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## COASTAL DRY FOREST IN CABO DELGADO PROVINCE, NORTHERN MOZAMBIQUE **BOTANY & VEGETATION**

November 2010



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## ACKNOWLEDGMENTS

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## LIST OF CONTENTS

List of Figures and Tables.....	14
INTRODUCTION .....	15
Justification for Choosing Coastal Forests .....	15
What are «Coastal Forests» .....	17
STUDY AREA .....	19
Area Covered .....	19
Landform .....	21
Geology & Soils .....	21
Climate .....	23
History .....	24
Previous Botanical Work .....	28
FINDINGS .....	33
Main Features of Coastal Dry Forest and Associated Vegetation .....	33
Descriptions of Dry Forest and Other Vegetation Types .....	34
Past and Present Extent of Forest .....	40
Original Extent .....	42
Present Extent .....	43
Botanical Composition .....	46
Species Distribution Patterns .....	47
Red Data Assessments .....	51
Plot Species Richness .....	53
COASTAL FORESTS ACROSS EAST AFRICA .....	54
General Comments .....	54
Geology & Geomorphology .....	55
Remaining Distribution of Coastal Forests .....	56
CONSERVATION .....	58
Background.....	58
Existing Conservation Areas .....	59
Conservation Threats .....	62
Expanding Settlement and Agriculture .....	63
Logging .....	64
Oil and Gas Exploration .....	65
Wildfire .....	66
Conservation Approach .....	67
Proposed Conservation Areas .....	69
CONCLUSIONS .....	74
RECOMMENDATIONS .....	78
BIBLIOGRAPHY & REFERENCES .....	80
ANNEX 1. List of persons involved in the botanical and vegetation studies .....	85
ANNEX 2. Checklist of plants collected on Pro-Natura International Cabo Delgado project expeditions in 2008–2009 .....	86
ANNEX 3. New plant species and records resulting from recent coastal forest collections .....	105
ANNEX 4. Summary of findings from species-richness plot, Quiterajo .....	113

## LIST OF FIGURES

Figure 1. East African coastal forest ecoregion.	16
Figure 2. Cabo Delgado study area, showing extent and the four detailed study sites.	19
Figure 3. False colour Landsat image of north-eastern Cabo Delgado, 1999–2002.	20
Figure 4. Natural colour Landsat image of northern part of Cabo Delgado study area.	20
Figure 5. Geology of Cabo Delgado study area.	22
Figure 6. Sketch map of O'Neill's 1882 trip from the coast to the Mueda plateau	25
Figure 7. British Admiralty map of northern Mozambique, 1903.	26
Figure 8. Old map of Tanganyika (German East Africa) showing the Quionga enclave.	27
Figure 9. Flora Zambesiaca vegetation map showing part of Cabo Delgado.	31
Figure 10. Dry forest vegetation types	36
Figure 11. Vegetation types – miombo woodland, palm savanna and riverine vegetation	37
Figure 12. Vegetation types – miombo woodland.	38
Figure 13. Other vegetation types in survey area.	39
Figure 14. Aerial view over Lake Nhica	40
Figure 15. Original inferred extent of «dense vegetation cover» across study area, based on landform and Landsat imagery.	41
Figure 16. Present (2000) extent of «dense vegetation cover» across study area, as determined from Landsat imagery.	45
Figure 17. Location of botanical collections in Cabo Delgado, 2003–2009	46
Figure 18. Distribution records of selected coastal plant species	52
Figure 19. Map of proposed Reserva Nacional de Palma	59
Figure 20. Conservation areas, forestry and mining concessions in north-eastern Cabo Delgado, with exploration cut-lines shown	61
Figure 21. Dry forest clearance and burning, Palma area and Nhica do Rovuma.	63
Figure 22. Recently cut <i>Azelia</i> tree, dry forest near Quiterajo.	64
Figure 23. Prospecting cutlines, part of proposed Transfrontier Conservation Area, and extension of Sensitive Area Zone, 2008	65
Figure 24. Prospecting cutline 'sealed off' using bulldozers and cut branches, Palma area	66
Figure 25. Proposed areas for biodiversity conservation in NE Cabo Delgado.	69

## LIST OF TABLES

Table 1. Summary climatic data for various stations in NE Mozambique	24
Table 2. Pre-Independence plant collectors in the Cabo Delgado study area	29
Table 3. Assumed original extent of «dense vegetation cover» based on interpretation from geology and landform on Landsat imagery	42
Table 4. Original and remaining extent of dense woodland and dry forest vegetation types based on interpretation of 2002 Landsat imagery	43
Table 5. New species recorded from Cabo Delgado study area, 2003–2009	47
Table 6. New records for Mozambique from Cabo Delgado study area, 2003–2009	48
Table 7. Number of taxa from the main plant families found in the Cabo Delgado study	49
Table 8. Preliminary IUCN Red Data status for seven selected eastern African dry forest species	53
Table 9. Extent of coastal forest along the East African coast and in Mozambique	56



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# INTRODUCTION

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This report covers the main botanical and vegetation findings resulting from expeditions to the coastal region of Cabo Delgado Province in northern Mozambique in November–December 2008 and November 2009. It also covers findings from a reconnaissance trip in April–May 2008, which included aerial survey. Results from previous trips to the area undertaken by Quentin Luke (December 2003) and John Burrows *et al.* (2005, early 2008, mid-2009) are also incorporated. Preliminary conclusions are given on the past and present extent of the forests, their botanical composition, conservation significance and their relationship with the better-known coastal forests of southern Tanzania. The main conservation issues are outlined, along with a prioritised set of 14 proposed conservation areas or sites.

## Justification for Choosing Coastal Forests

Although little-known botanically, the coastal region of north-eastern Mozambique has long been recognised as a probable area of high biological diversity and interest (Barbosa 1968, Brenan 1978, Huntley 1978, White & Moll 1978). This recognition was primarily based on the known high species diversity and high number of narrow-range endemics in the flora of coastal south-eastern Tanzania, with no apparent geographical isolation from Mozambique across the border, and also because a significant number of Mozambique narrow-range endemics were confined to the northern coastal areas (Brenan 1978). It was also recognised that the climate along the coastal strip is more moist and humid than in the continental interior (White & Moll 1978), and thus likely to be different ecologically.

The coastal forests of Eastern Africa have, over the last 20 or so years, been recognised as forming the most important part of a distinct ecoregion – the Eastern Africa Coastal Forests Ecoregion – and one with a particularly high level of species endemism. Although small, this ecoregion is often regarded as a globally important conservation priority area (Burgess & Clarke 2000, Burgess *et al.* 2004a, 2004b). The Eastern Africa Coastal Forests Ecoregion extends from southern Somalia to southern Mozambique, with the most important section being from southern Kenya through Tanzania and into northern Mozambique (Fig. 1). However, as there had been so few studies in Mozambique until recently it was not possible to confirm the distribution, extent or composition of the coastal forests there.

Within the whole Eastern Africa Coastal Forests Ecoregion, covering around 260,000 km<sup>2</sup> (WWF EARPO 2007), only 6260 km<sup>2</sup> (2%) is reported to be actual forest. Over 400 separate patches form a chain of relict forest and thicket patches set within savanna woodland (Burgess *et al.* 2004a). Although typically small and fragmented, these forests contain high levels of biodiversity, often varying greatly between patches.

One of the richest and most interesting parts of the Ecoregion from a biodiversity perspective is along the southern Tanzania coast from Lindi to the Rio Rovuma (Clarke 1998, 2001), the river forming the border with Mozambique. Biological surveys here in recent years have discovered a number of endemic species and forest patches with a unique species composition. Yet there are also severe threats from clearance for agriculture and settlement, cutting for charcoal or building timber, and developments associated with oil extraction, both offshore and onshore (WWF EARPO 2006, Smelror *et al.* 2006).

It is estimated that up to 80% of forest extent here has been lost over the last few hundred years (see Chapter 'Findings', Section 'Past and Present Extent of Forest' p39) and perhaps only 10% of the original coastal forest vegetation in Eastern Africa can be considered intact (Burgess *et al.* 2004a). The conservation imperative is clear. The situation is particularly severe now in Cabo Delgado, where human and agricultural settlement has increased very rapidly in recent years after a long period of insecurity. There is also renewed logging for commercial timber along with the construction of cutlines associated with oil and gas exploration.

From the above it can be seen that northern Mozambique reportedly holds not only a large and potentially significant extent of what have been termed coastal forests, forests that are now coming under increasing threat as development and exploitation of natural resources expands, but that their extent and the levels of endemism and diversity are little known.

One of the objectives of this project was to address this lack of knowledge, and bring scientific findings on their biodiversity into the planning and decision-making processes.



Figure 1.  
East African Coastal  
Forests Ecoregion (from  
Myers *et al.* 1999).



## What are «Coastal Forests»

The term «coastal forest» has been used widely in recent years (e.g. Hawthorne 1993, Myers, Lovett & Burgess 1999, Burgess *et al.* 2004a, Burgess & Clarke 2000, Clarke 2000, WWF EARPO 2006), but there has been inconsistency in definition. In some cases, most of the dense vegetation formations found in the coastal area (e.g. within 100–150 km of the coast) or within White's (1983) Zanzibar-Inhambane phytochorion are included, while others (e.g. WWF EARPO 2006) have included various forest or woodland formations up to 300 km inland (except mangroves), possibly as they were lowland vegetation types and contained some species with a typically East African coastal distribution.

Clarke (2000a) formally defines East African Coastal Forests as forests (i.e. a continuous stand of trees with crowns overlapping or interdigitating, usually comprising several layers and/or interlaced with lianas, often with a sparse or absent ground layer) dominated by Swahilian endemic or near-endemic tree species. He uses the term collectively to encompass both typical Eastern African coastal dry forests as well as variant and transitional formations, where they share features with forests of other phytochoria. He lists six types: (1) Eastern African Coastal Dry Forest (semi-evergreen or evergreen undifferentiated dry forest), (2) Eastern African Coastal Scrub Forest (often lower than 10 m in height), (3) Eastern African Coastal *Brachystegia* Forest (a transition woodland), (4) Eastern African Coastal Riverine/ Groundwater/ Swamp Forest (with a high watertable or poor drainage), and (5) Eastern African Coastal/ Afromontane Transition Forest (lowland forest under higher rainfall). On the other hand, Hawthorne (1993) adopts a more geological and geomorphological definition, defining «coastal» as lying on sedimentary (or volcanic) sediments of the coastal plains and plateaux, excluding any vegetation formations on Basement Complex substrates.

However, in practice areas termed «coastal forest» shown on some regional maps cover a wide range of vegetation from dense woodland, through dry forest to true moist forest. More importantly, there appears to be no common or linking feature between these 'forest patches' in terms of species composition or ecology, which has led to confusion in determining the distribution of coastal dry forests in Mozambique, their biodiversity attributes, ecology, possible origins and conservation significance. The assumed commonality in terms of the origin and conservation importance of this group of vegetation types has masked our understanding of them, and perhaps inhibited selection of important or representative areas for conservation.

In this study we have attempted to define «coastal forest» in a more restricted way, at least as regards those in northern Mozambique. It is hoped this definition and understanding will apply equally well to forests in Tanzania south of the Rufiji River.

We define coastal dry forest here as essentially dry forest or thicket formations that are found within 50–100 km of the coast. These are generally vegetation formations with a closed or almost-closed canopy (80% cover or more when undisturbed) with a high proportion of deciduous woody species that lose their leaves during the long dry season. The definition does not include moist forest, i.e. forest dominated by species with non-drought adapted leaves, nor does it include vegetation that is dominated or characterised by what are primarily woodland species (such as *Brachystegia* or *Julbernardia*). Lower altitude moist forests of the continental interior may contain some tree species that are found in moister coastal forests, but, unless such species are dominant, this does not mean they are coastal forests. Moist forests of the continental interior, miombo and similar woodlands and mangroves are excluded, as is vegetation associated with watercourses such as rivers. Coastal dry forests are characterised as much by their species composition as by their physical structure (which can of course be modified by land uses such as logging or cultivation). Under our definition the main characteristics of coastal dry forest are:

- Dry, often early-deciduous forest (80% canopy cover or more), becoming thicket-like with disturbance. The main species are not moisture-demanding or even mesic. They occur in areas subject to a lengthy dry season (in excess of 6 months), with the majority of species responding by losing leaves.
- Contain a significant number of sclerophyllous evergreen species in the understorey.
- Have a significantly different species composition from the surrounding woodlands (mostly miombo). The overlap in species composition between the two types is often less than 30%.
- Have a very patchy distribution, and are often apparently restricted to particular soils and geomorphological positions.
- Show a marked change in species composition between patches with very few species found regularly or widely. There are a high number of species of restricted distribution, often from particular families and genera (e.g. Annonaceae, Leguminosae: Caesalpinioideae, Rubiaceae).



# STUDY AREA

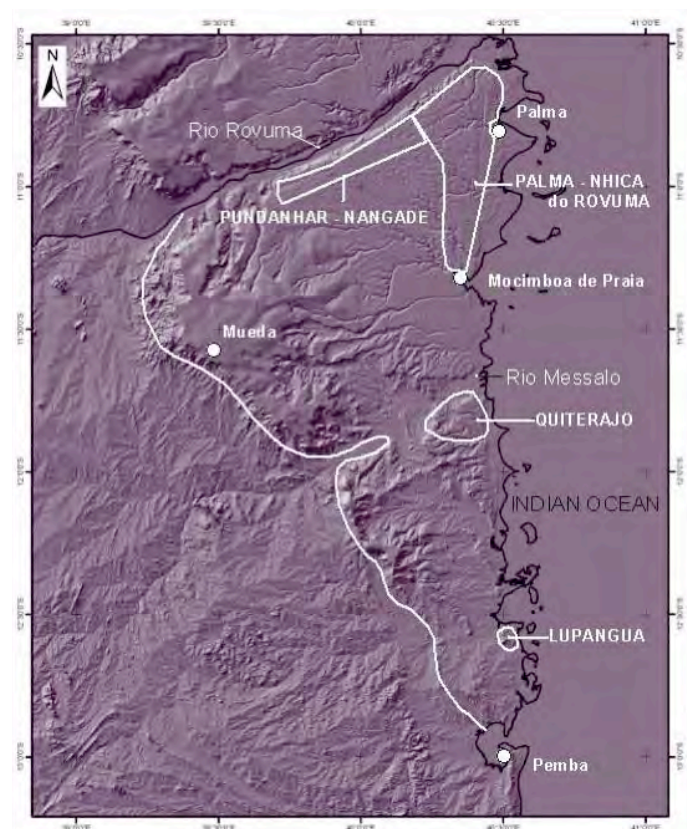
## Area Covered

The broad study area runs the length of Cabo Delgado Province in north-eastern Mozambique from the Rovuma River, forming the border with Tanzania, south to Pemba. Its delineation is based on geology and landform, and it includes only Cretaceous and more recent deposits. Covering approximately 18,150 km<sup>2</sup> it forms a long triangle about 280 km at its longest and 100 km at its widest between Mueda and Mocimboa do Rovuma in the west, Quionga and the Rovuma estuary in the northeast, and Pemba in the south (Figs. 2–4).

The principal focus of the project was on coastal dry forest formations, known from similar studies in Tanzania to be both species-rich and contain numerous endemic species or species of restricted distribution. Associated vegetation types such as miombo (*Brachystegia*-dominated) and similar woodlands, pan grassland and riverine grasslands and formations, were only looked at in order to obtain a broader context.

