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COASTAL FOREST RESEARCH PROGRAMME

STATUS REPORTS FOR 6 COASTAL FORESTS

IN

LINDI REGION, TANZANIA

G. P. CLARKE

AUGUST 1995

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

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.

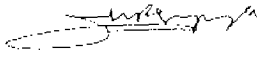
In Africa there are many areas of exceptional biological richness which have scarcely been studied. Even basic data on the status of resources may be lacking or outdated.

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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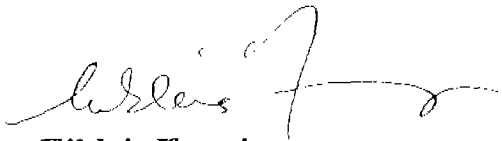

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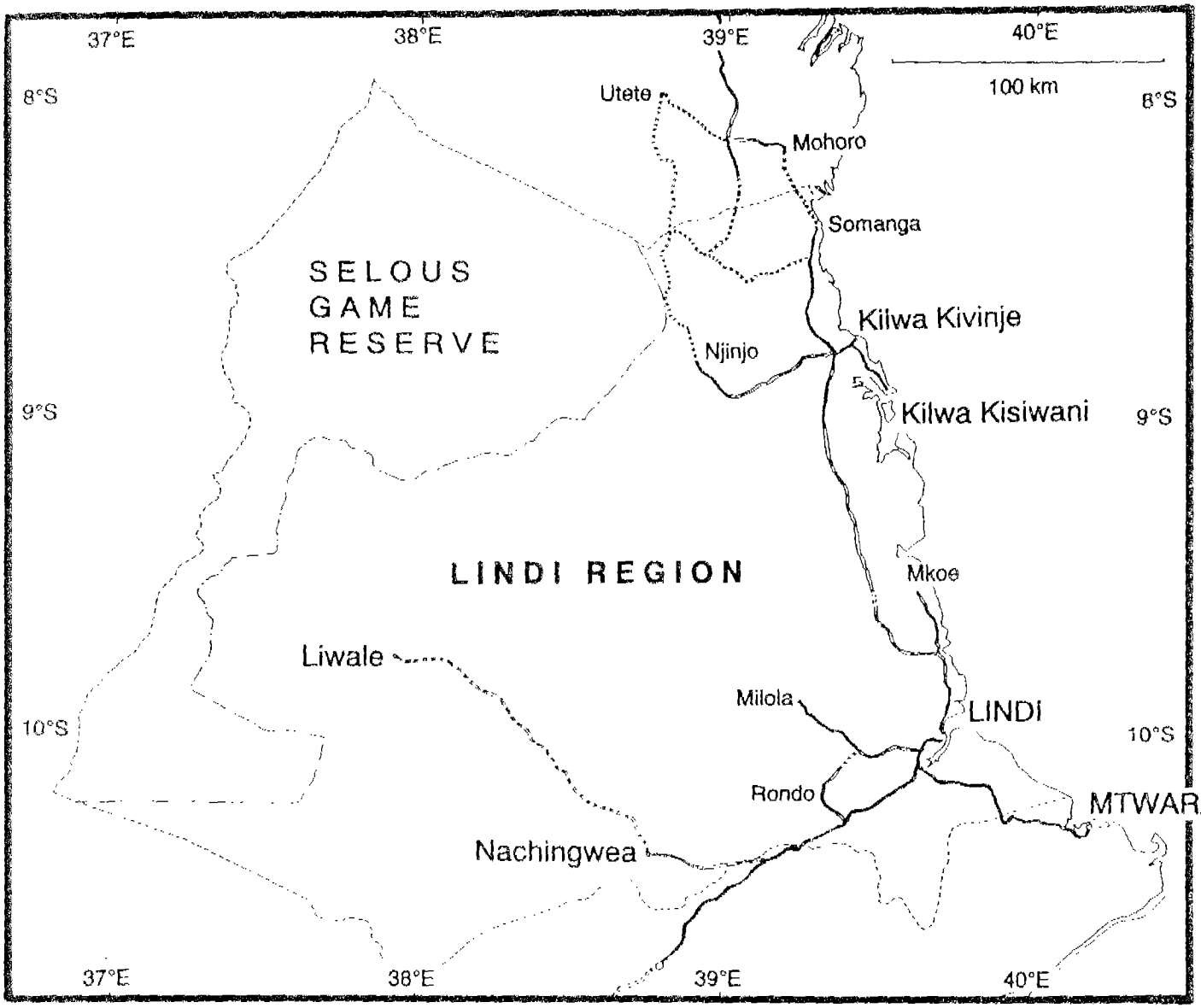
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Milola
LINDI
Rondo
MTWARA
Nachingwea

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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 to 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 Julian Bayliss, Michael Brewin and Leigh Stubblefield, as well as by the editor. 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 Garden, 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 restricted 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 lodged at the larger museums of the world (e.g. the Museum of Comparative Zoology).

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 LINDI REGION

Lindi Region is the largest and least known of the three regions covered by the Status Reports. Although most of the forest reserves in Lindi Region can be expected to contain Coastal Forest, only the six forest reserves covered by this volume of the Status Reports, together with Pindiro Forest Reserve, Ngarama Forest Reserve, Nyangamara forest, and the forest patches in the Selous Game Reserve and Matumbi Hills have been recently visited by biologists. Many other forest patches must exist, both within and outside the formal protection of Forest Reserves.

The fauna and flora of Lindi Region is still poorly known, and most species records are from the detailed collections of a few scientists, in particular by Busse, Schlieben, Loveridge, Ionides and Vollesen. In spite of being under collected, Lindi Region is acknowledged to be rich in endemic species, especially reptiles, plants and amphibians. It is for this reason that Status Reports for Ruawa and Ndimba Forest Reserves have been included in this volume, even though these forests have been only briefly visited by the Frontier-Tanzania Coastal Forest Research Programme. Other known and possible Coastal Forests in Lindi Region include the following (in approximately north to south order) :

Kilwa District

Kitope Forest Reserve (8°20'S, 39°10'E) contains approximately 8 square km of forest which occurs mainly on the south side of Kitope Hill. The forest has yet to be studied for its biological values, but as it occurs at 100-230 m elevation, 7 km from the coast it can be expected to reveal some interesting species. Efforts are currently underway by the regional and district Forestry Offices to settle a boundary encroachment dispute, and to then clear the boundaries and plant exotic tree species as boundary markers.

Old records in the Forestry office in Dar es Salaam indicate that the **Naminangu Forest Reserve** has now been incorporated into the Kitope Forest Reserve. Naminangu means 'place of the Gum Copal trees' in the Kimatumbi language, which must indicate that this species is here, and therefore that forest is also present. The reserve was gazetted during the German administration.

Mbinga Forest Reserve (8°30'S - 8°32'S, 38°49' - 38°51'E) on the southern scarp edge of the Matumbi Hills contains about 6 square km of secondary evergreen thicket and low forest (canopy to 4 m on Kimate Hill) with scattered mvule *Milicia excelsa* in the north (Kilwa District Forestry Office records). Riverine forest is also present along the watercourses. This forest is probably similar to that on the Kichi Hills and in Namakutwa-Nyamuete forest (see Status Reports for 12 Coastal Forests in Coast Region).

The **Nangoma Caves** (located between Nandete and the Mbinga Forest Reserve, at approximately 8°30'S, 38°52'E) contain a small patch of forest around the sink-hole mouth of the caves. This forest is the type locality for the rare amphibian *Spelaeophryne methneri*. The forest here was more extensive in 1910 when it was first visited by the Germans.

Mitarure Forest Reserve (8°50'S - 9°06'S, 39°00'E - 39°10'E) is described by the Kilwa District forestry records as containing miombo with 'good green thicket in places' and was included in the 1961 Southern Province Enumeration Project when it was found to contain 'mature mninga'. The forest reserve also contains a 4 acre trial plot of mninga *Pterocarpus angolensis* that was established in 1968.

Mitundumbea Forest Reserve (9°10'S, 39°15'E) forms a northern extension of Ngarama North Forest Reserve on the Ruwawa Plateau. This reserve was enumerated by the 1961 Southern Province Enumeration Project and was found to contain miombo woodland with mninga *Pterocarpus angolensis* as well as 'thicket patches containing a few mvule *Milicia excelsa*'. These 'thicket patches' may be a type of scrub forest similar to that on Ngarama North Forest Reserve.

Rungo Forest Reserve (9°30'S, 39°00'E) and **Malehi Forest Reserve** to the west and south-west of Kilwa have yet to be visited by biologists, but might contain Coastal Forest on the low hills within the reserves. The Kilwa District forestry records indicate that 'poor miombo' is present in these reserves.

Ngarama North Forest Reserve (9°15'S - 9°33'S, 39°15'E - 39°27'E) has been visited briefly by a Danish ICBP expedition (see Eriksen *et al.*, 1994), who report that patches of closed lowland forest exist on the western boundary of the reserve, with riverine forest along the rivers. Ngarama North was enumerated by the Southern Province Enumeration

Project in 1961, which found a belt of Baobab *Adansonia digitata* forest in the southern part of the reserve, with a very large area of scrub forest on the Ruwawa plateau with a fairly high concentration of mvule *Milicia excelsa* as emergents above a 9 m canopy forest with *Grewia* sp., *Hymenocardia ulmoides*, *Polysphaeria* sp., *Cussonia zimmermannii*, *Bombax rhodognaphalon*, *Draecaena usambarensis*, *Cordyla africana* and *Vitex schliebenii*. The northern part of the reserve consists of miombo where mninga *Pterocarpus angolensis* was reported to have become scarce from over-exploitation during the 1960s. A small remnant patch of forest (9°24'S, 39°22'E) has recently been found on the eastern edge of the reserve with a 25 m high canopy of *Hymenaea verrucosa* together with smaller trees including *Scorodophloeus fischeri*, *Strychnos henningsii*, *Diospyros* sp. and *Synaptolepis kirkii*. This forest patch contains the rare tree *Karomia gigas*, which was previously thought to be extinct.

Ngarama South Forest Reserve (9°31'S - 9°33'S, 39°23'E - 39°26'E) has also been visited by the Danish ICBP expedition (Eriksen *et al.*, 1994) and contains low forest and scrub forest with *Milicia excelsa*, *Markhamia* sp., *Pteleopsis myrtifolia* and *Zanthoxylum* sp. Elsewhere mpingo *Dalbergia melanoxylon* is numerous on the higher rocky areas with shallow soils. The boundaries of the reserve are currently being cleared and planted with *Cassia* sp.

Pindiro Forest Reserve (9°27'S - 9°34'S, 39°14'E - 39°19'E) has been visited by the Danish ICBP expedition (Eriksen *et al.*, 1994), and followed by a further visit by Danish botanists for two months. The Kilwa District Forestry office records the occurrence of a 'grassy type of miombo' with lots of *Brachystegia microphylla* in the south of the reserve. Elsewhere in the reserve are patches of closed forest with a low canopy, together with at least 15 ha of swamp forest (Eriksen *et al.*, 1994). Pindiro has been enumerated by transects 73-76 of the Southern Province Enumeration Project in 1961.

More forest may be present further to the north of Pindiro on the **Mbwalawala Plateau**.

Lindi District

A small patch of dry forest (9°41'30"S, 39°43'E) dominated by the rare tree *Cynometra filifera* (known elsewhere only from the Lindi Creek area) together with *Scorodophloeus fischeri* is found by the coast 4 km north of **Mchinga mbili**.

Patches of forest occur on the steep, rocky hills on either side of the main Dar es Salaam to Lindi road in the vicinty of **Mchinga** (e.g. at 9°43'S, 39°41'E).

Matapwa Forest Reserve (9°38'S - 9°47'S, 39°14'E - 39°24'E) was gazetted during the German administration and contains predominatly Mpingo *Dalbergia melanoxylon* wooded grassland, although a patch of forest is said to occur on a low ridge in the south of the reserve. Riverine forest is also present in the reserve. **Tendaguru Hill** (9°42'S, 39°13'E) lies about 1km to the west of the reserve, where a few endemic plants and *Brachyosaurus* sp. have been collected. The hill is covered by wooded grassland.

A patch of Boabab (*Adansonia digitata*) forest (9°51'S, 39°47'E) is present near **Kikwetu**, to the east of Lindi Airport, and near Mbanja where the endemic reptile *Chirindia ewerbecki ewerbecki* was found. This forest may be similar to that found elsewhere on coral rag where Baobabs are also prominent.

A small area of forest has been reported from the western end of the **Likonde Plateau** (9°47'S - 9°49'S, 39°23'E - 39°29'E), but has not been visited. The proximity of this forest to the those of the Noto and Rondo Plateaux would suggest that it will contain many rare species.

Most of the northern and eastern part of the **Kiwawa Plateau** (9°46'S - , - 39°16'E) has been visited which contains a mosaic of patches of scrub forest within closed canopy Mninga *Pterocarpus angolensis* woodland. A small area of closed canopy forest occurs on the extreme northern escarpment edge.

A large tract of forest is said to still exist on the **Noto Plateau** (9°51'S - 9°54'S, 39°19'E - 39°27'E) where the botanist Schlieben collected a number of rare plants in the 1930s, including *Artabotrys modestus* Diels ssp. *modestus* [Annonac.], *Xylia schliebenii* Harms [Fabac.], *Homalium elegantum* Sleumer [Flacourtiac.], and *Clerodendrum* sp. A of FTEA [Verbenaceae] which have not been recollected elsewhere, so gazettement and protection of this forest is essential to ensure the survival of these species. Other rare species found here include *Mimusops acutifolia* Mildbr. [Sapotac.], *Premna hans-joachimii* Verdc. [Verbenac.] both of which are only found in the Rondo & Noto forests, and *Canthium impressinervum* Bridson [Rubiac.] which is only known from 3 other sites in SE Tanzania.

The local authority **Nandimba Forest Reserve** (not to be confused with the Ndimba Forest Reserve dealt with in this volume of the Status Reports) is present near Mandawa but nothing is known of its status.

Makangala Forest Reserve (9°59'S - 10°01'S, 39°20'E - 39°25'E) lies on the south side of the main road between Rutamba and Milola and contains miombo woodland with scattered patches of thicket. Given its proximity to the Rondo Plateau, this reserve may contain some interesting plant species.

The hills on the eastern side of **Lindi Creek** contain a number of diverse patches of forest. Of these, the forest patches at **Kitunda** (immediately opposite Lindi town) are theoretically protected to safeguard the catchment for part of Lindi's water supply, but cultivation is nonetheless taking place here. These forests are on land owned by the abandoned sisal estate on the hilltop.

The **Mnacho Forest Reserve** on the road between Lindi and Mingoyo/ Mnazi Mmoja contains thicket and scrub of 1 square mile in extent planted with *Cassia siamea* in 1978 to provide woodfuel for Lindi town.

A forest at **Mlinguru** should be present '20km from Lindi' according to the citation for *Cynometra filifera* in the *Flora of Tropical East Africa,* although the Mlinguru Sisal Estate (10°06'S, 39°44'E) is just 10 km from Lindi as the Coucal flies, on the other (eastern side) of Lindi Creek. Mlinguru forest is probably located somewhere on the escarpment edge to the west of the sisal estate, overlooking Lindi Creek, which is cited as another of the collection localities for *Cynometra filifera*. The botanist Schlieben collected a number of plant species in Mlinguru that have not been collected since.

Liwengula Forest Reserve (10°00'S - 10°01'S, 39°33'E - 39°34'E) was gazetted during the German Administration and is found 1 km north of the main Lindi to Milola road, near Lake Narunyu and immediately north of the Naitivi coconut plantation. The reserve was cancelled in 1960 (G.N. 487) and is now an old cashewnut woodland, although the local people say that forest did exist there in the past and that forest is still present to the north-west of the reserve area.

Forest is still present at the extreme southeastern corner of the Rondo Plateau on a hill to the immediate south-east of the **Chiponda trig** point (10°11'S, 39°26'E).

Mtama Forest Reserve is located about halfway between Lindi and Masasi, about 2 km north of Nyangao (10°19'S, 39°17'E). This reserve contains woodland rather than forest but may still include some rare plant species as it is on the base of the Rondo massif. 2 acre trial plots of *Pinus carribea* and *Pinus insularis* were established here during the 1960s.

