
Hale
Pangani
Falls
Handeni
Pangani
Mkata
Mkwaja
6°S
38°E
39°E
6°S

CONTENTS

INTRODUCTION

This report forms part of a set of three volumes summarising the findings of the Frontier-Tanzania Coastal Forest Research Programme during the first phase of its operations from July 1989 to April 1994. During this period visits ranging from two days to six months were made to 27 Coastal Forests, where general biological surveys were conducted and assessments made of the extent and condition of the forests. Apart from the forest on Chumbe Island (which is dealt with separately - see Stubblefield & Bayliss, 1994), all of the other forests are included in the three Status Report volumes, which cover each of the administrative regions visited - Tanga Region, Coast Region and Lindi Region, with Pande Game Reserve in Dar es Salaam Region and Kimboza Forest Reserve in Morogoro Region included as an appendix to the Coast Region volume. Some of the information for the forests presented here has been condensed from the more detailed *Site Report and Conservation Evaluation* documents produced as internal reports by the Frontier-Tanzania Coastal Forest Research Programme. Additional information from collections and visits by other scientists has been added where available.

These Status Reports are intended to present a concise summary of the key facts on the biological values, status, recent history and current management of the forests. It is hoped that these reports will be of assistance to conservationists for evaluating the importance of the forests, and will provide the necessary information for setting plans to support their future management. Final editing of the Status Reports was carried out under a separate project set up by Sarah Woodward and Jason Rubens of the Society for Environmental Exploration. Funding for the final editing and publishing of these reports was generously provided by NORAD through the Royal Norwegian Embassy of Dar es Salaam, with additional assistance from the British Council. Earlier drafts for the forests covered in this volume were produced by Michael Brewin, Anya Cockle, Paul Matthews and Paul Smith as well as by the editors. A draft version of the three volumes of the Status Reports was reviewed by Prof. K.M. Howell of the Department of Zoology & Marine Biology, University of Dar es Salaam.

The Coastal Forest Research Programme has been assisted throughout its operations by a number of taxonomists who have identified the material collected. Particular thanks to Dr. D. Kock of the Forschungsinstitut Senckenburg for identifying rodent and bat specimens; to Dr. P. Jenkins of the British Museum of Natural History for identifying shrew specimens; to Dr. D.G. Broadley of the Natural History Museum of Zimbabwe for identifying reptile specimens; to Prof. J.C. Poynton of the British Museum of Natural History for identifying amphibian specimens; and to Dr. K. Vollesen of the Royal Botanic Gardens, Kew for identifying plant specimens. Notes on bird identifications were provided by N.E. Baker of BirdLife-Tanzania.

The Status Report Format

The Status Reports follow a similar format to the 'Management Summaries' (Lovett & Pocs, 1993) as used by the Catchment Forestry Project of the Forestry and Beekeeping Division, Ministry of Tourism, Natural Resources and Environment, Tanzania, but have been expanded to provide more detailed information on the biological values of the forests. In addition, the Management Proposals section has been replaced with a commentary on the Conservation Issues relevant to each forest, since the purpose of the Status Reports is to provide a source of information rather than a management formula for the forests concerned.

The biological information presented in these Status Reports is not definitive and reflects the level of collection and study carried out at each site, as well as the time of year in which the research was conducted (collections in the dry season are generally less productive than during the rainy season).

The following approach has been adopted for the Status Reports :

Description

Name of the forest/forest reserve, with name spelt as in the official gazettement notice where applicable. Variations on the official spelling are indicated.

Administrative location of the forest/forest reserve by district and region.

Area of the forest reserve and/or forest.

Boundary Length for forest reserves only.

Status of the site, who owns/manages the forest on it.

Declaration details of forest reserves within Tanzanian (Tanganyikan) Law. Many forest reserves originally gazetted during the German administration have had to be re-declared to introduce them into the legal framework established after 1916 by the British Administration. In practice much of this was done in 1947 under Cap 132 of the forest ordinance.

Year of establishment where available for forest reserves. Details of original gazettement map or order where known.

Map information. Ordnance Survey 1:50,000 maps covering the area of the forest/forest reserve are listed. These are useful for background mapping information on features which are unmistakeable from aerial photos such as topography, rivers, roads, tracks, towns, and in most cases the smaller settlements, although a few maps have not been updated following the 'Ujamaa' villagisation programme of the early 1970s during which many settlements were moved. Where applicable notes on errors in the location of the reserve boundary are mentioned. The maps used for the reports have been traced from these Ordnance Survey maps, with the forest reserve boundaries and forest cover superimposed.

Forestry Division maps with their Jb number, scale and date. It should be noted that some of the very early maps contain errors due to the chain and compass survey method used, which can induce horizontal distance errors by failing to account for hillslopes.

Location

Latitude and longitude determined from 1:50,000 Ordnance Survey maps.

A general description of the location of the forest/forest reserve in the context of the surrounding landscape with elevation/altitudinal range and rough notes on the location of forest areas within the forest reserves where applicable. Approximate distances in kilometres from the nearest towns and villages.

Information on how to reach the forest/forest reserve by road, with notes on road conditions.

Information on how to reach the forest/forest reserve by public transport.

Soils

A brief description of the soils in the forest/forest reserve using the UNESCO soil classification system where samples have been taken.

Climate

Estimates of rainfall from the nearest available rainfall station.

Vegetation

Vegetation description following the UNESCO *Vegetation of Africa* classification (White, 1983) for the main formation types such as grassland, woodland, forest etc., as well as for the formation sub-types such as scrub forest, transition woodland etc.

A brief list of tree species, with names that follow the nomenclature of the *Flora of Tropical East Africa* for those families that have been published. Tree species from published sources (where available) and from collections by the Frontier-Tanzania Coastal Forest Research Programme (specimens identified at the Royal Botanic Gardens, Kew).

Catchment Values

A brief description of the catchment values of the forest/forest reserve is given, based on qualitative observations of slopes, streams and rivers in the forest/ forest reserve.

Timber Values

A brief description of the timber values of the forest/forest reserve is given, based on the occurrence of tree species currently in demand for commercial timber.

Biodiversity

A brief note is provided on the level of biological study carried out in the forest, to give an indication of how representative the list of rare and endemic species is compared with a list that would be produced by an exhaustive biological survey. For most of the forests it is expected that further study will increase the known biological value of that forest, through the discovery of additional regional and local endemic species.

In order to keep the Status Reports as concise as possible, it has been decided to limit the cited biological values to endemic species only, since in many cases over 75% of the flora and fauna of a Coastal Forest is composed of species that are widespread in distribution. Thus records of the occurrence of such species are of little value to conservationists. Information on the endemic vertebrate species occuring in each forest is taken from draft chapters of Burgess & Clarke (ined.), Burgess & Muir (1994) as well as from the data sheets from the Frontier-Tanzania collections and of other collections managed by Prof. K.M. Howell of the Department of Zoology and Marine Biology, University of Dar es Salaam. Information on endemic plants is taken from all the hitherto published volumes of the *Flora of Tropical East*

Africa, together with more recent information from the Frontier-Tanzania botanical collections, from Robertson & Luke (1993), Bidgood & Vollesen (1991), Beentje (1988) and Luke (1988).

Endemic species are cited in order of their range; single site endemics are listed first as the most important since the loss of that particular forest would lead to the extinction of those species. Area endemics are listed for the plants section where applicable for the three areas where there appears to be a local flora that is restricted to the nearby forests - three such areas are cited for the forests around Dar es Salaam, for the forests inland of Lindi and for the forests in the lower Pangani River basin. Coastal Forest endemics are listed for species that are limited to the Coastal Forests (including those in southern Somalia, Kenya, Mozambique, southern Malawi and eastern Zimbabwe), although for the plant species this list is resricted to those species that are only known from fewer than seven Coastal Forests. An exhaustive survey of botanical records in the major herbaria of the world would be required to generate a full list of Coastal Forest plant endemics for each forest.

Specimen collection numbers/citations are listed where known. The vertebrate specimens collected by the Frontier-Tanzania Coastal Forest Research Programme have a KMH number as they form part of Prof. K.M. Howell's collection series.

Information on the biological values has been limited to the vertebrate orders and the vascular plants, since it is usually only these biological groups that are of interest to conservationists in setting priorities. Endangered and commercially threatened species that are present in the forests/forest reserves are also listed (threatened birds according to the latest BirdLife list of endangered species (Collar *et al.*, 1994); threatened mammals, reptiles and amphibians according to the latest IUCN (Groombridge, 1993) and CITES (1995) lists). Only CITES Appendix 1 species (on which there is a prohibition on international trade) are listed. CITES Appendix II species which are found in the Coastal Forests include the following :

Mammals :	All cats (Felidae), all primates, and all Pteropus bats (i.e. *Pteropus seychellensis* on Mafia Island).
Reptiles :	All tortoises (Testudinae), all pythons (Boidae), all monitor lizards (Varanidae), and the chameleon genera *Bradysiphon* and *Chamaeleo*.
Plants :	All Euphorbias (*Euphorbia* spp.), all Aloes (*Aloe* spp.), all milkweeds of the genus *Ceropegia*, and all orchids [Orchidaceae]. Refer to CITES (1995) for further details on the levels of restrictions regarding export of these plants.

Mammal names follow Wilson & Reeder (1993).

Human Impacts

A brief description of current human disturbance and pressure on the forest is given, together with notes on former disturbance where known.

Conservation Issues

A summary of the present management activities being carried out in the forest is given, together with the present and expected future threats to the forest. Although a number of conservation strategies exist which would be more or less common to all the forests (such as the provision of extra guards, clearing the boundaries, replanting cleared areas etc.) these have been omitted since the precise choice of a conservation plan for the forests is considered to be outside the scope of this report, and in any case is dependant on the level of funds available and of the conservation objectives of the management body.

Literature

Literature on the biological values of the forest is listed as far as possible with a commentary summarising the content of that literature. General literature on the Tanzanian Coastal Forests, such as Burgess & Muir (1994) is omitted, as a list of these sources of information is provided in the next section.

SOURCES OF ADDITIONAL INFORMATION

Additional information on each biological group listed in the Status Reports is available from Burgess & Muir (1994) as well as from the following sources :

Birds
A full list of forest bird species found in each of the forests (with the exception of Ruawa and Ndimba) will be published under the following reference :

Mlingwa, C.O.F., Waiyaki, E., Bennun, L. & Burgess, N.D. (ined.) Birds. Chapter 8 in : Burgess, N.D. & Clarke, G.P. (eds.) *Coastal Forests of eastern Africa: status, history, biodiversity and conservation.*

Further information is available from the Tanzanian Bird Atlas database being compiled by Neil & Liz Baker, P.O. Box 23404, Dar es Salaam, Tanzania; and after 1996 from the Important Bird Areas project being carried out by the Wildlife Conservation Society of Tanzania (P.O. Box 70919, Dar es Salaam, Tanzania) in partnership with BirdLife International of Cambridge, U.K.

Mammals
A full list of mammal species found in each of the forests (with the exception of Ruawa and Ndimba) will be published under the following reference :

Burgess, N.D. & Cockle, A. (ined.) Mammals. Chapter 7 in : Burgess, N.D. & Clarke, G.P. (eds.) *Coastal Forests of eastern Africa: status, history, biodiversity and conservation.*

Data sheets of mammal specimen collections as well as of observations by the Frontier-Tanzania Coastal Forest Research Programme are available for reference at the Department of Zoology & Marine Biology, University of Dar es Salaam and at the offices of the Coastal Forest Research Programme in Dar es Salaam (Plot 709, Mfaume Road, Upanga).

In future further data will be available from a biological inventory database being set up at the Department of Zoology & Marine Biology of the University of Dar es Salaam under funding by the FAO/GEF biodiversity support project. This database will incorporate the Frontier collections as well as those by other collectors.

Reptiles
A full list of the forest-dependant reptile species found in each of the forests (with the exception of Ruawa and Ndimba) will be published under the following reference :

Broadley, D.G. & Howell, K.M. (ined.) Reptiles. Chapter 9 in : Burgess, N.D. & Clarke, G.P. (eds.) *Coastal Forests of eastern Africa: status, history, biodiversity and conservation.*

Data sheets of reptile specimen collections as well as of observations by the Frontier-Tanzania Coastal Forest Research Programme are available for reference at the Department of Zoology & Marine Biology, University of Dar es Salaam and at the offices of the Coastal Forest Research Programme in Dar es Salaam (Plot 709, Mfaume Road, Upanga). A further copy of these notes is lodged at the Natural History Museum of Zimbabwe, P.O. Box 240, Bulawayo, Zimbabwe.

In future further data will be available from a biological inventory database being set up at the Department of Zoology & Marine Biology of the University of Dar es Salaam under funding by the FAO/GEF biodiversity support project. This database will incorporate the Frontier collections as well as those by other collectors.

Amphibians
A full list of the amphibian species found in each of the forests (with the exception of Ruawa and Ndimba) will be published under the following reference :

Poynton, J. (ined.) Amphibians. Chapter 10 in : Burgess, N.D. & Clarke, G.P. (eds.) *Coastal Forests of eastern Africa: status, history, biodiversity and conservation.*

Data sheets of amphibian specimen collections by the Frontier-Tanzania Coastal Forest Research Programme are available for reference at the Department of Zoology & Marine Biology, University of Dar es Salaam and at the offices of the Coastal Forest Research Programme in Dar es Salaam (Plot 709, Mfaume Road, Upanga). A further copy of these notes is lodged at the British Museum of Natural History, Cromwell Road, London, SW7 5BD, UK.

In future further data will be available from a biological inventory database being set up at the Department of Zoology & Marine Biology of the University of Dar es Salaam under funding by the FAO/GEF biodiversity support project. This database will incorporate the Frontier collections as well as those by other collectors.

Vascular Plants

Further records of some of the vascular plants collected at the various forests are available from the published editions of the *Flora of Tropical East Africa* (FTEA) where type specimens and an example specimen are usually cited for each of the former administrative provinces of Tanzania. This means that in practice much information is available for some of the forests from which many types have been collected (such as Litipo/Lake Lutamba and Pugu), and for certain forests which are often cited as examples of the occurrence of a species in the area (e.g. Rondo). Complete lists for each forest can however only be generated by compiling data from all plant collections ever undertaken, which would require an examination of specimens deposited at the Berlin, Kew, East African (Nairobi) and Dar es Salaam herbaria, and even then the resulting species lists would very much reflect the level of collecting intensity at each forest. Only Pugu Forest near Dar es Salaam has been studied to the level where a representative species list would be available, which would amount to some 2000 species (L.B. Mwasumbi, pers. comm.).

Copies of the FTEA are available from the Royal Botanic Garden, Kew, Richmond, Surrey, U.K.

General sources of information

The following references contain general notes on the Coastal Forests of Tanzania and information on their status and biological values :

Burgess *et al.* (1992) - General information on some Tanzanian Coastal Forests.

Burgess *et al.* (1993) - General information on some Tanzanian Coastal Forests.

Burgess & Muir (1994) - summarises the information gained on the status and biological values of the Coastal Forests from the results of a workshop on Coastal Forests held at the University of Dar es Salaam in 1993.

Hawthorne (1993) - summarises the findings of the author's PhD study on Tanzanian Coastal Forests.

Kingdon, J. (1990) - includes a chapter on the Coastal Forests which is useful background reading.

Sheil (1992) - General information on some Tanzanian Coastal Forests with a case study of Kiwengoma forest.

BACKGROUND NOTES ON THE FORESTS OF TANGA REGION

Although Tanga Region is the smallest of the regions covered by the three volumes of the Status Reports, the region contains many more forest reserves than either Coast Region or Lindi Region. Most of these forest reserves contain montane and submontane forest that can be classified as belonging to the Afromontane archipelago-like regional centre of endemism by White (1983). Coastal Forest is predominantly found in lowland areas close to the coast.

Most of Tanga Region's forest reserves are located in the East and West Usambara Mountains, and are administered by the East Usambara Catchment Forest Project and by the Magamba Forest Project respectively. The remaining forest reserves cover outlying hills of the Usambara Mountains and the North Nguru Mountains, with a few reserves found at lower altitudes nearer the coast. Most of these reserves have recently been visited by biologists, especially by Lovett & Pocs (1993) as part of a botanical appraisal conducted for the Catchment Forestry Project based in Tanga.

The 7 Coastal Forests listed in this volume of the Status Reports include the most important known Coastal Forests of Tanga Region outside those in the lowland areas of the East Usambara mountains (where fieldwork is currently being undertaken by the second phase of the Frontier-Tanzania Coastal Forest Research Programme). Other Coastal Forests in Tanga Region (outside the East Usambaras) include the following :

Muheza District

A small patch of Coastal Forest is present near the main Tanga to Mombasa road 1 km south of the border post at **Horohoro**. This forest has been extensively damaged by fuelwood collection for salt production.

Coastal Forest is cited from the garden of the Manager's house on the **Mtotohovu** sisal estate to the north of Moa. This forest is the type locality for *Mkilua fragrans* Verdc., an endemic Coastal Forest plant genus.

Large tracts of *Brachylaena huillensis* forest are present to the north of the East Usambara mountains to the Kenya border. The extent, importance and location of these forests are yet to be determined, but they are reported to be heavily exploited for the *Brachylaena* by people from Kenya (who cross the border illegally to obtain the wood).

About 2 square km of scrub forest are present on **Yambe Island** near Tanga with emergent baobabs *Adansonia digitata* over a dense forest/thicket with a canopy to 6 m.

Kwani Forest Reserve adjoins to the immediate south-west of the Tongwe Forest Reserve and still contains some 6 km^2 of natural forest. More information on this forest is contained as an addendum to the Pangani Falls Status Report.

Steinbruch Forest Reserve, Gombero Forest Reserve, Bwiti Forest Reserve, Magogoni Forest Reserve have all been revoked as forest reserves and are currently government land without status.

Kolekole Forest Reserve on the Pongwe to Tongoni road has been planted with teak but still contains some natural forest.