Figure 2.

Cabo Delgado study area, showing extent and the four detailed study sites.



For the two expeditions, four smaller study sites were chosen (Fig. 2), based in part on preliminary analysis of Landsat imagery (Fig. 3) and reconnaissance aerial survey in April 2007.

1. **Pundanhar–Nangade** in Palma and Nangade Districts, west of Pundanhar along the W–E higher ground associated with the Rio Rovuma, including a hunting concession (approx. 750 km<sup>2</sup>).
2. **Palma–Nhica do Rovuma** area in Palma District, along the W–E higher ground from Nhica do Rovuma associated with the lower reaches of the Rio Rovuma, and along the main road south from Palma (approx. 1400 km<sup>2</sup>).
3. **Quiterajo** in Macomia District, situated on the coast 45 km south of Mocímboa da Praia, just south of the Rio Messalo (approx. 750 km<sup>2</sup>).
4. **Lupangua** in Quissanga District, inside the Quirimbas National Park, 15 km south of Quissanga and opposite Ilha Mefunvo (approx. 25 km<sup>2</sup>) (see Clarke 2010).

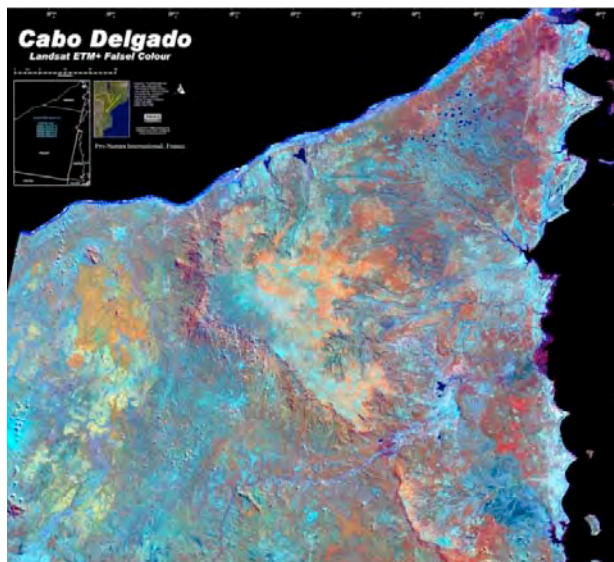


Figure 3. False colour Landsat image of north-eastern Cabo Delgado, 1999–2002.



Figure 4. Natural colour Landsat image of northern part of Cabo Delgado study area (1999–2002).

These sites were chosen on the basis of their apparent good condition and size, uniqueness and accessibility, and were significantly different from each other in terms of landscape and substrate. The great majority of the study was focussed on sites 1 to 3; Lupangua was only visited briefly.

## Landform

The study area comprises a gently tilting interior plateau, rising from about 100 m above sea-level along the Palma–Mocímboa road to over 600 m in the west above the Mueda escarpment. To the east of the Palma–Mocímboa road the land drops down to a narrow coastal plain consisting of recent sediments. Much of the interior plateau, as seen from Landsat imagery, acts as a ‘sponge’ with pans and edaphic grasslands (a result of seasonally-poor drainage) and numerous drainage lines flowing to the south-east or, in the northernmost section, to the north-east. Some of these are deeply incised where they come down to the coast. The landscape in the central portion is relatively level and not that well drained.

On the northern margin, the Rio Rovuma, which appears to be an ancient continental drainage, has cut through these plateau sediments to create a wide valley (c. 10 km wide).

Most of the study sites lie between altitudes of 80 and 180 m, but patches of dry forest were found down to an altitude of 40 m.

## Geology & Soils

Most data used here are derived from the 1: 1 million scale national geological map (ING 1987). More detailed geological maps have not been located.

At a national level north-eastern Cabo Delgado is seen to have a different geological origin from the rest of the country. There is an elongated triangle (Bacia de Rovuma Moçambique) of relatively younger formations dating from the Lower Cretaceous period (145–97 Mya) up to the Neogene (23–1.6 Mya), adjacent to the much older continental block that comprises Precambrian granites and other rocks (Fig. 5). As elsewhere in the country, there is also a narrow coastal strip comprising recent Quaternary (1.6 Mya–present) deposits. The strata in these apparently marine deposits from the Cretaceous and Neogene are relatively level (60° slope, Smelror *et al.* 2006), hence the area’s landform is primarily determined by differential resistance to erosion by the different strata, resulting in numerous flat-topped plateaux.

Nearly all the coastal dry forest patches encountered were located on iron-rich sandstone and conglomerates of the Mikindani Formation (mid-Neogene,  $\pm$  15–10 Mya), while associated miombo and similar woodlands were mostly found on more recent Quaternary formations (Pleistocene,  $\pm$  1.6–0.01 Mya). Mikindani Formation strata are generally found in the form of a plateau raised about 20–30 m above the surrounding woodland.



The relationship is very clear in the Quiterajo area with its forest-capped plateau, but is less clear along the Rovuma rim (Nhica do Rovuma to Nangade). In the latter area it seems possible that the coarser-scale geological map is incorrect in its depiction of the Mikindani Formation, showing the area to be underlain by undifferentiated Tertiary deposits and fossiliferous or reef limestones of the Sancul–Cogune Formation. However, red sandstone outcrops, suggesting the Mikindani Formation, were often encountered here, as well as significant areas with dry forest species.

It would appear that the soils derived from the Mikindani Formation (coarse sandy, unstructured, well-drained, red-brown in colour, presumably quite acidic) are what gives rise to the distribution of the dry forest formations studied.

Figure 5.  
Geology of Cabo Delgado study area (from I.N.G. 1987).

[Simplified legend:

**Quaternary:**

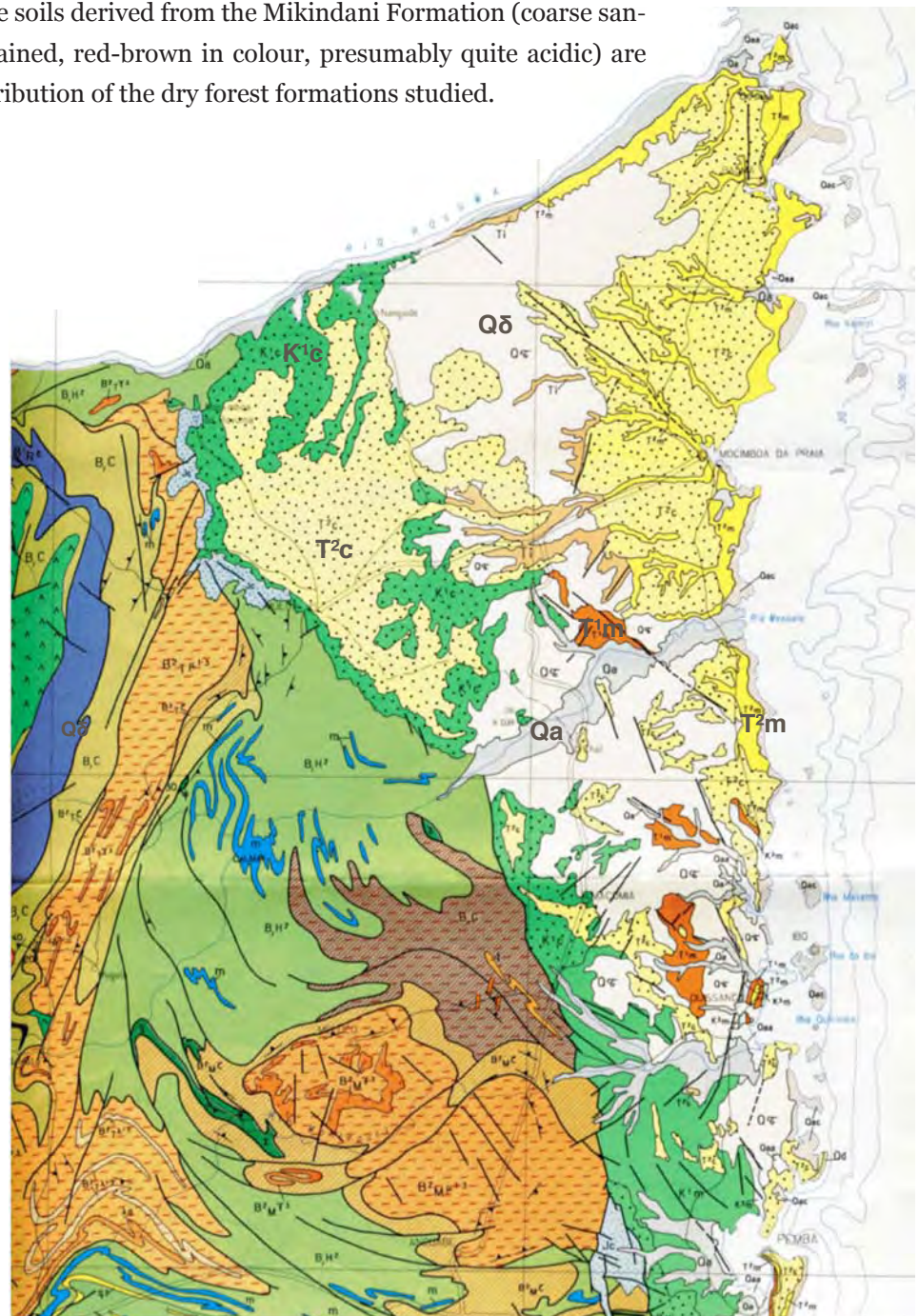
**Qa**, Recent alluvium; **Qδ**, footslope formations.

**Neocene:**

**T<sup>2c</sup>**, Mikindani Formation, iron-rich reddish sandstones & conglomerates; **T<sup>1m</sup>**, reef limestones, marls & clays; **T<sup>2m</sup>**, Sancul–Congane Formation, reef limestones.

**Lower Cretaceous:**

**K<sup>1c</sup>**, Macondes Formation, conglomerates & arkoses.]



However, at present this link has not been specifically tested and causation has not been established. It remains an important area for future investigation (see Recommendations p77). It is this assumed relationship that was used to help determine what the original extent and distribution of dry forest formations may have been across the study area (see Chapter ‘Findings’, Section ‘Past and Present Extent of Forest’ p39).

Interestingly, along the Macomia–Mucojo road some limestone outcrops (probably nummulitic limestones or marls from the Palaeocene period, 60–65 Mya) were seen. The calcareous and clay-rich soils developed from these rocks support a very different *Acacia*-dominated vegetation from that seen elsewhere in the study area.

## Climate

Detailed climatic data have not yet been located. Summary monthly data have been taken from Kassam *et al.* (1981) and are shown in Table 1 below. As can be seen, most localities had only records at that time (1980) for just under 30 years (Mueda is exceptional; other climatic data for that locality are for 27 years).

Table 1.

Summary climatic data for various stations in NE Mozambique (from Kassam *et al.* 1981).

locality	rainfall (mm/yr)	years	pET (mm/yr)	mean temp (°C)	mean of min. month (month)	mean of max. month (month)
Macomia	1198.2	28	1474.2	24.8	17.6 (Jul)	31.9 (Nov)
Mocimboa da Praia	986.1	28	1502.2	25.4	18.2 (Aug)	31.6 (Jan)
Mueda	1094.4	7	1340.8	21.4	14.3 (Jul)	28.8 (Nov)
Palma	1139.0	29	1479.1	25.0	17.5 (Jul)	32.0 (Mar)
Pemba	880.3	23	1688.6	26.3	19.5 (Jul)	31.4 (Mar)
Quissanga	998.4	24	1648.9	25.1	17.9 (Jul)	31.6 (Mar)

From these data it is assumed that rainfall in the Nhica and Quiterajo areas is around 900–1100 mm/year. Potential evapotranspiration (Penman) significantly exceeds rainfall for the period May to November–December for most sites, giving a growing season of around 4–5 months. Local wisdom suggests the rains generally start in early December, with a long hot dry period before that.

Although there is a coastal influence and some effects from the Indian Ocean monsoon, the climate across the study sites generally follows that more typical of the continental interior. There is a long hot dry season before a single clearly-defined rainy season from December to April, although the atmospheric humidity during November and early December is high.



## History

The Province of Cabo Delgado, originally named after the low coral peninsula jutting into the ocean 20 km north-east of Palma, has a long and rich history stretching back to before the initial Portuguese settlements in the 16th century. The coastal area is believed to have been settled for centuries before the first European contact around 1500, and during the latter part of this period was visited repeatedly by Swahili traders, as were many places along the Indian Ocean coastline. Later on, coastal settlements were visited by traders from Oman who brought Islam.

This brief section, however, will focus on the period since 1880 and the impacts of human activities on vegetation.

Although by the mid-19th century, nearly all of what is now Mozambique was regarded as being in the Portuguese «sphere of influence» and nominally under their control, the boundaries of this sphere were not always clear or accepted. Indeed, the Portuguese authorities had unwittingly restricted their influence by the building of isolated fortifications pointing out towards the sea lanes, rather than by turning their attention inland to develop infrastructure and trade. This left the hinterland both undeveloped and more open to external influence. In the latter part of the 19th century, following on from the explorations of Livingstone across South Central Africa in the 1850s to 1860s, there appears to have been repeated pressure from the British authorities to gain a level of dominance or control across parts of northern Mozambique. In part this may have been driven by concerns on slave trading, which was still occurring in the area, but probably primarily revolved around the need to ensure unfettered access to the sea for the main British settlements in Nyasaland (now Malawi). This access had principally focussed on the Zambezi River, then the main route from the sea to Blantyre and Lake Nyassa (Malawi), but alternative land routes were being explored in case the river route became less usable, which was beginning to happen in the 1870s owing to the natural silting of the Shire River and increasing difficulties in navigation up the Zambezi. One of the principal aims of Livingstone's Zambesi Expedition (1858–1864) and subsequent mission settlements had been to promote trade in the Shire Highlands in present-day Malawi to provide economic alternatives to the slave trade (Dritsas 2010). Problems of navigation on the Zambezi (access through the delta, the Cabora Bassa [Kaborabassa] rapids, and low water levels) had prompted Livingstone to explore the Rovuma as an alternative route to the interior, and one that also avoided passing through Portuguese territory.

Meanwhile, in Cabo Delgado, there was also strong pressure from the German colonial authorities to extend German East Africa (now Tanzania) southwards. To this end, there were recorded attempts by German traders to create trading posts inland from Pemba prior to the Berlin Conference of 1884 so that the areas could be said to be important economically for Germany, with the possibility of them then being annexed from Portuguese control.

In 1882 Henry O'Neill, the then British Consul to Mozambique based at Isla de Moçambique near Nampula, walked from Menangene (now Palma) in Tunghi Bay inland to find out more about a «strangely isolated tribe» called the Mavia or Mabiha, people living up on the Mueda plateau. These people had first been mentioned by Livingstone, but it appears no European had been there before.

He was also looking for signs of continuing slave trading in the coastal area. His account and sketch map (Fig. 6) appears to be the first depiction of settlements across part of our study area. The settlement of Chimsaka (now Pundanhhar) is described, as are Lakes Nangadi and Lidedi. The main items of trade, he records, were india rubber (presumably *Landolphia* latex), gum copal (*Hymenaea* resin) and ivory. Slaving had been important, but was apparently becoming less so. O'Neill also refers to the numerous «sponges» or swampy depressions in the area, many of which form large shallow lakes in the rainy season «several miles in circumference» (O'Neill 1883).