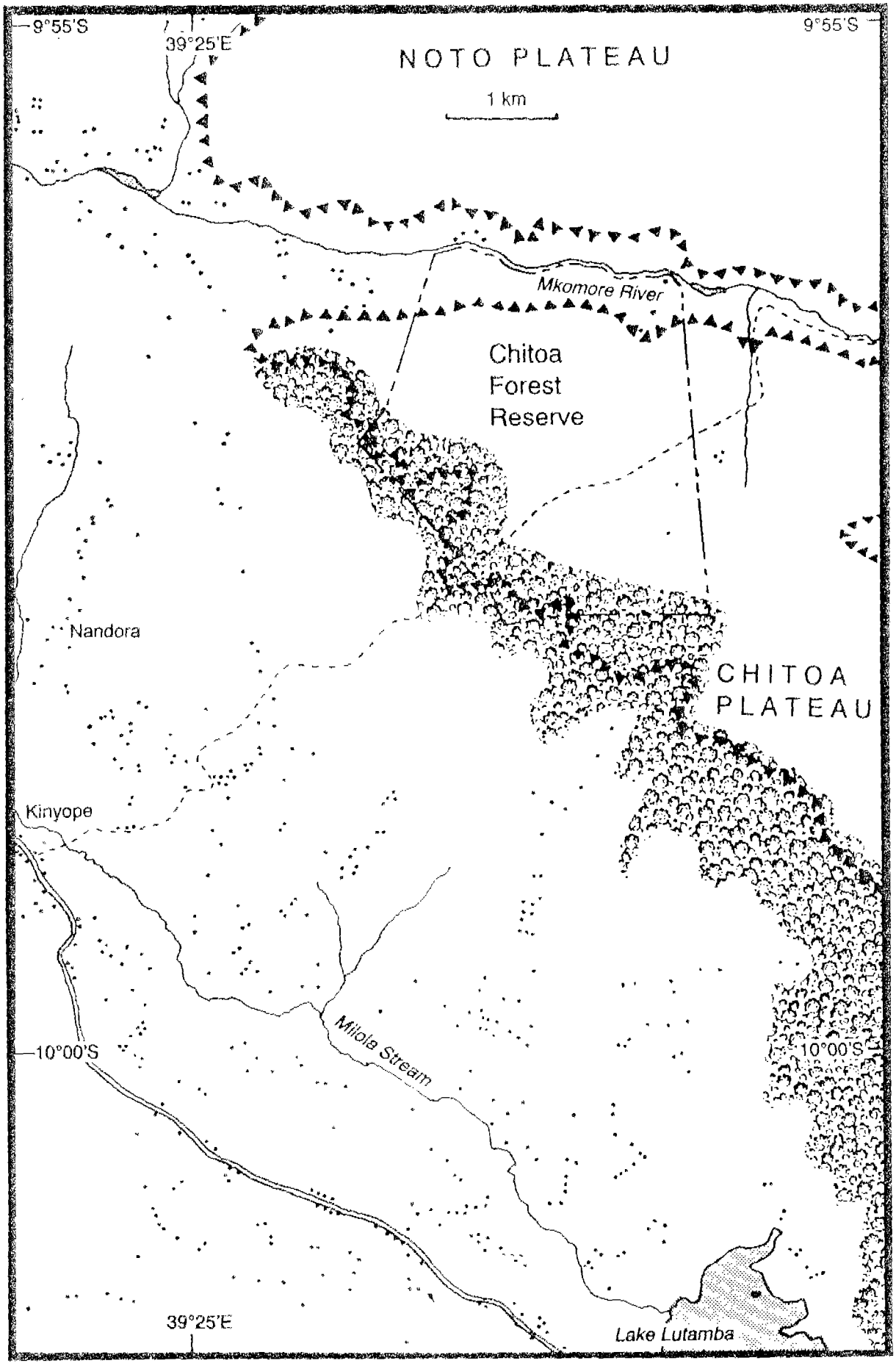
Nyangamara forest (10°23'S, 39°35'E) in the extreme south of the region has been visited by a Danish ICBP expedition (see Faldborg *et al.*, 1991), and comprises some 6 square km of low forest with bamboos in the understorey. Discussions are currently under way with the local villages to have the forest gazetted into a reserve.

Old botanical collections at **Sudi** (10°05'S - 10°07'S, 39°52'E - 39°54'E) on the coast at the extreme south-east of the region include *Hymenaea verrucosa* and *Scorodophloeus fischeri* which suggest that Gum Copal forest may be present on the coastal sands near Sudi village. If this should be the case then this would be the only known Gum Copal forest south of the Rufiji River, and possibly the largest and least threatened tract of this forest type remaining in Tanzania, therefore urgently in need of gazettement. The other Gum Copal Forests at Kisiju, Mchungu and Kilindoni on Mafia Island are described in more detail in the Coast Region volume of the Status Reports. *Xylopia* sp. A of FTEA is endemic to Sudi.

Liwale and Nachingwea Districts

Liwale and Nachingwea Districts in Lindi Region are almost completely unexplored by biologists and contain just one forest reserve each - **Lionja Forest Reserve** (Nachingwea) and **Nyera Kiperere Forest Reserve** (Liwale), both near the Nachingwea to Liwale road. Records of rare amphibians (e.g. of the forest dependant *Stephopaedes loveridgei* and *Spelaeophryne methneri*) as well as of reptiles collected by J.P. Ionides (who ususally just cited the district rather than giving a precise locality) indicate that forest must exist in these districts.

The **Lungonya Forest Reserve** at the extreme north-east of Liwale District is now contained within the **Selous Game Reserve** where Coastal Forest is known to occur, e.g. the goundwater forest near the Miombo Research Centre at **Kingupira**, and on the **Tundu Hills**. These are the least threatened of all the Coastal Forests in Tanzania, as they are far from human habitation.


9°55'S
39°25'E
NOTO PLATEAU
1 km
9°55'S
Mkomore River
Chitoa
Forest
Reserve
Nandora
CHITOA
PLATEAU
Kinyope
Miloia Stream
10°00'S
10°00'S
39°25'E
Lake Lutamba

CHITOA FOREST RESERVE

DESCRIPTION

NAME: Chitoa Forest Reserve
Lindi District, Lindi Region, Tanzania.

AREA: 7718 ha; 7.72 sq. km; 1905 acres; 2.98 sq. miles.

BOUNDARY LENGTH: 11 km. Concrete beacons planted in 1966.

STATUS: Protective and Productive Forest Reserve
Gazetted 1909, original German map ref. RS/L/7/1
Declaration Order Cap 389, supp. 59 of 1959, p. 65.

MAPS: Ordnance Survey topographic maps 1:50,000 Series Y742
Sheet 283/4 'Nangaru' of 1967, mapped from aerial photos of 1965 & 1966.
Forest reserve boundary incorrectly marked on the Ordnance Survey map.

Forest Division map Jb 591 1:5,000 1964.

LOCATION

Grid Reference: 9°56'S - 9°58'S, 39°26'E - 39°28'E.

Elevation: 240 - 420 m a.s.l.

Chitoa Forest Reserve is located approximately 45 km from the Indian Ocean, west of the coastal town of Lindi. It is 3 km north east of the villages of Kinyope and Nampawara on the main Lindi-Milola road but is only accessible by footpath (there is no vehicle access). The forest is situated on the Chitoa plateau 330 - 420 m above sea level, north west of Lake Lutamba.

Public transport access is by the Lindi-Milola bus which stops at Kinyope and Nampawara. Take the footpath to Nangaru, which passes through the reserve.

SOILS

Red brown sandy soils prone to retreating scarp erosion at the plateau edge.

CLIMATE

Chitoa Forest Reserve is influenced by tropical East African oceanic temperatures that are slightly modified by the altitude. There is a well defined dry season between May and October when the lowest monthly temperatures are recorded. The nearest rainfall station is at the Rutamba Tanganyika Refugee Service (10°02'S, 39°30'E, 300 m altitude), where an average of 1074 mm of rainfall per year has been recorded for the 4 years prior to 1973, with June, July, August, September & October having a monthly average of less than 50 mm rainfall during this period.

VEGETATION

Chitoa Forest Reserve contains at least three different vegetation types :

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

Dry scrub forest is limited to the southern escarpment edge of the Chitoa plateau with a diverse tree species assemblage including *Baphia macrocalyx, Grewia conocarpa, Hymenocardia ulmoides, Dielsothamnus divaricatus, Bombax rhodognaphalon, Scorodophloeus fischeri* and the occasional *Hymenaea verrucosa*. The lianas *Pseudopropsis euryphylla* and *Millettia schumannii* are locally abundant. *Scorodophloeus fischeri* and *Afzelia quanzensis* become more dominant on the ridge tops.

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

Dry forest occurs on the southern rim of the Chitoa plateau, to about 100-300 m north of the plateau edge. There is a diverse tree species assemblage with shifting canopy tree dominance. Tree species include *Teclea simplicifolia, Guibortia schliebenii, Cynometra webberi, Terminalia* sp. and *Sterculia schliebenii*.

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

Plot 1 : Dry forest on the Chitoa plateau at 300 m altitude, 60 m x 5 m plot.
0.03 ha in area with 30 trees over 10 cm dbh giving an equivilant of 1000 trees per ha.
Mean tree dbh 22.1 cm; mean tree height 12.6 m; mean bole height 5.9 m.
Mean crown area 35.3 m^2/tree; mean basal area 38.3 m^2/ha; mean stand volume 227 m^3/ha.
Within the plot the following trees were recorded 12 x *Cola clavata* (40%), 4 x Diospyros sp. near *verrucosa* (13%), 2 x *Diospyros* sp., probably *D. quiloensis* (7%), 2 x *Strychnos* sp. near *henningsii* (7%), 2 x *Manilkara discolor* (7%), 2 x *Terminalia* sp., 1 x *Millettia* sp. near *M. usaramensis* (3% each), 1 x *Cleistanthus* sp. aff. *polystachyus* (3%), 1 x *Commiphora* sp. (3%), 1 x *Teclea nobilis* (3%), 1 x Annonaceae indet. (3%). One tree could not be unidentified.

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

The majority of the forest reserve is covered by woodland on the Chitoa plateau and on the slope running down to the Mkongore river. Old mango trees *Mangifera indica* scattered throughout this vegetation type suggest that it may have regenerated following past cultivation, and the local people say that villages existed on the plateau before the reserve was gazetted. The woodland is very mixed but includes *Combretum, Bombax rhodognaphalon, Millettia* and *Markhamia*. Small patches of forest are found scattered within this woodland area.

BIODIVERSITY

Chitoa forest reserve has been little studied by biologists, and has only been briefly visited for a few days by the Danish ICBP expedition and the Frontier-Tanzania Coastal Forest Research Programme in 1993.

Birds

83 bird species have been recorded (Eriksen *et al.*, 1993) of which 32 are forest birds.

Coastal Forest endemics - Fischer's Greenbul *Phyllastrephus fischeri*.
Reichenow's Batis *Batis reichenowi*.

BirdLife listed species - East Coast Akalat *Sheppardia gunningi* [BirdLife Vulnerable; IUCN Rare].
Plain-backed Sunbird *Anthreptes reichenowi* [BirdLife Near threatened].

Other - White-chested Alethe *Alethe fuelleborni* - only Tanzanian record below 900m.

Mammals

11 mammal species have been recorded from observations Eriksen *et al.* (1994), and bat collections by Frontier-Tanzania [2 species from 3 specimens]. No systematic trapping for small mammals has yet been carried out.

Chitoa area endemics - Rondo Dwarf Galago *Galago* sp. nov. B (J. Kiure, pers. obs.) Rondo and Chitoa only.

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

Reptiles

No rare reptiles have yet been recorded from Chitoa forest.

Amphibians

3 species are recorded by Frontier-Tanzania collections from 8 specimens.

Coastal Forest endemics - Leaf-litter toad *Stephopaedes loveridgei* (Specimen Frontier CH 008). Known only from 8 sites in SE Tanzania, probably all Coastal Forests.

Plants

Chitoa area endemics - *Pavetta* sp. nov. (= *Frontier* 3141; *Bidgood et al.* 1342) [Rubiac.] Rondo and Chitoa forests only.

Coastal Forest endemics - *Sterculia schliebenii* Mildbr. [Sterculiac.] Chitoa and 3 other Coastal Forests (*Frontier* 3147).

HUMAN IMPACTS

There is no evidence of major human interference threatening the forest at present. Timber trees are infrequent, and only a few small trees are collected by the local people for building poles. Uncontrolled bushfires (which are usually started by humans) pose a possible threat, as these could encroach into the forest.

CONSERVATION ISSUES

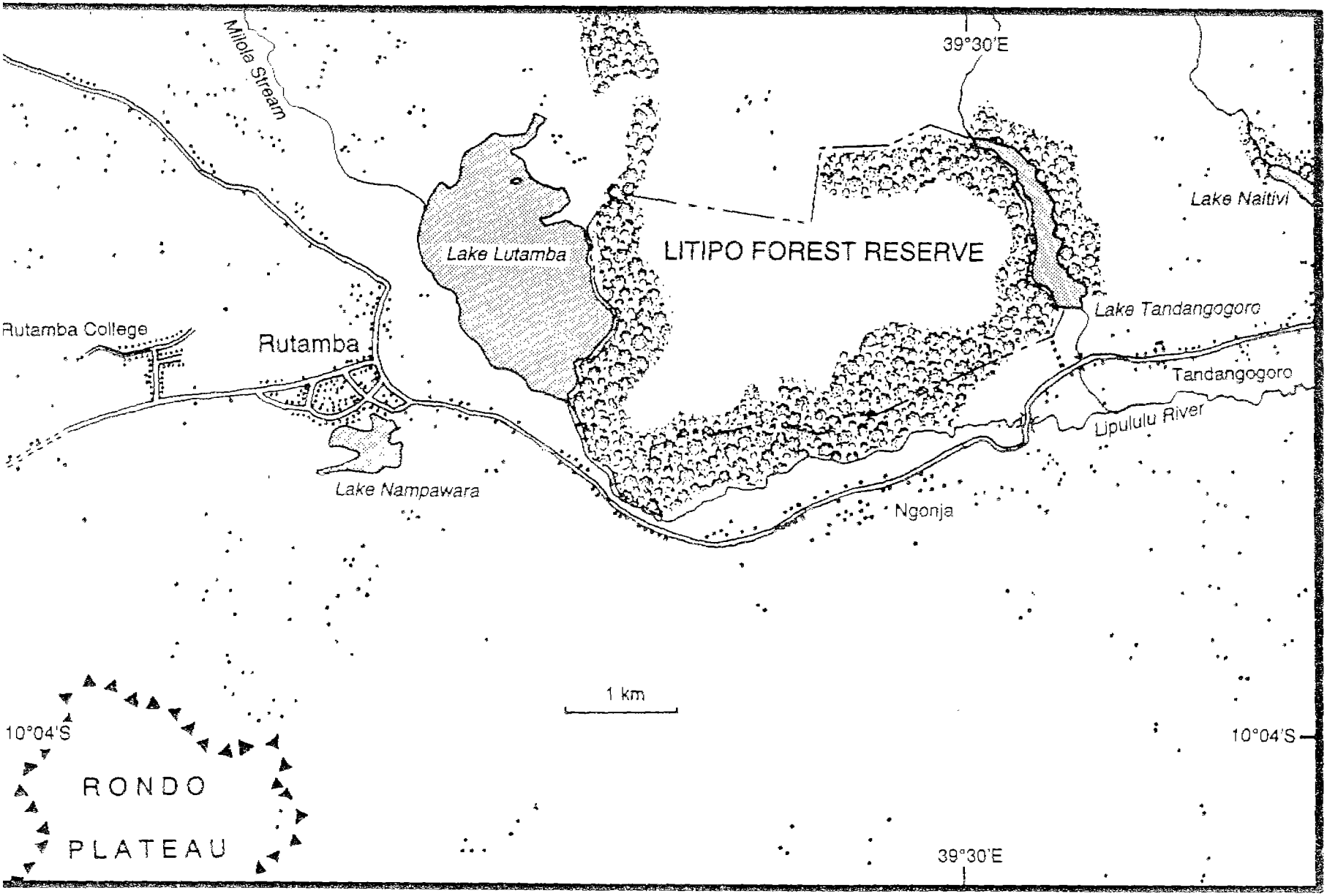
At present Chitoa Forest Reserve is little threatened by human activity as it has a low timber value and is situated some kilometres from the nearest areas of cultivation and habitation.

The boundaries of the reserve (cleared in June 1983, requiring 200 man days) are currently being cleared and planted with *Cassia*. There are signs that this measure has already resulted in some local cultivation leaving the northern part of the reserve.

LITERATURE

Eriksen *et al.* (1994) list mammal, bird, reptile and butterfly species.