Pangani District

The **Bushiri, Mwera, Kilimanguido** and **Sakura** sisal estates near Pangani all contain remnant patches of Coastal Forest, and the forest/thicket at Kilimanguido, as well as the riverine forest near the village of Langoni within the Mwera estate are discussed in Hawthorne (1984, pp. 209-214). A number of rare plant species have been found in these forests.

The Tanga Catchment Forest Office is presently proposing the gazettement of forest patches at **Kibubu, Jipe** and **Misakazi** (in between the Msumbugwe and Garafuno Forest Reserves).

Handeni District

A large patch of dry scrub forest is present to the south of the army base at **Mgambo**, on the old road from Pangani to Kabuku. Part of this forest reaches the main Dar es Salaam to Tanga road along a river a few miles south of Kabuku, where the botanist Faulkner has made some collections.

Patches of Coastal Forest occur along the railway line from Tanga to Dar es Salaam south of Gendagenda, near **Mkalamu.**

Magambazi Forest Reserve, Mtunguru Forest Reserve, Kwasumba Forest Reserve and **Handeni Hill Forest Reserve** all contain Coastal Forest. More details on Handeni Hill Forest Reserve are contained in Lovett & Pocs (1993, p. 115).

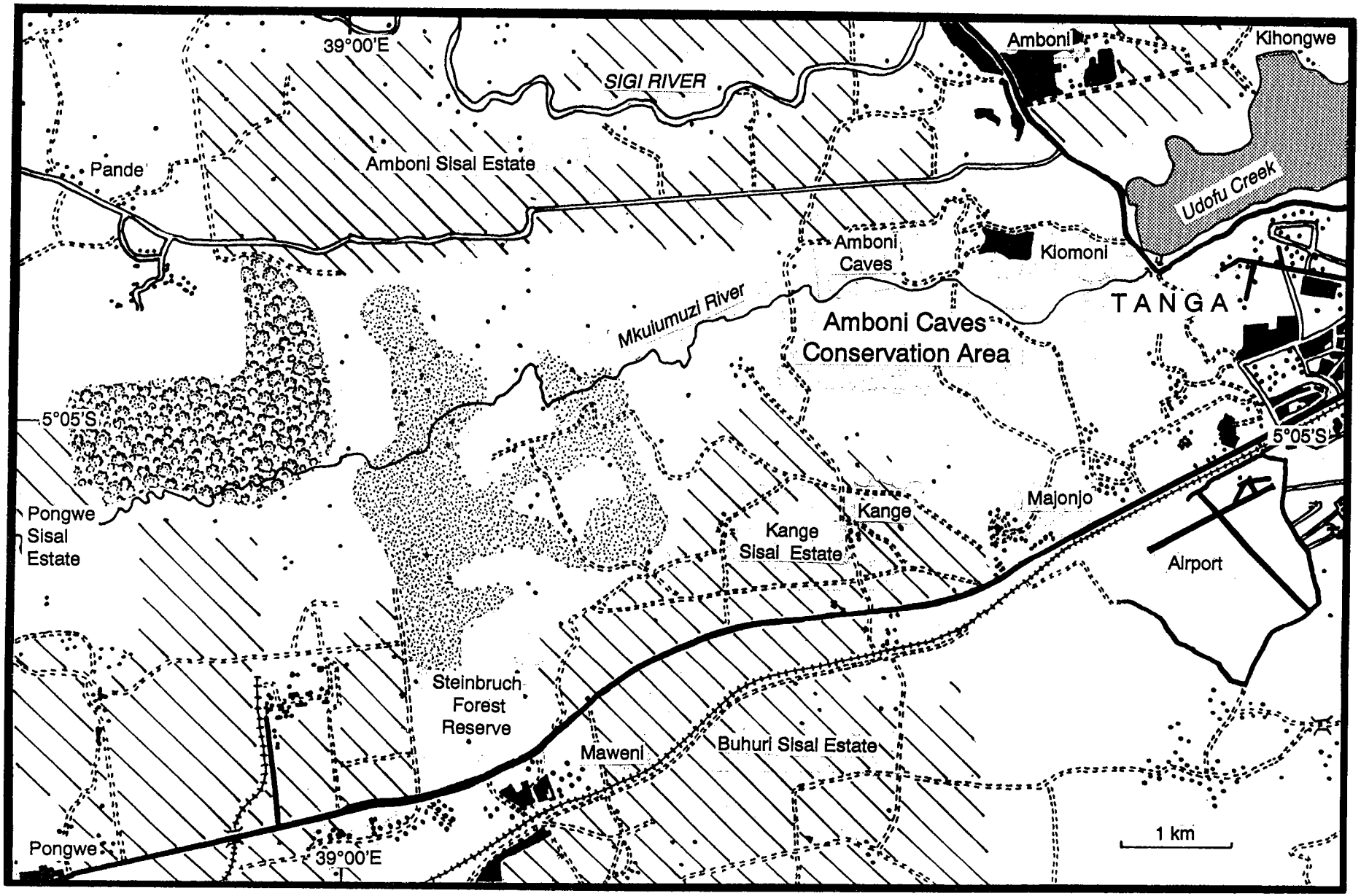
Kwediboma Forest Reserve, Mkuli Forest Reserve and **Pumula Forest Reserve** in the North Nguru Mountains area all contain elements of Coastal Forest vegetation in the drier forest types at the lower altitudes, as indicated by the presence of *Scorodophloeus fischeri.* These forests may be intermediate between Afromontane and Zanzibar-Inhambane types. For more details on these reserves see Lovett & Pocs (1993, pp. 119-129).

Lushoto District

Bombo West Forest Reserve contains Coastal Forest/Thicket with *Cynometra* sp. and *Brachylaena huillensis, Croton* sp., *Euphorbia* sp., *Teclea* sp. and *Uvaria* sp. More information is contained in Lovett & Pocs (1993, p. 135).

Mweni-Gombelo Forest Reserve contains dry lowland Coastal Forest and riverine forest with *Scorodophloeus fischeri, Antiaris toxicaria, Sterculia appendiculata, Milicia excelsa, Parkia filicoidea, Sorindeia madagascariensis, Trilepesium madagascariensis, Malacantha alnifolia, Cola scheffleri* and *Bequaertiodendron natalense.* More information on this reserve is contained in Lovett & Pocs (1993, p. 147).

Migombani Forest Reserve contains lowland groundwater forest that can be expected to include some Coastal Forest species, especially in the shrub layer. *Bombax rhodognaphalon* is present, and more information on this reserve is contained in Lovett & Pocs (1993, p. 145).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SIGI RIVER
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Amboni
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Amboni Caves
Conservation Area
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Forest
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AMBONI CAVES AND TANGA LIMESTONE FORESTS

INCLUDING THE MSITU WA MBOGO FOREST

DESCRIPTION

NAME: Amboni Caves and Tanga Limestone forests (including the Mkulumuzi/Kanga and Sigi Gorges). Tanga Municipality, Tanga Region, Tanzania.

A further forest patch to the west is known as the Msitu wa Mbogo forest Muheza District, Tanga Region, Tanzania.

AREA: Approximately 350 ha (3.5 sq. km) of forest, degraded forest and evergreen thicket.

BOUNDARY: LENGTH Approximately 4 km around the Amboni Caves Conservation Area.

STATUS: Amboni Caves Conservation Area protected by the Protection of Monuments (Amboni Caves) Order, 1937, amended 1954. Area originally protected during the German administration.

Areas outside the conservation area are currently government land without protected status. A part of this area was formerly protected within the Steinbruch Forest Reserve, which was originally gazetted during the German administration, but has now been degazetted.

MAPS: Ordnance Survey topographic map 1:50,000 Series Y742
Sheets 130E/1 'Tanga' of 1990, mapped from aerial photos of 1982 & 1983.
130/2 'Muheza' of 1989, mapped from aerial photos of 1982 & 1983.

LOCATION

Grid Ref: 5° 04'S - 5°06' S, 39°00'E - 39°03' E

Elevation: Sea level to 80 m a.s.l.

The Amboni Caves and Tanga Limestone forests occur in an area of karst limestone outcrops to the immediate west and north-west of the city of Tanga. Forest patches exist along the Mkulumuzi and Sigi river valleys, becoming more extensive further west where they extend onto the limestone plateau to the north of the former Steinbruch Forest Reserve.

Access is by road from the Tanga - Mombasa road. For access to the main forest block (Msitu wa Mbogo) turn left 5 km after Tanga onto the B121 road to Mjessani. Park the vehicle 5.5 km along this road and walk south along paths for 2 km to reach the river. For access to Amboni Caves forest patches take the left turning to Kiomono village 4 km after leaving Tanga on the main road to Mombasa. The road runs through the village and down to the caves. Park and proceed on foot along the river to reach the other forest patches further up-river.

All sites can be reached directly from Tanga by foot within two hours.

SOILS

Shallow reddish-brown sandy clays on the ridges above the river gorges. High nutrient content where covered by vegetation.

Soils of the lower slopes are deeply weathered colloidal secondary clays. These soils are baked hard and are susceptable to erosion in exposed areas.

CLIMATE

The Amboni Caves and Tanga Limestone Forests are influenced by tropical East African oceanic temperatures. The average annual temperature is 26°C, and no month has a mean temperature below 23.5°C. It is coolest between July and September.

The nearest rainfall station is at the Tanga Meteorological Station (5°03'S, 39°03'E, 60 m altitude), where an average of 1206 mm of rainfall per year has been recorded for the 29 years up to 1973, with January and February having a monthly average of less than 50 mm rainfall during this period. A peak annual rainfall of 2016 mm and a minimum annual rainfall of 815 mm has been recorded between 1950 and 1970 from this rainfall station.

VEGETATION

Most of the original vegetation of the Tanga Limestone area has been cleared during the last 100 years. Only a few remnants of the natural vegetation remain, and these can be grouped into three main types :

Dry Forest [Zanzibar-Inhambane undifferentiated forest (*sensu* White, 1983)]

Small patches of the original dry forest remain which are dominated by *Scorodophloeus fischeri* and *Cynometra webberi*. Other tree species include *Pycnocoma littoralis, Nectaropetalum zuluense, Sterculia appendiculata, Pandanus rabaiensis, Aristogeitona monophylla* and *Ricinus communis*. Hawthorne (1984) describes an assemblage of *Lecaniodiscus fraxinifolius, Combretum schumannii, Sorindeia madagascariensis* and *Adansonia digitata* with *Sterculia appendiculata* and *Acacia clavigera* above both the Mkulumuzi and the Sigi River gorges.

Riverine Forest [Zanzibar-Inhambane undifferentiated forest (*sensu* White, 1983)]

Moister forest is found in the river valleys with many of the usual widespread riverine tree species such as *Barringtonia racemosa* and *Ficus sycomorus, Ficus scassellati, Ficus sansibarica, Rauvolfia mombasiana, Khaya anthotheca, Sorindeia madagascariensis* and *Tabernaemontana ventricosa*. Other trees include *Acacia seyal* and *Rinorea elliptica*.

Thicket [Zanzibar-Inhambane evergreen thicket (*sensu* White, 1983)]

Some of the previously disturbed and cleared areas are regenerating as secondary thicket with scattered baobabs *Adansonia digitata* and the occasional relict forest patch. Typical thicket species include *Zanthoxylum chalybeum, Bridelia cathartica* and *Magaritaria discoidea*.

TIMBER VALUES

Few or no commercially valuable timber species are found in the remaining patches of forest. Most trees are currently only exploited for charcoal.

BIODIVERSITY

The easy access to the Amboni Caves and Tanga Limestone forests, along with their proximity to a large town, has enabled many biologists to visit. Botanical collections by Verdcourt, Bogner, Eggeling, Faulkner, Hawthorne, Grey-Wilson, Carmichael, Cribb, Peter, Volkens, Drummond & Hemsley, Harris and others are recorded (Polhill, 1988). Bats have been collected by Howell & Easton in 1973. Bird surveys have been carried out by Loveridge and by the Danish ICBP expeditions. A brief general biological survey was carried out by the Frontier-Tanzania Coastal Forest Research Programme in 1992, followed by further bat collections in 1993.

Birds

55 species of bird have been recorded, of which 18 are forest species (Faldborg *et al.*, 1990; Matthews, 1995). A full list of these bird species is given in Matthews (1995).

BirdLife listed species - Plain-backed Sunbird *Anthreptes reichenowi* [BirdLife Near-threatened].

Mammals

16 mammal species have been recorded from collections and observations by Frontier-Tanzania, including 8 bat species [11 specimens from over 200 captures] and 3 rodent species [6 specimens collected from 580 trap nights]. 7 further bat specimens have been collected by Howell & Easton.

Coastal Forest/Eastern Arc endemics - Horseshoe Bat *Rhinolophus* sp. nov. (Specimen KMH 7673) Known only from the Amboni Caves and the East Usambara Mountains.

Reptiles

14 reptile species are recorded from collections by Frontier-Tanzania as well as by Loveridge (1944), including 3 forest species [3 specimens collected by Frontier-Tanzania].

Amboni Caves endemic - Dwarf Gecko *Lygodactylus* sp. nov. A. (Specimen KMH 7677). To be cited by Pasteur (in press).

CITES/IUCN species - Nile Crocodile *Crocodylus niloticus* [CITES Appendix 1] (Obs.).

A number of early collections cited as Tanga but not re-collected here may originally be from the Amboni Caves and Tanga limestone forests. These species include the Tanga Blind-Snake *Typhlops platyrhynchus* (known only from the type collection), the Green Keel-bellied Lizard *Gastropholis prasina* (known from Coastal Forests of SE Kenya and NE Tanzania as well as the East Usambara Mountains), the Gecko *Urocotyledon wolterstorffi* which is only elsewhere known from the forests on the East Usambara and Uluguru Mountains, and a record for Werner's Tree-snake *Dipsadaboa werneri* known only elsewhere from the Usambara Mountains (Broadley & Howell, 1991).

Amphibians

11 species are recorded by Loveridge (1944). 9 specimens have since been collected by Frontier-Tanzania. No rare species have yet been found.

Plants

89 species of plant have been recorded (Hawthorne, 1983; Verdcourt 1952), and these are listed by Matthews (1995).

Steinbruch endemic - *Tricalysia elegans* Robbrecht [Rubiac.] From the Gorge area, cited in FTEA.

Coastal Forest endemics - *Isoglossa anisophylla* [Acanthac.] Steinbruch and 3 other sites in NE Tanzania. Cited in *Kew Bulletin* **40**, 4.
Psilotrichum fallax C.C. Townsend [Amaranthac.] 'Kange Gorge and Pande' and 3 sites in Kenya, where it is considered rare. Cited in FTEA.
Monanthotaxis faulknerae Verdc. [Annonac.] Amboni estate and 3 other sites. Cited in FTEA.
Micrococca scariosa Prain [Euphorbiac.] Amboni Caves and 5 other sites. Cited in Beentje (1988).
Monadenium crispum N.E. Br. [Euphorbiac.] Kange Gorge and 2 other sites between the Mkulumuzi and the Pangani Rivers. Cited in FTEA.
Allophylus zimmermannianus F.G.Davies [Sapindac.] Sigi River & 2 other sites. Cited in Beentje (1988).

Coastal Forest/Eastern Arc endemics - *Saintpaulia diplotricha* B.L. Burtt [Gesneriac.] Mkulumuzi River Gorge and East Usambara Mountains only. Cited in Johannson (1978).
Saintpaulia gesneriana H.Wendl [Gesneriac.] Amboni Caves, Kiwengoma Forest & Udzungwa Mountains only. Cited in Johannson (1978).
Saintpaulia intermedia B.L. Burtt [Gesneriac.] Sigi River Gorge & East Usambara Mountains only. Cited in Johannson (1978).

CITES listed plant - *Encephalartos hildebrandtii* A.Br. & Bouche [Zamiac.] CITES Appendix 1.

CATCHMENT VALUES

The main catchment for the Mkulumuzi and Sigi Rivers are in the East Usambara Mountains, but forest cover along the lower courses of these rivers prevents soil erosion which could lead to the siltation of the river.

HUMAN IMPACTS

The forests of the Tanga Limestone area have been extensively disturbed due to their proximity to the city of Tanga (the third largest city in Tanzania in 1995, after Dar es Salaam and Mwanza).

Charcoal Production

Tree felling for charcoal production is widespread in the main forest block of Msitu wa Mbogo. The removal and burning of trees leads to considerable secondary damage to the vegetation and associated microhabitats. Current levels of exploitation appear to be unsustainable.

Firewood

Firewood removal is common (bundles are sold along the Mjessani road) and is rarely all dead wood. Most of the firewood comes from the Msitu wa Mbogo forest.

Pole Cutting

A high level of sapling cutting for building poles is noted by Matthews (1995), and few saplings remain to replace the canopy trees.

Agriculture

Clearance along the river banks for the planting of spinach, maize, oranges and bananas is common along the rivers. The forest patches are surrounded by cultivation and are being continuously eroded to provide additional agricultural land.

Domestic livestock browse in the forests and may hinder the regeneration of the remaining forest patches.

Pitsawing

Pitsawyers' pits have been found on the north bank of the river about 2.5 km from the caves.

Limestone quarrying

Limestone quarrying is taking place to the north and east of the Amboni Caves Conservation Area. The limestone is being extracted by both large scale industrial contractors (through dynamite blasting) and by the local farmers (through removal of the karsts).

Bat guano extraction

Bat guano extraction has taken place in the past but has been discontinued.

Forestry

Plans were put forward in 1953 to plant the Steinbruch Forest Reserve with exotic fuelwood plantation tree species, and plantations of *Cassia* and teak *Tectona grandis* are now found in this area. The Steinbruch Forest Reserve has since been degazetted.

CONSERVATION ISSUES

The forest patches near the Amboni caves which have no formal protection could be included in an expanded Caves Conservation Area. This needs to be properly demarcated and illegal cultivation within the Caves Conservation boundary should be halted.