Joseph Last, on his epic walk to Mt Namuli from 1885–1887, initially landed at Lindi in Tanzania, just to the north of the present study area, and travelled down to the Rio Lugenda, joining it some 60 km upstream of Lake Nangadi. From here he continued upstream along the Rovuma and Lugenda rivers to Lake Chiuta and Malawi, and then on to Namuli (Last 1887). The published map based on his travels (Last 1890) also shows O'Neill's route and numerous settlements in the lower Rovuma area.

Figure 6.

Sketch map of O'Neill's 1882 trip from the coast to the Mueda plateau (from O'Neill 1883).

Also interesting is a map, ascribed to surveys by Last in 1885–87 (source not clear but probably also from the Proceedings of the Royal Geographical Society), showing a proposed railway line from Pemba on the coast, past what are now Montepuez and Marrupa to the Rio Lugenda, and then on to Lake Niassa/Malawi near what is now Mepondo. Potential gold, copper and coal deposits are marked. It is clear that there was a strong attempt at the time by the British to exploit economically, or possibly annex, this part of northern Mozambique.

At this time, the area to the north of the Rio Rovuma was considered German territory – German East Africa (now Tanzania) – which was confirmed politically by the Berlin Conference of 1884. However, there was also a small triangle of German territory, the Quionga Triangle, just south of the Rio Rovuma mouth, based around the small town of Quionga (see Figs. 7 & 8). This was finally occupied by the Portuguese in 1916 during the First World War, leading to the present international border with Tanzania which lies along the Rovuma River itself.

Figure 7.  
British Admiralty map of  
northern Mozambique,  
1903.







Figure 8.  
Old map of Tanganyika  
(German East Africa)  
showing the Quionga  
enclave.

In the face of the territorial and economic ambitions of both Germany and Great Britain in the latter part of the 19th century, the Portuguese authorities did not have the resources to effectively colonise this part of northern Mozambique. Hence in 1891 a concession was granted to a private company, the Companhia do Niassa (or the Niassa Company), ironically mostly owned by British and French interests, to govern and manage what are now the provinces of Niassa and Cabo Delgado. Much of the company's agricultural activities were based on forced labour, causing much resentment. This concession – which was effectively rule – only finished in 1929 when the concession was not renewed and «control» reverted to the Portuguese crown.

During the Portuguese colonial period after the Second World War, much more emphasis was placed on economic exploitation of the natural resources of the «Overseas Province». Large parts of what are now Cabo Delgado Province were placed under cotton plantations in the 1950s, as well as being planted to cashew. It appears that there was a significant logging industry over parts of the present study area, presumably primarily for *Pterocarpus angolensis*, *Millettia stuhlmannii* and *Azelaia quanzensis*. During the Independence struggle in the 1960–70s, FRELIMO was based in southern Tanzania so the Rovuma border area saw much military action.

As can still be seen today, major roads were constructed (unpaved but cleared to a significant width), minefields were laid, and airstrips and military barracks built. The minefields were only finally cleared by the Halo Trust in 2007.

After Independence and during the civil war, there was little development away from the coastal strip and major settlements, but this has been changing since the early 1990s. A renewed wave of timber extraction is taking place, at least some of it illegal and uncontrolled, people are moving into what are either new agricultural areas or areas that have long been fallow, and recently there has been exploration for oil and gas which has involved the making of cutlines for geophysical exploration. These cutlines, despite attempts to close them off, are giving ready access enabling new settlements in areas that were, in practice, inaccessible before.

These changes in land ownership and management systems over the last 150 years have obviously had major effects on land use practices and settlement patterns, although this has not been adequately documented. However, it is clear that the study area has had a long and varied history of different forms of exploitation for many centuries – for ivory, slaves, gum copal, ‘rubber’ and timber – and this is bound to have significantly modified the present vegetation distribution and composition. What is not clear is exactly what these specific effects were, and where they have been most marked.

## Previous Botanical Work

Prior to 2000 various plant collections had been made in the coastal areas of Cabo Delgado Province, in particular by L.A. Grandvaux Barbosa, F. Mendonça, Gomes e Sousa and A.R. Torre (Table 2). However, the earliest records (26 Feb–29 March 1861) are from John Kirk and Charles Meller who collected along the lower reaches of the Rovuma River during a break in Livingstone’s expeditions up the Zambezi into what is now Malawi. Kirk returned to the Rovuma with Livingstone again from 7 Sept–16 Oct 1862, when they explored almost as far as Negomano, where rapids prevented further progress upstream (Foskett 1965). They collected on both the Mozambique side and in Tanzania, and the list of species indicates that they went at least some way away from the river banks. Kirk reported a local trade in copal and made perceptive comments on the branched and unbranched doum palms (*Hyphaene* species). None of these early collections appeared to have been comprehensive or focussed on dry forests in particular, but were rather to coastal areas in general.

There also appears to have been nothing published on the vegetation of the area other than in general accounts of national vegetation distribution (e.g. Pedro & Barbosa 1955, Wild & Barbosa 1967, White 1983), and nothing on the dry forests that form the focus of the present study and which have been shown to be so interesting botanically across the border in southern Tanzania.



Collector/s	Dates
Kirk, John .....	1861, 1862
Meller, Charles .....	1861
Peters, Carl .....	?1860s
de Carvalho, Manuel Rodriques.....	1884
Stocks, J. ....	1906
Allen, Charles E.F.....	1909 – 1912
Pires de Lima, Américo .....	1917
Mendonça, Francisco .....	1942, 1948
Andrada, Eduardo Campos de .....	1948
Barbosa, L.A. Grandvaux .....	1948
Pedro, J. Gomes & J. Pedrógão .....	1948
Balsinhas, Aurélio .....	1952, 1953
Gomes e Sousa, Antonio Figueredo .....	1959 – 1965
Montenegro .....	1962
Torre, Antonio & Paiva, Jorge .....	1963, 1964

Table 2.

Pre-Independence plant  
collectors in the Cabo  
Delgado study area.

However, in recent years there has been a resurgence of interest in the area. As part of the establishment of the Maluane Conservancy in the Quiterajo area, a rapid survey was undertaken, with some preliminary notes on the vegetation of this part of Cabo Delgado based on aerial survey and previous literature (Garnier *et al.* 1999). Although some plant specimens were collected (F. Robertson, pers. comm.) and taken to the herbarium in Harare, they were not identified.

Since 2003 there has been a series of botanical collecting trips to north-eastern Cabo Delgado, in particular focussing on coastal dry forests and associated forest vegetation types. Botanists involved in these earlier trips (Quentin Luke, John & Sandie Burrows) have also been involved in the later Pro-Natura/Paris Museum expeditions. The overall findings reported on here incorporate these earlier findings (e.g. Luke 2004). In addition, preliminary studies have been made of the flora of Vamizi Island and the newly-designated Quirimbas National Park (Silveira & Paiva 2009, Bandeira *et al.* n.d.) and of the nearby Maluane Conservancy (Bandeira & Nacamo 2007), including dry forests in the Quiterajo area.

In addition to plant collecting, some botanists earlier attempted to place the vegetation of the area in a regional or continental context. The first study describing the vegetation of Cabo Delgado was by Pedro and Barbosa (1955) for the colonial Cotton Research Board. Out of 117 vegetation types described from across the whole of Mozambique, the present study area contains perhaps 11, of which three are particularly significant (complexes 87, 90 and 94).

Complex 87 covers the coastal strip of Quiterajo sands north of Pemba between Ibo Island and the Rio Messalo. Included here are thickets/dry forests with, amongst others, *Pteleopsis myrtifolia*, *Guibourtia schliebenii*, *Androstachys johnstonii* (a species we did not encounter), *Scorodophloeus fischeri*, *Baphia macrocalyx*, *Mecycylon* sp., *Pseudoprosopis euryphylla* and *Landolphia* spp. Complex 90 is confined to the Rovuma valley on sandstones, limestones of Cretaceous age or younger. Low deciduous woodland here contains *Azelia quanzensis*, *Berlinia orientalis* and *Brachystegia spiciformis*, with palms in savanna areas.

Complex 94 covers the undulating area inland from Palma with medium height semi-deciduous forest and shrubland, open woodland to savanna, riparian woodland and open grassy pans. Species such as *Brachystegia spiciformis*, *Julbernardia globiflora*, *Berlinia orientalis*, *Pteleopsis myrtifolia* and *Parinari curatellifolia* are common.

These descriptions are rather vague and the species composition listed overlaps significantly between types. However, the boundaries depicted are similar to those picked up at a landscape level in the present study. Complex 87 represents the dry forest formations we have been focussing on, while the other two (complexes 90, 94) correspond to what we have called miombo woodlands.

The vegetation map of the Flora Zambesiaca area (Wild & Barbosa 1967, Fig. 9), which for Mozambique was primarily based on Pedro & Barbosa's earlier map, also shows 11 vegetation types in the study area (types 6, 13, 14, 14a, 14b, 28, 32, 33, 45, 53, 54), including littoral vegetation and mangroves. Much of the Mueda plateau is covered by Dry Deciduous Lowland Forest on sandstone and calcareous conglomerates (type 6) with *Adansonia digitata*, *Balanites maughamii*, *Bombax rhodognaphalon*, *Cordyla africana*, *Dialium* sp. [*D. holtzii*?], *Milicia excelsa*, *Millettia stuhlmannii*, *Sterculia appendiculata*, *S. quinqueloba* and *S. schliebenii*.

However, there is little sign of this forest formation remaining there now.

Deciduous Miombo Savanna Woodland–Deciduous Woodland (type 32) covers much of the undulating plateau inland from Palma and Mocímboa da Praia. Soils are mostly sandy and derived from sandstone and calcareous conglomerates, with the lower parts poorly drained. There is a well-marked mosaic of open deciduous miombo woodland with *Berlinia orientalis*, *Brachystegia spiciformis*, *Julbernardia globiflora* containing patches of 'deciduous woodland' (which we would recognise as dry forest). This type was clearly seen in the present study. In the main *Pteleopsis myrtifolia* community, *Balanites maughamii*, *Erythrophleum suaveolens* and *Millettia* spp. are found, along with shrubs of *Tetracera*, *Dichrostachys*, *Strychnos* spp., *Dichapetalum* spp. and *Markhamia obtusifolia*.



*C. xanthothyrsus*, *Cynometra* [= *Scorodophloeus fischeri*], with scattered tall trees of *Bombax rhodognaphalon*, *B. stoltzii*, *Sideroxylon* [= *Manilkara*?] sp., *Manilkara discolor*, *Azelia quanzensis* and *Sterculia schliebenii*. This mix of species was not exactly what we recorded, but the vegetation type is clear from the description.

The main vegetation work covering the whole of Africa is Frank White's Vegetation of Africa (White 1983). In this work the whole of the East African coast from Kenya to South Africa is mapped as the Zanzibar–Inhambane regional mosaic, although this is a floristic unit, a phytochorion, not a vegetation unit. Unfortunately, White did not map any vegetation or structural units within it, other than some small patches of moist forest (not in the study area) and mangroves. However, in his accompanying descriptions (p.184–189), he briefly describes 10 broad vegetation types or groupings, of which perhaps only four (Zanzibar–Inhambane undifferentiated forest, Zanzibar–Inhambane transition woodland, Zanzibar–Inhambane woodland and scrub woodland and Zanzibar–Inhambane secondary grassland and wooded grassland) occur in northeast Mozambique. Most of the Cabo Delgado study area appears to fall under Zanzibar–Inhambane woodland and scrub woodland.

Surprisingly, White does not explicitly recognise dry coastal forest as separate type, unlike Wild & Barbosa (1967) on which much of his work for Mozambique was based. From species descriptions, though, dry coastal forest would probably fall within his Zanzibar–Inhambane undifferentiated forest.

Recently, Clarke (1998) has split White's regional mosaic into the Swahilian regional centre of endemism in the north and the Swahilian/Maputaland regional transition zone in the south. The study area lies towards the southern end of the Swahilian regional centre.



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## FINDINGS

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This section outlines the botanical and vegetation findings resulting from the recent expeditions. Firstly the vegetation types are briefly described, followed by an analysis of previous and present extent of dry forest. Then data from the botanical collections are outlined, followed by descriptions of plant distribution patterns and some initial conservation assessments for particular species. Finally, findings from a species richness plot are described.

### **Main Features of Coastal Dry Forest and Associated Vegetation**

The features that have characterised the coastal forests of eastern Africa, especially those in the drier southern regions, are:

- a patchy distribution across the landscape,
- a significant difference in species composition from surrounding woodland vegetation types,
- a relatively high turnover in species composition between forest patches, such that there is no single characteristic species found across large areas,
- the presence of numerous species of very restricted distribution, often only known from one or two forests.

These features have led to much of the recent conservation interest in them as many forest patches contain endemic or near-endemic species known from only a few localities, localities that are now coming under increasing threat from clearance for agriculture.



## Descriptions of Dry Forest and Other Vegetation Types

Geo-referenced vegetation samples were recorded from across the study area, in both dry forest and other vegetation types such as woodland and grassland. Data recorded were species composition in various strata (>2.5 m, 0.5–2.5 m, <0.5 m), cover-abundance values, and environmental attributes such as landscape position, soil type, land use and total woody cover.

More comprehensive descriptions of the main dry forest types will be done once the vegetation survey results are analysed. However, it was clear that there are basically eight vegetation types, which are not always clearly separable:

**1. Dry forest** – various types can be described, ranging from those dominated by *Guibourtia schliebenii* to those with *Scorodophloeus fischeri*. *Dialium holtzii* and *Sterculia schliebenii* are also typical. In some areas there was dominance of *Micklethwaitia carvalhoi*. Species composition between patches is varied, with perhaps only *Manilkara sansibarensis* and *Pteleopsis myrtifolia* being commonly found across sites. [Fig. 10]

**2. Miombo and similar woodland** – Woodland, sometimes dense and almost closed-canopy, characterised by one or more of *Brachystegia spiciformis*, *Julbernardia globiflora*, *Azelia quanzensis* and *Berlinia orientalis*. Small patches ('lenses') of dry forest are often found inside woodland areas in slightly elevated patches. The understorey in woodland is generally better developed than that under dry forest, and often characterised by grasses, which are mostly not present in dry forests. [Figs. 11, 12]

**3. Termite mound forest/woodland** – Patches of dense woodland, verging on dry forest, are commonly associated with large termite mounds, up to 20 m across. The most characteristic species here is *Hirtella zanzibarica*, with emergents of *Hymenaea verrucosa* and *Berlinia orientalis*. Lianas are also common and there is an abundance of Rubiaceae in the understorey.