Eriksen *et al.* (1993) lists bird species and discuss some conservation issues.


Milola Stream
39°30'E
Lake Naitivi
Lake Lutamba
LITIPO FOREST RESERVE
Lake Tandangogoro
Rutamba College
Rutamba
Tandangogoro
Lipululu River
Lake Nampawara
Ngonja
1 km
10°04'S
10°04'S
RONDO
PLATEAU
39°30'E

LITIPO FOREST RESERVE

DESCRIPTION

NAME: Litipo Forest Reserve
Lindi District, Lindi Region, Tanzania.

AREA: 996 ha; 9.96 sq. km; 2,470 acres; 3.86 sq. miles.

BOUNDARY LENGTH: 14.5 km. Boundary clearing and planting with *Senna siamea* is currently in progress (June 1995).

STATUS: Protective and productive forest reserve.
Forestry Division records indicate that the forest reserve was gazetted during the German administration.
Declaration Order Cap. 389 - supp. 59 of 1959, p. 65.

MAPS: Ordnance Survey topographic maps 1:50,000 Series Y742
Sheet 294/2 'Rondo' of 1966, mapped from aerial photos of 1965 & 1966.
The reserve boundry is not accurately delineated on the Ordnance Survey map.

Forestry Division map Jb 488 of June 1959, 1:10,000.

LOCATION

Grid reference: 10°01'S - 10°03' S, 39°28'E - 39°31'E.

Elevation: 180 - 270 m a.s.l.

The reserve lies approximately 35 km inland from the Indian Ocean, 39 km west of Lindi by road. To gain access to it by road, drive west out of Lindi on the road to Mtwara and turn off right after approx 10 km, towards Ngapa and Rutamba. Access to the forest can be gained by following one of several paths which leave the road on the north and enter the reserve in the area between the villages of Tandangogoro and Rutamba.

The forest reserve lies between Lake Tandangogoro and Lake Lutamba, following the Matamba/Lipulu river along part of the southern boundary. The closest villages are Rutamba, (approx. 2 km to the west) and Tandangogoro. The reserve has an altitude range of between 180-270 m. The District Forestry Office is based in Lindi, with a local forest officer living in Rutamba.

Public transport access by the Lindi to Milola bus, which passes the forest (to within 0.5 km of the reserve).

SOILS

Soil samples from the forest have a pH that ranges from slightly acidic to neutral. The texture of the soil is sandy and the moisture content low. The leaf litter is fairly shallow and there is no fermentation layer due to the quick turnover of minerals and ions. The soils may be classed by the FAO/UNESCO 'Soils Map of the World' as arensols, (possibly ferralic arensols). Soil profiles from the riverine forest show more of a mineral horizon.

CLIMATE

Litipo Forest Reserve is influenced by tropical East African oceanic temperatures that are slightly modified by the altitude. There is a well defined dry season between May and October when the lowest mean monthly temperatures are recorded. The nearest rainfall station is at the Rutamba Tanganyika Refugee Service (10°02'S, 39°30'E, 300 m altitude), where an average of 1074 mm of rainfall per year has been recorded for the 4 years prior to 1973, with June, July, August, September and October 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 Naitivi Plantation (10°02'S, 39°33'E, 90 m altitude), where an average of 1096 mm of rainfall per year has been recorded for the 23 years prior to 1957, with June, July, August, September & October having a monthly average of less than 50 mm rainfall during this period. A peak annual rainfall of 1418 mm and a minimum annual rainfall of 667 mm has been recorded between 1932 and 1962 from the Ngurumahamba Estate rainfall station, which is some 12 km to the east of Litipo Forest Reserve.

VEGETATION

The vegetation of Litipo varies from forest with low trees and many climbers to woodland in the north. Dry undifferentiated forest with a very regular structure (12-20 m canopy) occurs on many of the slopes rising above Lake Lutamba. Moist undifferentiated forest occurs in the riverine areas and around parts of both lakes. Scrub woodland occurs in extensive patches on the ridgetops. Evergreen thicket occurs in large areas on the slopes towards Lake Tandangogoro and in places on the ridgetops. Wooded grassland occurs in patches at higher altitudes throughout the reserve.

The following vegetation types can be recognised :

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

Dry evergreen forest strongly dominated by *Berlinia orientalis* is restricted to a narrow belt between the southern end of Lake Lutamba and Lake Tandangogoro. *Dracaena usambarensis, Garcinia acutifolia, Pterocarpus tinctorius* and *Xylia africana* are also found, especially around the stream at the outlet of Lake Lutamba. The climber *Millettia impressa* is everywhere abundant.

This *Berlinia orientalis* forest has been found to contain the highest density of liane/climber individuals for any forest in the world (Bailey, 1994).

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

Plot 1: Evergreen forest beside the Lipulu River at 180 m altitude, 16 subplots of 100 m^2.
0.16 ha in area with 49 trees over 10 cm dbh giving an equivilant of 310 trees per ha.
Mean tree dbh 21.0 cm; mean tree height 14.6 m; mean bole height 3.9 m.
Mean crown area 58.7 m^2/tree; mean basal area 10.7 m^2/ha; mean stand volume 41 m^3/ha.
The plot comprised the following tree species : 42 x *Berlinia orientalis* (86%), 3 x *Rinorea angustifolia* ssp. *ardisiiflora* (6%), 1 x *Kigelia moosa, Ricinodendron rautanenii, Paropsia braunii* and *Grewia conocarpa* (2% each).

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

Forest containing trees characteristic of riverine areas is found along the eastern shore of Lake Lutamba, and includes *Khaya anthotheca, Trichilia emetica* and *Newtonia buchananii* as 20 m high emergents. *Kigelia africana* occurs as a forest tree here together with *Tamarindus indica, Ficus sur, Mimusops riparia, Cola discoglypremnophylla, Sterculia appendiculata, Ficus tremula, Millettia bussei* and *Grandidiera boivinii*. The climber *Flagellaria guineensis* is abundant.

On the western side of Lake Tandangogoro a low riverine forest with an 8 m canopy is present with *Ficus* spp., and *Kigelia africana*.

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

Plot 3 : Disturbed riverine forest at 180 m altitude on the shores of Lake Lutamba, 60 m x 5 m plot.
0.03 ha in area with 13 trees over 10 cm dbh giving an equivilant of 400 trees per ha.
Mean tree dbh 20.8 cm; mean tree height 8.6 m; mean bole height 3.4 m.
Mean crown area 43.9 m^2/tree; mean basal area 13.6 m^2/ha; mean stand volume 46 m^3/ha.

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

Dry semi-deciduous forest is found on the slopes running down to the eastern edge of Lake Lutamba. This forest type is very diverse and includes *Millettia bussei, Baphia punctulata, Cussonia zimmermannii, Bombax rhodognaphalon, Diospyros abyssinica, Diospyros kabuyeana, Polyalthia verdcourtii, Olax pentandra, Rinorea elliptica, Rinorea ferruginea, Lettowianthus stellatus, Xylotheca tettensis, Xylia africana, Tabernaemontana ventricosa, Lepisanthes senegalensis, Oxyanthus zanguebaricus, Garcinia buchananii, Baphia macrocalyx* and *Ziziphus pubescens*. Lianas are frequent and include *Strophanthus courmontii, Hugonia castaneifolia, Adenia rumicifolia, Anisocycla blepharosepala, Dalbergia arbutifolia, Hippocratea africana, Hippocratea clematoides, Acacia adenocalyx* and *Pseudopropsis euryphylla*.

Forest on the ridges within these slopes are of a different composition and include *Scorodophloeus fischeri, Cynometra webberi, Hymenocardia ulmoides* and *Euphorbia* sp. in some areas, and *Erythrina sacleuxii* in others on the hills above Lake Lutamba. To the south the ridges contain a more diverse tree assemblage of *Scorodophloeus fischeri, Euphorbia* sp., *Hymenaea verrucosa, Manilkara sulcata, Strychnos henningsii, Hymenocardia ulmoides* and *Millettia* sp. *Scorodophloeus fischeri* becomes more dominant towards the base of the hill. The sisal *Sanseviera sulcata* is often common.

A single vegetation plot has been constructed in the dry semi-deciduous forest area :

Plot 2 : Semi-deciduous forest to the east of Lake Lutamba at 200 m altitude on a hillside, 16 subplots of 100 m^2.
0.16 ha in area with 62 trees over 10 cm dbh giving an equivilant of 390 trees per ha.
Mean tree dbh 17.8 cm; mean tree height 12.1 m; mean bole height 3.9 m.
Mean crown area 42.2 m^2/tree; mean basal area 9.7 m^2/ha; mean stand volume 38 m^3/ha.
The plot comprised the following tree species : 12 x *Hymenocardia ulmoides* (19%), 9 x *Grewia conocarpa* (15%), 5 x *Ricinodendron heudelotii, Dialium holzii* (8% each), 3 x *Zanthoxylum holtzianum*, sp. A indet. (5% each), 2 x *Vitex mossambicensis, Dielsothamnus divaricatus, Carpodiptera africana, Xylia africana, Uvariodendron gorgonis* (3% each), *1* x *Grewia holstii, Milicia excelsa, Paropsia brauni, Pteleopsis myrtifolia, Pterocarpus tinctorius, Bombax rhodognaphalon, Baphia punctulata, Cussonia zimmermannii*, Bignoniaceae sp., poss. *Kigelia moosa* (2% each). 4 trees were not identified.

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

Scrub forest is present on the higher areas of the main north-south ridge at the western end of the reserve and contains *Baphia kirkii, Millettia punctulata, Manilkara sulcata* and *Pteleopsis myrtifolia*.

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

Open woodland is present in the centre of the reserve with *Sterculia* appendiculata and baobabs *Adansonia digitata*.

BIODIVERSITY

The Litipo forest has been fairly well studied compared to most of the other Coastal Forests in Tanzania. The German botanist Busse briefly visited the forest in 1902. The botanist Schlieben spent approximately 2 years (1933-1936) camped on the shores of Lake Lutamba and collected extensively in the forest and surrounding areas. Further visits by botanists include Gillet, Wingfield, Mwasumbi, Bidgood and Vollesen. A number of ornithological surveys have been conducted (Bagger *et al.*, 1990; Faldborg *et al.*, 1991; Eriksen *et al.*, 1993) and a general biological survey was carried out by the Frontier-Tanzania Coastal Forest Research Programme for 2 months during 1993.

Birds

94 bird species are reported from the area of which 59 species have been recorded from the forest (Bagger *et al.*, 1990; Eriksen *et al.*, 1993), of which 26 species are forest birds.

Coastal Forest endemics - Fischer's Greenbul *Phyllastrephus fischeri.*
Reichenow's Batis *Batis reichenowi.*

BirdLife listed species - East Coast Akalat *Sheppardia gunningi* [BirdLife Vulnerable; IUCN Rare].
Plain-backed Sunbird *Anthreptes reichenowi* [BirdLife Near Threatened].

Mammals

27 mammal species have been recorded from observations by Eriksen *et al.* (1994), together with collections and observations by Frontier-Tanzania, including 8 bat species [8 specimens collected] and 4 rodent species [from 208 trap nights].

Coastal Forest/Eastern Arc endemic - Lesser Pouched Rat *Beamys hindei.* Skinned specimen deposited at the University of Dar es Salaam [IUCN Vulnerable].

CITES/IUCN 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.* (Specimen KMH 10120) [IUCN Rare].
Zanzibar Galago *Galagoides zanzibaricus* [IUCN Vulnerable].

Other species - 'Newala Small Galago' a pygmy form of *Otolemur crassicaudatus*, of uncertain taxonomic status known only from Litipo and the Makonde Plateau (cited in Bearder & Honess, 1990).

Reptiles

18 reptile species have been recorded from observations and a total collection of 22 specimens by Frontier-Tanzania.

Litipo endemic - Limbless Skink *Scolecoseps* sp. nov. (Specimen KMH 10022). To be cited by Broadley (in press).

Litipo area endemics - Rondo Sharp-snouted Amphisbaenian *Ancylocranium ionidesi haasi* (KMH 10029). Subspecies known only from the Rondo and Litipo forests. Species known only from these 2 sites and 'Kilwa'.

Coastal Forest endemic - Eastern Four-toed Fossorial Skink *Sepsina t. tetradactyla.* (Specimen KMH 10144).

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

A thread-snake (Specimen KMH 10342) has been provisionally identified as *Leptotyphlops* sp. near *conjunctus*, but a revision of the taxonomy of this genus is required before a full identification can be attempted.

Amphibians

8 species of amphibian have so far been recorded from the forest, with a further 2 species recorded just outside the forest.

Coastal Forest endemic - Leaf-litter Toad *Stephopaedes loveridgei* (specimen KMH 10031). Known only from 8 sites in SE Tanzania, probably all Coastal Forests.

Plants

Litipo endemics -
Monanthotaxis tricantha (Diels) Verdc. [Annonac.] Cited in FTEA.
Momordica pycnantha Harms [Cucurbitac.] Cited in FTEA.
Thladiantha africana C.Jeffrey [Cucurbitac.] Cited in FTEA.
Monotes lutambensis Verdc. [Dipterocarpac.] Cited in FTEA.
Acalypha sp. A of FTEA [Euphorbiac.]
Phyllanthus schliebenii A.R.-Sm. [Euphorbiac.] Cited in FTEA.
Erythrina schliebenii Harms [Fabac.] Cited in FTEA.
Rhynchosia calobotrya Harms [Fabac.] Cited in FTEA.
Triaspis schliebenii A.Ernst [Malphigiac.] Cited in FTEA.
Didymosalpinx sp. A of FTEA [Rubiac.]
Pavetta schliebenii Bremek. [Rubiac.] Cited in FTEA.
Psychotria sp. J of FTEA [Rubiac.]
Tapiphyllum schliebenii Verdc. [Rubiac.] Cited in FTEA.
Tricalysia sp. G of FTEA [Rubiac.]
Clerodendrum sp. G of FTEA [Verbenac.]

Possible Litipo endemic - *Chazaliella* sp. aff. *abrupta*, not matched (= *Bidgood et al.* 1704) [Rubiac.].

Litipo area endemics -
Streptosiphon hirsutus Mildbr. [Acanthac.] (Specimen *Frontier 3591*). Rondo and Litipo forests only
Jasminum ellipticum Knobl. [Oleac.] Litipo and Mingoyo forests only. Cited in FTEA.
Coffea schliebenii Bridson [Rubiac.] Rondo and Litipo forests only. Cited in *Kew Bulletin* **49**, 331.
Cuviea schliebenii Verdc. [Rubiac.] Rondo and Litipo forests only. Cited in FTEA.

Coastal Forest endemics -
Maerua schliebenii C.Gilg [Capparac.] Rondo, Litipo forests and 1 site in Mozambique only. Cited in FTEA.
Strictocardia lutambensis (Sculz-Menz.) Verdc. [Convulvulac.] 3 sites only, all in Tanzania. Cited in FTEA.
Peponium leucanthum (Gilg.) Cogn. [Cucurbitac.] Litipo and Tong'omba only. Cited in FTEA.
Dalbergia acariiantha Harms [Fabac.] Litipo and 4 other sites in Tanzania only. Cited in FTEA.
Olax pentandra Sleumer [Olacac.] Litipo & 2 other Tanzanian sites only, cited in FTEA.

Rytigynia pergracilis Verdc. [Rubiac.] Litipo & 3 other sites in SE Tanzania, Cited in FTEA.
Clerodendrum lutambense Verdc. [Verbenac.] Litipo and a few sites in Mozambique. Cited in FTEA.

Other rare species - *Thladiantha africana* C.Jeffrey [Cucurbitac.] Litipo, Nachingwea & Nigeria. Cited in FTEA.
Setaria sulcata Raddi [Poac.] Litipo and tropical South America only. Cited in FTEA.

A number of the endemic plants collected by Schlieben at 'Lake Lutamba' have not been relocated (e.g. *Erythrina schliebenii*), in spite of repeated searches for these. It is possible that they may have originally been collected just outside the Litipo Forest Reserve near Makangala hill where forest was present until cleared for cashewnut, cassava and coconut cultivation during the 1940s (Schlieben camped at this hill).

CATCHMENT VALUES

The low hills in Litipo Forest may be a source of orographic rainfall that feeds additional water to Lakes Lutamba and Tandangogoro.

HUMAN IMPACTS

There are major settlements in the area and over much of its area the reserve shows signs of prolonged and regular human disturbance.

Logging

The *Berlinia orientalis* forest is said to have been extensively logged during the German administration to supply timber for the construction of Lindi. Many of the older trees in this part of the forest show signs of coppice regeneration (multi-stemmed branching at just above ground level) and are of a smaller stature than would be expected for such a forest.