There is so little forest remaining in the Amboni Caves area that a plan has been put forward for the replanting of degraded areas with indigenous species (Matthews, 1995). This plan highlights the need for improved tourist and education facilities, to attract tourists, and to make the site a viable commercial concern.

The Amboni Caves are the largest bat roost in Tanga, and these bats may be important in controlling and keeping down mosquito numbers in Tanga.

The Amboni Caves are the second most popular attraction of the Antiquities Department's sites (Matthews, 1995).

LITERATURE

Cooke (1967 & 1973) describe aspects of the Speleology of the Amboni Caves.

Faldborg *et al.* (1990) present the results of the Danish ICBP expedition to the Amboni Caves with preliminary bird and mammal species lists.

Harpum (1949) presents notes on the formation of the Amboni Caves.

Hawthorne (1984) describes the vegetation of the Amboni Caves area.

Johansson (1978) describes a search for African Violets in the Tanga limestone gorges, and maps their distribution. Notes on the distribution and threats to all African Violet species are also presented.

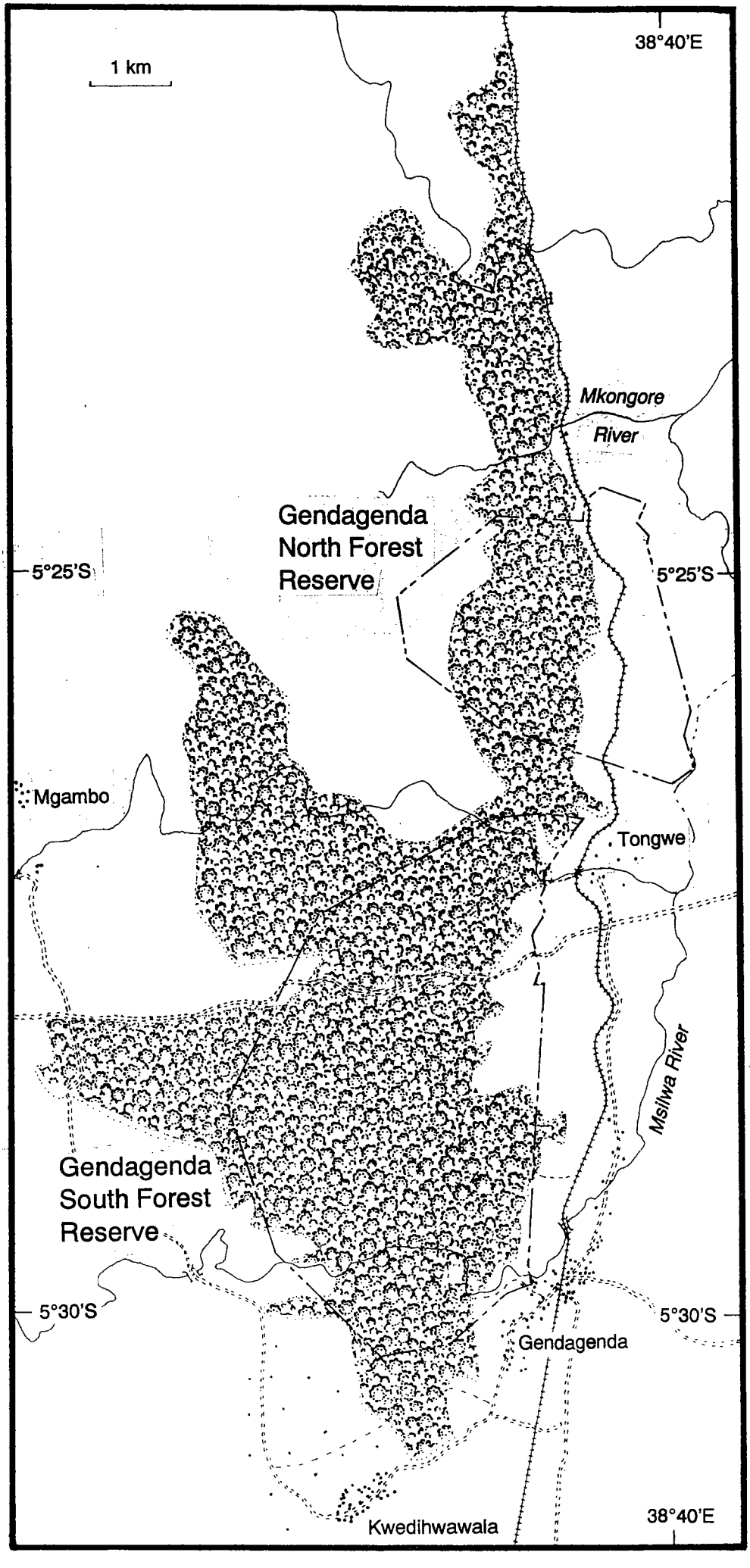
Loveridge (1944) includes brief notes on collections from the Tanga limestone gorges and caves.

Manson-Bahr (1958) records cases of the disease Pulmonary Histoplasmosis (arising from spores in bat guano) from people who have visited the Amboni Caves.

Matthews (1995) presents a management plan for the Amboni Caves area, with proposals on reconstructing the forest habitat in the area, together with the development of visitor facilities.

Peet (1957) describes the discovery of further caves in the Amboni system.

Verdcourt (1952) gives a brief description of the forest on the limestone escarpment of the Amboni Caves, followed by a short list of molluscs found there.


1 km
38°40'E
Mkongore
River
Gendagenda
North Forest
Reserve
5°25'S
5°25'S
Mgambo
Tongwe
Mslwa River
Gendagenda
South Forest
Reserve
5°30'S
5°30'S
Gendagenda
Kwedihwawala
38°40'E

THE GENDAGENDA FOREST RESERVES

Including Gendagenda North and Gendagenda South Forest Reserves

DESCRIPTION

NAME: Gendagenda South Forest Reserve
Gendagenda North Forest Reserve

Handeni District, Tanga Region, Tanzania.

AREA: Gendagenda South 1909 ha; 19 sq. km; 4717 acres; 7.37 sq. miles
Gendagenda North 891 ha; 8.9 sq. km; 2201 acres; 3.44 sq. miles [4,050 acres cited in Cap. 389]

BOUNDARY: Gendagenda South 17 km. Boundaries cleared and planted with *Senna siamea* in 1992.
LENGTH Gendagenda North 11 km. 10 km cleared, 6.5 km planted with teak stumps by mid-1995.

STATUS: Central Government Protective Reserves.
Catchment Forestry Reserves.

Gendagenda South gazetted 1910.
Original Declaration Order Cap 132 of 1947, superseded by Cap. 389 - supp. 59 of 1959, p. 32.

Gendagenda North gazetted during the German administration as indicated on old maps
Variation Order 24/7/5/1980 on Declaration Order Cap. 389 - supp. 59 of 1959, p. 32.

MAPS: Ordnance Survey topographic maps 1:50,000 Series Y742
Sheets 130/3 'Hale' of 1988, mapped from aerial photos of 1981 and 1982.
149/1 'Gendagenda' of 1987, mapped from aerial photos 1981-1983.
Both maps show the incorrect location of the forest reserve boundaries.

Forestry Division Maps: Jb 785 of 1910, 1:10,000 'Gendagenda South' (retraced 1953)
Jb 526 of 1963 1:10,000 'Gendagenda North'

Note : Jb 693 'Garafuno' of 1969 shows an incorrect orientation of Gendagenda North

LOCATION

Grid ref: Gendagenda North 5°26'S - 5°26'S, 38°38'E - 38°40'E
Gendagenda South 5°27'S - 5°30'S, 38°37'E - 38°39'E

Elevation: 80 - 545 m a.s.l.

The Gendagenda forest covers a north-south fault line escarpment which rises to 280 m a.s.l. above the coastal plain at 80-100 m altitude. The twin peaks of Gendagenda hill (which rise to 545 m and 500 m) are located on this escarpment edge within Gendagenda South Forest Reserve. The reserves are located 40 km south-south-west of Pangani, 35 km inland from the Indian Ocean. The nearest village is Gendagenda, at the south-eastern edge of Gendagenda South Forest Reserve.

The District Forestry Office is in Handeni, 75 km to the west (100 km by road). A Catchment Forestry Officer is stationed at Gendagenda village.

Access to the forests by vehicle is from the main Dar es Salaam to Moshi tarmac road. Take the eastward track at Kabuku to Mwera and Pangani. The track goes through Gendagenda South Forest Reserve (21 km of the track are overgrown). A 4WD vehicle is required. The track is impassable during the rainy season. Alternative access is from Pangani by taking the road south and taking a westward turning at Mwera. This track goes through Msubugwe forest before reaching Gendagenda. This track is also impassable during the rains.

Public transport access by the northern railway line to the station at Gendagenda.

SOILS

Derived from Noegene deposits and underlying marine clays and mudstones of Miocene to Pleistocene age on lower slopes of the escarpment (Hawthorne, 1984). Soil tests carried out by Frontier recorded loamy soils with pH between 6.3 and 6.83. Riverine soils were sandy loams with a pH range of 6.1-6.5. The organic matter content was comparatively high for both soil types (Frontier data).

Surrounding woodland soils contained less organic matter with a pH of 6.4 to 6.6.

CLIMATE

The Gendagenda Forests are influenced by tropical East African oceanic temperatures that are slightly modified by the altitude. The nearest rainfall station is at the Mgambo Sisal Estate (5°31'S, 38°35'E, 288 m altitude), where an average of 1202 mm of rainfall per year has been recorded for the 6 years up to 1973, with January & August having a monthly average of less than 50 mm rainfall during this period. Longer term climatic data is available from the rainfall station at the Mkwaja Ranch (5°43'S, 38°50'E, 100 m altitude), where an average of 1000 mm of rainfall per year has been recorded for the 25 years from 1955 to 1979, with January, Febraury, July & August having a monthly average of less than 50 mm rainfall during the 7 years before 1973. The Gendagenda peaks are expected to receive additional orographic rainfall and occult precipitation from the westward moving moist sea air.

Temperature maxima at the Mkwaja Ranch vary from 28.5°C in August to 32.5°C in March. Minima vary from 20.5°C in August to 24°C in February-March (monthly averages on 20 years from 1959 to 1979).

VEGETATION

The forest reserves incorporate some 13 km^2 of dry evergreen and semi-evergreen forest of the Zanzibar-Inhambane Undifferentiated Forest Type and 5 km^2 of thicket with close affinities to Zanzibar-Inhambane scrub forest (White, 1983). A further 20 km^2 of Undifferentiated Forest and 10 km^2 of Scrub Forest lie outside the two Gendagenda forest reserves.

Dry Forest [Zanzibar-Inhambane undifferentiated forest (*sensu* White, 1983)]

Dry forest on the Gendagenda Hills (within Gendagenda South Forest Reserve) has an even canopy varying from 10 to 16 m in height, with dominance shifting between *Craibia brevicaudata, Diospyros kabuyeana, Lecaniodiscus fraxinifolius, Combretum schumannii, Scorodophloeus fischeri* and *Manilkara sulcata*. Other tree species include *Afzelia quanzensis, Premna chrysoclada, Tarenna nigrescens, Rhoicissus revoilii, Toddaliopsis sansibarensis, Balanites maughamii, Polysphaeria multiflora, Spirostachys africana, Croton pseudopulchellus, Vepris eugeniifolia, Rawsonia lucida, Psydrax micans, Garcinia buchananii, Allophylus stachyanthus, Carpodiptera africana, Bridelia cathartica, Ludia mauritiana, Tamarindus indica, Drypetes reticulata, Ficus lutea, Ficus kirkii, Macphersonia hildebrandtii* and *Diospyros greenwayi.*

To the south of the Gendagenda Hills the forest is dominated by *Cynometra webberi, Manilkara sulcata* and *Scorodophloeus fischeri.*

At the northern end of Gendagenda South, within Gendagenda North, and in the areas outside, the forest is strongly dominated by *Cynometra brachyrrachis,* with frequent *Euphorbia tirucalli* and *Euphorbia nyikae* in the small tree stratum.

Strychnos henningsii is common in small stands throughout all areas of the forest, occurring locally as a dominant tree species.

Eight vegetation plots have been constructed in the dry forest :

Plot J : Dry Forest on a ridge on the east side of the southern Gendagenda peak, 50 m x 50 m plot.
0.25 ha in area with 114 trees over 10 cm dbh giving an equivilant of 456 trees per ha.
Mean tree dbh 25.9 cm; mean tree height 10.2 m; mean bole height 5.1 m.
Mean basal area 24.0 m^2/ha; mean stand volume 123 m^3/ha.

Plot A : Dry Forest on a ridge on the east side of the southern Gendagenda peak, 50 m x 5 m plot.
0.025 ha in area with 14 trees over 10 cm dbh giving an equivilant of 560 trees per ha.
Mean tree dbh 29.6 cm; mean tree height 12.6 m; mean bole height 5.4 m.
Mean crown area 70.4 m^2/tree; mean basal area 38.5 m^2/ha; mean stand volume 208 m^3/ha.
The following tree species were identified : 6 x *Diospyros kabuyeana* (43%), 3 x *Ludia mauritiana* (21%), 1 x *Cola* sp., *Combretum schumannii, Dalbergia* sp., *Drypetes* sp., *Lecaniodiscus fraxinifolius* (7% each).

Plot B : Dry Forest in a gully to the south of the Gendagenda Hills at 150 m a.s.l., 60 m x 5 m plot.
0.03 ha in area with 15 trees over 10 cm dbh giving an equivilant of 500 trees per ha.
Mean tree dbh 27.7 cm; mean tree height 14.0 m; mean bole height 6.8 m.
Mean crown area 31.1 m^2/tree; mean basal area 30.1 m^2/ha; mean stand volume 205 m^3/ha.
The following tree species were identified : 4 x *Strychnos henningsii* (27%), 3 x *Combretum schumannii, Scorodophloeus fischeri* (20% each), 1 x *Afzelia quanzensis, Lecaniodiscus fraxinifolius* (7% each). The remaining three trees were all different species but could not be identified.

Plot E : Dry Forest at the eastern base of the Gendagenda Hills at 200 m altitude, 60 m x 5 m plot.
0.03 ha in area with 20 trees over 10 cm dbh giving an equivilant of 670 trees per ha.
Mean tree dbh 28.8 cm; mean tree height 11.5 m; mean bole height 4.7 m.
Mean crown area 45.2 m^2/tree; mean basal area 43.7 m^2/ha; mean stand volume 206 m^3/ha.
The dbh, basal area and stand volume measurements can be expected to be slightly skewed by the presence of a large baobab tree in the plot. Baobabs are however frequent in this area.
The following tree species were identified : 6 x *Croton jatrophoides, Scorodophloeus fischeri* (30% each), 2 x *Balanites maughamii, Ludia mauritiana, Manilkara sulcata* (10% each), 1 x *Adansonia digitata,* tree sp. indet. (5% each).

Plot F : Evergreen forest on the south-eastern face of the southern Gendagenda peak, 60 m x 5 m plot.
0.03 ha in area with 20 trees over 10 cm dbh giving an equivilant of 667 trees per ha.
Mean tree dbh 23.3 cm; mean tree height 11.3 m; mean bole height 4.7 m.
Mean crown area 64.6 m^2/tree; mean basal area 28.4 m^2/ha; mean stand volume 134 m^3/ha.
The following tree species were identified : 10 x *Diospyros kabuyeana* (50%), 2 x *Diospyros consolatae, Julbernadia magnistipulata* (10% each), 1 x *Afzelia quanzensis, Diospyros cornii, Diospyros* sp. aff. *amaniensis, Croton jatrophoides, Lecaniodiscus fraxinifolius,* tree sp. indet. (5% each).

Plot G : Dry Forest on a hillside at the northern end of Gendagenda South, 2 x 30 m x 5 m plots.
0.03 ha in area with 27 trees over 10 cm dbh giving an equivilant of 900 trees per ha.
Mean tree dbh 24.3 cm; mean tree height 12.2 m; mean bole height 4.9 m.
Mean crown area 44.6 m^2/tree; mean basal area 41.7 m^2/ha; mean stand volume 205 m^3/ha.
The following tree species were identified : 18 x *Cynometra brachyrrachis* (67%), 3 x *Croton jatrophoides* (11%), 2 x *Afzelia quanzensis, Scorodophloeus fischeri* (7% each), 1 x *Terminalia boivinii,* tree sp. indet. (4% each).

Plot H : Dry Forest below the northern Gendagenda peak at 350 m altitude, 60 m x 5 m plot.
0.03 ha in area with 20 trees over 10 cm dbh giving an equivilant of 670 trees per ha.
Mean tree dbh 24.6 cm; mean tree height 16.4 m; mean bole height 5.5 m.
Mean crown area 73.1 m^2/tree; mean basal area 31.9 m^2/ha; mean stand volume 174 m^3/ha.
The following tree species were identified : 13 x *Strychnos henningsii* (65%), 3 x *Lecaniodiscus fraxinifolius* (15%), 1 x *Celtis africana, Diospyros kabuyeana, Manilkara sulcata, Scorodophloeus fischeri* (5% each).

Plot I : Dry Forest on the western side of the Gendagenda Hills at 250 m altitude, 60 m x 5 m plot.
0.03 ha in area with 27 trees over 10 cm dbh giving an equivilant of 900 trees per ha.
Mean tree dbh 26.4 cm; mean tree height 14.4 m; mean bole height 6.3 m.
Mean crown area 76.2 m^2/tree; mean basal area 49.3 m^2/ha; mean stand volume 310 m^3/ha.
The following tree species were identified : 10 x *Craibia brevicaudata* (37%), 8 x *Combretum schumannii* (30%), 2 x *Croton jatrophoides, Diospyros kabuyeana* (7% each), 1 x *Dobera loranthifolia, Strychnos henningsii, Tamarindus indica* (4% each). The remaining two trees were different and could not be identified.