**4. Palm savanna** – A wooded grassland dominated by *Borassus aethiopum* palms is commonly encountered along the upper parts of the Rovuma floodplain. Smaller areas characterised by *Hyphaene compressa* and *Phoenix reclinata* palms are commonly seen associated with pan margins and poorly-drained margins. [Fig. 11]

**5. Pan grassland** – Open grasslands associated with pans and other areas with seasonally poor drainage are very common in the Nhica–Pundanhar area in the lower parts of the gently undulating landscape. The main trees found here are *Parinari curatellifolia*, along with *Uapaca nitida* and *Pseudolachnostylis maprouneifolia*. [Fig. 13]

**6. Riparian or lakeshore woodland** – A narrow fringe of dense woodland is found along permanent drainage lines or on some lake margins. Some of the trees found here were not seen elsewhere. [Fig. 11, 14]

**7. Regenerating fallow** – Where dry forest or woodland has been cleared for agriculture, or where there has been recent extensive logging, a fallow vegetation is found comprising regenerating woody plants. Many of these are widespread, while others reflect the previous vegetation type. *Berlinia orientalis*, which is of restricted distribution along the Eastern African coast, is surprisingly common in such areas. [Fig. 11]

**8. Coral rag** – An almost impenetrable thicket to low early-deciduous dry forest on raised coral rock with minimal soil cover. This is a relatively recent formation only found close to the sea (e.g. on the Cabo Delgado peninsula) and has little relationship to the dry forests or woodlands further inland, although some species are common. [Fig. 13]

Worthy of mention here is a possible vegetation type in the area that now seems to have effectively disappeared, a somewhat moister, tall forest that was found in higher potential areas. Wild & Barbosa (1967) in their vegetation map (Fig. 9) show a significant extent (type 6) of Dry Deciduous (lowland) Forest (*Adansonia*, *Cordyla* or *Bombax*) on the eastern part of the Mueda plateau and south of the Rio Messalo around Chai. Such an extent of well-developed forest («dry to sub-humid, deciduous, with a closed thick and almost impenetrable layer of deciduous to semi-deciduous shrubs») does not show on recent satellite imagery; it is probable that it has been all but destroyed through agricultural expansion and logging during the pre-Independence period. Today, along the main road from Chitunda via Chai to Macomia it is possible to see a few tall remnant large-girthed trees in fields with lush secondary growth underneath, suggesting a very different vegetation previously. This is particularly noticeable on the ‘shoulders’ of the Messalo valley where soils are probably more fertile with a higher moisture status owing to lateral movement of both water and nutrients in the soil profile. It is possible that less-destroyed stands exist in inaccessible areas away from the main motorable tracks. If confirmed, the prior occurrence of this vegetation type shows that some areas of NE Cabo Delgado had a more mesic coastal vegetation than is generally found now, perhaps more similar to some of the coastal forests seen in northern Tanzania.





Figure 10.  
Dry forest vegetation types (clockwise, from top left: dry forest in the «banana» at Quiterajo; *Micklethwaitia* forest near Quiterajo; *Micklethwaitia* forest at Lupangua [photo GPC]); dry forest near Palma [bottom]; *Scorodophloeus* forest near Hunter's concession at Pundanhar).





Figure 11.  
Vegetation types –  
miombo woodland,  
palm savanna and  
riverine vegetation  
(clockwise, from top left:  
*Borassus* palm savanna  
in Hunter's concession  
near Pundanhar; palm  
savanna along Rovuma  
valley near Pundanhar;  
miombo-*Berlinia* fringing  
vegetation near Nhica do  
Rovuma; regenerating  
miombo woodland near  
Nhica do Rovuma [bot-  
tom]; riverine vegetation  
by backwater below  
Nhica do Rovuma).





Figure 12.  
Vegetation types –  
aerial view of miombo  
woodland and grassy  
drainage line, Nhica do  
Rovuma [top]; young low  
miombo woodland, Nhica  
do Rovuma [bottom].  
Photos by Xavier Des-  
mier, © X.Desmier/Pro-  
Natura/MNHN.



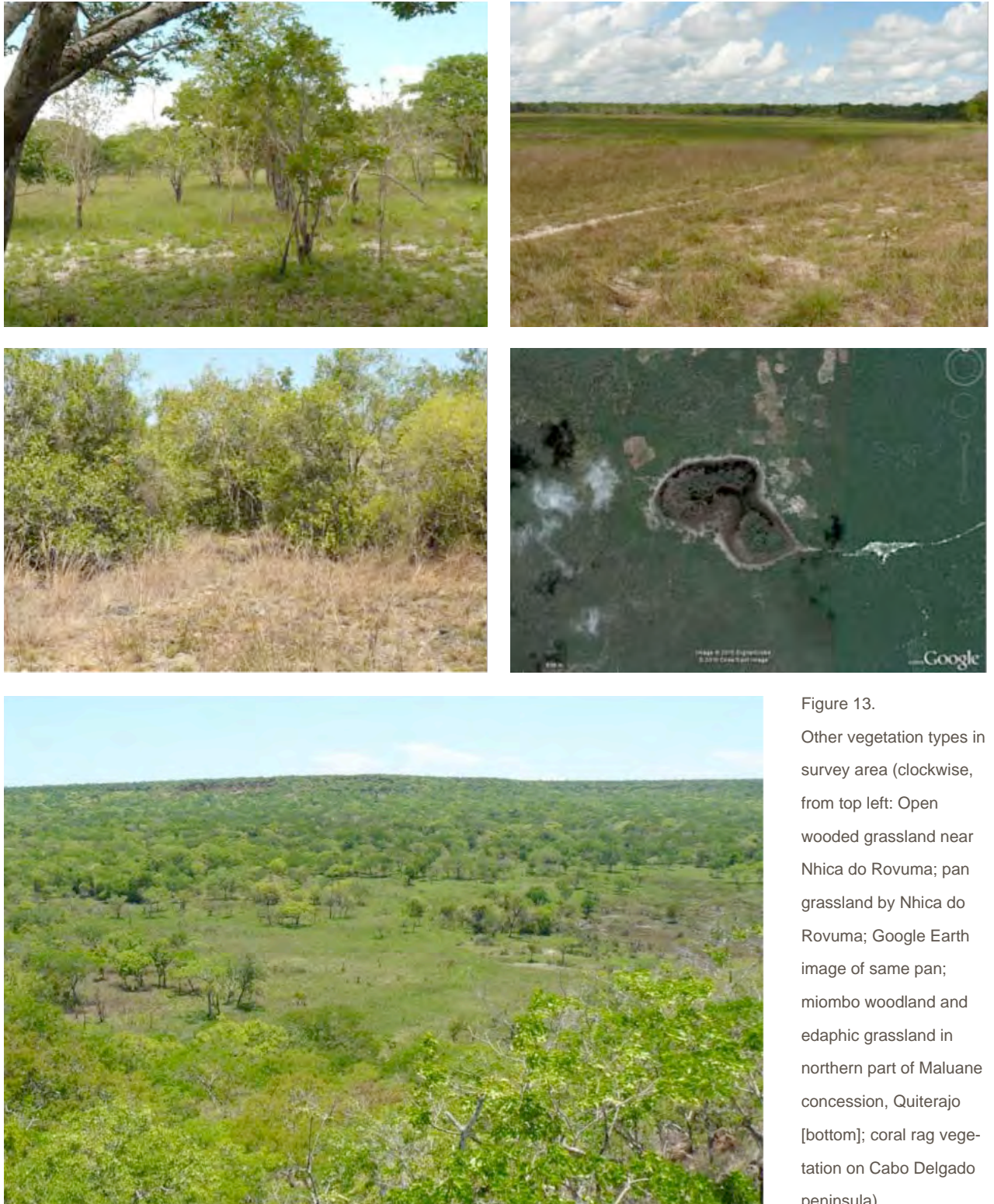


Figure 13.

Other vegetation types in survey area (clockwise, from top left: Open wooded grassland near Nhica do Rovuma; pan grassland by Nhica do Rovuma; Google Earth image of same pan; miombo woodland and edaphic grassland in northern part of Maluane concession, Quiterajo [bottom]; coral rag vegetation on Cabo Delgado peninsula).



Figure 14.  
Aerial view over Palma  
area showing miombo  
woodland and flooded  
grasslands. Photo Martin  
Guard, Artumas.

## Past and Present Extent of Forest

An attempt was made to estimate the remaining extent of coastal dry forest and similar formations remaining in the study area, and also to get an approximation of what the possible original extent was some 100–150 years ago, before significant changes in land use occurred.

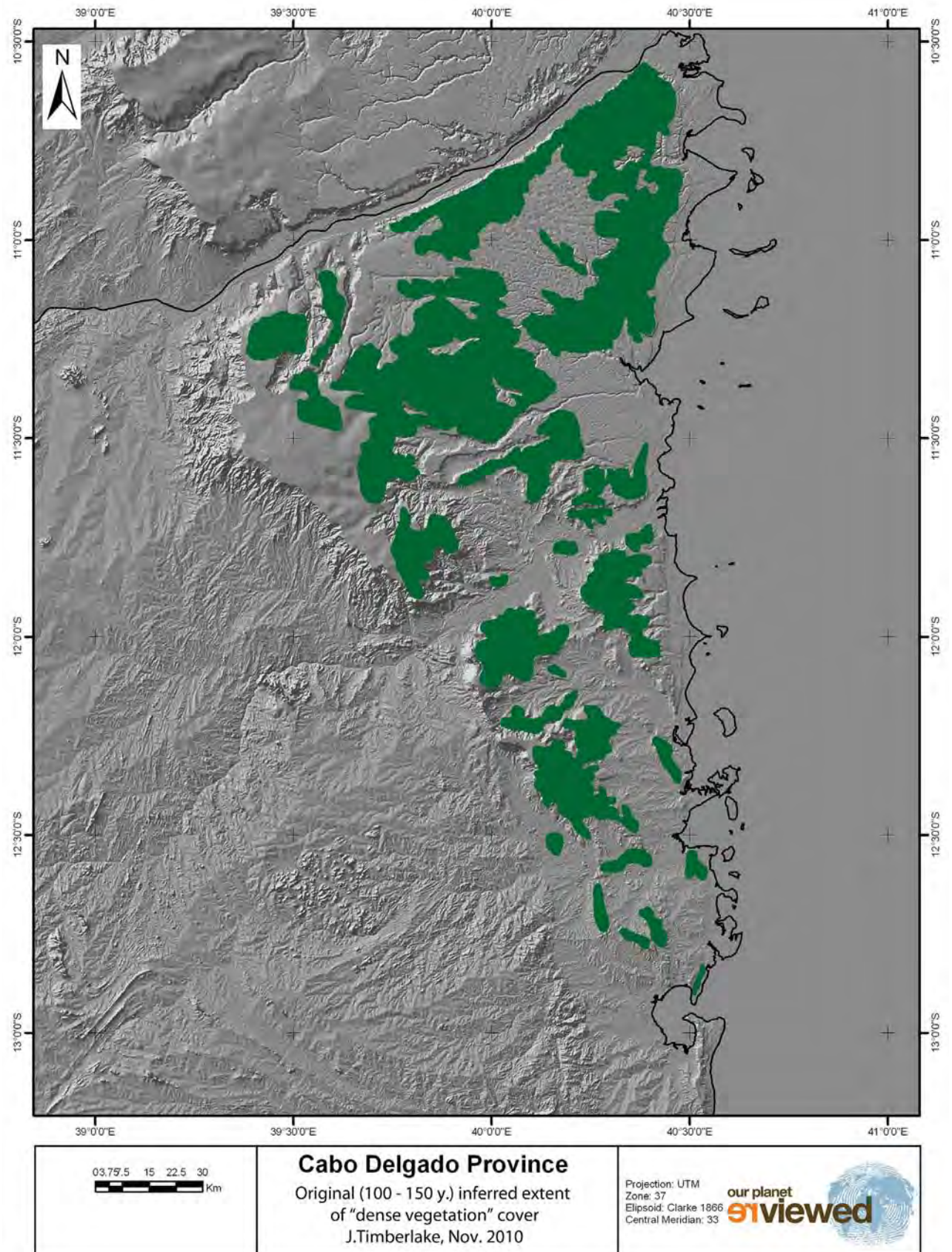
Estimates were made using photographic copies of 1999–2002 false-colour Landsat ETM imagery at a scale of 1: 800,000 or 1: 250,000. The scenes used were:

Path/row	Date	Area
165/067	25 May 2001	far N
165/068	12 May 2002	main block
165/069	15 July 2002	far S (small)
164/068	7 Dec 1999	Pemba & coastline
164/069	31 MAY 2000	far SE (small)

Delineation was done by manual interpretation using a transparent mylar sheet overlay, after which a dot planimeter was used to determine area. The overlays were then scanned and put into a GIS. Results are presented by geographical block.



Figure 15. Original inferred extent of «dense vegetation cover» across study area, based on landform and Landsat imagery.



## ORIGINAL EXTENT

The determination of possible original extent of dry forest was made based on a combination of (a) suitable upland landform, (b) underlying geology, and (c) reflectance (smooth reddish texture on image). A reduced image at 1: 800,000 scale was used to obtain a better synoptic view. The resulting map is shown in Fig. 15. Based on field observations of species composition and distribution, it is thought that only a small part of the area of «dense vegetation cover» would have been what we term dry forest, with the majority being miombo or similar woodland types, at least within any time scale we are concerned with here. As dry forest patches appear to be restricted to certain soils and landscape units, it was assumed that only 10% of the total extent of dense vegetation would have been dry forest rather than woodland.

Area	thick veg. cover (km <sup>2</sup> )	dry forest (km <sup>2</sup> )
NW, Mueda plateau & E slopes	2325	235
NE, Nangade-Pundanhar-Nhica-Quionga-Palma-Mocímboa	2173	220
EC, Rio Messalo-Quiterajo	576	60
S, Chai-Mucojo-Pemba, S of Rio Messalo	1006	100
TOTAL	6080	615

Table 3.  
Assumed original extent of «dense vegetation cover» (closed woodland + dry forest + thicket), based on interpretation from geology and landform on Landsat imagery.

The original extent of «dense vegetation cover» was determined as having been 6080 km<sup>2</sup>, but incorporating the assumptions and rounding up, the extent of dry forest within that was probably only around 615 km<sup>2</sup> (Table 3), or 3% of the whole 18,150 km<sup>2</sup> study area. Even with a higher proportion of dry forest vs. woodland, the extent was unlikely to have been more than 1000 km<sup>2</sup>. The interpretation error is probably around 20%, while the area determination has a calculation error of  $\pm 10\%$ . Although the assumptions used are not well substantiated, and the errors in interpretation rather high, it is probably the best that can be realistically done given our present ecological knowledge and the lack of historical data.

It can be seen from Fig. 15 that the main densely vegetated areas were probably in the north along the Rovuma margin and on the eastern slopes of the Mueda plateau. However, there were probably also some significant blocks around the lower reaches of the Rio Messalo and in the Macomia area. Most are associated with the sloping exposed sandstone strata.

## PRESENT EXTENT

After this exercise, a more detailed assessment was made of the present (2002) existing extent of dense vegetation cover. For this various key assumptions were made:

a) that relatively smooth-textured non-mottled reddish areas on the imagery indicate sandy soils from the Mikindani Formation, most of which lie up on the plateau. Dark blue areas indicate woodland on Quaternary deposits, and lighter blue is grassland – both these were not included;

b) that deeper red-hued, ± homogeneous blocks are likely to be dry forest or dense woodland;

c) areas that are mottled are assumed to include significant patches of cultivation, and so are now not likely to have any conservation value and were excluded;

d) based on field evidence, the proportion of suitable substrate (deeper, vegetated sands derived from the Mikindani Formation and associated strata) likely to support homogeneous dry forest patches (as opposed to dense woodland, transitional areas or areas with just a sprinkling of dry forest species) is around one-third (33%);

e) rugged terrain, usually deep red on the imagery, along the Rovuma valley rim was included. From field experience these areas support some good patches of dry forest as well as a mix of woodland types.

Based on these assumptions, the total extent of «dense vegetation cover» was measured as 1181 km<sup>2</sup> in 2002, giving a rough estimate of 394 km<sup>2</sup> of dry forest (Fig. 16, Table 4), or 2% of the total study area. The overall loss of dense vegetation cover over the last 100–150 years appears to be around 80%, with losses ranging from 96% on the Mueda plateau to around 65% in the Nhica area. It is not clear if dry forest has been cleared preferentially over woodland, so the actual loss of forest itself may be greater.