Logging in the area is now prohibited, but much fuelwood is collected in the reserve and there is evidence of a high degree of small scale logging by the local inhabitants, particularly near the lake for trees suitable for dug-out canoes. Sapling cutting for building purposes is common. Valuable timber species are rare within the reserve, so there is little danger of intensive commercial logging.

Agriculture

The land bordering the reserve to the south is intensively farmed for the production of crops such as coconuts, bananas, cashewnuts, cassava, maize, tomatoes, beans, rice and spinach. There appears to have been little recent encroachment into the reserve area and clearing for new cultivation is discouraged by the presence of a forestry officer at Rutamba (5 people were fined for cultivating within the reserve in 1978). There is evidence however that during the past 50 years at least, some of the forest area outside the reserve boundary has disappeared, particularly around the lake. Recent sightings of areas of burnt vegetation on the shores of the lake also indicate that there may still be some danger of encroachment.

Hunting

Snares have been found within the forest, where hunting is carried out to provide food, and especially to reduce the numbers of agricultural pests such as bush pig and the blue monkey.

Fire

The forest is naturally protected from fire by the lakes and the Milola/Matamba/Lipulu stream.

Other forest products

On a small scale local inhabitants also collect honey, forest fruits, mushrooms and medicinal plants from the forest.

CONSERVATION ISSUES

In addition to containing a number of endemic species, Litipo forest merits conservation as the only known example of an almost completely deciduous Coastal Forest. It also contains a unique *Berlinia orientalis* assemblage and has the highest known liana density for any forest in the world.

Currently the greatest threats to the forest are from the excessive pole and firewood collections on its southern margins. Tree planting around the local villages could be encouraged to create alternative sources of fuel and timber and to thereby reduce the pressure for these resources on the forest.

Agricultural encroachment remains a potential future threat in the future, and an active presence of the Forest Division will be required to discourage this.

LITERATURE

Bagger *et al.* (1990) list bird and mammal species seen by the 1990 Danish ICBP expedition.

Bailey (1994) gives the results on a detailed ecological experiment on lianas in Litipo forest.

Bearder & Honess (1990) list bushbaby (galago) species recorded from Litipo.

Bhatia (1990) contains a few notes on the forest.

Bidgood & Vollesen (1991) list plant species collected by the 1991 Kew Expedition, which briefly visited Litipo.

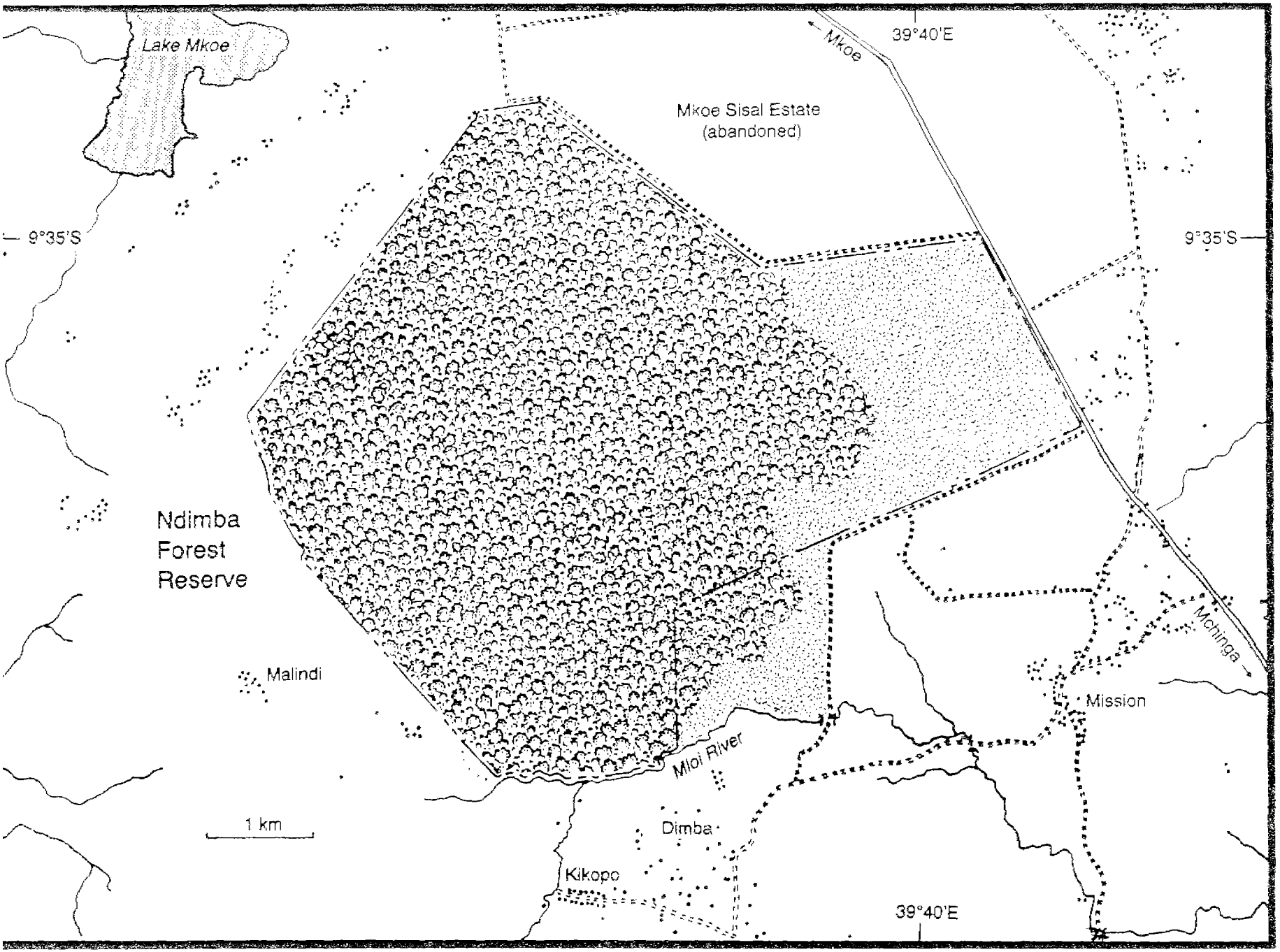
Eriksen *et al.* (1994) list mammal, bird, reptile and butterfly species observed/collected in Litipo.

Eriksen *et al.* (1993) list bird species and discusses some conservation issues for Litipo.

Faldborg *et al.* (1991) list bird and mammal species observed by the 1991 Danish- ICBP expedition.

Polhill (1968) is one of the first publications to highlight the botanical importance of 'Lake Lutamba', which is recommended to be included within the protection of a nature reserve.

Litipo forest is also mentioned in passing by numerous papers and reports discussing Coastal Forests.


Lake Mkoe
Mkoe
39°40'E
Mkoe Sisal Estate
(abandoned)
9°35'S
9°35'S
Ndimba
Forest
Reserve
Malindi
Mchinga
Mission
Mloi River
1 km
Dimba
Kikopo
39°40'E

NDIMBA FOREST RESERVE

DESCRIPTION

NAME: Ndimba Forest Reserve (not to be confused with Nandimba F. R. near Mandawa).
Lindi District, Lindi Region, Tanzania.

AREA: 2,687 ha; 26.8 sq. km; 6,640 acres; 10.3 sq. miles (18,608 acres according to Cap. 389-supp. 59).

BOUNDARY: 23 km. Beacons planted in 1966.
LENGTH Boundary last widened, white painted and cleared in June 1970, requiring 360 man days.

STATUS: Protective Forest Reserve.
Gazetted 1911.
Declaration Order Cap 132, p. 1364; superseded by Cap. 389 - supp. 59 of 1959, p. 65.

MAPS: Ordnance Survey topographic map 1:50,000 Series Y742
Sheet 284/1 'Mchinga' of 1967, mapped from aerial photos of 1965-66.

Forest division map RS/L/5/1 1:20,000 1911, retraced 1959.

LOCATION

Grid ref: 9°34'S - 9°37'S, 39°35'E - 39°4'E

Elevation: 75 - 150 m a.s.l.

Ndimba Forest Reserve is located on a low hill from 75 to 150 m a.s.l. approximately 10 km inland from the Indian Ocean. The eastern boundary of the reserve borders the Mchinga-Mkoe road. The reserve lies approximately 2 km south-east of Lake Mkoe. The Mitoi River forms the southern boundary of the reserve.

Access is from the Dar es Salaam to Lindi main road. Take the northward track about 5 km inland of Mchinga bay, and continue through the village of Mchinga Mbili on the road to Mkoe. After about 8 km take a westward (left) turning to the village of Kikopo. The track ends at Kikopo (about 8 km). There is a footpath from this village, which reaches the forest and forest reserve after half a kilometre.

Public transport access by the Lindi to Dar es Salaam buses. Ask to be put down at the turning for Mchinga Mbili and walk the remaining 20 km to the reserve. Alternatively there is a lorry which runs daily from Mchinga Mbili in the morning to Lindi, and from Lindi to Mchinga Mbili in the afternoon. From here it is about a 16 km walk.

SOILS

Not surveyed.

CLIMATE

Ndimba Forest Reserve is influenced by tropical East African oceanic temperatures that are slightly modified by the altitude. The nearest rainfall station is at the Mkoe Plantation (9°32'S, 39°39'E, 91m altitude), where an average of

899 mm of rainfall per year has been recorded from 1931 to 1960, with June, July, August, September, October & November having a monthly average of less than 50 mm rainfall during this period.

VEGETATION

The original German gazettement map indicates that thick forest occurred on the southern part of the reserve in 1911. The northern part of Ndimba hill consited of a mosaic of thick forest and fallow cultivation, and the eastern end of the reserve consisted of fallow cultivation at that time.

Brief surveys of the reserve indicate that the following vegetation types are present :

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

Dry forest with a canopy to 8 m is present over much of the southern and western part of the reserve. Tree species diversity is high, although legumes are poorly represented. Tree species inlcude *Acacia* sp. and *Flueggea virosa*.

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

Thicket is present at the eastern end of the reserve, bordering the Mchinga to Mkoe road.

Plantation

There is a 'token' plantation of mvule *Milicia excelsa* planted at 30' (9 m) intervals over former cultivation in the north-west of the reserve in 1958.

TIMBER VALUES

Mvule (*Milicia excelsa*) is present in low densities in the reserve.

BIODIVERSITY

Ndimba Forest Reserve was only briefly visited by the Frontier-Tanzania Coastal Forest Research Programme during September 1993.

Birds

20 bird species have been recorded from a preliminary bird survey in the Ndimba Forest Reserve (by J. Kiure).

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

Mammals

The only mammals recorded from Ndimba forest include 2 bat species [2 specimens taken] from a single night of netting. Neither of these species were rare.

Reptiles

No reptiles are known to have been recorded from Ndimba forest.

Amphibians

No amphibians are known to have been recorded from Ndimba forest.

Plants

Possible Ndimba endemic - *Cynometra gillmannii* Harms [Fabaceae] Collection locality cited as Mkoe (3 km north of Ndimba Forest Reserve). Cited in FTEA.

CATCHMENT VALUES

The forest/thicket on Ndimba Hill feeds some small streams in the area, such as the Mitoi River. Slopes on Ndimba Hill are shallow, but soil erosion has been observed to occur.

HUMAN IMPACTS

The condition of the scrub forest is deteriorating where excesive slope erosion has occured and where local villagers have cut trees down for use as fuelwood.

Agriculture

Squatters were evicted from the north-west of the reserve in 1958, when 76 small holdings were discovered.

According to the district records, 200 acres of the reserve were given to the local people for cultivation during the resurvey and re-demarcation of the reserve in 1959.

Logging

44 trees were felled by the Prison Department in 1964 for use in constructing a bridge.

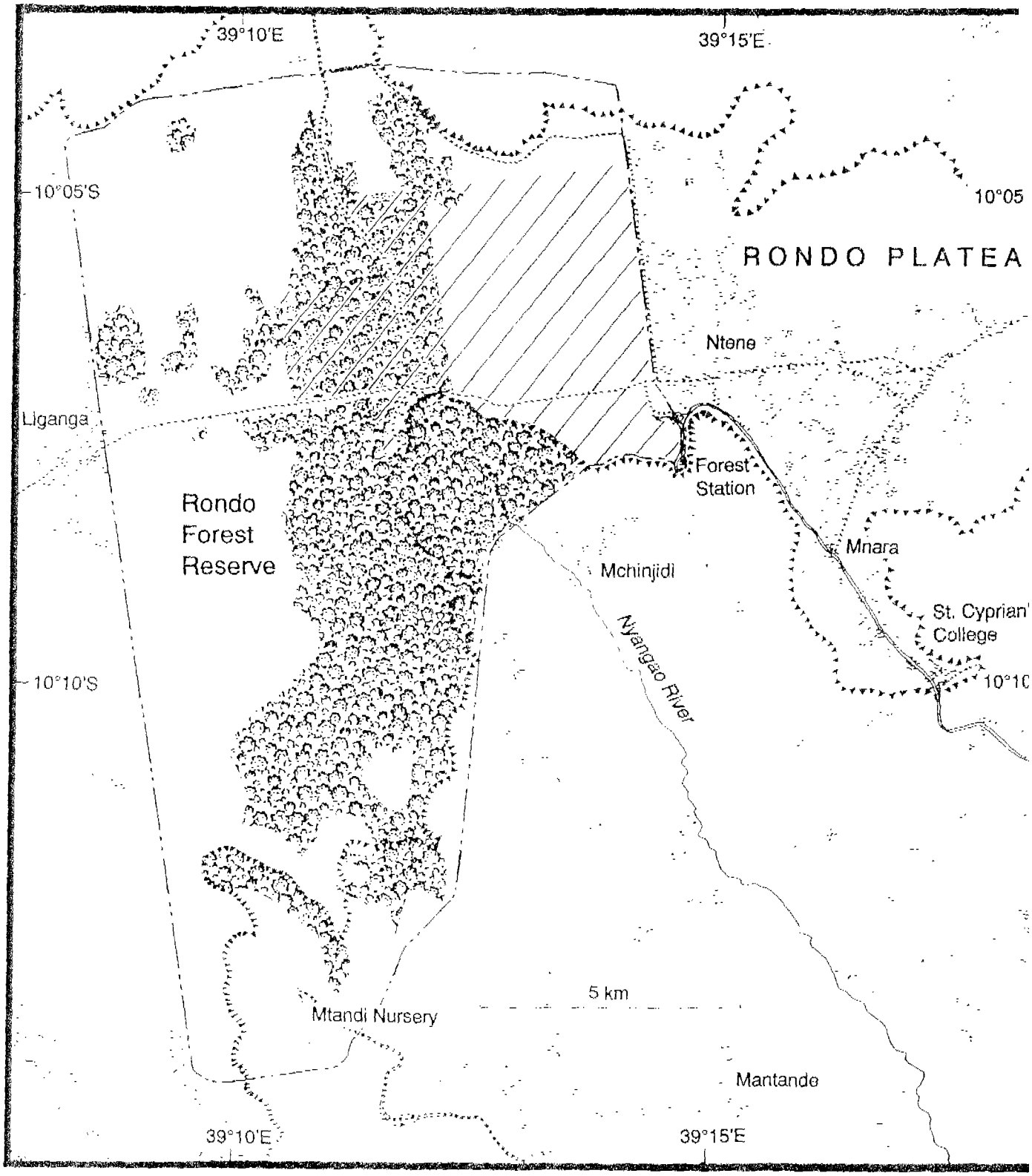
CONSERVATION ISSUES

The forest reserve boundaries need to be better demarcated to prevent 'accidental' agricultural encroachment.

Further biological research is required to determine the importance of the reserve.

LITERATURE

None known.


39°10'E
39°15'E
10°05'S
10°05
RONDO PLATEA
Ntene
Liganga
Forest
Station
Rondo
Forest
Reserve
Mnara
Mchinjidi
St. Cyprian'
College
10°10'S
10°10
Nyangao River
5 km
Mtandi Nursery
Mantande
39°10'E
39°15'E

RONDO FOREST RESERVE

INCLUDING NOTES ON THE RONDO PLATEAU

DESCRIPTION

NAME: Rondo Forest Reserve
Lindi District, Lindi Region, Tanzania.

AREA: 14,060 ha; 140.1 sq. km; 34,744 acres; 54.29 sq. miles.

BOUNDARY: 55 km.
LENGTH The reserve boundary is well demarcated by a track.