Riverine Forest [Zanzibar-Inhambane undifferentiated forest (*sensu* White, 1983)]

Riverine forest occurs in the steep gulleys in the escarpment to the north of the Gendagenda Hills. Along the watercourses *Scorodophloeus fischeri* is the most common tree, and occurs together with *Pandanus rabaiensis, Barringtonia racemosa, Sorindeia madagascariensis, Psychotria riparia, Kigelia africana, Byttneria fruticosa, Ficus scassellatii, Ficus sur, Ficus lutea, Grandidiera boivinii, Ophrypetalum odoratum, Stuhlmannia moavi, Fernandoa magnifica, Terminalia sambesiaca, Gardenia volkensii, Grewia goetzeana, Manilkara mochisia, Pancovia holtzii, Garcinia livingstonei, Markhamia zanzibarica, Psychotria lauracea, Drypetes reticulata, Gyrocarpus americana, Polysphaeria multiflora, Buxus obtusifolius* and *Julbernadia magnistipulata.*

A single vegetation plot has been constructed in this forest type :

Plot D : Riverine Forest at the northern end of Gendagenda South at 180 m altitude, 60 m x 5 m plot.
0.03 ha in area with 15 trees over 10 cm dbh giving an equivilant of 500 trees per ha.
Mean tree dbh 27.3 cm; mean tree height 16.0 m; mean bole height 6.6 m.
Mean crown area 76.5 m^2/tree; mean basal area 29.2 m^2/ha; mean stand volume 193 m^3/ha.
The following tree species were identified : 3 x *Cola* sp., *Scorodophloeus fischeri* (20% each), 2 x *Strychnos henningsii,* tree sp. indet. (13% each), 1 x *Bombax rhodognaphalon, Celtis africana, Milicia excelsa, Pandanus rabaiensis, Sorindeia madagascariensis* (7% each).

Scrub Forest [Zanzibar-Inhambane scrub forest (*sensu* White, 1983)]

Scrub Forest occurs on the periphery of the main forest block, forming a canopy to 8m with occasional emergents to 15 m.

A single vegetation plot has been constructed in this forest type:

Plot C : Scrub Forest at the eastern base of the Gendagenda Hills at 130 m altitude, 60 m x 5 m plot.
0.03 ha in area with 10 trees over 10 cm dbh giving an equivilant of 330 trees per ha.
Mean tree dbh 16.0 cm; mean tree height 10.3 m; mean bole height 3.2 m.
Mean crown area 33.3 m^2/tree; mean basal area 6.6 m^2/ha; mean stand volume 21 m^3/ha.
The following tree species were identified : 3 x *Grewia holstii, Lecaniodiscus fraxinifolius* (30% each), 1 x *Combretum schumannii, Dobera loranthifolia, Strychnos henningsii* (10% each). One tree species could not be identified.

Woodland [Zanzibar-Inhambane woodland (*sensu* White, 1983)]

To the west of both reserves closed *Combretum/Terminalia/Brachystegia* woodland is present on the escarpment.

Grassland and thicket [Zanzibar-Inhambane secondary grassland and evergreen thicket (*sensu* White, 1983)]

White's Zanzibar-Inhambane secondary grassland occurs on the coastal plain to the east of the escarpment edge interspersed with small patches of evergreen thicket. Doum palms *Hyphaene compressa* are common.

TIMBER VALUES

Pitsawing is carried out on a small scale especially for *Milicia excelsa* (Mvule) and *Afzelia quanzensis* until 1992.

BIODIVERSITY

Gendagenda forest has been briefly visited by a number of botanists including Procter, Tanner and Hawthorne. The Frontier-Tanzania Coastal Forest Research Programme conducted a general biological survey for six months in 1991 with brief visits in 1992.

Birds

57 bird species have been recorded (by C. Mlingwa).

Coastal Forest endemics -	Fischer's Greenbul *Phyllastrephus fischeri.*
	Little Yellow Flycatcher *Erythrocercus holochlorus.*
Coastal Forest/Eastern Arc endemic -	Fischer's Turaco *Tauraco fischeri* [BirdLife Near Threatened].
Other BirdLife listed species -	Southern Banded Snake-eagle *Circaetus fasciolatus* [BirdLifeNear Threatened].
	Plain-backed Sunbird *Anthreptes reichenowi* [BirdLife Near Threatened].

Mammals

26 mammal species have been recorded from collections and observations by Frontier-Tanzania, including 15 bat species [27 specimens from over 200 captures] and 4 rodent species [4 specimens collected from 500 trap nights].

Possible Gendagenda endemic -	Shrew *Crocidura* sp. ?nov. (b) det. BMNH (specimen KMH 6973a).
Coastal Forest endemics -	Woolly bat *Kerivoula africana.* Known from just 1 other Coastal Forest (Specimen KMH 6504).
Coastal Forest/Eastern Arc endemics -	East African Collared Fruit Bat *Myonycteris relicta.* (Specimen KMH 7628) Known from only 8 other localities [IUCN Vulnerable].
Other CITES/IUCN listed species -	Black-and-Rufous Elephant Shrew *Rhynchocyon petersi petersi* [IUCN Rare].
	Zanzibar Galago *Galagoides zanzibaricus* [IUCN Vulnerable].
	Leopard *Panthera pardus* [CITES Appendix 1; IUCN Threatened].

Teeth of the African Elephant *Loxodonta africana* [CITES Appendix 1; IUCN Vulnerable] were found in a dry river bed in 1991, but these are probably from an individual that died many years earlier since the local people have not seen elephants in the forest since the 1970s.

Reptiles

3 forest dependant reptile species have been recorded from observations and a collection of 65 specimens by Frontier-Tanzania.

Coastal Forest endemics - Kenya Pigmy-Chameleon *Rhampholeon k. kerstenii.* (Specimen KMH 7523)
Known only from Gendagenda and the Kenyan Coastal Forests.

Coastal Forest/Eastern Arc endemics - Usambara Green Snake *Philothamnus macrops.* (Specimen KMH 6739a)
Known only from the Usambaras and 3 Tanzanian Coastal Forests.

A specimen of Grote's Dwarf Gecko *Lygodactylus capensis grotei* (specimen KMH 7528) collected in woodland represents the northernmost record of this subspecies.

Amphibians

9 species are recorded by Frontier-Tanzania collections from 66 specimens.

Coastal Forest endemics - Treefrog *Leptopelis flavomaculatus.* (Specimen KMH 6627a, KMH 7556).

A rare Caecilian (KMH 7652, possibly *Schistometopum gregorii*) has been found in woodland at the edge of the reserve.

Plants

288 fertile botanical samples have been collected from Gendagenda by Frontier-Tanzania.

Gendagenda area - endemics
Saintpaulia tongwensis B.L.Burtt [Gesneriac.] (Specimen *Frontier* 2485).
Known only from Tongwe, Gendagenda and Pangani Falls.
Cynometra brachyrrachis Harms [Fabac.] (Specimen *Frontier* Genda 193).
Known only from Tongwe, Pangani Falls and the lowland East Usambaras.
Stuhlmannia moavi Taub. [Fabac.] (Specimen *Frontier* 2568 etc.). Known only from Gendagenda and 5 other sites in the Pangani River basin area.

Coastal Forest endemics - *Uvaria* sp. nov. = *Mwasumbi* 12532 [Annonac.] (Specimen *Frontier* Genda 112).
Gendagenda and 4 other sites.
Croton jatrophoides Pax. [Euphorbiac.] Gendagenda and 5 other Tanzanian sites.
Cited in Hawthorne (1984).

CITES listed plant - *Encephalartos hildebrandtii* A.Br. & Bouche [Zamiac.] CITES Appendix 1.

CATCHMENT VALUES

Numerous small seasonal streams drain off the escarpment edge, along with the perennial Msilwa River, all within the Pangani river basin. In addition, the hills are composed of porous rock which provides an important source of groundwater to feed wells in the area.

The slopes on the Gendagenda hills and the escarpment edge are steep, and some of these exceed 40°.

HUMAN IMPACTS

Logging

One villager in Gendagenda was actively logging in 1991, apparently under license, and was employing six people. Disturbance is presently slight as logs are cut and transported by hand, and the preferred tree species (*Milicia excelsa* and *Afzelia quanzensis*) occur in low concentrations in the forest. Quantitative assessment of logging found that an average of 2.9% of trees over 10 cm diameter have been cut on the Gendagenda hills.

Pole cutting

Quantitative assessment of pole cutting activity on the Gendagenda hills found that 12.3% of saplings under 10cm diameter had been cut, with disturbance density being concentrated about the paths in the forest.

Firewood

The villages of both Gendagenda and Kwedihwawala collect firewood from the forest but the effects of this are limited to areas close to human habitation. Much firewood is also collected from surrounding woodland. The scale of firewood collection is not thought to be detrimental to the forest.

Agriculture

Areas within the forest (and the reserves) are being cleared for cultivation, along with encroachment of forest areas surrounding Gendagenda, Kwabojo and Kwedihwawala villages.

Agricultural encroachment was formerly concentrated at the old village site of Tongwe, which was largely abandoned during the 'Ujamaa' villagisation programme of the 1970s. This may account for the local absence of forest on the escarpment edge around this site.

Fire

Bush fires caused by uncontrolled burning of agricultural land near the forest pose a threat of spreading to the forest itself. According to local tradition, an area of forest that formerly existed on the northern of the two Gendagenda peaks was burnt during the last century, and this has now been replaced by grassland. Other parts of the forest have been observed to be in retreat from bushfires.

Hunting

Hunting is practised locally with both snares and guns. This activity is predominantly carried out in the savannah and woodland areas surrounding the reserves and forest. Shots are heard daily (1991) but no snares have been found in the forest.

Spiritual

There is a large cave on the southern face of the southernmost of the two Gendagenda peaks which has spiritual significance for the local inhabitants of Gendagenda village.

Plantation

A small rubber plantation was established within Gendagenda South Forest Reserve on the Kabuku to Pangani road (according to the original map of 1910). All traces of this plantation have since disappeared.

CONSERVATION ISSUES

The Gendagenda forests appear to have been little disturbed except near the two villages at their southern end, and more recently (since 1992) from Kwabojo village to the north-east where 26 families have managed to clear approximately 120 acres of Gendagenda North Forest Reserve. Much of Gendagenda forest, especially to the north, is inaccessible to vehicles, and the area surrounding the north of the forest block is virtually uninhabited.

Boundary clearing and planting with *Senna siamea* and *Tectona grandis* is being undertaken by the Tanga Catchment Forestry Project, and this is expected to be completed during 1996. Discussions with village and district authorities are underway to deal with the encroachment problem. 3 ha of the encroached area in Gendagenda North Forest Reserve has been planted with *Afzelia quanzensis* and *Albiziz schimperiana* during 1995.

A forest guard/nursery attendant is now stationed at Gendagenda.

The quality and availability of drinking water seems to be a major issue with the local inhabitants of Gendagenda, and this concern could be utilised by introducing an educuation programme to inform these people of the importance of the forest for safeguarding their water supply.

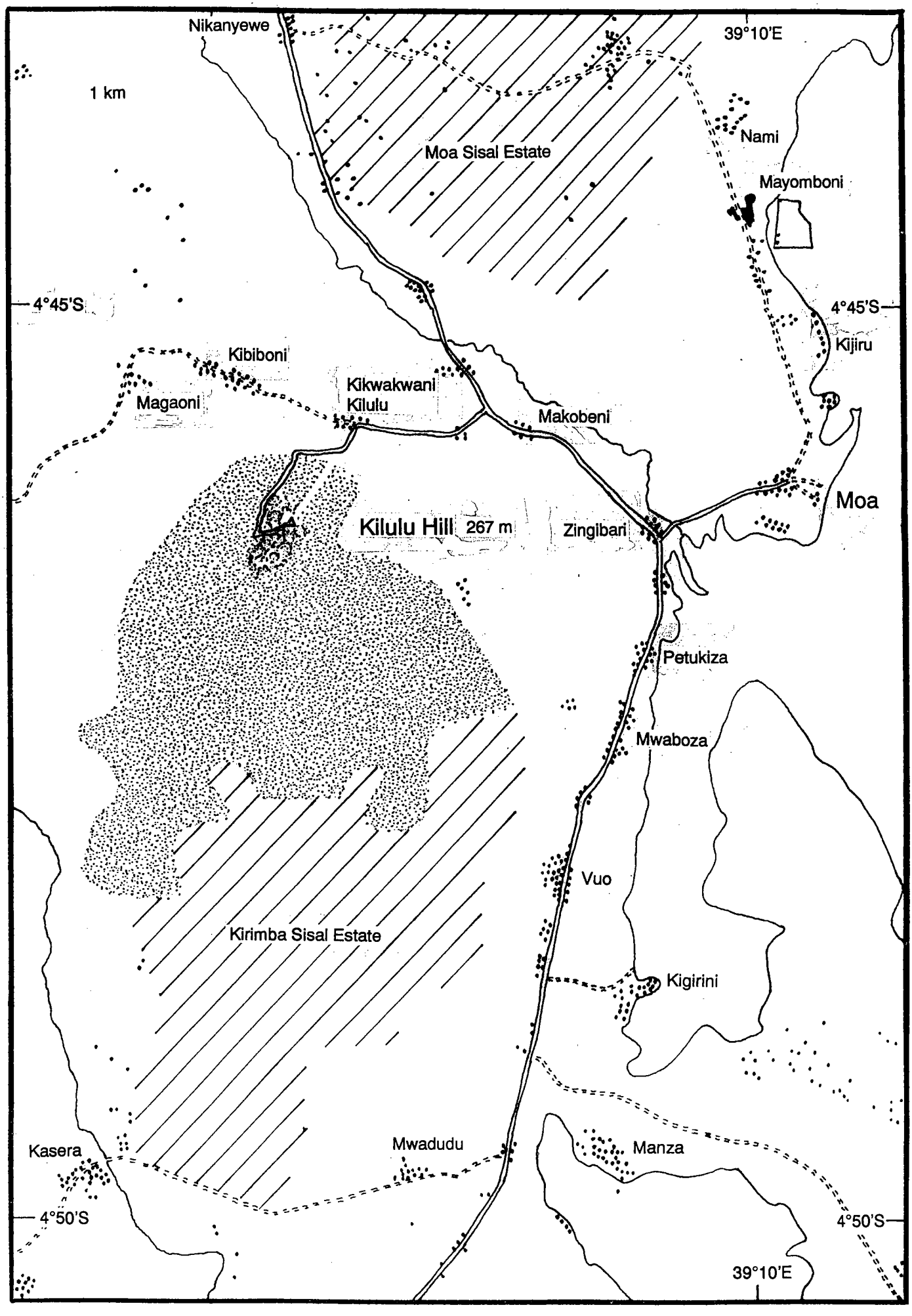
There are potential future threats to the forest from charcoal production (to supply Dar es Salaam or Tanga by rail) and from fuelwood collection by the coastal salt producers.

LITERATURE

Hawthorne (1984) briefly describes the vegetation of Gendagenda and discusses its ecological affinities.

Lovett & Pocs (1993) list facts on the status of the two Gendagenda forest reserves.

Matthews (1993) lists the medicinal plants collected in Gendagenda along with their local name, use, preparation and Frontier collection number.


Nikanyewe
39°10'E
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Makobeni
Moa
Kilulu Hill 267 m
Zingibari
Petukiza
Mwaboza
Vuo
Kirimba Sisal Estate
Kigirini
Kasera
Mwadudu
Manza
4°50'S
4°50'S
39°10'E

KILULU HILL FOREST

DESCRIPTION

NAME: Kilulu Hill Forest
Muheza District, Tanga Region, Tanzania.

AREA: 160 ha; 0.16 sq. km; 395 acres; 0.06 sq. miles.

BOUNDARY: LENGTH 2.4 km

STATUS: Proposed Forest Reserve. A small area on the peak is owned by the Tanzania Post and Telecommunications Company (TPTC).

MAPS: Ordnance Survey topographic maps 1:50,000
Series Y742 Sheet 111/3 'Moa' of 1989, mapped from aerial photos of 1982 & 1983.

LOCATION

Grid ref: 4°46'S, 39°07'E

Elevation: 200 - 267 m a.s.l.

The Kilulu forest and thicket cover a small hill rising to 267 m a.s.l., within 5 km of the coast, close to the Kenyan border. The hill is located 30 km north of Tanga. The nearest village is Kilulu, 0.5 km to the north.

There is a mangrove forestry officer based at Moa.

Access is by road from Tanga on the main Tanga-Mombasa road to Makobeni. A local track from Makobeni leads to the summit of the hill, and is used as a service road for the TPTC radio mast on the hill.

Public transport access is by bus from Tanga to Mombasa. Get off at Makobeni and walk the remaining 3 km to the top of the hill.

SOILS

Sandy soils derived from the underlying parent rock of Mesozic sandstones and siltstones.

Laterite developed on roads.

CLIMATE

Kilulu Forest is influenced by tropical East African oceanic temperatures that are slightly modified by the altitude. The nearest rainfall station is at the Mtotohovu Sisal Estate (4°43'S, 39°09'E, 46 m altitude), where an average of 1068 mm of rainfall per year has been recorded for the 30 years from 1931-1960, with October, January & February having a monthly average of less than 50 mm during this period. A peak annual rainfall of 1541 mm and a minimum annual rainfall of 661 mm has been recorded between 1931 and 1970 from this rainfall station.

Kilulu Hill receives additional orographic rainfall from westward moving sea air, but the vegetation on the hill also suffers from an additional desiccation pressure due to the strong onshore/offshore winds near the coast.

VEGETATION

Kilulu Hill contains two main vegetation types as follows :

Dry Forest [Zanzibar-Inhambane undifferentiated forest (*sensu* White, 1983)]

Approximately 160 ha of dry Zanzibar-Inhambane undifferentiated forest (White, 1983) is found on the peak of the hill with a continuous canopy 15-18 m high except in highly disturbed areas. Dominant tree species include *Cynometra webberi, Scorodophloeus fischeri* and *Manilkara sulcata.* Other trees include *Fernandoa magnifica, Millettia usaramensis* and *Draecaena usambarensis.* Cycads *Encephalartos hildebrandtii* are present in the forest.