Table 4. Original and remaining extent of dense woodland and dry forest vegetation types based on interpretation of 2002 Landsat imagery and the assumptions given above.

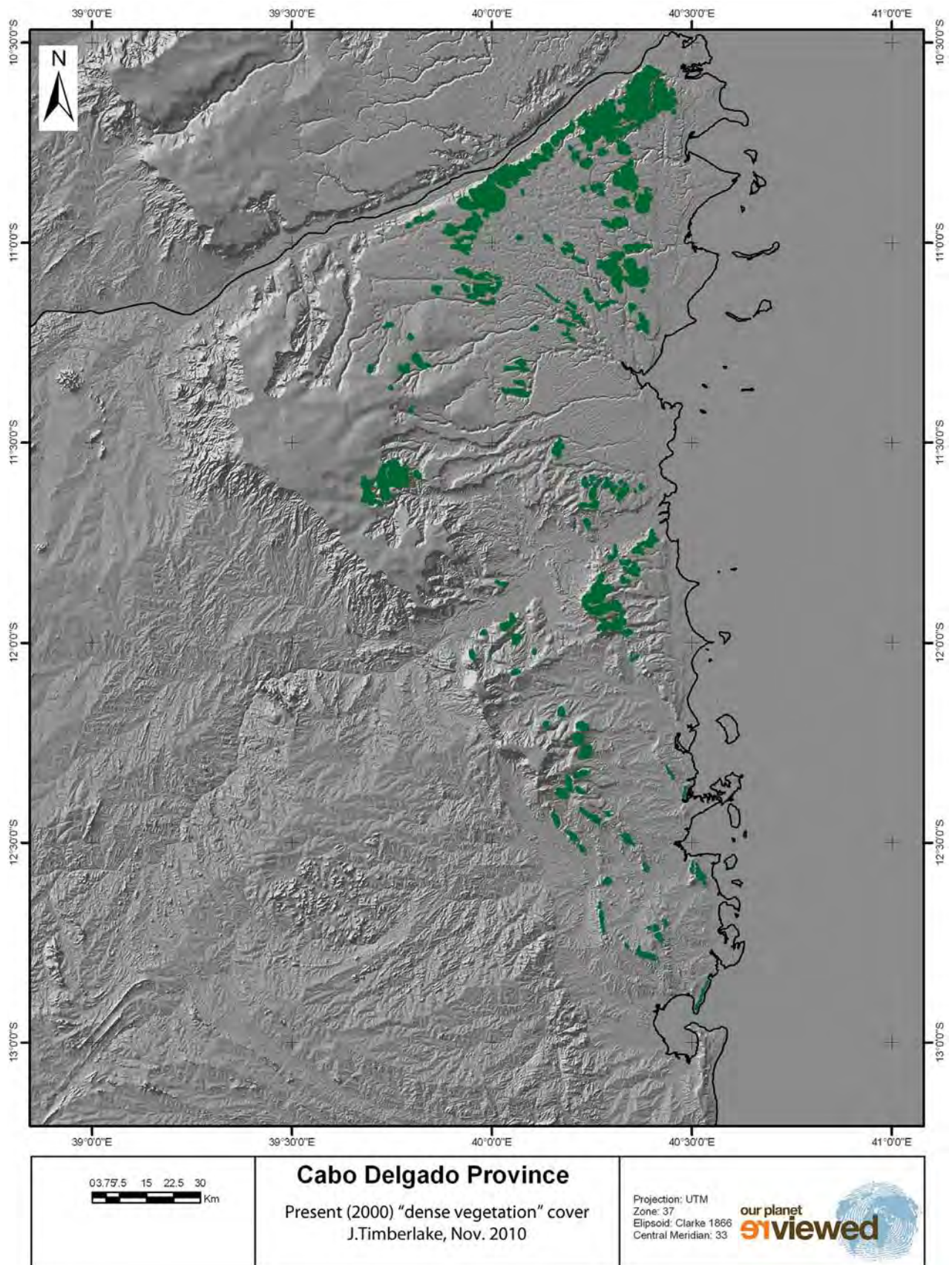
Area	Original extent (km <sup>2</sup> )	Present extent (km <sup>2</sup> )		Loss of dense veg. cover (%)
		dense veg. cover	dry forest (est.)	
NW, Mueda plateau & E slopes	2325	89	30	96.2
NE, Nangade–Pundanhar–Nhica–Quionga–Palma–Mocímboa	2173	769	260	64.6
EC, Rio Messalo–Quiterajo	576	166	55	71.2
S, Chai–Mucojo–Pemba, S of Rio Messalo	1006	158	53	84.3
TOTAL	6080	1181	398	80.6



The main remaining areas of dry forest are found in the north-east part of the study area associated with the southern margin of the Rovuma valley from Pundahar to Nhica do Rovuma, and in the Quionga area associated with the Rio Luvumba/Macanga, which drains into the Rovuma estuary. There are also sizeable areas away from the Palma–Mocímboa da Praia road. Other significant areas of dry forest include the banana-shaped forest patch at Quiterajo («The Banana», 31 km<sup>2</sup>) and others south of this, and the patch at Lupangua (20 km<sup>2</sup>).

As can be seen from the imagery, large parts of the area have been cleared for agriculture over the last 100 years (probably most in the last 20–50 years). Yet from personal observation many additional expanses have been cleared close to population centres and main roads since 2002, when the last images were taken. It is also believed that forest habitat quality on the ground is often low owing to previous logging, old (5–50 years ago) clearance for fields, and frequent fire, none of which are readily detectable on the images. Hence the total extent of remaining dry forest (almost 400 km<sup>2</sup>) given here, from a conservation or biodiversity viewpoint is likely to be an over-estimate. It is possible that the total area is now only 300–350 km<sup>2</sup>, with most of the recent loss in the Palma area.

Figure 16. Present (2000) extent of "dense vegetation cover" across study area, as determined from Landsat imagery.





## Botanical Composition

A large effort was put into stratified botanical collecting, with particular emphasis on the patches of dry forest. More open vegetation types, such as around the pans, on the coastal margins and in the Rovuma valley, were not well-collected. All species seen with flowers or fruit were collected at least once. Specimens were dried in the field, with final drying and sorting done in Maputo, from where they were sent to the herbarium at the Royal Botanic Gardens, Kew for identification. Kew has the best available collections from this part of the world.

It should be emphasised that most of the plant collecting was done in the late dry season or just after the first rains, hence many species were not found in a fertile state or with adequate vegetative material. This resulted in a marked under-representation of herbs and grasses.

Approximately 2250 collections of higher plants were made over the course of the various «Our Plant Reviewed» trips and expeditions of 2008 and 2009 (distribution shown in Fig. 17). The 2008/9 collections were duplicated in sets of four for fertile material, and sets of two for material lacking flowers or fruit. They will be distributed to herbaria in Mozambique (Instituto de Investigação Agrária de Moçambique [LMA] and Eduardo Mondlane University, Maputo [LMU]), UK (Royal Botanic Gardens Kew [K]) and France (Museum national d'Histoire naturelle, Paris [P]), with some collections also being deposited in South Africa (Buffelskloof Nature Reserve, Lydenburg [BNRH]) and in Kenya (National Museums of Kenya [EA]).

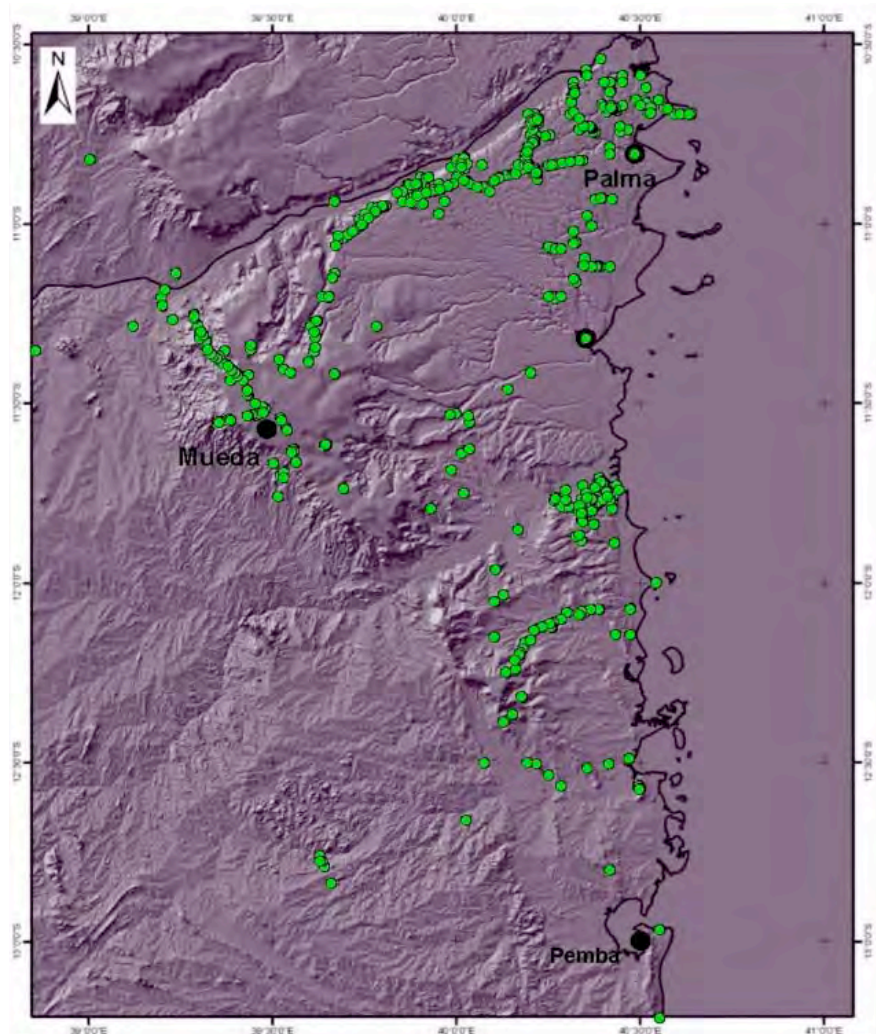


Figure 17.  
Location of botanical collections in Cabo Delgado, 2003–2009.

A full list of species identified is given in Annex 2, although this is still not fully complete. A total of 738 plant taxa have been recorded from Cabo Delgado Province during project-funded expeditions (2008–2009), of which 35 taxa are either entirely new to science or were known previously from material too fragmentary to describe formally (Table 5); 23 of these were discovered during project-funded trips. The recent high quality collections will help in drawing up detailed descriptions for many of the inadequately-known species. Excluding the new species, 67 new plant species records are reported for Mozambique (Table 6), 57 of them found during the project's trips, with a further 37 species not previously recorded from Cabo Delgado Province (Annex 3). This is an exceptionally high number of new records to discover anywhere in southern and eastern Africa, and indicates not just the marked lack of previous collecting, but also the richness of the area and the number of range-restricted species.

Table 5. New species recorded from Cabo Delgado study area, 2003–2009.

#### **Monocotyledons**

##### **Asparagaceae**

*Asparagus* ?sp. nov.

##### **Araceae**

*Stylochaeton* sp., uncertain status

#### **Dicotyledons**

##### **Annonaceae**

*Xylopia* sp. nov.

*Xylopia* sp. A of FTEA

##### **Celastraceae**

*Pleurostylie* ?sp. nov. aff. *serrulata* Loes.

##### **Compositae**

*Vernonia* ?sp. nov. aff. *inhacensis* G.V.Pope

*Vernonia* ?sp. nov. 2

##### **Convolvulaceae**

*Ipomoea* ?sp. nov.

##### **Euphorbiaceae**

*Euphorbia* ?sp. nov. aff. *ambroseae* L.C.Leach

##### **Flacourtiaceae**

*Casearia* ?sp. nov.

##### **Lamiaceae**

*Vitex* ?sp. nov. aff. *buchananii*

*Vitex* cf. *mossambicensis* Gürke

##### **Leg: Papilionoideae**

*Baphia* ?sp. nov.

*Erythrina* ?sp. nov.

##### **Melastomataceae**

*Warneckea* sp. nov.

##### **Meliaceae**

*Trichilia* ?sp. nov.

##### **Ochnaceae**

*Ochna* ?sp. nov.

##### **Rubiaceae**

?*Chassalia* cf. *umbraticola* Vatke

*Didymosalpinx callianthus* J.E.& S.M.Burrows

*Oxyanthus* sp. A of FZ

*Oxyanthus biflorus* J.E.& S.M.Burrows

*Polysphaeria* ?sp. nov.

*Psilanthus* sp. nov., cf. sp. A of FTEA

*Pyrostria* sp. B of FZ

*Pyrostria* sp. D of FTEA

*Pyrostria* ?sp. nov. = Luke 9724

*Rytigynia* cf. *umbellulata* (Hiern) Robyns

= de Koning et al. 9759 of FZ

*Tarenna* sp. 53 of Degreef

*Tricalysia* sp. A of FZ

*Tricalysia* sp. B of FZ

##### **Rutaceae**

*Vepris* sp. nov.

*Zanthoxylum lepreurii* Guill.& Perr., subsp. nov.?

##### **Sapindaceae**

*Deinbollia* ?sp. nov.

##### **Sterculiaceae**

*Cola* sp. nov. 1 aff. *clavata* Mast.

*Cola* ?sp. nov. 2 aff. *clavata* Mast.

Two categories of range-restricted endemics can be outlined (Annex 3) – 30 species are restricted to the northernmost provinces of Mozambique, principally to the coastal dry forests of Cabo Delgado, while a further 43 species are restricted to the area either side of the border with Tanzania, demonstrating strong links between Cabo Delgado and the well documented Lindi centre of endemism in SE Tanzania.



Table 6. New records for Mozambique from Cabo Delgado study area, 2003–2009.