STATUS: Productive Forest Reserve managed by the Rondo Forest Project.
Originally gazetted in 1909. Original German gazettement map ref. RS/L/4/1, 1:25,000.
Declaration Order Cap 132 of 1948; Variation Order 354/20/11 of 1959.
Superseded by Cap. 389 - supp. 59 of 1959, p. 65.

MAPS: Ordnance Survey topographic map 1:50,000 Series Y742
Sheet 294/1 'Mandarawe' of 1967, mapped from aerial photos of 1965-66.
The forest reserve is incorrectly located on the Ordnance Survey map, where it is displayed partly on the adjoining map Sheet 249/2 'Rondo'.

Forest Division maps:
Boundary map Jb 464 of 1969, 1:25,000.
Plantation maps Jb 1742 of 1972, 1:25,000.
Jb 2050 of 1980, 1:25,000.
Vegetation maps Jb 604 of 1964, 1:25,000 shows the extent of closed forest in 1964.
Jb 5/6/8/1 of 1938. 4 inches to the mile shows enumerations of the quantity of harvestable 'mvule' *Milicia excelsa* on the plateau to the east of the forest reserve.
Jb 78 of 1960, 4 inches = 1 mile gives enumerations of 'mvule' stock in the forest reserve.

LOCATION

Grid Ref: 10°04'S - 10°14'S, 39°08'E - 39°15'E

Elevation: 465 - 885 m a.s.l.

The forest is located on part of the Rondo (Mwera) plateau at around 870 m a.s.l. (to a maximum of 885 m a.s.l.). Some forest is found on the escarpment edge from 465 m a.s.l. in the Mchindiji, Mtandi and Manyolyo valleys. The reserve is about 4 km from Ntene Rondo village, itself approximately 60 km west of Lindi. The Rondo Forestry Project Office (TAFORI) is located on the eastern side of the reserve and is 80 km by road from Lindi.

There is all-weather access to the reserve from Lindi by taking the tarmac Lindi-Masasi road to Nyengedi (50 km), where there is a turning to the north marked by a sign for St. Cyprian's college. Proceed on this graded road past St. Cyprian's College on the crest of the Rondo (Mwera) plateau until reaching the village of Ntene. Take a turning to the west until the forest reserve is reached after about 4 km.

Alternative access to Ntenc village is by taking the road from Lindi to Rutamba, where a very steep and narrow dirt track climbs the eastern edge of the Rondo (Mwera) plateau. This option is only for small 4WD vehicles during the dry season.

Public transport by bus reaches within 25 km of the reserve, either by taking the Lindi-Masasi bus and getting off at Nyengedi, or by taking the Lindi-Milola bus and getting off at Rutamba. Walk the remaining distance.

SOILS

Deep, leached sandy soils derived from terrestrial sands, gravels, calcretes and laterites of Miocene to Pleistocene age. Bhatia (1990) observed severe erosion where trees had been cleared on the forest boundaries.

CLIMATE

The Rondo Forest Reserve receives a single rainy season (November-May), with an average annual rainfall of 1088 mm (1951-1979) recorded at the Rondo Forest station. Temperatures vary between 32°C and 11°C with the coolest period between June and August (Annual Report of the Forest Department, 1952). A minimum monthly mean of 15°C (August) and a maximum monthly mean of 31°C (December) were recorded in 1952.

Rainfall on the Rondo Plateau appears to be quite variable, with the rainfall station at Ntenc Rondo (10°08'S, 39°15'E, 758 m altitude) recording an average of 1215 mm of rainfall per year for the 19 years prior to 1973, with June, July, August, September & October having a monthly average of less than 50 mm rainfall during this period. A much lower rainfall has been recorded at the nearby St. Cyprian's College with 1034 mm per annum for the 10 years prior to 1973. Just 771 mm of rainfall was recorded from Rondo in 1953.

Loveridge (1944) describes a significant occult precipitation effect from both the morning and evening mists that gather over the plateau.

VEGETATION

The vegetation of the Rondo Forest Reserve is extremely variable as a result of a long history of human disturbance in the area. Small patches of forest remain that appear to be in primary condition, together with areas that have regenerated following extensive logging, areas that may have regenerated from earlier cultivation and also large areas of plantation forest. Griffith (1951) considered the forest to be secondary (much of it thicket) with emergent mvule trees that showed little sign of regeneration on the ground. Many of the larger mvule trees were characterised by having multiple stems, which is indicative of either coppice regeneration following clearance of the forest for cultivation, or of fire sucker regeneration following the burning of woodland areas.

The following vegetation types can be recognised :

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

The remaining areas of natural forest are limited to the southern and eastern rim of that part of the Rondo plateau that is contained within the forest reserve, especially in the Mchinjidi Valley. Little is known about which parts of this forest are original (primary) forest, and which are seral (secondary) forest types. *Dialium holtzii, Bussea eggelingii* and *Millettia eetveldeana* appear to be dominant on the plateau rim at the eastern end of the forest, but dominance shifts towards *Albizia adianthifolia* and *Albizia petersiana* on the plateau south of the Mchinjiri Valley. In all areas tree species diversity appears to be high. A number of these forest tree species are listed in Bidgood & Vollesen (1992) and Eriksen *et al.* (1993), including *Lannea antiscorbutica, Sorindeia madagascariensis, Lettowianthus stellatus, Xylopia parvifolia, Cussonia zimmermannii, Rawsonia rhodesiensis, Parinari excelsa, Pteleopsis myrtifolia*

Pteleopsis apetala, Terminalia sambesiaca, Drypetes natalensis, Ricinodendron heudelotii, Casearia gladiiformis, Afzelia quanzensis, Albizia adianthifolia, Albizia petersiana, Brachystegia spiciformis, Cordyla africana, Dialium holzii, Millettia eetveldeana, Newtonia buchananii, Pterocarpus tinctorius, Tetrapleura tetraptera, Ficus spp., *Fagaropsis angolensis, Manilkara discolor, Manilkara sulcata, Celtis gomphophylla, Funtumia africana, Tabernaemontana pachysiphon, Tabernaemontana ventricosa, Commiphora fulvotomentosa, Commiphora serrata, Vismia orientalis, Tapura fischeri, Antidesma membranaceum, Bridelia atroviridis, Suregada zanzibariensis, Flacourtia indica, Dalbergia boehmii, Xylia africana, Pseudobersama mossambicensis, Turraea holstii, Turraea robusta, Bersama abyssinica, Olax obtusifolia, Schrebera trichoclada, Tricalysia ruandensis, Zanthoxylum lepeurii, Zanthoxylum deremense, Vitex mossambicensis, Vitex zanzibarensis.*. Other tree species include *Brachystegia bussei, Didymosalpinx norae, Cuviera semsei, Newtonia buchananii* and *Porterandia penduliflora.*

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

Plot 1 : Closed forest at 870 m altitude at the head of the Mchinjidi Valley, 60 m x 5 m.
0.03 ha in area with 24 trees over 10 cm dbh giving an equivilant of 800 trees per ha.
Mean tree dbh 33.9 cm; mean tree height 22.2 m; mean bole height 7.8 m.
Mean crown area 73.1 m^2/tree; mean basal area 72.3 m^2/ha; mean stand volume 561 m^3/ha.
The following tree species were identified : 6 x *Cleistanthus* sp. nov 2 (25%), 1 x *Newtonia buchananii, Ricinodendron heudelottii, Teclea trichocarpa, Dialium holzii, Rinorea ferruginea, Ficus thonningii, Baphia macrocalyx, Ficus exasperata, Celtis mildbraedii,* Annonaceae indet (4% each). The remaining 8 trees could not be identified, but all trees were different.

Transition Woodland/*Brachystegia* Forest [Zanzibar-Inhambane transition woodland (*sensu* White, 1983)]

Parts of the steep slopes of the plateau edge are covered by a forest where *Brachystegia microphylla* is strongly dominant, with interspersed *Faurea saligna*. This is believed to be the natural vegetation type for the plateau edges (Vollesen & Bidgood, 1992).

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

Woodland containing *Parinari curateifolia, Pteleopsis, Julbernardia, Isoberlinia* and *Brachystegia* is found outside the forest areas on the plateau, especially to the west and north of the reserve. Tree species diversity appears to be high. The valuable timber tree mninga *Pterocarpus angolensis* is found in this woodland and Vollesen (1994) notes the presence of 'several unusual species' in the herb layer which seems to indicate at least a relatively well-established vegetation.

Plantation

Plantation forestry was initiated in 1952 and continued until 1978, during which various pine (*Pinus*) species and the indigenous timber tree 'mvule' *Milicia excelsa* were extensively planted. Trial plots of teak *Tectona grandis, Grevillea robusta* and *Cupressus* have also been planted.

A single vegetation plot has been constructed in the 'mvule' *Milicia excelsa* plantation forest area :

Plot 2 : 'Mvule' plantation compartment from 1959, measured in 1993, 16 subplots of 100 m^2.
0.16 ha in area with 48 trees over 10 cm dbh giving an equivilant of 300 trees per ha.
Mean tree dbh 18.9 cm; mean tree height 13.4 m; mean bole height 4.9 m.
Mean crown area 60.9 m^2/tree; mean basal area 8.4 m^2/ha; mean stand volume 41 m^3/ha.
The following tree species were identified : 11 x *Milicia excelsa* (23%), 4 x *Albizzia gummifera* (8%), 2 x *Albizzia petersiana, Celtis africana, Cussonia zimmermannii* (4% each), 1 x *Antiaris toxicaria, Clausena anisata, Dracaena usambarensis, Salacia stuhlmanniana, Tabernaemontana pachysiphon, Tabernaemontana ventricosa, Turraea floribunda, Trilepesium madagascariensis, Blighia unijugata, Bridelia* sp. indet. (2% each). 17 trees could not be identified but were all different species.

TIMBER VALUES

Rondo Forest has long been recognised as being the finest 'mvule' *Milicia excelsa* forest in East Africa, which has led to the misconception that the natural forest was dominated by this species. Enumerations in the 1930s found that 'mvule' trees over 6 ft in girth (58 cm dbh) occurred at a density of 2.76 trees per acre (6.8 per hectare) within the reserve and at about a third of this density in the public lands outside the reserve, with a 16% error for the reserve and a 23% error for the public lands. A total of 8 million cubic feet was reported to be present on the plateau in 1946, making it the largest concentration of mvule in East Africa (Annual Report of the Forest Department, 1946), though 75% of these mvule trees were of coppice origin which suggests intensive past disturbance. Both the natural forest and the woodland areas on the plateau have since been intensively logged, and the major timber value of the reserve is now contained within the plantation compartments (see following section on forestry).

The woodland at the western side of the reserve contains the valuable timber tree 'mninga' *Pterocarpus angolensis*.

An area of natural forest in Rondo forest has the highest recorded stand volume (561 m^3/ha) of all the plots constructed in Coastal Forests by the Frontier-Tanzania Coastal Forest Research Programme.

BIODIVERSITY

Rondo Forest has received many visits from biologists, and even the most recent collections have revealed species new to science. The forest has been visited by the botanists Busse, Brain, Schlieben, Eggeling, Semsei, Milne-Redhead, Taylor, Mwasumbi, Bidgood and Vollesen. The herpetologist Loveridge visited the reserve in 1939 (Loveridge, 1942 & 1944) and the lepidopterist Kielland visited during the 1980s. Birds were probably first collected by the Germans, and later observations and surveys include those by Bulbock, Stjernstedt, Holsten *et al.* (1991) and the Danish ICBP/BirdLife Denmark expeditions (Faldborg *et al.*, 1991 and Eriksen *et al.*, 1993 & 1994). The Frontier-Tanzania Coastal Forest Research Programme carried out a brief general biological survey in 1993.

Birds

At least 121 bird species have been recorded from Rondo (Holsten *et al.*, 1991, Bagger *et al.*, 1990, Eriksen *et al.* 1993 & 1994) which is ranked as the joint 44th most important forest in Africa and Madagascar for threatened bird conservation (Holsten *et al.*, 1991).

67 bird species have been recorded in the forest of which 32 are forest birds.

Coastal Forest endemics - Rondo Green Barbet *Stactolaema olivacea* ssp. *hylophona* Subspecies endemic to Rondo and Ngarama.
Fischer's Greenbul *Phyllastrephus fischeri*.
Reichenow's Batis *Batis reichenowi*.

Coastal Forest/Eastern Arc endemic - Green-headed Oriole *Oriolus chlorocephalus*.

BirdLife listed species - Southern Banded Snake-eagle *Circaetus fasciolatus* [BirdLife Near threatened].
East Coast Akalat *Sheppardia gunningi* [BirdLife Vulnerable; IUCN Rare]
Spotted Ground Thrush *Turdus fischeri* [BirdLife Endangered; IUCN Rare]. Only known breeding site].
Plain-backed Sunbird *Anthreptes reichenowi* [BirdLife Near threatened].

Mammals

26 mammal species are recorded in Eriksen *et al.* (1994) and from collections and observations by Frontier-Tanzania, including 4 bat species [4 specimens] and 2 rodent species [at least 2 specimens have been collected].

Rondo area endemics -	Rondo Dwarf Galago *Galago* sp. nov. B (Bearder *et al.*, 1994; specimen cited in Jenkins, 1986) Known only from the Rondo and Chitoa forests.
Coastal Forest/Eastern Arc endemics -	East African Collared Fruit Bat *Myonycteris relicta.* (Specimen KMH 10061) Known from only 8 other localities [IUCN Vulnerable]. Lesser Pouched Rat *Beamys hindei* (Specimen cited in Christensen, 1987) [IUCN Vulnerable].
Other CITES/IUCN - listed species	African Elephant *Loxodonta africana* [CITES Appendix 1; IUCN Vulnerable]. Leopard *Panthera pardus* [CITES Appendix 2; IUCN Threatened]. Black-and-Rufous Elephant Shrew *Rhynchocyon petersi petersi* [IUCN Rare]. Zanzibar Galago *Galagoides zanzibaricus* [IUCN Vulnerable].
Other species -	Mouse-cared Bat *Myotis welwitschii.* (Specimen KMH 10059) Infrequently encountered throughout its range.

Reptiles

A total of 13 forest dependent reptile species have been recorded from Rondo from a total collection of 30 species by Loveridge (1942 & 1944), the Danish ICBP expeditions and by the Frontier-Tanzania Coastal Forest Research Programme [3 specimens].

Rondo endemics -	Rondo Limbless Skink *Melanoseps rondoensis.* (Cited in Broadley & Howell, 1991). Rondo Blind-snake *Typhlops rondoensis.* (Cited in Broadley & Howell, 1991).
Rondo area endemics -	Rondo Round-snouted Amphisbaenian *Chirindia rondoensis.* Endemic to the Rondo and Makonde Plateaux. (Cited in Broadley & Howell, 1991). Rondo Sharp-snouted Amphisbaenian *Ancylocranium ionidesi haasi.* Subspecies endemic to Rondo and Litipo. Species endemic to Rondo, Litipo and Kilwa District (Cited in Broadley & Howell, 1991).
Coastal Forest/Eastern Arc endemics -	Bearded Pigmy-Chameleon *Rhampholeon brevicaudatus.* (Specimen KMH 10188). Endemic to the Eastern Arc and 6 Tanzanian Coastal Forests. Usambara Green Snake *Philothamnus macrops.* (KMH 10077). Known only from the Usambaras and 3 Tanzanian Coastal forests.

Amphibians

6 species are recorded from collections by Loveridge, Frontier-Tanzania and others. The total number of specimens collected is not thought to exceed 20.

Coastal Forest endemics -	Tree toad *Mertensophryne micranotis.* (Cited in Poynton, 1991). Leaf-litter toad *Stephopaedes loveridgei.* (Cited in Poynton, 1991). Known only from 8 sites in SE Tanzania, probably all Coastal Forests.
Coastal Forest/Eastern Arc endemic -	Methner's toad *Spelaeophryne methneri.* (Cited in Poynton, 1991).