Three vegetation plots have been constructed in the forest :

Plot A : Dry forest in good condition on Kilulu Hill, 60 m x 5 m plot.
0.3 ha in area with 21 trees over 10 cm dbh giving an equivilant of 700 trees per ha.
Mean tree dbh 26.9 cm; mean tree height 11.4 m; mean bole height 3.7 m.
Mean crown area 58.0 m^2/tree; mean basal area 28.8 m^2/ha; mean stand volume 105 m^3/ha.
The following tree species were identified : 8 x *Cynometra webberi, Scorodophloeus fischeri* (38% each), 2 x *Manilkara sulcata* (10%). The remaining three trees were all different and could not be identified.

Plot B : Dry forest in good condition on Kilulu Hill, 60 m x 5 m plot.
0.3 ha in area with 21 trees over 10 cm dbh giving an equivilant of 700 trees per ha.
Mean tree dbh 18.0 cm; mean tree height 12.0 m; mean bole height 4.8 m.
Mean crown area 46.0 m^2/tree; mean basal area 17.8 m^2/ha; mean stand volume 86 m^3/ha.
The following tree species were identified : 9 x *Scorodophloeus fischeri* (43%), 3 x *Cynometra webberi* (14%). The remaining 9 trees were not identified.

Plot C : Dry forest in good condition on Kilulu Hill, 60 m x 5 m plot.
0.3 ha in area with 13 trees over 10 cm dbh giving an equivilant of 433 trees per ha.
Mean tree dbh 17.3 cm; mean tree height 10.1 m; mean bole height 4.4 m.
Mean crown area 40.8 m^2/tree; mean basal area 10.2 m^2/ha; mean stand volume 45.3 m^3/ha.
The following tree species were identified : 5 x *Cynometra webberi* (38%), 2 x *Scorodophloeus fischeri* (15%), 1 x *Cola* sp., *Craibia* sp. (8% each). The remaining four trees were not identified.

Thicket [Zanzibar-Inhambane evergreen and semi-evergreen thicket (*sensu* White, 1983)]

Impenetratable semi-evergreen thickets surround the forest on heavily leached, degraded soils. These are dominated by *Croton pseudopulchellus* with *Maytenus mossambicensis* as another fairly common species. Other species include *Grewia villosa, Polysphaeria parvifolia* and *Mildbraedia carpinifolia.*

To the north-east of the peak a different kind of evergreen thicket is present, dominated by 4 m high *Scorodophloeus fischeri* with baobabs *Adansonia digitata* as emergents.

TIMBER VALUES

The small area of forest on Kilulu Hill has been logged for most of its valuable timber species; mainly *Milicia excelsa* and *Bombax rhodognaphalon.* A few mature specimens of these species remain in the least accessible places.

BIODIVERSITY

Apart from botanical collections by Mohammed and Greenway, Kilulu Hill is only known to have been studied by the Frontier-Tanzania Coastal Forest Research Programme during 1992, although an old record for the Sokoke Pipit from Moa indicates that bird collectors have also been in the area (see note below).

Birds

27 bird species have been recorded (by C. Mlingwa) of which 10 are forest species.

Coastal Forest/Eastern - Arc endemic: Fischer's Turaco *Tauraco fischeri* [BirdLife Near Threatened].

BirdLife listed species: Southern Banded Snake-eagle *Circaetus fasciolatus* [BirdLife Near Threatened].
Plain-backed Sunbird *Anthreptes reichenowi* [BirdLife Near Threatened].

The Sokoke Pipit *Anthus sokokensis* [BirdLife Vulnerable; IUCN Vulnerable] was recorded from Moa in the 1930s, which is only 8 km from Kilulu Hill, and it is assumed that the species was therefore recorded from the Kilulu forest/thicket.

Mammals

22 mammal species have been recorded from collections and observations by Frontier-Tanzania, including 9 bat species [7 specimens from 35 captures] and 1 observed rodent species [0 specimens were collected from 243 trap nights in the forest areas and 192 trap nights in the thicket areas].

Coastal Forest endemic: Horseshoe Bat *Rhinolophus deckenii.* (Specimen KMH 7557) Known from just 3 other Coastal Forests.

CITES/IUCN listed species: Zanzibar Galago *Galagoides zanzibaricus* (Obs.) [IUCN Vulnerable].

Reptiles

7 forest dependant reptile species have been recorded from observations and a total collection of 11 specimens by Frontier-Tanzania.

Coastal Forest endemics: Dwarf Gecko *Lygodactylus viscatus.* (Specimen KMH 7499, KMH 7833) Known from only 6 other Coastal Forests in Tanzania.
Wormlike Blind-Snake *Rhinotyphlops lumbriciformis.* (Specimen KMH 7497).

Coastal Forest/Eastern - Arc endemics: Conradt's Dwarf Gecko *Lygodactylus conradti.* (Specimen KMH 7846) Known only from Kilulu and the East Usambara Forests.
Dwarf Gecko *Lygodactylus* sp. nov. B. (Specimen KMH 7679) Known from only 2 other Coastal Forests and Amani in Tanzania. To be cited by Pasteur (in press).

Amphibians

4 species are recorded by Frontier-Tanzania collections from 4 specimens.

Coastal Forest endemic - Tree Toad *Mertensophryne micranotis* (specimen KMH 7837).

Plants

Few plant species have been collected from Kilulu forest, and the status of botanical knowledge of the forest is rather poor. At present the only possible endemic is *Aloe boscawenii* Christian [Liliac.] which is only known from a single collection from coastal bushland near the sea shore 13 km south of Moa (Cited in FTEA). Aloes have been observed growing on the cliff faces of Kilulu Hill, and it is possible that these may also be *Aloe boscawenii.* Ironically it was Col. Boscawen (after whom the plant is named) who logged the forest during the 1950s.

CITES listed plant - *Encephalartos hildebrandtii* A.Br. & Bouche [Zamiac.] CITES Appendix 1.

CATCHMENT VALUES

No permanent water courses are present on the site. Slopes only locally exceed 40 degrees, but are on average less than 30 degrees.

HUMAN IMPACTS

The extent of the forest has been dramatically reduced over the past 50 years, mostly through clearance for sisal plantations. Logging and further clearence for shambas has reduced the forest down to its present size. Only small areas of undisturbed forest remain.

Telecommunications facility

Disturbance connected with the operation of the radio mast on the summit has not been quantified but paths have been cleared through the forest to permit the installation of electricity cables, and a track cleared to permit vehicle access. Further disturbance is probably unlikely except by the maintenance staff of the tower who are responsible for clearing the forest on the hilltop for cultivation.

Fuelwood

The woodland and scrub areas are used by the locals as a source of firewood for home use and for salt boiling.

Cultivation

2.3 ha of forest have been cleared by the TPTC staff for cultivation on the summit of the hill.

Hunting

Hunting activities are widespread on the site; snares are set to catch Duiker, Suni and Bushpig, the favoured site being around the clearing on the peak of the hill.

Fire

The use of fire to clear scubland poses a threat to the forest as fires are often left to spread unchecked.

Spiritual

A small cliff face on the south-east side of the peak is the site of spiritual offerings placed by the local people.

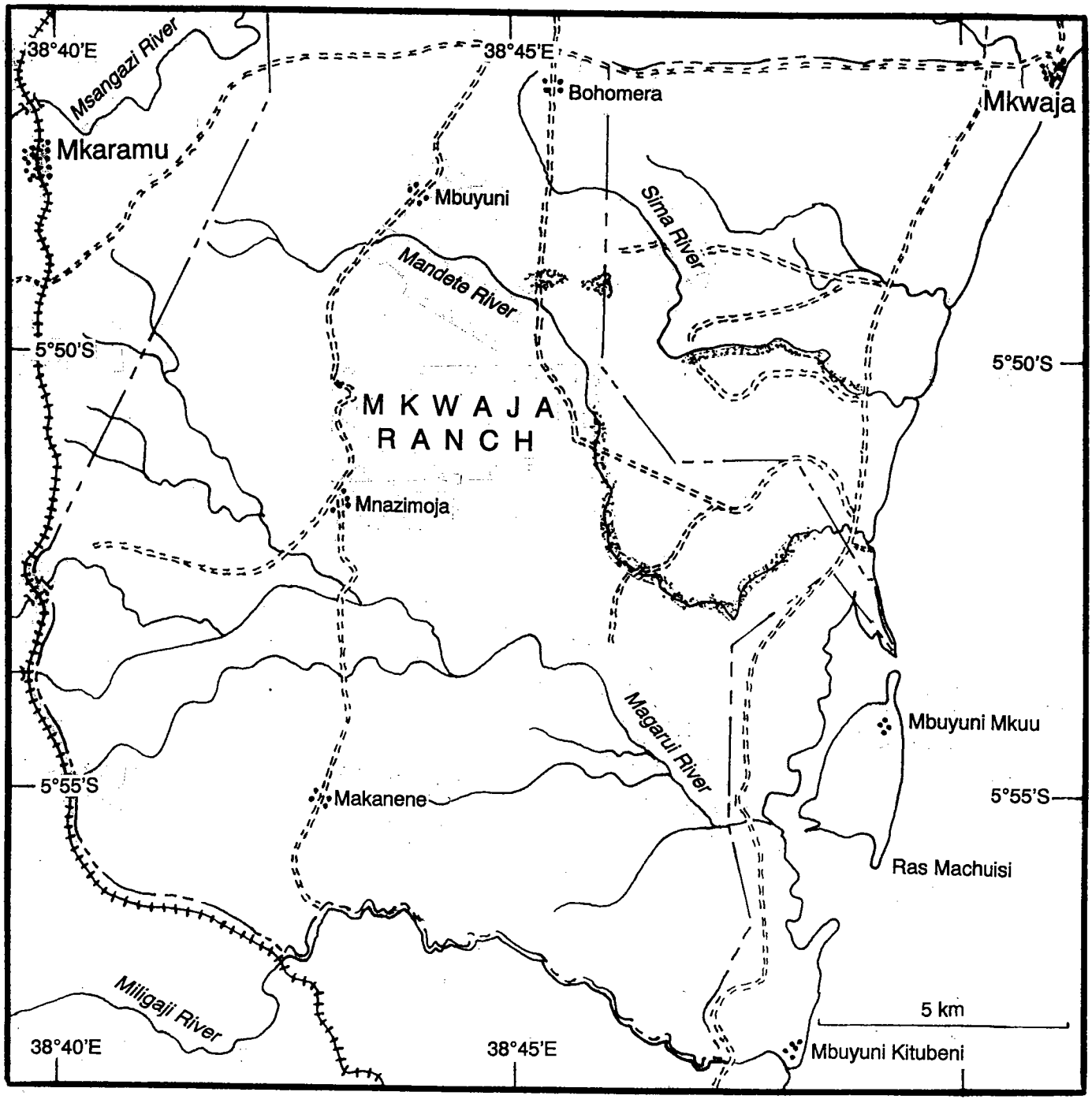
CONSERVATION ISSUES

The remaining forest on Kilulu Hill lies entirely within TPTC telecommunication mast site where a ban on any other human activities is supposed to be in existence. The TPTC authorities should be encouraged to maintain and enforce this ban, and to prevent their own staff from clearing further areas of forest for cultivation. Ideally the cultivated areas should be re-planted or be left fallow to regenerate back to forest.

The Kilulu Hill site is also of some historical importance as the site of the home of the last of the Digo kings. The graves and house foundations on the summit of the hill should be surveyed as these may be worthy of National Monument status.

LITERATURE

Clarke (in press) describes the search for a Kaya Forest at Kilulu Hill.


38°40'E
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Mbuyuni Kitubeni

MKWAJA COASTAL MOSAIC FORESTS

DESCRIPTION

NAME: Mkwaja Coastal Mosaic Forests
Pangani District, Tanga Region, Tanzania.

AREA: Mosaic : 24,600 ha; 246sq. km; approx. 60,800 acres; 95 sq. miles.

BOUNDARY: LENGTH Mkwaja Ranch southern boundary 70 km.

STATUS: Most of the land is contained within the Mkwaja Ranch, a privately owned cattle farm. Peripheral areas are government land without protected status.

MAPS: Ordnance Survey topographic maps 1:50,000 Series Y742
Sheets 149/3 'Kwamsisi' of 1987, mapped from aerial photos of 1981-1983.
149/4 'Mkwaja' of 1987, mapped from aerial photos of 1981-1983.

Mkwaja Ranch Boundary Map 1:62,500, Amboni Ltd, 1961.

LOCATION

Grid Ref: 5°46'40" - 5°58'S, 38°34'40" - 38°49'48"E

Elevation: Sea level to 100 m a.s.l.

The Mkwaja coastal mosaic is approximately 50 km south of Pangani and 10 km north of Sadaani. The mosaic is bounded by the main Mkwaja-Mkata road to the north, the coast to the east, the Dar es Salaam-Korogwe railway track to the west, and the Msingazi river (also called Msangazi, Mbuvini or Mligazi) to the south. Altitude ranges from 0 to 100 m a.s.l.

The nearest villages are Mkwaja, 5 km to the north-east, and Mkalamu, 5 km to the north-west. The nearest town is Pangani, 50 km to the north.

The District Forestry Office is in Pangani. The local Forestry Officer is based in Mkwaja.

Access is by road from Mkata (on the main Chalinze-Tanga tarmac road). Take the turning to the east for Kwamsisi, Mkalamu and Mkwaja. An alternative is to take the little used track from Sadaani to Mkwaja. Access from Tanga is by the coast road through Pangani to Mkwaja. All roads and tracks are difficult in wet conditions, and a 4WD vehicle is required to negotiate these roads.

Public transport access by bus from Pangani to Mkwaja, or by the northern railway line to the station at Mkalamu.

SOILS

"Black cotton" vertisol on the grassy lowlands, reddish soil on higher ground, on coralliferous limestone.

CLIMATE

The Mkwaja Coastal Mosaic Forests are influenced by tropical East African oceanic temperatures that may be slightly modified by the altitude. Temperature maxima vary from 28.5°C in August to 32.5°C in March. Minima vary from 20.5°C in August to 24°C in February-March (monthly averages on 20 years from 1959 to 1979).

The nearest rainfall station is at the Mkwaja Ranch's headquarters, 8 km north-north-east (5°43'S, 38°50'E, 100 m altitude), where an average of 1000 mm of rainfall per year has been recorded for the 25 years from 1955 to 1979, with January, Febraury, July & August having a monthly average of less than 50 mm rainfall during the 7 years before 1973.

VEGETATION

The Mkwaja Coastal Mosaic Forests are classified by White (1983) as Zanzibar-Inhambane undifferentiated forest, and this can be further sub-divided into two main groups :

Dry Forest [Zanzibar-Inhambane undifferentiated forest (*sensu* White, 1983)]

Dry undifferentiated forest with a very regular structure (8-12 m canopy) occurs in small patches on hilltops e.g. at Mbuyuni where the forest is dominated by *Julbernadia magnistipulata*. Other trees include *Euphorbia tirucalli, Thylacium africanum* and *Rothmannia macrosiphon.*

A single vegetation plot has been constructed in the Mbuyuni Forest :

Plot 1 : Dry Forest near Mbuyuni village at 100 m altitude, 60 m x 5 m plot.
0.03 ha in area with 17 trees over 10 cm dbh giving an equivilant of 567 trees per ha.
Mean tree dbh 18.4 cm; mean tree height 10.5 m; mean bole height 3.5 m.
Mean crown area 56.8 m^2/tree; mean basal area 15.1 m^2/ha; mean stand volume 52.7 m^3/ha.
The following tree species were identified : 15 x *Julbernadia magnistipulata* (88%), 1 x *Baphia kirkii, Hymenocardia ulmoides* (6% each).

Riverine Forest [Zanzibar-Inhambane undifferentiated forest (*sensu* White, 1983)]

Moist undifferentiated forest occurs along the Madete, the Mafui, and particularly along the Sima rivers. Tree species include *Ficus scassellatii, Sorindeia madagascariensis* and *Ixora narcissodora.*

A single vegetation plot has been constructed in this forest type :

Plot 2 : Riverine Forest along the Sima river at 20 m altitude, 60 m x 5 m plot.
0.03 ha in area with 13 trees over 10 cm dbh giving an equivilant of 413 trees per ha.
Mean tree dbh 26.3 cm; mean tree height 10.6 m; mean bole height 2.5 m.
Mean crown area 34.2 m^2/tree; mean basal area 22.4 m^2/ha; mean stand volume 55 m^3/ha.

TIMBER VALUES

The commercial timber value of the area is negligible, for although timber trees are present, these are scattered and occur in small numbers. The woodfuel value of the area is much higher as there is a high demand for woodfuel for salt boiling.

BIODIVERSITY

A few botanists have collected in the area (especially Peter, Procter, Tanner and Semsei) but the only known general biological survey was carried out by the Frontier-Tanzania Coastal Forest Research Programme in 1991.

Birds

No bird surveys have yet been carried out.

Mammals

20 bat and rodent species have been recorded from collections and observations by Frontier-Tanzania, including 11 bat species [12 specimens collected] and 2 rodent species [2 specimens collected from 522 trap nights]. Large numbers of game animals (buffalo, giraffe etc.) are also found in the area, and many of these enter the forests from time to time.

Coastal Forest/Eastern Arc endemics -	East African Collared Fruit Bat *Myonycteris relicta.* (Specimen KMH 6487a). Known from only 8 other localities [IUCN Vulnerable].
Other CITES/IUCN listed species -	African Elephant *Loxodonta africana* [CITES Appendix 1; IUCN Vulnerable]. Leopard *Panthera pardus* [CITES Appendix 1; IUCN Threatened]. Black-and-Rufous Elephant Shrew *Rhynchocyon petersi petersi* [IUCN Rare]. Zanzibar Galago *Galagoides zanzibaricus* [IUCN Vulnerable].