**Amaryllidaceae***Crinum aurantiacum* Lehmiller**Anthericaceae***Chlorophytum amplexicaule* Baker**Araceae***Anchomanes abbreviatus* Engl.*Culcasia orientalis* Mayo*Stylochaeton euryphyllum* Mildbr.**Arecaceae***Hyphaene petersiana* Mart.**Dracaenaceae***Sansevieria* cf. *metallica* Gérôme & Labroy**Orchidaceae***Eulophia acutilabra* Summerh.*Eulophia guineensis* Lindl.*Microcoelia megalorrhiza* (Rchb.f.) Summerh.*Microcoelia physophora* (Rchb.f.) Summerh.*Nervilia bicarinata* (Blume) Schltr.**Acanthaceae***Lepidagathis plantaginea* Mildbr.*Whitfieldia orientalis* Vollesen**Anacardiaceae***Lannea schweinfurthii* (Engl.) Engl.var. *acutifolia* (Engl.) Kokwaro**Annonaceae***Artabotrys modestus* Diels subsp. *macranthus* Verdc.*Letowianthus stellatus* Diels*Monanthes faulknerae* Verdc.*Monanthes trichantha* (Diels) Verdc.*Monodora minor* Engl. & Diels**Apocynaceae***Baissea myrtifolia* (Benth.) Pichon*Cryptolepis hypoglauca* K.Schum.**Balanitaceae***Balanites maughamii* Sprague subsp. *acuta* Sands**Burseraceae***Commiphora fulvotomentosa* Engl.*Commiphora pteleifolia* Engl.**Capparaceae***Maerua bussei* (Gilg & Gilg-Ben) Wilczek*Ritchiea capparoides* (Andr.) Brittonvar. *capparoides***Celastraceae***Elaeodendron buchananii* (Loes.) Loes.**Compositae***Vernonia zanzibarensis* Less.**Connaraceae***Vismianthus punctatus* Mildbr.**Cucurbitaceae***Peponium leucanthum* (Gilg) Cogn.**Ebenaceae***Diospyros kabuyeana* F.White*Diospyros magogoana* F.White*Diospyros shimbaensis* F.White**Euphorbiaceae***Croton polytrichus* Pax subsp. *polytrichus**Drypetes sclerophylla* Mildbr.*Omphalea mansfieldiana* Mildbr.**Labiatae***Orthosiphon scedastophyllus* A.J.Paton*Premna gracillima* Verdc.*Premna hans-joachimii* Verdc.**Leguminosae: Caesalpinioideae***Scorodophloeus fischeri* (Taub.) J.Léonard*Senna auriculata* (L.) Roxb.**Leguminosae: Mimosoideae***Newtonia paucijuga* (Harms) Brenan**Leguminosae: Papilionoideae***Dalbergia lactea* Vatke*Erythrina haerdii* Verdc.*Erythrina saculeuxii* Hua**Loganiaceae***Strychnos xylophylla* Gilg**Myrtaceae***Eugenia capensis* (Eckl. & Zeyh.) Sond.subsp. *multiflora* Verdc.**Ochnaceae***Ochna ovata* F.Hoffm.**Passifloraceae***Adenia kirkii* (Mast.) Engl.**Rubiaceae***Coffea schliebenii* Bridson (Coffea sp. D of FTEA)*Gardenia transvenulosa* Verdc.*Kraussia kirkii* (Hook.f.) Bullock*Leptactina papyrophloea* Verdc.*Pavetta lindina* Bremek.*Rhodopentia parvifolia* (Hiern) Kårehed & B.Bremer*Rothmannia macrosiphon* (Engl.) Bridson*Vangueria* cf. *randii* S.Mooresubsp. *vollesenii* Verdc.**Rutaceae***Vepris sansibarensis* (Engl.) Mziray*Zanthoxylum lindense* (Engl.) Kokwaro**Sapindaceae***Haplocoelum inoploeum* Radlk.**Thymelaeaceae***Synaptolepis kirkii* Oliv. sensu stricto**Tiliaceae***Grewia stuhlmannii* K.Schum.**Violaceae***Rinorea welwitschii* (Oliv.) Kuntzesubsp. *tanzanica* Grey-Wilson**Viscaceae***Viscum gracile* Polh. & Wiens**Vitaceae***Cissus phymatocarpa* Masinde & L.E.Newton*Cissus sylvicola* Masinde & L.E.Newton

The 738 taxa (species and subspecies) recorded come from 105 families, including 4 species of Pteridophyte and 73 monocotyledons. The largest family recorded was Rubiaceae with 83 taxa, followed by Leguminosae: Papilionoideae with 43 (Table 7), although the Leguminosae combined have the largest total at 96 taxa. [Leguminosae is treated throughout this report as three separate families – Caesalpinioideae, Mimosoideae and Papilionoideae.] Nineteen families had more than 10 taxa. The family with the largest number of new species was Rubiaceae (13), followed by Annonaceae, Compositae, Labiatae, Papilionoideae, Rutaceae and Sterculiaceae with two each.

Family	no. taxa found	no. new species	no. new Moz records
Araceae	12	1	3
Orchidaceae	11		5
Acanthaceae	18		2
Annonaceae	23	2	5
Apocynaceae	28		2
Capparaceae	19		2
Celastraceae	14	1	1
Combretaceae	17		
Compositae	11	2	1
Ebenaceae	12		3
Euphorbiaceae	41	1	3
Labiatae	28	2	3
Leg.: Caesalpinioideae	24		2
Leg.: Mimosoideae	29		1
Leg.: Papilionoideae	43	2	3
Rubiaceae	83	13	8
Rutaceae	9	2	2
Sapindaceae	12	1	1
Sterculiaceae	11	2	
Tiliaceae	12		1
Vitaceae	6		2

Table 7.

Number of taxa from the main plant families found in the Cabo Delgado study.

## Species Distribution Patterns

Part of the justification for this study was to see if the patterns of local endemism recorded from the Tanzania coast, especially in the Lindi region, are also found in coastal northern Mozambique. To do this properly requires the mapping of distributions of a large number of species using records both from this study and from herbaria elsewhere that have significant coastal collections, such as Kew (K), East African Herbarium (EA), Missouri (MO) and Maputo (LMA). This will take a number of months even though a number of records are available through on-line databases, and is not attempted here. Instead some preliminary observations are given on broad species distribution patterns and differences in this regard between vegetation types.

During the preliminary conservation assessments (see Chapter 'Findings', Section 'Red Data Assessments' p 51), records for seven species known to be restricted to coastal areas were collated and mapped (Fig. 18). From these it can be seen that two species appear to be endemic to coastal northern Mozambique (*Micklethwaitia carvalhoi* and *Thespesia mossambicensis*), one shows a Cabo Delgado–Lindi distribution (*Vismianthus punctatus*), and three show a somewhat broader Tanzania–Mozambique coastal distribution (*Monodora minor*, *Scorodophloeus fischeri* and *Guibourtia schliebenii*, although the latter is also found inland on the Eastern Arc mountains).

In the course of identification at the Kew Herbarium, it became apparent that there were 13 taxa endemic to coastal northern Mozambique (area Moz N: of Flora Zambesiaca) plus around 27 of the new species (see Annex 3). There are also 53 taxa known primarily from northern Mozambique and the adjacent areas in south-east Tanzania (area T8 of Flora of Tropical East Africa), showing the strong links between them. Most appear to be local endemics. Annex 3 also lists 11 taxa with wider distributions ranging from central to northern Mozambique to central Tanzania, and a further 46 taxa that appear to be at the southern end of their East Africa (Swahilian) distribution in Cabo Delgado.

It is also apparent that species found in miombo and similar woodland types, and in the fallows, grassland and wetlands, are far more widespread. Many are found across the Miombo Ecoregion of south central Africa (Timberlake & Chidumayo 2001) or even more widely, e.g. *Parinari curatellifolia*, *Azelia quanzensis*, *Brachystegia spiciformis*, *Uapaca nitida* and *Pseudolachnostylis maprouneifolia*. This is in marked contrast to the local distribution of so many dry forest species. An interesting exception is *Berlinia orientalis*, which commonly occurs in fallows and miombo woodland (and sometimes in dry forest), but is known only from a limited area of Cabo Delgado across to southeast Tanzania.

Future work will probably confirm these distribution patterns and show the very marked East African coastal element in the overall distribution of the dry forests of the study area, with particularly strong links to that found in the Lindi–Mtwara region of southeast Tanzania, whilst also showing that the woodland and grassland flora has a much wider distribution. The Lindi area has previously been suggested as a local centre of endemism (Clarke 2001), which the present findings support.

## Red Data Assessments

Preliminary conservation assessments to determine IUCN Red Data List categories were carried out on seven woody species known to be confined to the East African coastal region. Species were chosen primarily for their known restricted distribution patterns or their ecological importance. Later, a wider range of species from the area will be assessed and the results compared with any assessments for these species arising from the East African Red Listing process.

By using the Kew GIS Units extension tool, rapid conservation assessments based on IUCN categories and criteria were produced. The assessments use Extent of Occurrence (EOO), Area of Occupancy (AOO), number of sub-populations and number of locations (see [www.kew.org/gis/projects/cats/catsdoc.pdf](http://www.kew.org/gis/projects/cats/catsdoc.pdf)). Localities or data points were derived from collections made in the course of this study and from other specimens held in the Kew Herbarium, those available through the African Plants Initiative database (<http://plants.jstor.org>) and from Missouri Botanical Garden's Tropicos database ([www.tropicos.org](http://www.tropicos.org)), which also includes specimens from the East African Herbarium (EA), National Herbarium of Tanzania (NHT) and the Dar es Salaam University Herbarium (DSM). The cell size used for AOO was 4 km<sup>2</sup> (2 × 2 km), which is that recommended by IUCN (2008) for restricted distribution species. The total number of records for each species was noted.

As a result of these individual species assessments, distribution maps (Fig. 18) and IUCN status were produced for each species (Table 8). By using the default 4 km<sup>2</sup> cell size all species were assessed as being Endangered (EN) under IUCN's Red Data categories (IUCN 2001). It should be noted that if a larger cell size was used (e.g. 35–85 km sides), the threat status decreased in most cases to Least Concern. Of the seven species, the most narrowly distributed was the Mozambique endemic *Thespesia mosambicensis*, occurring in only 5 cells, while the other Mozambique endemics *Hexalobus mossambicensis* and *Micklethwaitia carvalhoi* were recorded from only 7 cells. *Scorodophloeus fischeri*, found from N Mozambique to S Kenya, was found in 53 cells.

These preliminary assessments are based solely on recorded past and present distribution derived from herbarium specimens. But as we know that their habitat, at least in northern Mozambique, is under marked threat, the Endangered status seems appropriate. It is likely that a number of other dry forest species, once assessed, will have a similar threat status. The new species, at present only known from 1 or 2 localities, are likely to have a higher threat status. However, the great majority of species associated with woodland across the study area are known to have a much wider sub-continental distribution and would undoubtedly be assessed as Least Concern.



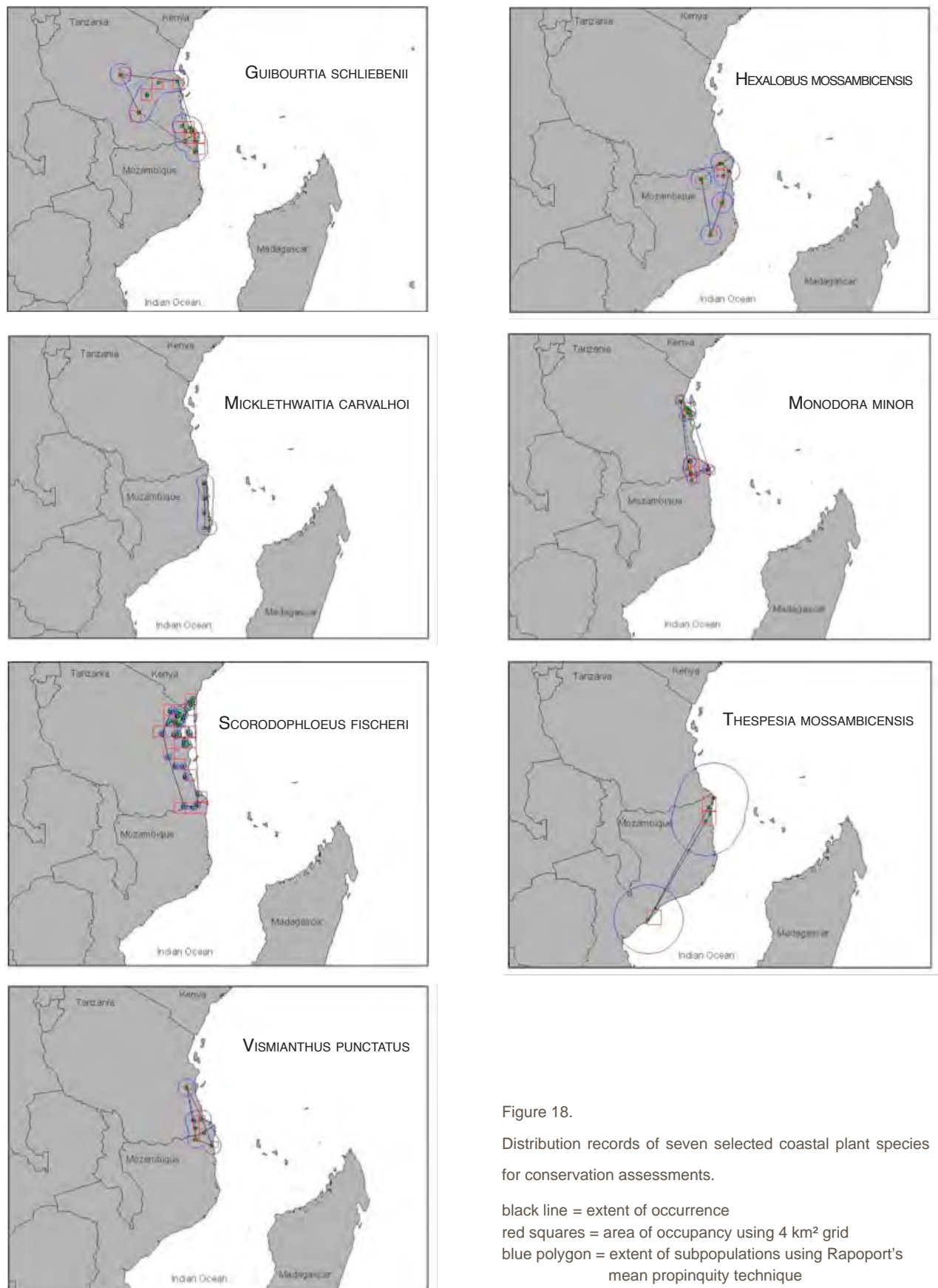


Table 8. Preliminary IUCN Red Data status for seven selected eastern African dry forest species.

Family/species	No. records	EOO (km <sup>2</sup> )	AOO (4 km <sup>2</sup> cell)	Status
<b>Annonaceae</b>				
<i>Hexalobus mossambicensis</i> N.Robson	11	45,043	28	EN
<i>Monodora minor</i> Engl. & Diels	23	54,062	68	EN
<b>Connaraceae</b>				
<i>Vismianthus punctatus</i> Milbr.	11	22,864	40	EN
<b>Leguminosae: Caesalpinioideae</b>				
<i>Guibourtia schliebenii</i> (Harms) J.Léonard	18	164,778	64	EN
<i>Micklethwaitia carvalhoi</i> (Harms) G.P.Lewis & Schrire	8	9,502	28	EN
<i>Scorodophloeus fischeri</i> (Taub.) J.Léonard	72	137,578	21	EN
<b>Malvaceae</b>				
<i>Thespesia mossambicensis</i> (Exell & Hillc.) Fryxell	5	16,416	20	EN

## Plot Species Richness

It is often stated that coastal forests can have a high species diversity, yet outside of the Kaya forests of coastal Kenya there do not appear to be counts of specific areas (Quentin Luke, pers. comm.). In order to get an indication of woody species diversity, a 0.25 ha plot was recorded in the «banana» forest (Namcubi forest) at Quiterajo. A 50 × 50 m plot, recorded using four 25 × 25 m subplots, was laid out centred on 11°45'47.1" S, 40°21'42.7" E next to a track through the main forest block. The canopy, which at this semi-leafless time was around 50–60%, was dominated by *Guibourtia schliebenii*, with some emergents such as *Vitex mossambicensis* and *Lannea antiscorbutica*. Numerous sub-canopy trees and shrubs were from 1 to 5 m high. The presence of all recognisable woody species was noted by subplot, and the number of stems recorded that exceeded 6 cm dbh.

Summarised results are given in Annex 4. A total of 46 woody species were recorded from 0.25 ha, of which 35 had at least one individual greater than 6 cm dbh. Given that there were some fairly widespread species seen nearby but not in the plot, and that lianas and cryptic woody species were under-recorded, it would seem that the mean woody species diversity in this forest is probably around 50–60 species/ha. Although comparative figures for other dry forests have not been seen, this figure is thought to be within the range for dry forest, higher than for many areas of miombo woodland across the Flora Zambesiaca region, but lower than those for moist forest.