Plants

Rondo endemics -

Asteranthe sp. nov. (= *Bidgood et al.* 1552) [Annonac.]
Monodora sp. A of FTEA [Annonac.]
Xylopia latipetala Verdc. [Annonac.] Cited in FTEA.
Hystricophora macrophylla Mattf. [Asterac.] Cited in *Kew Bull.* **43**, 2.
Gongronema sp. nov. (= *Bidgood et al.* 1435) [Asclepiadac.]
Secamone sp. nov. aff. *delagoensis* (= *Bidgood et al.* 1518) [Asclepiadac.]
Fernandoa lutea (Verdc.) Bidgood ined. [Bignoniac.]
Ehretia glandulosissima Verdc. [Boraginac.] Cited in FTEA.
Ipomoea consimilis Schulz-Menz [Convulvulac.] Cited in FTEA.
Ipomoea flavivilosa Schulz-Menz [Convulvulac.] Cited in FTEA.
Ipomoea sp. B of FTEA [Convulvulac.]
Ipomoea sp. D of FTEA [Convulvulac.]
Diplocyclos leiocarpus (Gilg.) C. Jeffrey [Cucurbitac.] Cited in FTEA.
Momordica sp. nov. aff. *glabra* (= *Bidgood et al.* 1376) [Cucurbitac.]
Diospyros magogoana F.White [Ebenac.] Cited in White (1988).
Cleistanthus sp. nov. 1 (= *Bidgood et al.* 1515)[Euphorbiac.]
Bussea eggelingii Verdc. [Fabac.] Cited in FTEA.
Vismia pauciflora Milne-Redhead [Hypericac.] Cited in FTEA.
Mostuea sp. A of FTEA [Loganiac.]
Mostuea sp. B of FTEA [Loganiac.]
Cincinnobotrys (Primularia) pulchella (Brenan) Jac.-Fel. [Melastomac.] Cited in FTEA
Memecylon sp. nov. (= *Bidgood et al.* 1338) [Melastomac.]
Tinospora sp. nov. aff. *tenera* (= *Bidgood et al.* 1392) [Menispermac.]
Plumbago ciliata Wilmot-Dear [Plumbaginac.] Cited in *Kew Bull.* **31**, 4.
?gen. nov. tribe VANGUERIEAE of FTEA[Rubiac.] Cited in FTEA.
Canthium parasiebenlistii Bridson [Rubiac.] Cited in FTEA.
Canthium rondoense Bridson [Rubiac.] Cited in *Kew Bulletin* **47**,3.
Ixora sp. nov. aff. *narcissodora* (= *Bidgood et al.* 1377) [Rubiac.]
Leptactina papyrophloea Verdc. [Rubiac.] Cited in FTEA.
Pavetta lindina Bremek. [Rubiac.] Cited in FTEA.
Psychotria sp. nov. (= *Bidgood et al.* 1585) [Rubiac.]
Pyrostria sp. D of FTEA [Rubiac.]
Rytigynia longipedicellata Verdc. [Rubiac.] Cited in FTEA as *Rytigynia* sp. C.
Premna sp. A. of FTEA [Verbenac.]
Cissus rondoensis Verdc. [Vitac.] Cited in FTEA.
Cyphostemma bidgoodae Verdc. [Vitac.] Cited in FTEA.
Afromomum sp. nov. aff. *alboviolaceum* (= *Milne-Redhead & Taylor* 7610) [Zingiberac.]

Possible Rondo - endemics

Monanthotaxis sp. ?nov. (= *Bidgood et al.* 1402) [Annonac.]
Ceropegia sp. ?nov. aff. *brevirostris* (= *Bidgood et al.* 1449) [Asclepiadac.]
Ceropegia sp. ?nov. aff. *denticulata* (= *Bidgood et al.* 1466) [Asclepiadac.]
Ceropegia sp. ?nov. aff. *meyeri-johannis* (= *Bidgood et al.* 1608)[Asclep.]
Tylophora sp. ?nov. (= *Eggeling* 6421) [Asclepiadac.]
Hippocratea sp. ?nov. aff. *graciliflora* (= *Bidgood et al.* 1688) [Celastrac.]
Tetracera sp. ?nov. aff. *littoralis* (= *Bidgood et al.* 1347) [Dilleniac.]
Strychnos sp. ?nov. aff. *scheffleri* (= *Bidgood et al.* 1521) [Loganiac.]
Chassalia sp. aff. *abrupta* (= *Semsei* 680, *Bidgood et al.* 1367) [Rubiac.]
Oxyanthus sp., not matched (= *Bidgood et al.* 1383) [Rubiac.]
Pentas sp. aff. *bussei* not matched (= *Bidgood et al.* 1573) [Rubiac.]
Tricalysia sp. ?nov. aff. *delagoensis* (= *Bidgood et al.* 1452) [Rubiac.]
Tricalysia sp. ?nov. aff. *pedicellata* (= *Bidgood et al.* 1461) [Rubiac.]
Allophylus sp. ?nov. (= *Semsei* 622) [Sapindac.]
Allophylus sp. ?nov. (= *Schlieben* 5895) [Sapindac.]

Grewia sp. ?nov. aff. *calymmatosepala* (= *Bidgood et al.* 1337) [Tiliac.]
Grewia sp. ?nov. aff. *meizophylla* (= *Bidgood et al.* 1685) [Tiliac.]
Rinorea sp. ?nov. aff. *ferruginea* (= *Bidgood et al.* 1352) [Violac.]

Rondo area endemics - *Streptosiphon hirsutus* Mildbr. [Acanthac.] (Specimen *Bidgood et al.* 1391 etc.) Known only from Rondo and Litipo forests.
Uvaria decidua Diels [Annonac.] (Specimen *Bidgood et al.* 1446). Known only from Rondo and Mlinguru forests.
Maerua acuminata Oliv. [Capparidac.] (Specimen *Bidgood et al.* 1631). Rondo, Ruvuma River & Newala. Cited in FTEA.
Coffea schliebenii Bridson [Rubiac.] Rondo and Litipo forests only (Cited in *Kew Bulletin* **49**, 331).
Cuviea schliebenii Verdc. [Rubiac.] Known only from Rondo and Litipo forests. Cited in FTEA.
Pavetta tendaguruensis Bremek. [Rubiac.] Rondo, Mlinguru & Tendaguru only. Cited in FTEA.
Pavetta sp. nov. (= *Bidgood et al.* 1342) [Rubiac.] Known only from Rondo and Chitoa forests.
Tarenna sp. A of FTEA [Rubiac.] Known only from Rondo and Mlinguru forests in SE Tanzania. Cited in FTEA.
Mimusops acutifolia Mildbr. [Sapotac.] (Specimen *Bidgood et al.* 1448). Rondo and Noto forests only.
Premna hans-joachimii Verdc. [Verbenac.] (Specimen *Bidgood et al.* 1403) Rondo & Mlinguru forests only.

Coastal Forest endemics - *Asystasia* sp. nov. [Acanthac.] (Specimen *Bidgood et al.* 1622). Rondo and other sites in SE Kenya & NE Tanzania.
Cyathula braunii Schinz. [Amaranthac.] 'Rondo-Lutamba' and 2 forests in SE Kenya. Cited in FTEA.
Psilotrichum vollesenii C.C.Townsend [Amaranthac.] (Specimen *Bidgood et al.* 1546). Rondo & Selous endemic.
Maerua schliebenii C.Gilg [Capparidac.] (Specimen *Bidgood et al.* 1511). Known only from Rondo and Litipo forests, and 1 site in Mozambique.
Pteleopsis apetala Vollesen [Combretac.] Rondo and 2 sites in SE Tanzania. Cited in Bidgood & Vollesen (1992).
Vismianthus punctatus Mildbr. [Connarac.] Rondo and Makonde plateau only. Cited in FTEA.
Dichapetalum braunii Engl. & Krause [Dichapetalac.] Rondo and 3 other sites. Cited in FTEA
Cleistanthus sp. nov. 2 [Euphorbiac.] (Specimen *Bidgood et al.* 1463). Rondo and a few sites in Kenya only.
Sapium trilochulare Pax & K.Hoffm. [Euphorbiac.] (Specimen *Bidgood et al.* 1634). Known only from Rondo and 3 other sites.
Bauhinia loesneriana Harms [Fabac.] Rondo & 2 other sites in SE Tanzania. Cited in Bidgood & Vollesen (1992).
Gigasiphon macrosiphon (Harms) Brenan [Fabaceae] Rondo and 3 other sites. Cited in Beentje (1988) and in FTEA.
Millettia schliebenii Harms [Fabac.] Rondo and 2 other sites in SE Tanzania. Cited in FTEA.
Acridocarpus pauciglandulosus Launert [Malphigiac.] Rondo, Kitangari on the Makonde Plateau and Pugu Hills only. Cited in FTEA.
Eragrostis mucronensis Pilg. [Poaceae] Rondo and one Zambian site only. Cited in FTEA.
Canthium impressinervum Bridson [Rubiac.] Rondo and 2 other sites in SE Tanzania. Cited in FTEA.

Heinsia bussei Verdc. [Rubiac.] Rondo and 3 other sites in SE Tanzania. Cited in FTEA.

Leptactina oxyloba Schum [Rubiac.] Rondo and 4 other sites in Tanzania. Cited in FTEA.

Oxyanthus sp. A of FTEA [Rubiac.] (Specimen *Bidgood et al.* 1341). Rondo and 3 other sites in Tanzania.

Rytigynia pergracilis Verdc. [Rubiac.] Rondo area and Matumbi Hills endemic. Cited in FTEA.

Tricalysia sp. F of FTEA [Rubiac.] Known only from the Rondo and Makonde plateaux.

Cola stelecantha Brenan [Sterculiac.] (Specimen *Bidgood et al.* 1554). Rondo and 2 other forests in Tanzania.

Premna tanganyikensis Moldenke[Verbenac.] (Specimen *Bidgood et al.* 1582). Rondo & 2 other sites.

Cissus wallacei Verdc. [Vitac.] Rondo and 1 other site in Morogoro District. Cited in FTEA.

Other species - *Thecacoris lucida* [Euphorbiac.] (Specimen *Bidgood et al.* 1508). Rondo and West/Central African distribution.

CATCHMENT VALUES

Much of the forest probably has little catchment value since surface water never forms on the highly porous plateau soils, even during periods of heavy rainfall (Loveridge, 1944). The water table is 300 m below the plateau surface (Eriksen *et al.*, 1993). Forest on the escarpment edges may slow down the scarp retreat erosion of these edges.

Small streams emerge from the Mtandi, Mchinjidi, Manyolyo and Nanyolyo valleys.

HUMAN IMPACTS

Rondo forest has been subjected to severe human disturbance as a result of shifting cultivation and intensive logging followed by the development of a commercial forestry industry at the site.

Agriculture

The original 1909 German map shows much of the present forest reserve was covered by light bush and areas of cultivation at the time of gazettement. Signs of former occupation (grindstones etc.) were reported during the 1938 enumeration (Annual Report of the Forest Department, 1949).

Loveridge (1942) notes that the forest suffered heavily from an incursion of refugees during the 1914-1916 war.

Fourteen people were fined for encroaching into the reserve in 1957. At present there is no agricultural encroachment into the reserve area, although cultivation now reaches the entire eastern boundary of the reserve.

Logging

Rondo contained the largest single concentration of 'Mvule' *Milicia excelsa* in East Africa before it was logged by the Steel Brothers (Tanganyika Forest Ltd.) from 1949-1961 and by TWICO (Tanzania Wood Industry Corporation) from 1962-1976. A sawmill was established at Ngala for processing the logged mvule (*Milicia excelsa*) and mninga (*Pterocarpus angolensis*), primarily for [illegible]

following quantities of timber were extracted by Steel Brothers from their concession (which covered the area from the Mbemkuru River to the Lukuledi River, and from Lake Lutamba to the western end of the Rondo Plateau, though the majority of the timber was extracted from the plateau itself, and the majority of the mvule from the Forest Reserve) :

1949 to 1951 approx. 3,800 cubic tons of mvule.
1952 - 3,600 cubic tons of mvule, with an average of 1.4 cubic tons per tree and 4.5-6 cubic tons per acre.
1953 - 4,750 cubic tons of mvule [863,000 logs of $^1/_4$ girth], with a 65% conversion loss for the mvule.
1000 cubic tons mninga [228,000 logs of $^1/_4$ girth]
1954 - 5,450 cubic tons
1955 - 7,460 cubic tons [779,350 mvule logs of $^1/_4$ girth, 183,750 mninga logs of $^1/_4$ girth, 48,200 other logs].
1956 - 8,060 cubic tons
1957 - 9,730 cubic tons[963,000 mvule logs of $^1/_4$ girth, 398,080 mninga logs of $^1/_4$ girth]
1958 - 7,370 cubic tons (approx.) [703,750 mvule logs of $^1/_4$ girth, 381,900 mninga logs of $^1/_4$ girth]
1959 - 8,445 cubic tons [762,064 mvule logs of $^1/_4$ girth, 507,936 mninga logs of $^1/_4$ girth]
1960 logging of mvule stopped.

The last logging within the natural reserve was carried out in 1984-85 for mninga (*Pterocarpus angolensis*) and Mpingo (*Dalbergia melanoxylon*) in the woodland areas. TWICO is presently continuing to log these species beyond the reserve at the western end of the Rondo (Mwera) plateau.

Some illegal small-scale pitsawing is still occurring within the reserve (Eriksen *et al.*, 1993).

Plantation Forestry

In 1952 the Rondo Forest Project was initiated and since then over 1100 ha of hardwoods and 1700 ha of pine have been planted, some of it at the expense of the natural forest (Procter, 1968). From the original German map of 1909 it would appear that the best area of natural forest (between the Rondo Forest Project office, the head of the Mchinjidi Valley and the main east-west road) was cleared for part of the pine plantation. The remaining areas of plantation have been established in areas that were formerly open woodland, light bush or fallow plantation.

Planting was stopped in 1982 as the exotic trees were growing poorly. A nursery project in the Mtandi valley was abandoned in 1986 as tree planting was stopped. The current policy in planted areas is to clear-fell and plant up with 'Mvule' *Milicia excelsa* and Teak (*Tectona grandis*).

A recent plan has been to establish a mobile sawmill in the nearby Ntene village to start processing the planted timber, with the aim of producing fork-lift truck palettes from the softwoods.

Pole cutting

Local people can obtain permits (20 Tsh. per headload, 1993 prices) to collect hardwood building poles. The rare tree *Cleistanthus* sp. nov. seems to be the preferred species (Vollesen, 1994).

Charcoal production

Some illegal charcoal burning takes place by local people. Teak offcuts are available for fuelwood.

Fire

Fires caused by the clearance of cultivated areas are a serious threat to the forest, especially between July and November. In 1981 334.6 ha of forest was burnt (Bhatia, 1990), in 1982 a further 745 ha of was burnt (Eriksen *et al.*, 1993). A further fire entered the plantation area in 1988.

CONSERVATION ISSUES

Rondo Forest contains a far greater number of endemic plant species than any other Coastal Forest (as well as endemic reptile species), but as yet there is no international support for a conservation initiative for this forest. Any such initiative would have to go through the Rondo Forestry Project which is directly controlled by the Ministry of Natural resources, Tourism and the Environment and is not administered through the Lindi Regional Forest office.

The presence of an active forestry operation at Rondo has probably helped to discourage agricultural encroachment into the reserve. The continuation of the Rondo Forestry Project may then be essential to ensure the survival of the remaining areas of natural forest as pressure for agricultural land on the plateau increases in the future. There are already 10,000 people living on the Rondo (Mwera) plateau [1993] and the agricultural potential of parts of the plateau is becoming exhausted.

There is little or no natural forest regeneration in the softwood plantation areas and as these are unsuccessful, a long term policy to replace these with 'mvule' *Milicia excelsa* plantations should be pursued. The older mvule plantation compartments have already returned to a semi-natural state and these may offer the best compromise between commercial forestry and the maintenance of the forest's biodiversity. Existing areas of natural forest should be left undisturbed.

The forest needs to be buffered against future fire incursions, either by widening the boundary track, by carrying out early burning along the boundaries, or by planting fire retardant species around the reserve.

Native tree species could also be replanted in some of the clear-felled areas, after re-establishing the Mtandi nursery to provide the required tree seedlings (e.g. of the *Cleistanthus*). Future 'mvule' plantations could be established in the non-forest areas of the reserve, in order to increase the overall total area of forest, and to increase the economic performance of the forestry operation since Mvule has been recorded to perform better in plantations outside of forest (Somi & Nshubemuki, 1980).

Further research is required to find out where the endemic species are located within the reserve, and to assess how well these are colonising the mvule plantation areas.

LITERATURE

Adams (1902) includes the earliest known vegetation map of the southern edge of the Rondo plateau.

Bagger *et al.* (1990) list bird species observed and captured on the Danish 1989 ICBP expedition.

Bearder *et al.* (1994) demonstrate the identity of a separate bushbaby species from Rondo on the basis of its call patterns.

Bhatia (1990) provides some interesting background information on forestry, exploitation etc. in Rondo forest.