Reptiles

5 forest dependant reptile species have been recorded from observations and a total collection of 19 specimens by Frontier-Tanzania.

Coastal Forest endemics -	Worm-snake *Leptotyphlops* sp. nov. A. (Specimen KMH 6541a) Known only from 5 Coastal Forests. To be cited by Broadley & Wallach (in press). Striped Keel-bellied Lizard *Gastropholis vittata.* (Specimen KMH 6542a) Known only from Tanzanian and Mozambiquan Coastal Forests.

Amphibians

8 species are recorded by Frontier-Tanzania collections from 33 specimens. No rare species have yet been found.

Plants

Possible Mkwaja forest endemic -	*Harveya* sp., not matched at Kew (= *Frontier* 3035) [Scrophulariac.]
Coastal Forest endemics -	*Stuhlmannia moavi* Taub. [Fabac.] Mkwaja and 5 other sites nearby. Cited in FTEA. *Canthium peteri* Bridson [Rubiac.] Mkwaja and 2 other Coastal Forests only. Cited in FTEA. *Polysphaeria* sp. A of FTEA [Rubiac.] (*Frontier* 3039). Possible 3rd collection. Otherwise known only from the Selous Game Reserve.
CITES listed plant -	*Encephalartos hildebrandtii* A.Br. & Bouche [Zamiac.] CITES Appendix 1.

CATCHMENT VALUES

No permanent river runs through or along the area, but many seasonal water courses originate from the shallow hills and feed into the lowlands and mangroves.

Dams have been built by the ranch management across minor tributary valleys to catch the water runoff during the rainy season. These catchment dams generally hold free water throughout the dry season.

HUMAN IMPACTS

Cultivation

No major settlements or cultivation are present within the area, so cultivation is limited to the areas close to the few villages that are present.

Fuelwood

Riverine forests along the Mafui and Sima Rivers, as well as the thicket clumps occurring in this same area, are heavily exploited for fuelwood by salt producers. Much of this fuelwood is taken from the ranch area without permission from the ranch management.

Fire

Bushfires are frequent in the area, and most of these are started by man.

Hunting

Hunting and poaching were relatively heavy until 1988, but have recently been kept in check by the ranch management to promote the recovery of the game population.

Livestock

The southern half of the Mkwaja ranch is currently (1995) managed as a joint lifestock and game area, although few cattle are in reality grazed in this area.

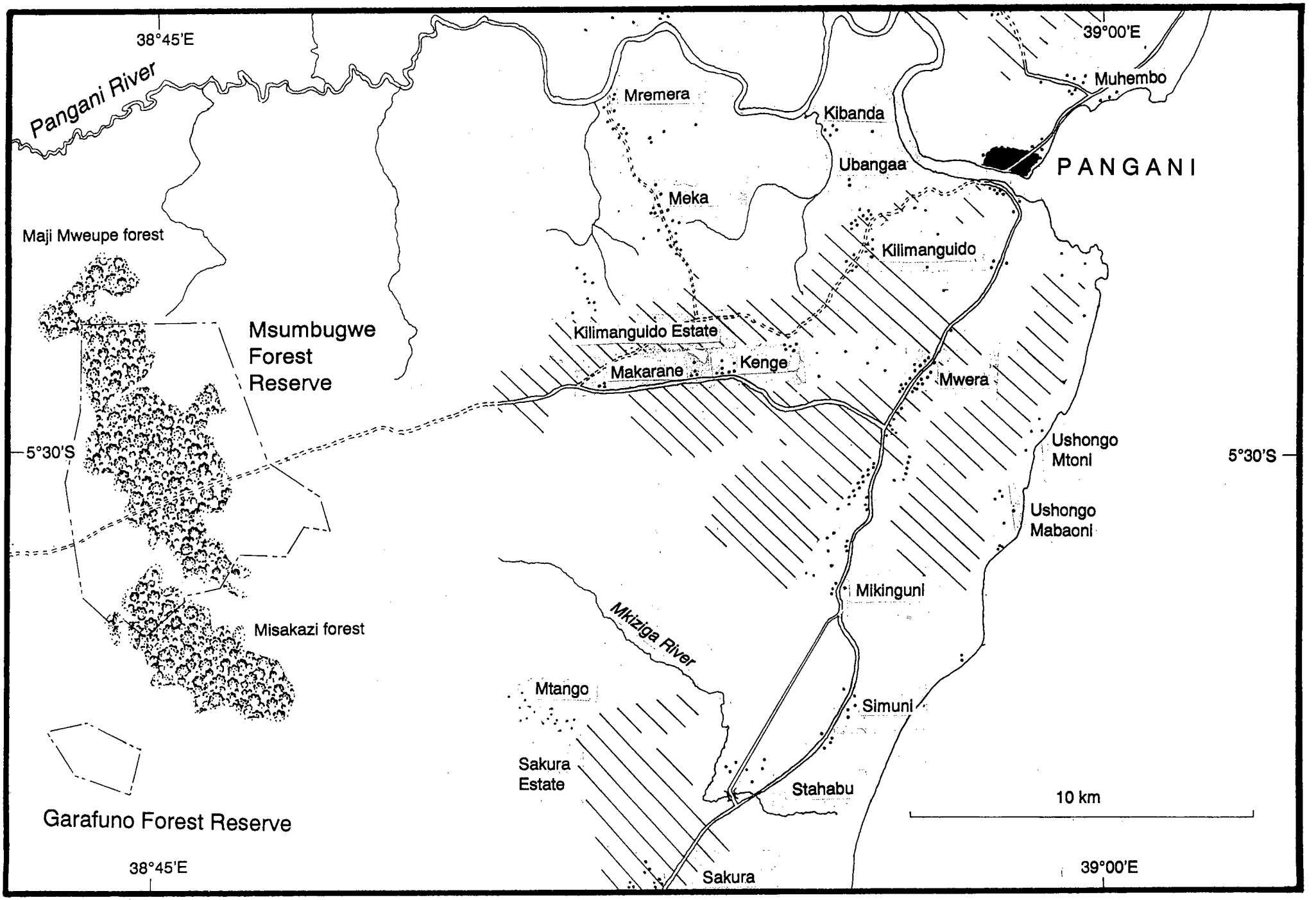
CONSERVATION ISSUES

The forests of the Mkwaja coastal mosaic are largely contained within the Mkwaja Ranch, where the southern half of the ranch is currently managed as a combined game and cattle area. The Mkwaja Ranch is currently (1995) up for sale for $3 million, and continued encouragement of the new owners and managers of the ranch is required to ensure that conservation of these forests is continued into the future.

The main threat to the forests is from illegal woodfuel collecting by salt boilers. A medium scale salt pan industry (using solar evaporation) could be developed in the area which might eliminate this threat.

LITERATURE

None known.


38°45'E
39°00'E
Pangani River
Mremera
Kibanda
Muhembo
PANGANI
Ubangaa
Meka
Maji Mweupe forest
Kilimanguido
Msumbugwe
Forest
Reserve
Kilimanguido Estate
Makarane
Kenge
Mwera
5°30'S
Ushongo
Mtoni
Ushongo
Mabaoni
Mikinguni
Misakazi forest
Mkiziga River
Mtango
Simuni
Sakura
Estate
Stahabu
10 km
Garafuno Forest Reserve
Sakura

MSUMBUGWE FOREST RESERVE

DESCRIPTION

NAME: Msumbugwe Forest Reserve
Pangani District, Tanga Region, Tanzania.

AREA: 4,407 ha; 44 km; 10,890 acres; 17 sq. miles.

BOUNDARY: LENGTH 28.33 km. 16 km of the boundary (north of the track which bisects the reserve) cleared and teak stumps planted in 1995. A 5 km fire line has been introduced along the NE side of the reserve.

STATUS: Catchment Forest Reserve. Gazetted 1947. Resurveyed and enlarged to include Garafuno Forest Reserve in 1966, but the new forest reserve was not gazetted.
Declaration Order Cap. 389 - supp. 59 of 1959, p. 112.

MAPS: Ordnance Survey topographic maps 1:50,000 Series Y742
Sheets 130/3 'Hale' of 1988, mapped from aerial photos of 1981 & 1982.
130/4 'Pangani' of 1988, mapped from aerial photos of 1982 & 1983.
149/1 'Gendagenda' of 1987, mapped from aerial photos of 1981-83.
149/2 'Sakura' of 1987, mapped from aerial photos of 1981-83.
Shows incorrect Forest Reserve boundary.

Forestry Division Boundary Map Jb 692 of 1969, 1:25,000.
Location map Jb 2004 of 1970, 1:50,000.

LOCATION

Grid ref: 5°27'S - 5°34'S, 38°43'E - 38°48'E

Elevation: 80 - 120 m a.s.l.

Msumbugwe Forest covers a low rise at 120 m altitude on the coastal plain, 24 km south-south-west of Pangani and 15 km inland from the Indian Ocean.

The District Forestry Office is in Pangani. Msumbugwe and nearby Garafuno are the only forest reserves in the district which contain neither mangroves nor plantation forest.

Access is by dirt track from Mwera (3 km south of Pangani) to Kabuku (on the main Dar es Salaam to Moshi road). This track bisects the forest reserve and a 4WD vehicle is required during the rainy season. The forest becomes inaccessible by vehicle during times of very heavy rain. The nearest village is Mtango, 5 km to the south-south-east.

Public transport access is by bus to Pangani, where a further bus can be obtained to Mkwaja. Get off at Mwera and walk the remaining 15 km to the forest. Alternatively take the northern railway line to Gendagenda and walk the last 10 km to the forest. Beware of buffalo.

SOILS

'Black-cotton' vertisol or Mbuga soil in woodland areas. Laterite is developed on the road in the forest areas only, which indicates sandy, red soils on the higher ground, e.g. in the forest.

CLIMATE

The Msumbugwe Forest Reserve is influenced by tropical East African oceanic temperatures that may be slightly modified by the altitude. The nearest rainfall station is at the Sakura Estate (5°37'S, 38°53'E, 40 m altitude), where an average of 1160 mm of rainfall per year has been recorded from 1931 to 1960, with February and July having a monthly average of less than 50 mm rainfall during this period. A peak annual rainfall of 2021 mm and a minimum annual rainfall of 682 mm has been recorded between 1927 and 1970 from this rainfall station.

VEGETATION

The forest reserve incorporates some 17 km^2 of dry evergreen forest of the Zanzibar-Inhambane Undifferentiated Forest (*sensu* White, 1983). A further 13 km^2 lies outside the reserve boundary (areas taken from the 1988 Ordnance Survey maps using aerial phots from 1982). Two main vegetation types are present in the forest reserve itself :

Dry forest [Zanzibar-Inhambane undifferentiated forest (*sensu* White, 1983)]

The forest is dominated by *Scorodophloeus fischeri, Cynometra webberi* and *Manilkara sulcata.* In undisturbed areas, an even 15-20 m closed canopy is present. Other species include *Croton pseudopulchellus, Hymenaea verrucosa, Bombax rhodognaphalon, Erythrina sacleuxii, Newtonia paucijuga* and *Croton jatrophoides* (Hawthorne, 1984). *Brachylaena huillensis* was formerly common, but most of the larger trees have been logged.

A single vegetation plot has been constructed in the dry forest :

Plot 1 : Dry Forest near the road at 110 m altitude, 60 m x 5 m plot.
0.03 ha in area with 16 trees over 10 cm dbh giving an equivilant of 533 trees per ha.
Mean tree dbh 22.0 cm; mean tree height 18.4 m; mean bole height 9.6 m.
Mean basal area 20.2 m^2/ha; mean stand volume 194 m^3/ha.

Grassland and thicket [Zanzibar-Inhambane secondary grassland and evergreen thicket (*sensu* White, 1983)]

White's Zanzibar-Inhambane secondary grassland occurs in the remaining 27 km^2 of the reserve, interspersed with small patches of evergreen thicket. Doum palms *Hyphaene compressa* are common.

TIMBER VALUES

The forested areas of Msumbugwe have been extensively logged for *Brachylaena huillensis*. The timber trees *Afzelia quanzensis* and *Bombax rhodognaphalon* are also present in the forest.

BIODIVERSITY

A number of biologists have visited Msumbugwe forest, but all of these visits have been short. A few botanists (Semsei, Tanner, Milne-Redhead, Taylor, Hawthorne) have collected in the forest. Williams and Archer collected bird specimens during the early 1960s (deposited at the British Museum of Natural History) and the Danish ICBP team visited to conduct an ornithological survey in 1990. A few brief visits were made by the Frontier-Tanzania Coastal Forest Research Programme in 1991.

Birds

83 bird species have been recorded (Faldborg *et al.*, 1990) of which 32 are forest birds. Further species records might be obtained by examining British Museum material.

Coastal Forest endemics -	Fischer's Greenbul *Phyllastrephus fischeri.* Little Yellow Flycatcher *Erythrocercus holochlorus.*
Coastal Forest/Eastern Arc endemic -	Fischer's Turaco *Tauraco fischeri* [BirdLife Near Threatened].
Other BirdLife listed species -	Southern Banded Snake-eagle *Circaetus fasciolatus* [BirdLife Near threatened]. Plain-backed Sunbird *Anthreptes reichenowi* [BirdLife Near threatened].

Mammals

13 mammal species are recorded from Msumbugwe forest by Faldborg *et al.* (1990).

CITES/IUCN listed species -	African Elephant *Loxodonta africana* [CITES Appendix 1; IUCN Vulnerable]. Leopard *Panthera pardus* [CITES Appendix 1; IUCN Threatened]. Black-and-Rufous Elephant Shrew *Rhynchocyon petersi petersi* [IUCN Rare]. Zanzibar Galago *Galagoides zanzibaricus* [IUCN Vulnerable].

Reptiles

No reptile species have yet been recorded from Msumbugwe forest.

Amphibians

1 species has so far been recorded for the reserve from the Frontier-Tanzania collection of 1 specimen. No rare species have yet been found.

Plants

Coastal Forest endemics -	*Convulvulus jeffrey* Verdc. [Convulvulac.] Msumbugwe and 1 district in SE Kenya. Cited in *Kew Bull.* **37**, 3. *Teclea* sp. aff. *simplicifolia* not matched [Rutac.] Msumbugwe and 1 other site. Cited in Robertson & Luke (1993).
CITES listed plant -	*Encephalartos hildebrandtii* A.Br. & Bouche [Zamiac.] CITES Appendix 1.

Many rare plants have been collected in the vicinity of Msumbugwe, particularly by Faulkner on the Mwera, Sakura and Bushiri sisal estates to the east. The majority of these rare plants are found in remnant forest patches and have

restricted distributions either around the lower Pangani River basin, or extending further north into SE Kenya. Further collecting in Msumbugwe will undoubtedly yield these specimens.

CATCHMENT VALUES

No permanent water courses are present in the forest, although it is the source of a number of seasonal streams. A permanent pool exists on the eastern boundary of the reserve (outside the forest), which is an important watering hole for large mammals, especially buffalo.

There are no steep slopes within the Msumbugwe Forest Reserve.

HUMAN IMPACTS

Logging

The forested areas have been extensively logged for *Brachylaena huillensis*, and logging trails criss-cross the forest. Disturbance is extremely heavy, and shrubs have been seen to be wilting due to the altered micro-climate. The risk of a forest fire will be increased by the subsequent drying out of the forest.

Hunting and Fire

Illegal hunting often takes place in or near the reserve. Hunters camp at the water hole and target large game animals e.g. buffalo. Many bushfires are started by the hunters in the vicinity of the reserve to drive the game.

Settlement

The village of Kwamgambo is marked on the 1963 Ordnance Survey map (from aerial photos taken in 1957) but is no longer in existence, perhaps following relocation under the 'Ujamaa' villagisation programme. There is currently no threat from clearing/encroachment for agriculture.

Fuelwood

Exploitation for the production of charcoal, or woodfuel for coastal salt production, remain as future threats. Other Coastal Forest near the coast in Tanga Region have been extensively damaged by salt producers, e.g. the Mkwaja Ranch forests and Horohoro Forest near the Kenya border.

Forestry

A small pine trial plot has been established by the road at the eastern end of the forest reserve. Results from this plot indicate that Msumbugwe is a marginal site for pine plantations (Procter, 1966, cited in Somi & Nshubemuki, 1980).

CONSERVATION ISSUES

Msumbugwe forest is one of the few Coastal Forests in Tanzania which is not threatened by agricultural encroachment and therefore can be conserved with much less effort than many of the other Coastal Forests. The main threat to the forest is for its wood value, both for commercial timber and for fuel. Both threats will remain from large

scale operators arriving with trucks or tractors, rather than from local small-scale extraction. Improved policing of the reserve is therefore required, especially of the main access road from Mwera.

A further possible threat may be from the former villagers of Kwamgambo moving back to their ancestral home in the forest.

Boundary clearing and planting with teak stumps is expected to be completed by the end of 1995 or the beginning of 1996.

LITERATURE

Faldborg *et al.* (1990) lists bird and mammal species seen in the forest by the 1990 Danish ICBP expedition.

Hawthorne (1984) decribes the vegetation of Msumbugwe forest with notes on its ecological affinities.