There were 332 stems greater than 6 cm dbh, suggesting a mean density of 1328 stems/ha. The main species by far was *Guibourtia schliebenii* (equivalent to 284 stems/ha), followed by the sub-canopy trees *Warneckea sansibarica* (140 stems/ha) and *Rinorea angustifolia* (128 stems/ha), *Xylopia* sp. nov. (120 stems/ha), *Mecycylon natalense* / *M. flavovirens* (92 stems/ha), and *Vitex mossambicensis* (72 stems/ha).

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# COASTAL FORESTS ACROSS EAST AFRICA

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## General Comments

We do not attempt here to compare coastal forests in Cabo Delgado with those further south in Nampula and Zambezia Provinces, or those to the north in Tanzania and Kenya. It is planned to look at such similarities and differences in vegetation types, species composition and distribution at a later stage. However, here we do try to place the figure for extent of coastal forests in Mozambique in a regional perspective, particularly as it has often been stated that northern Mozambique holds the largest coastal forest extent in Eastern Africa.

In this study it became clear that the remaining coastal forests in Cabo Delgado are generally dry and often sclerophyllous, quite different from the moist coastal forests found in north-east Tanzania and south-east Kenya (see Moomaw 1960, Robertson & Luke 1993, Hawthorne 1993, Burgess & Clarke 2000). Hawthorne clearly points out the difference in composition between what he terms Dry forest and Moist forest in this northern area, and suggests that in East Africa coastal forests are in fact a mosaic of a number of structural types, and not all are «forest» using standard physiognomic definitions. He also lists the phytogeographical affiliations of a number of species from forests in Tanzania north of the Rufiji River and southern Kenya. Clarke, Vollesen & Mwasumbi (2000) list 780 endemic plant taxa recorded from the Swahilian Regional Centre of Endemism (his Appendix 3), a geographical entity that is broader than just coastal forest, but he suggests there are at least 4500 plant taxa in this phytogeographical area, with an estimated 3000 found in coastal forests. Although coastal forests south of the Rufiji are generally much drier than many in northern Tanzania (Clarke 2000b), they are still species-rich with many local endemics (e.g. Bidgood & Vollesen 1992, Clarke 2001).

## Geology & Geomorphology

Hawthorne (1993) uses geology and geomorphology as much as vegetation physiognomy and composition in his definition of coastal forests. He defines «coastal» as lying on sedimentary (or volcanic) sediments of the coastal plains and plateaux, excluding any vegetation formations on exposed Basement Complex substrates. This is essentially the same as the limits used in this study. Using this definition, the possible extent of coastal forests in Mozambique north of the Zambezi River is limited, with the present study area having by far the largest suitable extent.

Comparisons of geology between the dry forests of northern Mozambique and those of Tanzania, especially in the area south of the Rufiji River, are not easy owing to difficulties for us in obtaining appropriate maps and literature. However, from the Tanzanian geological map (BRGM 2004) and the chapter on geology and geomorphology in the IUCN coastal forests book (Clarke & Burgess 2000), it is possible to make the following observations.

Whereas in northern Mozambique the remaining coastal dry forests seem confined to a particular, relatively recent and acidic strata (the Mikindani Formation of mid-Neogene age), in southern Tanzania the mapped forest patches occur on a wider range of substrates (Clarke & Burgess 2000). These range from Jurassic (208–145.6 Mya) through Cretaceous (145.6–65.0 Mya) to Neogene (23.3–1.64 Mya) in age, but with a major proportion on sediments from the more recent Neogene period. These sediments seem to be principally marine, lacustrine or fluvio-marine deposits, and are probably mostly sandstone or similar rocks. Available maps do not give a more detailed subdivision of strata or allow for location of forest patches on specific strata. However, this difference may be a result of differing definitions of what comprises coastal forest.

It would seem that along the East African coast there have also been various inundations of older sediments by the sea over the last 5–10 million years, further complicating the mineral and nutrient status of their soils (Clarke & Burgess 2000).

More careful mapping is required to determine which geological strata the dry forest patches occur or occurred on, their geomorphological position (which part of the landscape they sit in), and the depth, drainage status, pH and nutrient status of the soils on which they occur. This would be a most valuable predictive tool to indicate what the original extent of dry coastal forest might have been.



## Remaining Distribution of Coastal Forests

The earliest clearly measured figure (as opposed to gross estimate) for the extent of remaining coastal forest in Mozambique is 4780 km<sup>2</sup> (Conservation International, Hotspots Revisited in Burgess *et al.* 2004a). Shortly afterwards WWF (Eastern Africa Coastal Forests Ecoregion, WWF EARPO, 2006) estimated that Mozambique had 4180 km<sup>2</sup> of closed canopy coastal forest out of 6260 km<sup>2</sup> found along the entire East African coast from southern Somalia to southern Mozambique, compared to a much lower extent of 1050 km<sup>2</sup> in Kenya and 970 km<sup>2</sup> in Tanzania (Table 9). An earlier publication from Conservation International (Hotspots, Myers *et al.* 1999) gave a much lower estimate of 3000 km<sup>2</sup> of lowland coastal forest along the whole East African coast (1400 km<sup>2</sup> in Tanzania/Kenya and suggesting around 1600 km<sup>2</sup> in Mozambique), while WWF's Terrestrial Ecoregions of Africa (Burgess *et al.* 2004b) estimated approximately 1000 km<sup>2</sup> in the northern Zanzibar–Inhambane Coastal Forest Mosaic (Somalia, Kenya, Tanzania) plus approximately 4000 km<sup>2</sup> in the Southern Zanzibar–Inhambane Coastal Forest Mosaic (Tanzania, Malawi, Mozambique), with the majority of this in Mozambique. In the Eastern Africa coastal forests book, Burgess *et al.* (2000, p.78) give a figure of 1790 km<sup>2</sup> of coastal forest in Mozambique (based on Burgess & Muir 1994). The original figure of 4583 km<sup>2</sup>, on which they presumably based this estimate, came from FAO's Mapa Florestal (1980), which included many areas that are demonstrably dense woodland and not coastal or with the type of species composition that this study has been looking at.

Table 9. Extent of coastal forest (with varying definitions) along the East African coast and in Mozambique.

Extent in East Africa (km <sup>2</sup> )	Extent in Moz. (km <sup>2</sup> )	References	Notes
	4583	FAO 1980	includes dense woodland & moist forest
3000	1600	CI - Myers <i>et al.</i> 1999	
3171	1790	Burgess & Clarke 2000	Moz figure adapted from FAO
5000	?3000	WWF - Burgess <i>et al.</i> 2004b	no figure given for Moz
6259	4780	CI - Burgess <i>et al.</i> 2004a	GIS-derived?
6260	4180	WWF-EARPO 2006	GIS-derived?

However, it is not clear how most of these very varied figures were obtained. Nor has it been possible to locate a map showing in detail where this extent in Mozambique lies in order to get an indication of the proportion that might occur in the Cabo Delgado study area.

From what are really sketch maps in WWF EARPO (2006)<sup>1</sup>, it would appear that a third to a half of coastal forest shown for Mozambique lies within the present study area. The WWF EARPO figures above therefore suggest there should be around 1400–2400 km<sup>2</sup> of coastal forest in Cabo Delgado, whereas our figures ( $\pm$  400 km<sup>2</sup>, chapter 'Findings', section 'Past and present extend of forest' p40) show only a third to a sixth of this. Clearly, the extent of coastal forest in northern Mozambique has been greatly over-estimated. Our gross estimate, based on WWF EARPO's more realistic figures for Kenya and Tanzania, plus revised figures of 700 km<sup>2</sup> for Mozambique (based on 400 km<sup>2</sup> in Cabo Delgado and an assumed 300 km<sup>2</sup> further south), indicates that northern Mozambique probably supports around 15% of a total of 2600 km<sup>2</sup> of coastal forest remaining along the East African coast.

Although Cabo Delgado Province supports perhaps the main blocks of coastal forest in the country (depending on whether the moist Cheringoma woodlands/forests south of the Zambezi River are defined as coastal forests), smaller areas of what are definitely coastal dry forest occur in Nampula Province (Nacala, Mossuril), in a narrow band along the coast from Angoche to Pebane in Zambézia Province, with perhaps a similar extent along the coast in Inhambane Province.

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<sup>1</sup> This WWF map mistakenly shows a number of forest woodland and moist forest reserves in Mozambique (e.g. Moribane, Baixa Pindo, Nangade area, Naipoto) as being «coastal forests». These are not coastal but lower altitude moist forests of the continental interior. Because of their lower altitude and not-excessive distance from the coast, they may contain some tree species that are found in moister coastal forests but, unless such species are dominant, this does not mean they are coastal forests. In addition, very little of the 7500 km<sup>2</sup> of the Quirimbas National Park is dry forest as depicted, but the Palma forest area is more extensive than shown. If these erroneous areas are excluded, about 40% of the broadly-defined coastal vegetation areas shown for Mozambique are in Cabo Delgado

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# CONSERVATION

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## Background

The First National Report on the Conservation of Biological Diversity in Mozambique (MICOA 1997) did not mention coastal forests or their biological significance, nor did the more recent national strategy produced through IUCN (Républica de Moçambique 2003). However, more recent documents coming from official sources (e.g. Fourth National Report on Implementation of the Convention on Biological Diversity in Mozambique, 2009) do refer to the coastal forests as an important conservation objective. Their importance is now gradually being recognised.

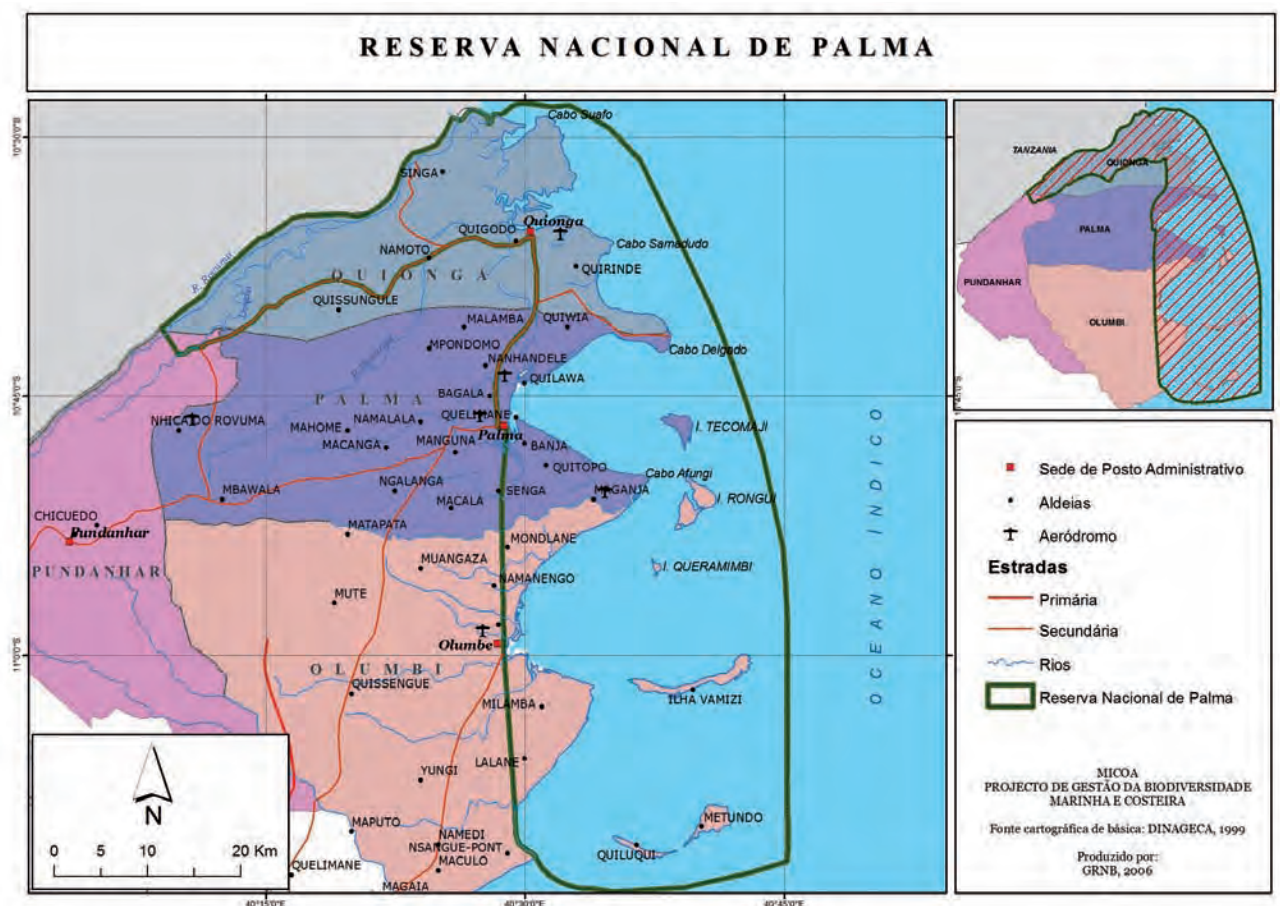
A new national conservation policy for Mozambique has been drawn up (MICOA 2008) and has recently been gazetted (Boletim da República, 1ª Série, no. 43 of 2 Nov. 2009), although the legislation is not yet in place. Hence conservation areas are still administered through the Forest and Wildlife law, which only recognises National Parks, National Reserves, Zones of Use and Sites of Historical or Cultural Value. The new strategy clearly lays out the revised scheme and categories for protected areas following the IUCN Protected Areas categories, and also the criteria required to qualify. For example, Technical Annex 5 shows the difference between Total Reserves, National Parks and Special Reserves. However, it is not clear where existing or proposed Forest Reserves (which fall under the responsibility of the Department of Forestry of the Ministry of Agriculture) fall. One fundamental point made clear in the legislation is the necessity for involvement and agreement of local communities and local government (i.e. the District and Provincial authorities) in any gazetting or management.

At present, the Ministry of Environment (MICOA) is the ‘umbrella’ ministry for coordination of all environmental, biodiversity and conservation issues, although responsibility for implementation and management lies with other ministries. National Parks, National Reserves and hunting areas (coutadas) are the responsibility of the Ministry of Tourism (MITUR), while management outside conservation areas falls under the National Directorate of Land and Forest in the Ministry of Agriculture, including existing Forest Reserves and wildlife ranches (fazendas do brávio). Hence any suggestions or proposals for conservation in Cabo Delgado need to be carefully thought through as to their extent and objectives before suggesting suitable categories for designation.

## Existing Conservation Areas

In recent years MICOA put forward a proposal for the proclamation of the Reserva Nacional de Palma (MICOA 2006), although the justification for this was based primarily on coastal and marine conservation concerns rather than on terrestrial biodiversity. The proposed reserve of 2352 km<sup>2</sup> would cover the islands and immediate coastline from 11°10' S north to the Rio Rovuma, and then inland in a broad swathe along the Rovuma valley and escarpment to Nhica do Rovuma (Fig. 19). This area would include some of the largest and best remaining coastal forest blocks north-west of Quionga (Rio Luvumba/Mavanga area), although the biodiversity descriptions given in the justification are not explicit. The mix of forest, miombo woodland and seasonally-flooded grassland in the area is, however, brought out. It is not known what has happened to this proposal, and whether it is still being pursued.