Bidgood & Vollesen (1992) include notes on the vegetation of Rondo Forest.

Broadley & Howell (1991) list some of the reptile species found on the Rondo Plateau.

Christensen (1987) records the collection of the Lesser Pouched Rat from the Rondo Plateau.

Eriksen *et al.* (1994) list mammal, bird, reptile and butterfly species from Rondo forest.

Eriksen *et al.* (1993) list bird species and discuss some conservation issues for the Rondo Forest Reserve.

Faldborg *et al.* (1991) list bird and mammal species oobserved and captured on the second Danish ICBP expedition.

Griffith (1951) gives a general description of the Rondo forest followed by comments on a technique used to quantify the quantity of 'mvule' *Milicia excelsa* on the plateau.

Holsten *et al.* (1991) include notes on some bird records from the forest.

Loveridge (1944) provides background notes on his collecting trip to the Rondo Plateau.

Loveridge (1942) lists herpetile species collected on the Rondo Plateau.

Polhill (1968) is one of the first publications to highlight the importance of the flora of the Rondo Plateau, with a recommendation to protect part of the plateau as a nature reserve.

Smart (1980) discusses some of the problems encountered with the forestry project at Rondo.

Verdcourt (1994) describes a new species of snail from the Rondo forest.

Vollesen (1994) provides a comprehensive summary on the status of the plants of the Rondo Plateau.

Vollesen & Bidgood (1992) list plant species collected by the two botanists on Rondo in 1991, with many new and possible new species.

Rondo forest is also mentioned in passing in numerous papers and reports discussing Coastal Forests (see Burgess & Muir, 1994 for a bibliography).

Rondo Forest is further mentioned in numerous reports and papers emanating from the silvicultural research into the plantations on the plateau. Most of these are summarised in Somi & Nshubemuki (1980) and include studies of the growth rate of some indigenous tree species such as *Milicia excelsa*, *Pterocarpus angolensis*, *Pterocarpus zimmermannii*, *Bombax rhodognaphalon* and *Afzelia quanzensis*. These notes also include the results of experiments to improve the regeneration performance of 'mvule' and to protect it against Giant African Land Snail *Achatina zanzibarica* damage.

ADDENDUM

During the 1950s a number of other forest reserves were designated (i.e. surveyed and boundaries cleared, but not formally gazetted) in order to protect the catchment of other parts of the Rondo scarp leading off the north-west, the north-east and the south-east corners of the Rondo Forest Reserve. All of these reserves were discontinued in 1959, but re-instating these reserves might be considered since a number of the rare plants found on the Rondo plateau were collected on the scarp edges outside of the Rondo Forest Reserve (see Bidgood & Vollesen, 1991). These reserves include the following :

Nyangadi Forest Reserve (a mis-spelling of Nyengedi)

Reference SD/4/39, 18 square miles in area. Demarcated 1953 to protect part of the Rondo scarp in the Nyengedi Valley, which is the catchment for the stream from which the water supply for the Rondo plateau is derived. A mvule *Milicia excelsa* nursery was established in the reserve from 1951-1958. Recorded as a protective forest reserve containing miombo woodland and some thicket.

Nanyalio - Nahungo Forest Reserve

Reference SD/4/40, 38 square miles in area. Demarcated 1954 & 1955 to protect part of the Rondo scarp from the N.W. of the Rondo Forest Reserve westwards. Recorded as a protective forest reserve containing miombo woodland

with considerable productive value (implying large quantities of mvule *Milicia* excelsa or mninga *Pterocarpus angolensis*).

Nyenga Forest Reserve

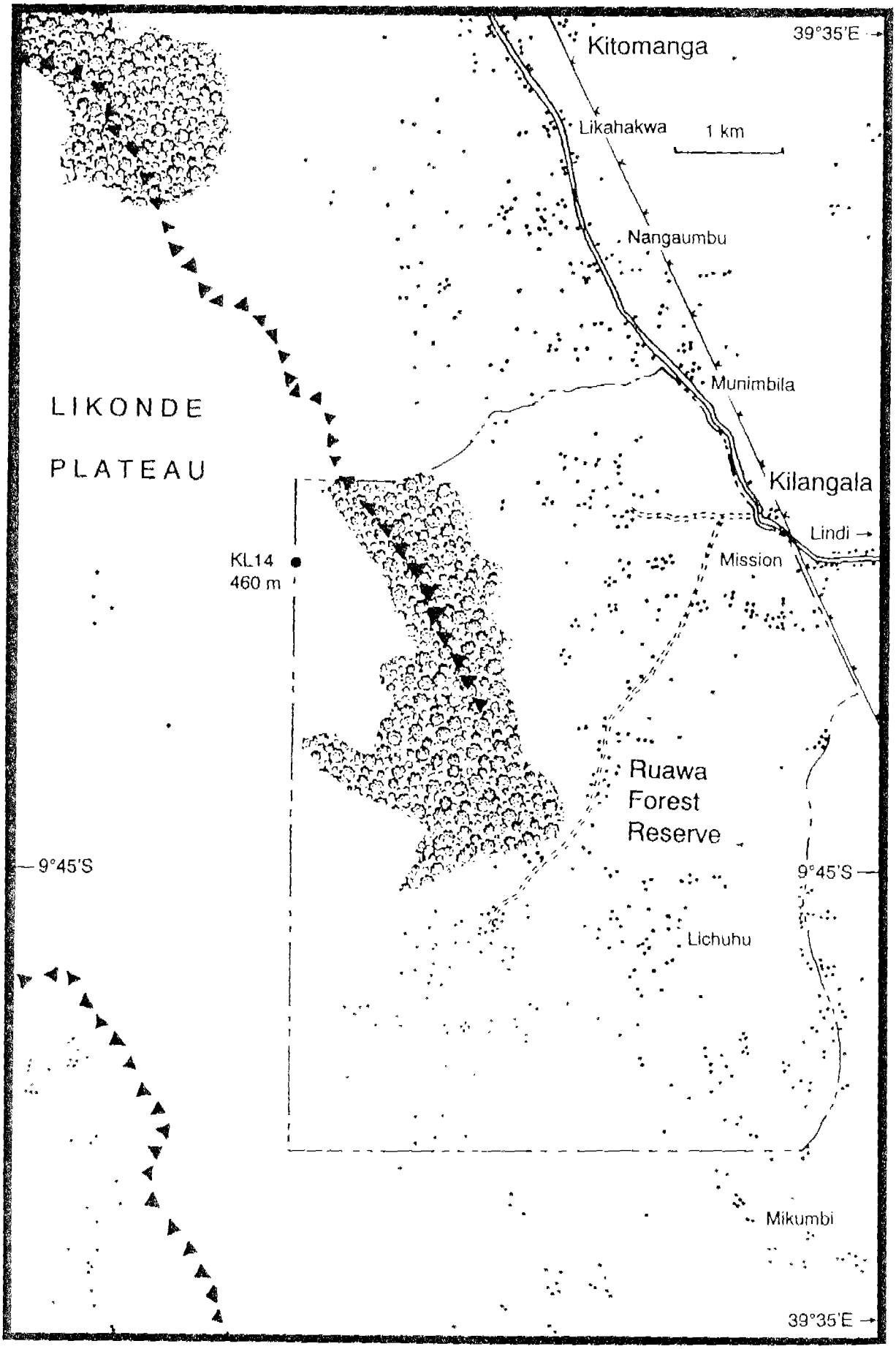
Reference SD/4/41, 4 square miles in area. Demarcated 1954 & 1955 to protect part of the Rondo scarp from the N.E. of the Rondo Forest Reserve eastwards. Recorded as a protective forest reserve containing miombo woodland.

Nanguile Forest Reserve

Reference SD/4/42, 2.5 square miles in area. Demarcated 1954 & 1955 to protect part of the Rondo scarp from the Rondo Forestry Project office at Mtene eastwards to Mnara. Recorded as a protective forest reserve containing miombo woodland and thicket.

Ntatala Forest Reserve

Reference SD/4/43, 3 square miles in area. Demarcated 1954 & 1955 to protect part of the Rondo scarp between the Nanguile Forest Reserve eastwards to the Nyangadi Forest Reserve. Recorded as a protective forest reserve containing miombo woodland.


39°35'E
Kitomanga
Likahakwa
1 km
Nangaumbu
Munimbila
LIKONDE
PLATEAU
Kilangala
Lindi
KL14
460 m
Mission
Ruawa
Forest
Reserve
9°45'S
9°45'S
Lichuhu
Mikumbi
39°35'E

RUAWA FOREST RESERVE

DESCRIPTION

SITE NAME: Ruawa Forest Reserve
Lindi District, Lindi Region, Tanzania.

AREA: 2,949 ha; 29.5 sq. km; 7287 acres; 11.4 sq. miles.

BOUNDARY LENGTH: 22 km. Boundary redemarcated 1970. Cleared and damaged beacons replaced in 1983.

STATUS: Central Government Productive Reserve.
Gazetted 1910.
Declaration Order Cap 132, p. 1363; superseded by Cap. 389 - supp. 59 of 1959, p. 64.

MAPS: Ordnance Survey topographic maps 1:50,000 Series Y742
Sheet 284/1 'Mchinga' of 1967, mapped from aerial photos of 1965-66.
284/3 'Limdi' of 1967, mapped from aerial photos of 1965-66.

Forestry Division Map RS/L/2/1 1:10,000 of 1910.

LOCATION

Grid ref: 9°43'S - 9°46'S, 39°32'E - 39°35'E

Elevation: 150 - 460 m a.s.l.

Ruawa Forest Reserve is situated on part of the south-eastern side of the Likonde plateau and includes an area of the coastal plain at the base of the plateau. The eastern boundary of the reserve is formed by the main Dar es Salaam to Lindi road and further south by the main Dar es Salaam to Lindi telegraph line. The northern boundary goes through a rocky gulley on the escarpment edge of the Likonde Plateau. The reserve covers an altitudinal range of 150-460 m.

Access by the main Lindi-Dar es Salaam road which forms the north-eastern edge of the reserve. From the road numerous paths lead westwards to the escarpment edge, and the forest can be reached after a 35 minute walk.

Public transport access by the Lindi-Dar es Salaam or Lindi-Kilwa bus, which stops at the village of Munimbila. From here it is a half-hour walk to the forest.

SOILS

Not studied.

CLIMATE

Ruawa Forest Reserve is influenced by tropical East African oceanic temperatures that are slightly modified by the altitude. There is a well defined dry season between May and October when the lowest mean monthly temperatures are recorded. The nearest rainfall station is at the Kikwetu Sisal Estate (9°51'S, 39°44'E, 60 m altitude), where an

average of 872 mm of rainfall per year has been recorded for the 39 years prior to 1973, with May, June, July August, September & October having a monthly average of less than 50 mm rainfall during this period. A peak annual rainfall of 1139 mm and a minimum annual rainfall of 533 mm has been recorded between 1934 and 1970 from this rainfall station.

VEGETATION

Preliminary visits to Ruawa Forest Reserve have identifed 2 main vegetation types :

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

Evergreen Coastal Forest is present on the escarpment edge of the Likonde Plateau, dominated in the northern end of the reserve by *Scorodophloeus fischeri* and *Craibia* sp., as 13 m high canopy trees with deciduous *Ricinodendron heudelottii* as emergents to 20 m. Other trees include *Euphorbia* sp. (a common understorey tree), *Bombax rhodognaphalon, Newtonia paucijuga, Millettia* sp. and *Inhambanella henriquesii.*

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

Areas to the east of the escarpment are cultivated or have become fallow after cultivation such that cashewnut woodland is becoming established, dominated by the cashew tree *Anacardium occidentale* .

TIMBER VALUES

The timber tree 'mvule' *Milicia excelsa* occurs at low densities throughout the remaining areas of closed forest.

BIODIVERSITY

The Ruawa Forest Reserve has only recently been visited by scientists. The Frontier-Tanzania Coastal Forest Research Programme briefly visited the reserve in 1993. Scientists from Oxford-Brookes University (Department of Anthropology) visited the reserve in 1994, in search of new species of bushbaby (*Galago/Otolemur* spp.).

The proximity of the Ruawa Forest Reserve to the Rondo and Litipo Forest Reserves suggests that it will contain many rare and endemic species. The caves on the northern boundary of the reserve are likely to be important bat roosts.

Birds

Not yet surveyed.

Mammals

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

Reptiles

No reptiles are known to have been recorded from Ruawa forest.

Amphibians

No amphibians are known to have been recorded from Ruawa forest.

Plants

Only a few plant specimens are known to have been collected in Ruawa forest (by the Frontier-Tanzania Coastal Forest Research Programme), and no rare species have yet been recorded.

CATCHMENT VALUES

The forest on the escarpment edge might be important for protecting the catchment of the streams and underground water supplies that flow eastwards off the Ruawa Plateau.

HUMAN IMPACTS

Ruawa Forest Reserve is situated in a fairly densely populated area, due to the proximity of the main Lindi-Dar es Salaam road. The original German Reserve map from 1910 indicates that forest occurred in a broad band from the north-west to the south-east of the reserve. The 1967 Ordnance Survey map indicates that half of this forest (in the south-east) has since been cleared for cultivation and settlement.

Cultivation

Along the escarpment edge there are massive outcrops of ancient coral rag which have probably been responsible for ensuring the survival of the forest in the north-western part of the reserve, as these have reduced the incentive to clear the area for agricultural land. Elsewhere in the reserve there is a long history of agricultural encroachment and the Lindi District forestry records note that 100 people were cultivating within the reserve area in 1950, and that this figure had increased to 157 people by 1957. These were all evicted in 1957, but the eastern half of the reserve (up to the base of the escarpment) in now cultivated again, mainly for maize, cassava and cashewnuts. The people of Munimbila village claim that the reserve boundary is situated at the base of the escarpment edge rather than reaching to the main Dar es Salaam to Lindi road.

Cultivation up to the western edge of the reserve is recorded on the original German boundary map of 1910, along with cultivation in the central part of the reserve.

Logging

Recent pitsawing for 'mvule' *Milicia excelsa* was observed in 1993.

Settlement

Parts of the villages of Lichuhu and Kilangala (including the mission) appear to be located entirely within the forest reserve.

CONSERVATION ISSUES

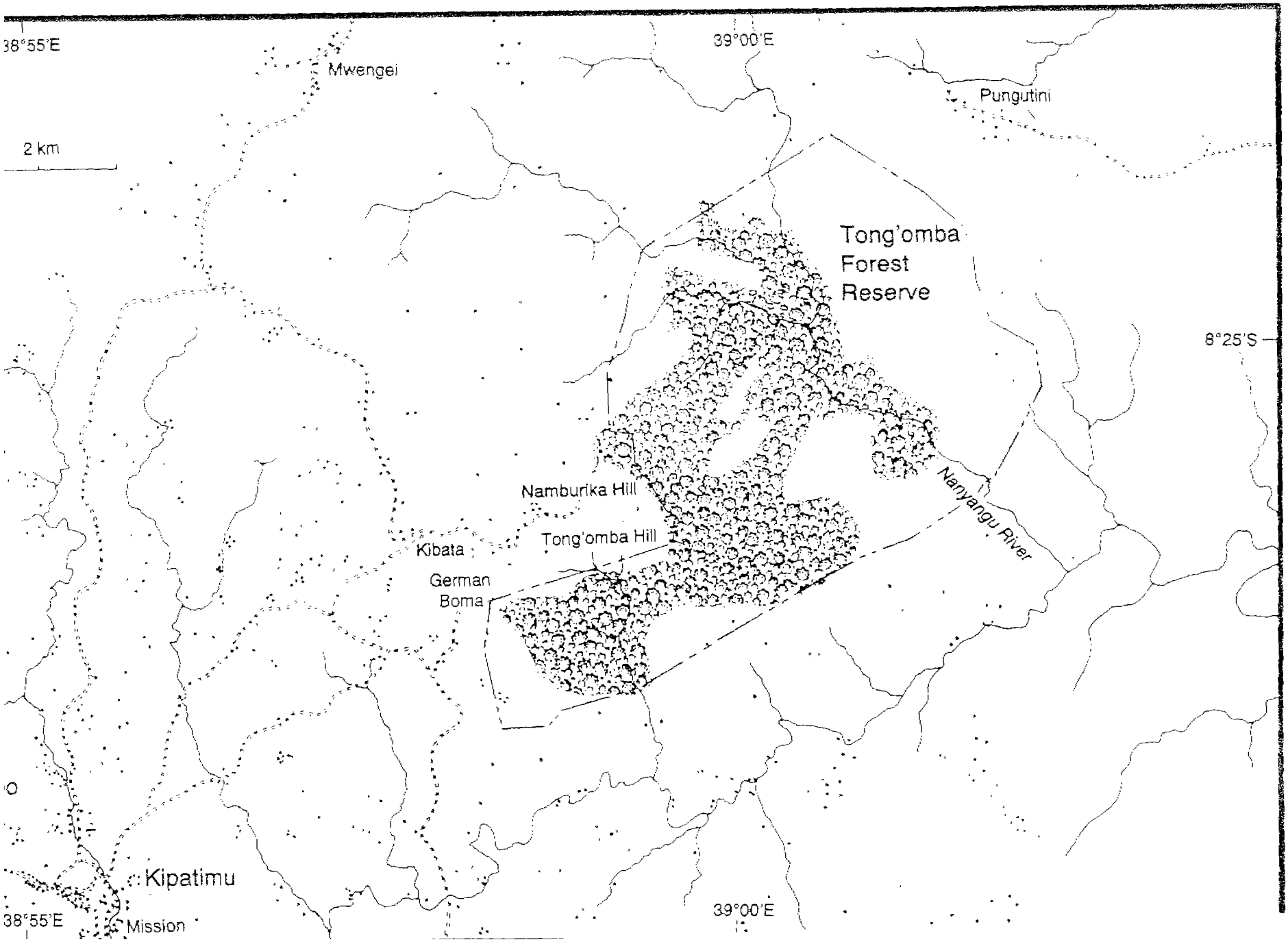
A thorough resurvey of the forest reserve is required, to identify its exact extent and to settle any disputes arising from possible illegal encroachment and settlement in the reserve. Boundaries need to be better demarcated and ultimately cleared to discourage future encroachment.