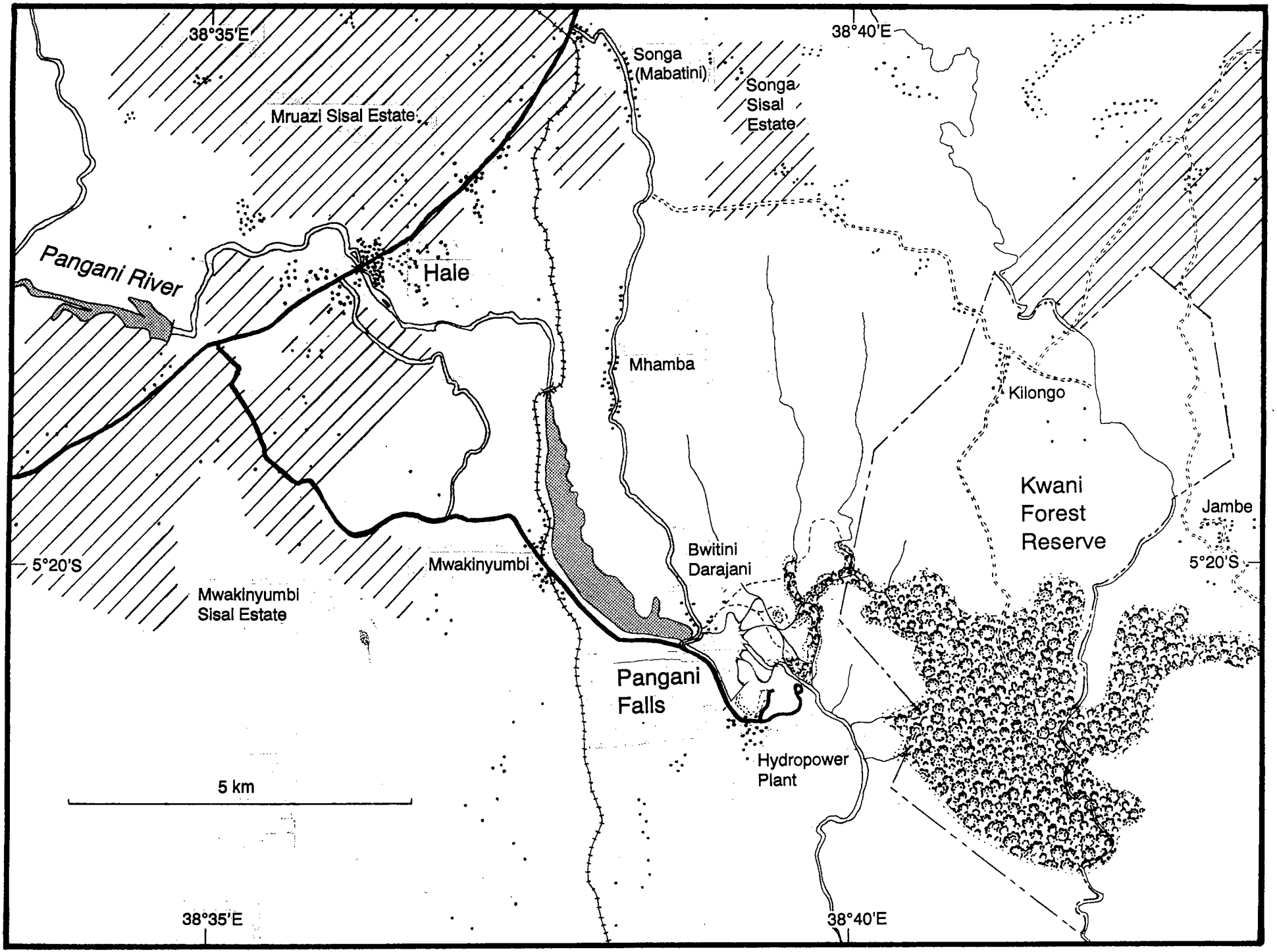
Polhill (1968) mentions Msumbugwe as a possible site for a Nature Reserve and briefly describes the forest.

Verdcourt (1952) briefly describes the forest with a list of the few molluscs found in Msumbugwe.

ADDENDUM

The Garafuno Forest Reserve is located a few km to the south of Msumbugwe (Forest Division maps Jb 693 of 1969, 1:50,000 and Jb 1999 of 1979, 1:10,000). This forest has not been visited but is expected to be very similar to Msumbugwe forest. In between this forest reserve and Msumbugwe there exists an area of high forest which would have been gazetted under the 1966 enlargement. The Tanga Catchment Forestry Office is planning to gazette this forest in a new forest reserve to be called the Misakazi Forest Reserve.

Tanga Catchment Forest Office will be clearing the boundary of the Garafuno Forest Reserve in 1996.


38°35'E
38°40'E
Songa
(Mabatini)
Songa
Sisal
Estate
Mruazi Sisal Estate
Pangani River
Hale
Mhamba
Kilongo
Kwani
Forest
Reserve
Jambe
5°20'S
Bwitini
Darajani
Mwakinyumbi
Mwakinyumbi
Sisal Estate
Pangani
Falls
Hydropower
Plant
5 km
38°35'E
38°40'E

PANGANI FALLS FOREST

DESCRIPTION

NAME: Pangani Falls Forest
Muheza District, Tanga Region, Tanzania.

AREA: Approx. 10 ha; 1 sq. km; 25 acres; 0.4 sq. miles.

STATUS: Government land with no formal protection.

MAPS: Ordnance Survey topographic map 1:50,000 Series Y742
Sheet 130/3 'Hale' of 1988, mapped from aerial photos of 1981-82.

LOCATION

Grid Ref: 5°20'S - 5°21'S, 38°39'E - 38°40'E

Elevation: 20 - 160 m a.s.l.

The Pangani Falls forests are located on the east/north bank of the Pangani River, at the site of a former waterfall which existed prior to the expansion of hydropower generating facilities at the site in 1994. The forests are present on steep slopes around a number of tributaries of the Pangani River over an altitudinal range of 20-160 m a.s.l. Riverine forest is also present along the main Pangani River and on islets in the river itself.

The forest is approximately 70 km west of Tanga, and 5 km south-east of Hale (on the main Dar es Salaam to Tanga road). Access to the site is by tarmac road from Hale to the TANESCO hydro-electric power dam development. Just before reaching the dam, take a northward turning and cross the lake by the causeway and bridge to the village of Bwitini Darajani. From here a number of footpaths go to the forest, which is about 2 km distant.

Note : Prior permission from TANESCO is required to visit the Pangani Falls forest.

Public transport access by the Dar es Salaam to Tanga bus. Get off at Hale where it is easy to pick up a lift to the hydropower site. Alternatively the northern railway line has a station at Mwakinyumbi, 2 km west of Bwitini Darajani village.

SOILS

Red silty clay soils with a low phosphate content, pH 5.4 - 6.4. A lower pH of 4.1 is recorded from the riverside.

CLIMATE

The Pangani Falls forests are influenced by tropical East African oceanic temperatures that may be slightly modified by the altitude. The nearest rainfall station is at the Makinyumbi Sisal Estate (5°19'S, 38°37'E, 197 m altitude), where an average of 1256 mm of rainfall per year has been recorded for the 36 years up to 1973, with only January having a monthly average of less than 50 mm during this period.

VEGETATION

Two main types of forest are present at Pangani Falls :

Dry Evergreen Forest [Zanzibar-Inhambane undifferentiated forest (*sensu* White, 1983)]

The dry forest is strongly dominated by *Cynometra brachyrrachis,* especially on the ridges where the dominance approaches 100% for this species. Other trees include *Scorodophloeus fischeri* (which may be dominant in some areas), *Manilkara sulcata, Julbernadia magnistipulata, Inhambanella henriquesii, Bombax rhodognaphalon, Dalbergia boehmii* and *Adansonia digitata.* Cycads *Encephalartos hildebrandtii* and *Euphorbia* spp. are common small trees and *Sanseviera bagamoyensis* and *Sanseviera conspicua* are common in the herb layer. The shrubs *Grandidieri boivinii* and *Ludia mauritiana* are common, along with saplings of *Cynometra brachyrrachis.*

A single vegetation plot has been constructed in the dry evergreen forest area :

Plot : Dry forest in good condition at 180 m altitude on a hillside, 16 subplots of 100 m^2.
0.16 ha in area with 58 trees over 10 cm dbh giving an equivilant of 360 trees per ha.
Mean tree dbh 20.0 cm; mean tree height 19.6 m; mean bole height 7.4 m.
Mean crown area 38.3 m^2/tree; mean basal area 11.3 m^2/ha; mean stand volume 83 m^3/ha.
The following tree species were identified : 43 x *Cynometra brachyrrachis* (74%), 6 x *Manilkara sansibarensis* (10%), 4 x *Scorodophloeus fischeri* (7%), 1 x *Albizzia* sp., *Bombax rhodognaphalon, Diospyros* sp., *Xylia africana* (2% each). One tree could not be identified.

Riverine Forest [Zanzibar-Inhambane undifferentiated forest (*sensu* White, 1983)]

The riverine forest contains a mix of the usual widespread riverine forest species such as *Ficus vallis-choudae, Parkia filicoidea, Barringtonia racemosa, Mascarenhasia arborescens, Rauvolfia mombasiana, Pancovia golungensis, Albizzia versicolor, Sesbania sesban, Breonadia salcina* and *Pandanus rabaiensis.* Other trees include *Burttdavya nyasica* and *Craibia zimmermannii.*

TIMBER VALUES

A number of timber trees are present e.g. *Milicia exelsa* but occur at low densities.

BIODIVERSITY

The botanists Peter and Stuhlmann have carried out plant collections around the Pangani Falls. More recently, a number of Environmental Impact Assessments have been carried out in conjunction with the hydropower expansion project at the Pangani Falls (e.g. Kapuya, 1993 & 1994; Kiwia *et al.*, 1992). These studies have concentrated on the riverine forest areas. The Frontier-Tanzania Coastal Forest Research Programme carried out a general biological survey of the dry forest areas in 1993.

Birds

96 bird species are recorded for the Pangani Falls site in Kiwia *et al.* (1992), and a further 31 species are recorded by C. Mlingwa and by Frontier volunteers, although only 20 of these species are recorded from the forest. No endemic Coastal Forest or threatened species are yet recorded.

The Pangani Falls site is one of only 4 locations in Tanzania where Pel's Fish Owl *Scotopelia pelis* has been recorded.

Mammals

28 mammal species are recorded for the area from Kiwia *et al.* (1992) and from collections and observations by Frontier-Tanzania, including 6 bat species [6 specimens] and 5 rodent species [24 specimens collected from 160 trap nights].

Rare species - Cyclops Leaf-nosed Bat *Hipposideros cyclops.* (Specimen KMH 10559). Isolated East African population of a West African species. Only 3 other East African locations, all Coastal Forests.

CITES/IUCN listed species - Black-and-Rufous Elephant Shrew *Rhynchocyon petersi petersi* [IUCN Rare].
Leopard *Panthera pardus* [CITES Appendix 1; IUCN Threatened].

Reptiles

Only 3 reptile species have so far been recorded from the Pangani Falls, and only 1 specimen is known to have been collected.

CITES/IUCN species - Nile Crocodile *Crocodylus niloticus* [CITES Appendix 1].

Amphibians

6 species are recorded by Frontier-Tanzania collections from 19 specimens. No rare species have yet been found.

Plants

271 plant species (including 39 tree species) are listed for all habitat types in Kapuya (1993). Further species have been collected by the Frontier-Tanzania Coastal Forest Research Programme in the forest areas.

Possible Pangani Falls endemics - *Uvaria* sp. ?nov., not matched at Kew (= *Frontier* 3486) [Annonac.].
Cynometra sp., not matched at Kew (= *Frontier* 3433) [Fabac.].

Pangani area endemics - *Saintpaulia tongwensis* B.L.Burtt [Gesneriac.] Pangani Falls, Tongwe and Gendagenda. Cited in Kapuya (1995).
Cynometra brachyrrachis Harms [Fabac.] (Specimen *Frontier* 3449). Also from Tongwe, Gendagenda and lowland forest in the East Usambara Mountains.

Coastal Forest endemics - *Agelaea setulosa* Schellenb. [Connarac.] Pangani River and 6 other sites. Cited in FTEA.
Zenkerella egregia J.Leon [Fabac.] Pangani Falls and 2 other Tanzanian sites. Cited in Kapuya (1994).

CITES listed plant - *Encephalartos hildebrandtii* A.Br. & Bouche [Zamiac.] CITES Appendix 1.

CATCHMENT VALUES

The Pangani Falls Forests are developed around a complex series of small streams, some of which are overflow streams from the main Pangani River. Two further streams flow through the forest which rise from a few km north of

the Pangani Falls. The Pangani Falls forests protect the catchment of these streams which have become more important recently since these stabilise the flow of the lower Pangani river during the times when the upper Pangani riverflow is being retained to provide increased generating capacity.

HUMAN IMPACTS

Hydroelectric dam

The development of a hydropower facility at the Pangani Falls has had the most significant impact on the nearby forests. The initial dam (constructed during the 1920s) created a number of secondary overspill channels which then developed a complex drainage network through the forest. The channels have flowed down steep slopes and have scoured away the overlying soils and forest, and have exposed large areas of bare rock. In some areas the new streams have already been colonised by riverine forest species such as *Barringtonia racemosa* and *Pandanus rabaiensis*.

The additional moisture supply from the streams has encouraged the development of elephant grass *Pennisetum purpureum* which burns more fiercely during bushfires than the other grasses in the area, thereby increasing the threat to the dry forest.

The recent enlargement of the hydropower facility at Pangani Falls (completed in 1994) has cut off the supply to the overspill channels such that the dry forest areas will now be left with corridors of bare rock going through them. The main body of the Pangani River has been diverted for about 2 km of its length through a tailrace pipe so that the riverine forest areas along this length will start to dry up.

Pole cutting

Some polecutting was observed in areas of forest closest to Pangani Falls village. A long term quantitative assessment is required to determine whether this is being carried out at a sustainable rate.

Fuelwood

Live trees were observed to have been cut for fuelwood in 1993. The preferred species appears to *Combretum schumannii*.

Fire

The forest is in retreat from the annual bush fires which are usually started accidentally or intentionally by man.

Spiritual

Part of the forest (near the base of the falls) is considered to be sacred by the local people.

Cultivation

Until recently there was little threat to the forests from agricultural encroachment. In 1994 however, the village people of the Pangani Falls area started to clear land along the river many kilometres from their homes. These new agricultural areas are on the other side of the forests to the village sites, and will expose the forests to greater levels of disturbance from the villagers passing through to reach their fields.

CONSERVATION ISSUES

Much conservation effort has been put into saving the biological values of the areas of riverine forest that have been lost as a result of the hydropower expansion. This has involved the short-term solution of transplanting various threatened species to similar habitats outside of the area, i.e. to riverine forest on islands below the tailrace outlet. There have been no efforts to protect the areas of dry forest, which are far more important than the widespread riverine forest for biodiversity and endemic species. Yet even for the riverine forests, there is no long-term conservation plan, and TANESCO should be encouraged to take an active interest in the conservation of the various forest types in the vicinity of the dam.

Of particular concern has been the recent (1994 & 1995) agricultural encroachment into formerly uninhabited and fairly remote areas along the river below the tailrace outlet. It is not known what has caused this activity but a socio-economic assesment is being planned by NorConsult to investigate its cause later in 1995.

LITERATURE

Bowen (in prep.) describes the sighting of Pel's Fishing Owl at Pangani Falls.

Clarke (1994) gives a preliminary assessment of the impact of the hydropower expansion on the forests of the area.

Kapuya (1993) provides detailed botanical inventories of the Pangani Falls area, along with preliminary ornithological and mammal species lists. Reference copy at the University of Dar es Salaam.

Kapuya (1994) provides a detailed botanical inventory of the island forests.

Kapuya (1995) reports on the relocation of threatened African Violets from the base of the Pangani Falls to new sites in the area.

Kiwia *et al.* (1992) report on the mammal, plant and birdlife of the Pangani Falls area, with preliminary species lists. Data superseded by Kapuya (1993).

NorConsult (1990) contains the inception report for an environmental impact assessment.

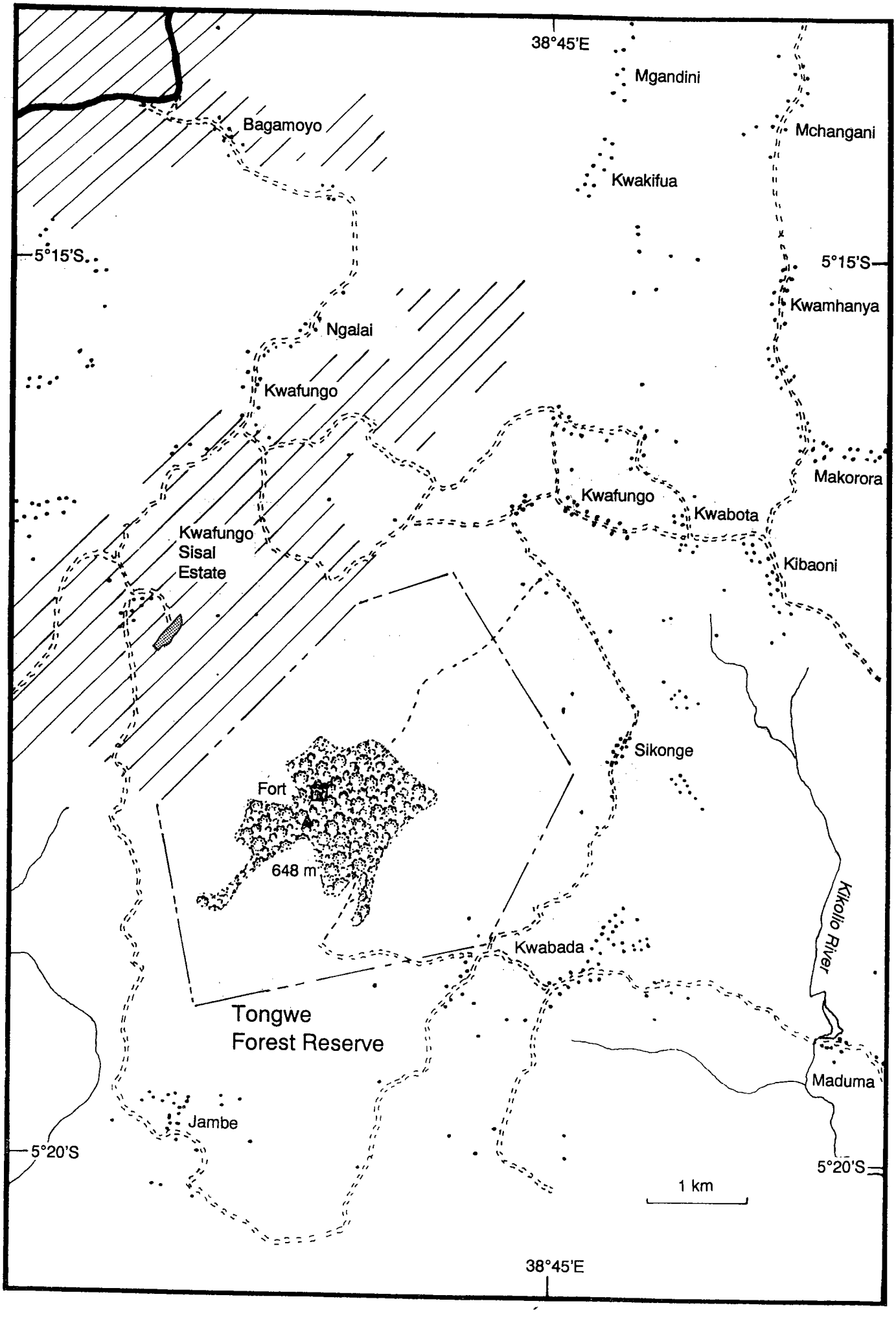
Sulusi-Sjo (1993) reports on the conditions of life for villagers living in the vicinity of the Pangani Falls.

ADDENDUM

The Pangani Falls forest joins onto a much larger area of forest that is contained within the Kwani Forest Reserve, which contains at least 6 km^2 of Coastal Forest.

The vegetation of Kwani Forest Reserve appears to differ from that at the Pangani Falls, with 20 m high individuals of *Antiaris toxicaria* at its western end where there appears to have been much disturbance through logging resulting in dense thickets of *Olyra latifolia*. At the southern end of this forest the trees are smaller and the canopy is about 10 m high with *Terminalia sambesiaca, Pancovia golungensis* and *Rawsonia lucida*. Good closed forest (with a 20 m high canopy) is present in the south-eastern side of the reserve where *Cynometra webberi* is frequent along the ridges. Other tree species in this area include *Julbernadia magnistipulata, Pterocarpus tinctorius, Parkia filicoidea, Combretum schumannii* and various species of Annonaceae and Rubiaceae. Cycads *Encephalartos hildebrandtii* are present in the small tree stratum.

Kwani Forest Reserve could be extended to the east to include the Pangani Falls forest.


38°45'E
Mgandini
Bagamoyo
Mchangani
Kwakifua
5°15'S
5°15'S
Kwamhanya
Ngalai
Kwafungo
Makorora
Kwafungo
Kwabota
Kwafungo
Sisal
Estate
Kibaoni
Sikonge
Fort
648 m
Kikollo River
Kwabada
Tongwe
Forest Reserve
Maduma
Jambe
5°20'S
5°20'S
1 km
38°45'E

TONGWE FOREST RESERVE

DESCRIPTION

NAME: Tongwe Forest Reserve
Muheza District, Tanga Region, Tanzania.

AREA: 1202 ha; 12 sq. km; 2970 acres; 4.6 sq. miles.

BOUNDARY LENGTH: 13 km. Boundary planted with teak *Tectona grandis* in 1960. Boundary cleared in 1983 and 1995. 6 km of teak stumps planted on the northern side in 1995.

STATUS: Catchment Forest Reserve (since 1990).
Gazetted during the German administration. Original map RT/PAN/5/2.
Declaration Order G.N. nos. 249 & 288 of 1956; superseded by Cap. 389 - supp. 59 of 1959, p. 137.

MAPS: Ordnance Survey topographic maps 1:50,000 Series Y742
Sheets 130/3 'Hale' of 1987, mapped from aerial photos of 1981 & 1982
130/4 'Pangani' of 1988, mapped from aerial photos of 1982 & 1983
Both maps show the incorrect forest reserve boundary.

Forestry Division Boundary Map Jb 271 of 1955, 1:25,000 'Kwani and Tongwe'.

LOCATION

Grid ref: 5°17'S - 5°19'S, 38°43'E - 38°45'E

Elevation: 220 - 648 m a.s.l.

Tongwe forest covers the isolated peak of Mount Tongwe, a southern outlier of the East Usambara mountains. The forest ranges in altitude from 220-648 m (Lovett & Pocs, 1992). The reserve is located 15 km west-south-west of Muheza, 30 km inland from the Indian Ocean. The nearest village is Kwabada, 2 km to the south.

The District Forestry Office is in Muheza. The District Catchment Forestry Office is in Amani. Local forest officer at Kwafungo (responsible for Tongwe Forest before it became a Catchment Forest).

Access is by a dirt road running south from Muheza or by another dirt road that leads south from the main Dar es Salaam to Tanga road near the village of Bagamoyo, through the Kwafungo Sisal Estate. Logging tracks lead from Kwabada to base of the hill. All tracks are bad in wet weather.

Public transport access is by the frequent Dar es Salaam to Tanga buses, or by rail to Muheza. Walk the remaining distance to the forest reserve.

SOILS

The forest contains reddish brown soils, which are classified under the FAO/UNESCO system as ferralsols. "Black Cotton" soils are present in the lowlands.

CLIMATE

The Tongwe Forest Reserve is influenced by tropical East African oceanic temperatures that are slightly modified by the altitude. The nearest rainfall station is at the Kwafungo Sisal Estate (5°17'S, 38°43'E, 212 m altitude), where an average of 1268 mm of rainfall per year has been recorded for the 7 years up to 1973, with January and February having a monthly average of less than 50 mm during this period. Standard climatic data is available from further away at the Karimi Estate (5°14'S, 38°35'E, 286 m altitude), where an average of 1239 mm of rainfall per year has been recorded for the 30 years from 1931-1960, with only July having a monthly average of less than 50 mm rainfall during this period.

VEGETATION

Tongwe Forest Reserve contains three major vegetation types as follows :

Forest [Zanzibar-Inhambane undifferentiated forest and lowland rainforest (*sensu* White, 1983)]

Approximately 3 km^2 of forest are present on Mount Tongwe, which is classified as Zanzibar-Inhambane undifferentiated forest (White, 1983) on the lower slopes and on the peak, and as Zanzibar-Inhambane lowland rainforest on the mid-slopes.

A few patches of forest are present below 450 m elevation at the south-eastern edge of the main forest block. The forest here is strongly dominated by *Cynometra brachyrrachis* and *Cynometra webberi*, with the occasional *Combretum schumannii, Scorodophloeus fischeri* and *Craibia brevicaudata* to a canopy height of 15 - 17 m. *Draecaena afromontanum* is also present as a small tree. Along the seasonal watercourses *Terminalia sambesiaca, Sterculia appendiculata* and *Antiaris toxicaria* occur as emergents to 25 m over a canopy. *Scorodophloeus fischeri, Pancovia golungensis, Drypetes natalensis, Tricalysia* sp. and *Oxyanthus pyriformis* are present as smaller trees 8-10 m tall.

Above 450 m the forest becomes moister and species typical of wet, rocky habitats become more common, e.g. *Pandanus rabaiensis, Impatiens walleriana* and *Saintpaulia tongwensis*. The tree canopy increases to 30 m with *Aningeria pseudoracemosa, Antiaris toxicaria, Barringtonia racemosa, Bequaertiodendron natalense, Bombax rhodognaphalon, Cola scheffleri, Drypetes usambarica, Erythrina sacleuxii, Isoberlinia scheffleri, Lecaniodiscus fraxinifolius, Macphersonia hildebrandtii, Pachystela msolo, Pandanus rabaiensis, Parkia filicoidea, Pterocarpus mildbraedii, Sorindeia madagascariensis, Sterculia appendiculata, Tabernaemontana pachysiphon* and *Terminalia sambesiaca.* Cycads *Encephalartos hildebrandtii* are also present along with many stumps of *Milicia excelsa*, which indicate that this species was formerly more common in the forest. *Trilepesium madagascariensis* is a common small tree.

Between the two main ridges running north-east from the peak woodland grasses have colonised the ground layer below 25 m high *Bombax rhodognaphalon* and *Antiaris toxicaria,* and the small tree and shrub strata are absent as fire has encroached into an area that was previously covered by forest. Relict patches of forest shrubs occur as islands within the grass.

Above 550 m dominance shifts to *Malacantha alnifolnia* with a canopy height to 20 m, especially in the areas around the fort.

In the rocky habitats around the peak (to 648 m), cycads *Encephalartos hildebrandtii* and screw pines *Pandanus rabaiensis* are common, and the forest canopy is restricted to 10 m in height.

Two vegetation plots have been constructed in Tongwe forest :

Plot A : Closed forest in good condition at 400 m altitude on Tongwe Hill, 60 m x 5 m plot.
0.3 ha in area with 16 trees over 10 cm dbh giving an equivilant of 533 trees per ha.
Mean tree dbh 35.5 cm; mean tree height 21.7 m; mean bole height 6.9 m.

Mean crown area 46.4 m^2/tree; mean basal area 53.1 m^2/ha; mean stand volume 364 m^3/ha.
The following tree species were recorded : 2 x *Scorodophloeus fischeri* (13%), 1 x *Pancovia holtzii, Sorindeia madagascariensis, Sterculia appendiculata* (6% each). The remaining tree species have yet to be identified.

Plot B : Closed forest in good condition on a ridge at 500 m altitude, 60 m x 5 m plot.
0.3 ha in area with 12 trees over 10 cm dbh giving an equivilant of 400 trees per ha.
Mean tree dbh 40.1 cm; mean tree height 19.8 m; mean bole height 7.6 m.
Mean crown area 51.1 m^2/tree; mean basal area 50.47 m^2/ha; mean stand volume 381 m^3/ha.
The following tree species were recorded : 3 x *Pachystela msolo* (25%), 1 x *Tabernaemontana pachysiphon* (8%). The remaining trees have still to be identified.

Woodland [Zanzibar-Inhambane secondary wooded grassland (*sensu* White, 1983)]

The forest is surrounded by woodland (with trees up to 10 m tall) and wooded grassland. Common trees include *Albizia versicolor.*

Grassland [Zanzibar-Inhambane secondary grassland (*sensu* White, 1983)]

The south western ridge of Tongwe Hill is covered by grassland.

TIMBER VALUES

Tongwe forest has recently been extensively logged, mostly for *Milicia excelsa* and *Bombax rhodognaphalon. Pterocarpus mildbraedii, Isoberlinia scheffleri* and *Sterculia appendiculata* have also been felled for timber. Few timber trees worthy of commercial exploitation remain in the forest.

BIODIVERSITY

The *Flora of Tropical East Africa Index of Collecting Localities* (Polhill, 1988) indicates that numerous botanists have visited Tongwe forest. The Frontier-Tanzania Coastal Forest Research Programme has carried out the only known general biological survey in 1992.

The position of Tongwe Hill between the East Usambara forests and the larger Coastal Forests further south means that it contains examples of both vegetation types and can be expected to include species that are characteristic of both

Birds

A brief bird survey by Frontier-Tanzania volunteers recorded 15 bird species from the reserve (9 species in the forest).

Coastal Forest/Eastern - Arc endemic — Fischer's Turaco *Tauraco fischeri* [BirdLife Near Threatened].

Mammals

18 mammal species have been recorded from collections and observations by Frontier-Tanzania, including 9 bat species [8 specimens collected from 40 captures] and 1 rodent species [a single specimens collected from 390 trap nights].

Possible Tongwe - endemic: Shrew *Crocidura* sp. ?nov. (a) det. BMNH (Specimen KMH 7597).

Coastal Forest endemics - Horseshoe Bat *Rhinolophus deckenii.* (Specimen KMH 7590) Known from just 3 other Coastal Forests.

Rare species - Cyclops Nose-leaf Bat *Hipposideros cyclops.* (Specimen KMH 7595) Isolated East African population of a West African species. Only 3 other East African locations, all Coastal Forests.

CITES/IUCN species - Black-and-Rufous Elephant Shrew *Rhynchocyon petersi petersi* [IUCN Rare]. Zanzibar Galago *Galagoides zanzibaricus* [IUCN Vulnerable].

Reptiles

11 reptile species (9 forest dependant) have been recorded from observations and a total collection of 23 specimens by Frontier-Tanzania.

Coastal Forest/Eastern Arc endemics - Dwarf Gecko *Lygodactylus ulugurensis.* (Specimen KMH 7530?) Endemic to the Uluguru mountains and Tongwe forest.
Bearded Pygmy Chameleon *Rhampholeon brevicaudatus.* (Specimen released). Known only from the Eastern Arc and 6 Tanzanian Coastal Forests.
Uluguru Forest Gecko *Cnemaspis barbouri.* (Specimen KMH 7474) Endemic to the Uluguru Mountains, Tongwe and the East Usambara Mountains.

Amphibians

3 species are recorded by Frontier-Tanzania collections from 10 specimens. No rare species have yet been found.

Plants

Tongwe area endemics - *Saintpaulia tongwensis* B.L.Burtt [Gesneriac.] Also Gendagenda and Pangani Falls. Cited in Johannson (1978).
Cynometra brachyrrachis Harms [Fabac.] (Specimen *Frontier* Tongwe 23). Also Gendagenda, Pangani Falls and the lowland East Usambara Mts.

CITES listed plant - *Encephalartos hildebrandtii* A.Br. & Bouche [Zamiac.] CITES Appendix 1.

CATCHMENT VALUES

The reserve became part of the NORAD/FBD Catchment Forestry Plan in 1990 in which all forests close to streams or on slopes of over 40° are protected from over exploitation.

Several seasonal water courses arise from the site. The reserve supplies the surrounding villages and the Kwafungo Sisal Estate with underground streams.

HUMAN IMPACTS

Logging and fires have reduced the size of both the forest and the woodland within the reserve.

Logging

The north-west side of mount Tongwe has been heavily logged for mvule *Milicia excelsa* and Bombax *Bombax rhodognaphalon.* No logging licences have been issued since 1990 but illegal tree felling and pit sawing continued until 1994 when a group of loggers were arrested by Catchment Forestry officials. The loggers are now (1995) awaiting trial and their case has discouraged others from logging Tongwe forest.

Agriculture

Remains of numerous villages and plantations on and around the slopes of Mount Tongwe were pointed out to the missionary Krapf in 1848, and these were said to have been abandoned in 1840 (Lane, 1993). The explorer Richard Burton later found maize and cassava fields around the fort in 1857. Since that time no cultivation is known to have taken place within the limits of the present forest reserve. Iversen (1991 & 1987) however mentions that large tracts of forest were cleared and cultivated on the summit area after independance, but this area is now covered by forest and no evidence could be seen of recent cultivation.

There is a danger that agricultural land shortages in the area may force locals to encroach on reserve land, especially into the woodland areas at the base of the hill. Parts of the hill are too rocky and steep to support agriculture.

Fire

Parts of the eastern boundary of the forest have been observed to be in retreat from the regular bush fires that occur in the surrounding woodland areas.

Other forest products

The woodland is used by the local people as a source of firewood and medicinal plants.

Military

Tongwe Hill was chosen as the site for a fort by the Sultan of Zanzibar in about 18853 due to its strategic position guarding the ancient caravan routes along the Pangani River and along the southern edge of the Usambara Mountains. Part of the forest was cleared to build the small fort, which is depicted in a sketch by the explorer Richard Burton in 1857. The forest has since regenerated around the fort, and this might the subject of an interesting study in regeneration.

CONSERVATION ISSUES

Tongwe forest contains a mix of typical Eastern Arc and typical Coastal Forest species and may be an intermediary between the two forest types. Such intermediaries are usually rich in endemic species (e.g. Kimboza forest and the East Usambara lowland forests). Further biological survey is required to determine whether this is also the case for Tongwe forest.

The fort in Tongwe forest is of national historical importance as one of the oldest standing buildings in Tanga Region and urgent action is required to save the remaining walls (see Lane, 1994). The Tanga Catchment Forest Programme s considering a proposal to carry out conservation work at the fort, in collaboration with the Department of Antiquities.

LITERATURE

Baumann (1891) makes an early mention of the forest on Tongwe Hill, which at that time is described as being covered by dense rainforest on the ridges and summit area.

Burrt (1958) presents the vegetation notes from Greenway's collection of *Saintpaulia tongwensis*, which includes a short list of tree species.

Iversen (1991 & 1987) mentions the cultivation on Tongwe hill after independance.

Iversen (1988) calls for the conservation of Tongwe on account of its African Violet population.

Johannson (1978) refers to Mount Tongwe on account of its African Violet population.

Lane (1993) decribes the history and status of the fort on Mount Tongwe, and contains an illustration of the fort from 1857 showing forest in the background. This is a very useful paper with much background information on the early references that mention mount Tongwe.

Lovett & Pocs (1993) include a Management Summary for the Tongwe Forest Reserve.

Verdcourt (1952) gives a detailed description of the vegetation of Mount Tongwe, followed by a list of mollusc species from the site.

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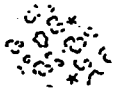
MAP KEY

Vegetation

Forest (Closed canopy).



Forest/Woodland mosaic (Ruvu North map only).

Thicket (Mafia Island and Kilulu Hill maps only).

Plantation (Forest plantation within forest reserve boundaries, sisal plantation outside reserve boundaries).

Natural Features

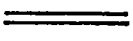
River/Stream.

Plateau Escarpment Edge (Lindi Region maps).

Lake.

Human Features

Tarmac Road (may contain potholes).

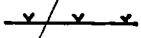


All-Weather/Graded Road.

Dirt Road.

Footpath.

Railway.



Telegraph Line (Ruawa Forest Reserve map only).

Rural Settlement (number of dots indicates population size).

Urban Settlement.

Forest/Game Reserve Boundary.

MAP KEY

Vegetation

Forest (Closed canopy).

Forest/Woodland mosaic (Ruvu North map only).

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