A more active presence of the Forestry Division is required to control/prevent illegal logging, as well as to discourage agricultural encroachment.

From the main Dar es Salaam to Lindi road there appears to be a lot more forest further north along the Likonde Plateau escarpment. A possible option might be to include this area within a variation order of the Ruawa Forest Reserve, in exchange for areas that are currently under cultivation.

LITERATURE

None known.


38°55'E
39°00'E
Mwengei
Pungutini
2 km
Tong'omba
Forest
Reserve
8°25'S
Namburika Hill
Tong'omba Hill
Kibata
German
Boma
Nanyangu River
Kipatimu
Mission
38°55'E
39°00'E

TONG'OMBA FOREST RESERVE

DESCRIPTION

NAME: Tong'omba Forest Reserve (incorporating the former Kisangi Forest Reserve)
Kilwa District, Lindi Region, Tanzania.

AREA: 2509 ha; 25.1 sq. km; 6,200 acres; 9.69 sq. miles.

BOUNDARY LENGTH: 23 km. There are plans to reclear the boundary at the end of 1995, and to demarcate with *Cassia siamea*.

STATUS: Protective Forest Reserve.
Declaration Order 250/14/7 of 1961.
The earlier Tong'omba and Kisangi Forest Reserves were gazetted during the German administration. Original maps G.Jb 96 or RS/K/3/1 Tong'omba, covering ca. 930 ha. to the east and north-east of the existing reserve; and Jb 469 Kisangi, to the south-west of the existing reserve, covering 768 acres.

MAPS: Ordnance Survey Topographic Maps 1:50,000
Series Y742 Sheets 239/4 'Kipatimu' of 1967, mapped from aerial photos of 1965-66.
240/3 'Kinjubi' of 1967, mapped from aerial photos of 1965-66.

Forestry Department map:
Boundary Map Jb 451 of 1959, 1:25,000.

LOCATION

Grid Ref: 8°24'S - 8°28'S, 38°58'E - 39°02'E

Elevation: 150 - 540 m a.s.l.

Tong'omba Forest Reserve comprises a series of sinuous forested ridges and steep sided, narrow valleys at the eastern edge of the Matumbi Highlands. The village of Kibata (formerly a centre of local government during the British Administration) is situated to the immediate south-east of the reserve.

Access is from the Dar es Salaam to Kilwa road, for which a 4WD vehicle is required south of the Rufiji River during much of the year (especially January to June). Turn west at Njianne, taking a local track to Kipatimu (40 km). From here there are direct tracks to Kibata, but these are usually impassable after February until they are repaired by the local people at the end of July. There is an alternative route by the track from Kipatimu north to Mwenge, and about halfway along this track there is a turning to the south-east towards Kibata.

Alternative road access from Somanga on the main Dar es Salaam to Kilwa road. Take the track west to Kinjumbi and then to Pungutini. From there is an 8 km walk to the north-eastern side of the forest reserve.

District Forestry Office in Kilwa Masoko, local Forestry Officer in Kipatimu.

Public transport along the Dar es Salaam to Kilwa road only. From there it is a long walk, although many lorries go to Kipatimu during the dry season.

SOILS

Sandy loams on ridgetops and upper slopes derived from superficial red Neogene sands and the underlying parent sandstone. Where exposed these soils are rapidly eroded and subject to laterisation. Black cotton Vertisols (FAO/UNESCO) are found in some valley bottoms (Moore, 1961). Sandy soils predominate in riparian forest areas partly derived from alluvial deposits. Soils acidity appears to be very variable with a pH range of 5.5 to 8.9.

CLIMATE

Tong'omba Forest Reserve is influenced by tropical East African oceanic temperatures that are slightly modified by the altitude. The area experiences a 6 month dry season (mid-May to mid-December) with a corresponding 6 month wet season. October is the warmest month, with June being the coolest.

The nearest rainfall station is at the Kipatimu Mission (8°31'S, 38°55'E, 424 m altitude), where an average of 1112 mm of rainfall per year has been recorded for the 24 years prior to 1973, with June, July, August & September having a monthly average of less than 50 mm rainfall during this period.

VEGETATION

The original German gazettement map indicates that much of the original Tong'omba Forest Reserve was formerly under cultivation.

Tong'omba Forest Reserve now contains a many different forest types as well as woodland and cultivation :

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

Approximately 9 km^2 of dry forest are found about the Kisangi, Likubantandya, and Tong'omba Hills, with a very diverse range of vegetation assemblages. On the south side of Tong'omba Hill *Scorodophloeus fischeri* and *Cynometra* sp. are co-dominants. On the hills to the south of the Nanyangu River *Hymenaea verrucosa* and *Dialium holtzii* become more frequent.

Two vegetation plots have been constructed in the dry forest area :

Plot 1 : Dry forest on Tong'omba Hill at 560 m altitude, 16 subplots of 100 m^2.
0.16 ha in area with 49 trees over 10 cm dbh giving an equivilant of 310 trees per ha.
Mean tree dbh 27.7 cm; mean tree height 18.8 m; mean bole height 9.8 m.
Mean crown area 47.7 m^2/tree; mean basal area 18.7 m^2/ha; mean stand volume 183 m^3/ha.
The following tree species were identified : 15 x *Trilepesium madagascariensis* (31%), 7 x *Dichapetalum stuhlmannii* (14%), 4 x *Tabernaemontana pachysiphon* (8%), 3 x sp. A indet. (6%), 2 x *Drypetes natalensis*, sp. B indet. (4% each), 1 x *Brachystegia microphylla, Trichilia emetica, Khaya anthotheca* (2% each). The remaining 11 trees were all different species and could not be identified.

Plot 2 : Dry forest on Namburika Hill at 500 m altitude, 16 subplots of 100 m^2.
0.16 ha in area with 22 trees over 10 cm dbh giving an equivilant of 138 trees per ha.
Mean tree dbh 29.0 cm; mean tree height 18.2; mean basal area 10 m^2/ha.

Transition Woodland/*Brachystegia* Forest [Zanzibar-Inhambane transition woodland (*sensu* White, 1983)]

Approximately 1 km^2 of dry 'transition woodland' occupies the top of some of the ridges, particularly along part of the former Kipatimu to Somanga road. *Brachystegia microphylla* strongly dominates this vegetation type, forming a continuous 16 m high canopy over an 8 m subcanopy with a diverse tree assemblage including *Baikiaea*

ghesquiereana, Hymenaea verrucosa, Diospyros kabuyeana and *Croton sylvaticus*. Saplings are frequent and grasses are absent.

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

Approximately 2 km^2 of riverine and moist valley bottom forest is developed along the many streams within the reserve, containing characteristic riverine tree species such as *Sorindeia madagascariensis, Ficus* spp., *Milicia excelsa, Khaya anthotheca, Barringtonia racemosa* etc. Along the rockier courses *Scorodophloeus fischeri* dominates the small tree layer.

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

Plot 3 : Riverine forest along the Nanyangu River at 330 m altitude, 16 subplots of 100 m^2.
0.16 ha in area with 34 trees over 10 cm dbh giving an equivilant of 210 trees per ha.
Mean tree dbh 21.6 cm; mean tree height 18.0 m; mean bole height 8.3 m.
Mean crown area 53.9 m^2/tree; mean basal area 7.7 m^2/ha; mean stand volume 63 m^3/ha.
Only a few of these species have been identified, and these include 4 x *Dichapetalum stuhlmannii* (12%), 3 x *Syzygium guineensis* (9%), 2 x *Drypetes arguta, Malacantha alnifolia, Baphia* sp., sp. A indet. (6 % each), 1 x *Diospyros consolatae, Tabernaemontana* sp., *Grewia* sp. (3% each). The remaining 16 trees were all different but have yet to be identified.

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

Diverse woodland types are found in the reserve including *Brachystegia* spp., *Pseudobersama mossambicensis, Cassia petersiana, Erythrina* sp., *Kigelia africana, Cassia abrevaiata* and *Pterocarpus angolensis*. It is not known whether these woodland types are semi-natural or whether they have regenerated from areas that were cultivated prior to the gazettement of the reserve during the German administration. 8 m high cassava plants *Manihot glaziovii* in areas of semi-natural woodland may date from earlier cultivation, or may have seeded from the wild.

Cultivation

There is some recent agricultural encroachment into the reserve.

TIMBER VALUES

The numbers of commercial timber trees such as *Pterocarpus angolensis* and *Milicia excelsa* have been reduced by locally based logging (pitsawing)operations. Mature specimens of hardwood species do still exist within the reserve but their scattered distribution and relative inaccessibility renders removal commercially unviable.

The southern areas of the reserve, around Kibata, have been planted with the introduced species Mpili (possibly *Cassia* sp.).

BIODIVERSITY

The German botanists Busse, Brulz and Grasse have collected in Tong'omba (citing Kibata as the collection locality), and collections by Braun citing Pungutini may also be from the forest. General biological surveys of Tong'omba have been limited to the visit by the Frontier-Tanzania Coastal Forest Research Programme in 1992.

Birds

Not yet studied in detail. Only 9 species have so far been recorded from Tong'omba Forest Reserve.

Mammals

26 mammal species have been recorded from collections and observations by Frontier-Tanzania, including a possible 8 bat species [14 specimens collected] and 4 rodent species [6 specimens collected from 224 trap nights].

Possible Tong'omba - endemic: Shrew *Crocidura* sp. ?nov. (c) det. BMNH (Specimen KMH 10440).

Coastal Forest endemics - Woolly bat *Kerivoula africana*. (Specimen KMH 10429) Known from just 1 other Coastal Forests.
Horseshoe Bat *Rhinolophus deckeni*. (Specimen KMH 10433) Known from just 3 other Coastal Forests.

Coastal Forest/Eastern Arc endemics - East African Collared Fruit Bat *Myonycteris relicta*. (specimen KMH 10061) Known from only 8 other localities [IUCN Vulnerable].

CITES/IUCN 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].

One bat specimen (KMH 10425) *Pipistrellus* sp. could not be identified to species level.

Reptiles

17 reptile species (10 forest dependent) species have been recorded from observations and a total collection of 23 specimens by Frontier-Tanzania.

Coastal Forest Endemics - Dwarf Gecko *Lygodactylus viscatus*. (Specimen KMH 10377-8) Known only from 7 Tanzanian Coastal Forests.

Coastal Forest/Eastern Arc endemics - Uzungwa Forest Gecko *Cnemaspis uzungwae*. (Specimen KMH 10371) Known only from the Udzungwa mountains and the Matumbi Hills.
Bearded Pygmy-Chameleon *Rhampholeon brevicaudatus*. (Specimen KMH 10368). Known only from the Eastern Arc and 6 Tanzanian Coastal Forests.

Amphibians

7 species are recorded by Frontier-Tanzania collections from 31 specimens.

Coastal Forest endemics - Leaf-litter toad *Stephopaedes loveridgei*. (Specimens KMH 10307 - 10309 etc.). Known only from 8 sites in SE Tanzania, probably all Coastal Forests.
Treefrog *Leptopelis flavomaculatus* (Specimen KMH 10319).

A full identification is still awaited for a further specimen KMH 10325, provisionally identified as *Bufo* sp.

Plants

Matumbi Hills endemic - *Baikeaea gesquiereana* J.Leon [Fabaceae] (Specimen *Clarke* 81). Known only from Kibata /Tong'omba and Namakutwa - Nyamuete.

Coastal Forest endemics - *Peponium leucanthum* (Gilg.) Cogn. [Cucurbitac.] (Specimen *Frontier* 2746). Tong'omba and Rondo/Litipo only.
Cynometra sp. aff. *longipedicellata* Harms [Fabac.] (Specimen *Clarke* 82). Known only from the East Usambara Mountains, and possibly also Pugu.

CATCHMENT VALUES

Tong'omba Forest Reserve gives rise to two perennial tributaries of the Hanga River and several seasonal streams, which supply water to surrounding villages. The forest covers slopes of over 40°.

HUMAN IMPACTS

Logging

Legal logging activities were suspended after the forest was re-gazetted in 1953. In 1987, Kilwa District forestry office granted permission to the chairmen of Mwenge and Pungutini CCM to authorise logging of 50 trees each year. The chairman of Kibata CCM was granted similar permission in 1989 and selective logging began in 1991. Levels of extraction are low, with *Milicia excelsa* being the favoured species. However exploitation is likely to increase if the Dar es Salaam to Lindi road is repaired to an all-weather road, which will improve access to the area.

Agriculture

The Matumbi Hills are densely cultivated outside of the present areas of forest, and cultivation is recorded up to the boundaries of the original Tongomba Forest Reserve during the German administration. Local people in the Kibata area are primarily subsistence farmers, though some cash crops are grown. According to local sources cotton and coffee were grown during German colonial times.

Some agricultural encroachment is occurring along the north-west and southern edges of the forest reserve. Local information suggests that there is still much unclaimed fertile land available outside the reserve (1992 information).

Hunting

The local game officer is responsible for the extermination of game animals deemed to be a threat. A charge of 10,000 Tsh. is made for this service (1992 prices) and this makes it too expensive for local villagers.

Some evidence of hunting has been observed within the reserve, mainly snares set for bushpig and small antelopes. Rock Hyrax (*Heterohyrax brucei*) are trapped as a local delicacy and Sykes' Blue Monkey are occasionally hunted as an agricultural pest.

Game numbers within the reserve used to be higher but poaching has reduced populations of leopard and buffalo. Kipatimu is recognised as one of the forwarding posts of illicit game produce from the Selous Game Reserve and surrounding areas. The proximity of Tong'omba to this town results in a higher hunting pressure.

Pole cutting

Some pole cutting along forest paths was evident, apparently carried out by those living on the forest edge. No significant damage has resulted from this small scale exploitation.

Other forest products

Local people collect bark, honey, rubber, incense, traditional medecines and some fruit from the forest.

Road

A road was constructed through the reserve in the 1920s to link Somanga to Kipatimu via Pungutini and Kibata, but this was abandoned as the cars of that time found the slopes on either side of the Manyangu River to be too steep. Most of this road is now overgrown, except where it passes through the transition woodland/*Brachystegia* forest, where there has been little regeneration.

CONSERVATION ISSUES

The boundary of Tong'omba Forest Reserve needs to be resurveyed and clearly demarcated to prevent accidental agricultural encroachment. The existing boundary map contains a number of inaccuracies and needs to be updated following a survey of the reserve edge with a GPS system. The updated reserve bondary needs to be printed on the next publication of the Ordnance Survey topographical map of the Kipatimu area.

Hardwood/exotic plantations outside the reserve might be needed to provide the local villages with a long-term alternative source of timber.

The sustainability of the timber licensing system needs to be reviewed.

The presence of the forest provides a refuge for many agricultural pests (bushpigs, elephants, monkeys) which are not common in other densely cultivated areas of the Matumbi Hills. These pests will cause the forest to have a negative image in the eyes of the local farmers.

LITERATURE

None known.

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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.