Figure 19.  
Map of proposed  
Reserva Nacional de  
Palma (MICOA 2006).





More attention has been given in recent years to another series of similar proposals to create a trans-frontier conservation area extending roughly from Palma to Mtwara in southern Tanzania. The main driving forces for this appear to be the protection of the rich coastal and marine biodiversity (including coral reefs and mangroves) of the Rovuma mouth and associated islands from damage due to increasing levels of oil and gas exploration, and the desire to protect and allow large mammal populations (elephant, lion, etc) to move between the two countries. This would also perhaps be able to link in with the two large protected areas of the Niassa National Reserve in Mozambique and the Selous Game Reserve in Tanzania. It is not clear at what stage such plans are, although the Artumas environmental impact statement (EIS) certainly took them into account (Impacto 2007) and WWF Mozambique is seeking funding (Rosalind Salter, pers. comm. Nov. 2010) to take this forward.

A large new national park, the Quirimbas National Park, was created in Cabo Delgado in 2002, covering 7506 km<sup>2</sup> including a large area on the mainland plus numerous islands and marine areas. The Park extends from just north of Pemba along the coast to the towns of Mipando and Macomia in the north, and to around 150 km inland beyond Meluco town. Management of this extensive area, within the boundaries of which at least 55,000 people live (Ministry of Tourism 2006), has been extensively supported by the French development and environmental agencies AFD and FFEM, the Danish agency DANIDA, and the World Wide Fund for Nature (WWF).

Much of the eastern part of the Quirimbas National Park lies within our study area. However, as little coastal forest was noted to lie within its boundaries (just a few small patches such as that at Lupangua), most of the project's efforts were directed towards areas further north.

Within the broad study area there are also two other protected areas – the Maluane Wildlife Conservancy and a wildlife hunting concession, along with a number of forestry concessions (Fig. 20). In both cases, although management is not primarily focussed on vegetation and plant diversity, there is some level of control and a basis on which to build future conservation initiatives, especially with Maluane.

The Maluane Conservancy is a privately-managed tourism concession in the Quiterajo area (“Game Farm” in Fig. 20) where wildlife is actively protected and tourism is considered to be a major form of land use. Game guards are employed and are active in stopping poaching and unauthorised extraction of natural resources. One of our main study sites lies in this concession.

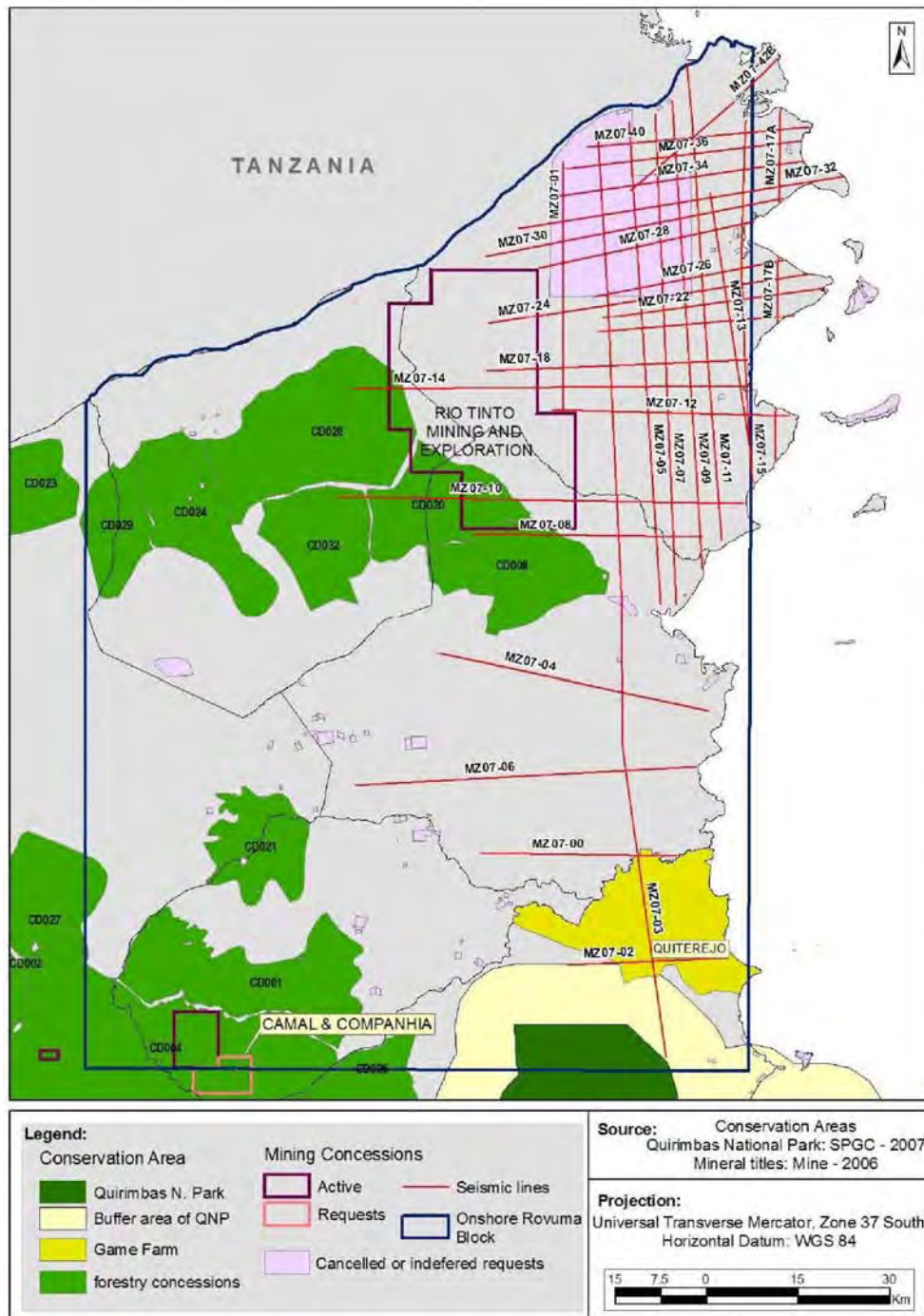


Figure 20.  
Conservation areas,  
forestry and mining con-  
cessions in north-eastern  
Cabo Delgado, with oil  
exploration cut-lines  
shown (source: Impacto  
2007).

At least one managed hunting concession, with a semi-permanent camp, resident manager and staff, is found along the Rovuma escarpment north-west of Pundahar (not shown in Fig. 20, but north of CD028). The concessionaire employs game scouts and tries to control poaching in the area, both of wildlife and timber.

## Conservation Threats

The study area has been settled for centuries and the Rovuma valley has been a trading route, probably dating from before the Portuguese arrived on the coast in the early 1500s. Certainly from Livingstone's time up until the First World War, it was a significant route into the interior (see Last 1887), whilst slave traders used the ports during the 19th century (O'Neill 1883). In addition, both gum from *Hymenaea verucosa* (gum copal) and latex from *Landolphia* lianas ('African rubber') were major items of trade, and collection of these products may well have had a significant local effect on vegetation. According to White & Moll (1978), by the beginning of the 20th century much of the natural vegetation of the Indian Ocean coastal regions had already been replaced by "secondary fire-maintained grassland and wooded grassland". However, it is likely that this transformation was primarily confined to the coastal strip and did not extend significantly into the densely wooded and forested interior. Cultivation and settlement further inland is likely to have been localised and confined to areas with good access to perennial water and where the vegetation was more open and soils more suited to low-input agriculture.

With increasing development by the Colonial authorities in the 1950s after the Second World War, forest exploitation through selective logging became much more widespread, particularly focussing on *Pterocarpus angolensis* (umbila), *Milletia stuhlmannii* (panga panga, jambire), *Azelia quanzensis* (chanfuta), *Swartzia madagascariensis* (pau ferro), *Dalbergia melanoxylon* (pau preto) and *Milicia excelsa* (tule). This is likely to have had a major effect on vegetation structure across parts of the study area, effects that can still be seen now.

During the Independence war in the 1960–70s, much military infrastructure was put in along the frontier, including roads, airstrips, barracks and minefields. All these had a significant local impact on vegetation in areas along the Rovuma rim, while the roads facilitated subsequent development after Independence. The new government's policy of villagisation also created marked local impacts through radiating clearance for agriculture. Logging also underwent a resurgence at this time after the hiatus provided by the insecurity of the war years.

In recent years, since the end of the civil war in 1992, the threats have been of four main types: (a) immigration and increased settlement, resulting in extensive clearance for arable fields; (b) extensive and often uncontrolled or illegal logging for timber; (c) exploration for oil and gas; and (d) wild fires. These are elaborated upon below. The first has also resulted in increased human–wildlife conflict, primarily with elephant and lion, which compounds the current pressures on biodiversity.



## EXPANDING SETTLEMENT AND AGRICULTURE

Since the end of the civil war, particularly over the last decade, local populations have been moving away from the coastal margins into the wooded and forested interior of the coastal plateau. This movement is primarily along roads and passable tracks, also including those constructed for oil and gas exploration. How much of this settlement is completely new, and how much consists of people returning to places they had been before the wars, is not clear. However, it is apparent that the present settlement is more permanent and intensive than was the case previously.

Areas of significant settlement in recent years are along both sides of the Mocimboa–Palma road down to the coast, and in the Pundanhara area (Fig. 21). What was obviously extensive woodland and forest between Mocimboa and Palma has now been mostly destroyed, with significant differences being seen by us over the 18-month period of our visits in 2008–9.



Figure 21.  
Dry forest clearance  
and burning, Palma  
area (left) and Nhica do  
Rovuma (right).

The Mueda plateau is now almost wholly transformed, something that has probably occurred over the last 100 years. From the topography and soils, the area should have been dense miombo woodland with patches of dry forest, but it is now mostly fields and fallows. Some early plant collections from the area show dry forest species in areas that are now cleared. There are likely to be some remaining patches of good vegetation, especially on the escarpment and on the eastern slopes away from roads, but it would appear that there is now little of biodiversity conservation interest left.

Previous agriculture appears to have been somewhat itinerant, with slash & burn practices, little stumping, and extensive fallows. This does not seem to be so much the case now, with more stumping practised and more continued use of areas than previously. It is not clear to us the extent to which vegetation returns to what it was before being cleared if only slash & burn practices are used. Woodland, with its deep-rooted coppicing species, probably returns to something approaching its ‘original’ state in terms of composition and structure within 50–100 years. But this is unlikely to be the case with dry forest, which primarily consists of non-coppicing and more shallow-rooting species. It is also not clear to what extent the remaining dry forest patches are ‘original’ or have been subject to historic clearance. Certainly, the age structure of the dry forest patches, with few if any large-boled trees, suggests an age of only 50 or so years. But this may well be a natural feature.

## LOGGING

There are a number of forest concessions across the study area, with some large blocks east and south-east of Lake Nangade on the headwaters of rios Uncundi and Matapata (see Fig. 20). Although these are sometimes termed ‘protected areas’ and the level of offtake and measures to ensure sustainability are part of the lease agreement, it is unlikely that there is any significant conservation-orientated management occurring here. In practice it is probably an area where all marketable trees are removed. Logging tracks also act as a means for illegal hunters to operate easily, and also encourage the spread of small arable fields.

Illegal logging and hunting, often emanating from or linked to Tanzania, is by its very nature unplanned and not easy to control. It also seems to be linked to Chinese companies with the timber destined for that country (see Mackenzie 2006, Chilalo 2008, Mackenzie & Ribeiro 2009).

The main targeted timbers now, at least in the area north of the Rio Messalo, are primarily woodland, not forest, species – *Pterocarpus angolensis*, *Azelia quanzenensis* and *Millettia stuhlmannii*. Over the last 50 years there appears to have been extensive and heavy exploitation of large trees in the somewhat moister forests on the slopes of the Messalo valley around Chitunda and Chai, to the point where the previous forest or woodland structure is only discernable from a few large remnant trees – these forests have effectively been destroyed, probably past any potential point of recovery.

The extent of the present logging threat into the Palma–Rovuma area is not clear; presumably it is closely linked to accessibility via motorable tracks and proximity to a point of export, whether a port or across the border in Tanzania. Certainly there was evidence of *Azelia* and *Pterocarpus* trees being freshly cut in both the Pundanhara area and in Quiterajo (Fig. 22), and large numbers of logs were seen stacked in yards of commercial enterprises on the roads into Pemba and Mocímboa da Praia.

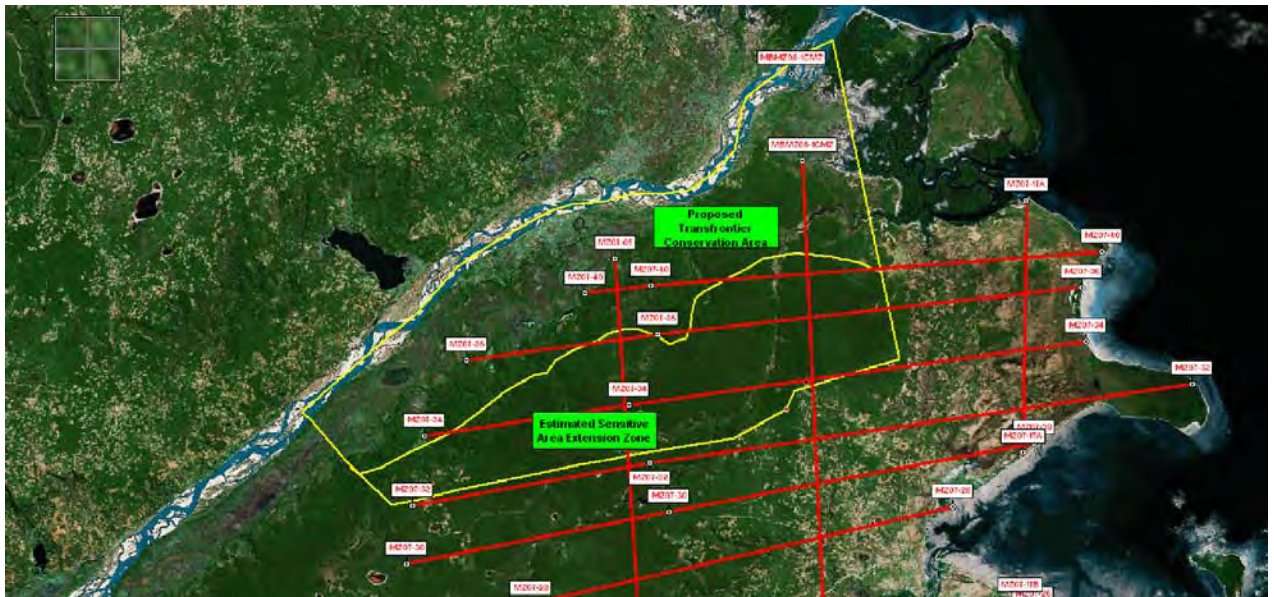


Figure 22.  
Recently cut *Azelia* tree,  
dry forest near Quiterajo.

## OIL AND GAS EXPLORATION

The presence of gas and oil deposits in the Palma area has been suspected for many years but it is only since 2007 that active exploration on land has occurred, although a test well was drilled in 1986 (Smelror *et al.* 2006). In 2008 a network of cut-lines, each between 3 and 5 m wide to allow for vehicle access, was made by the exploration company Artumas across the northern part of the study area (see Figs. 20 & 23). An initial environmental impact study was made (Impacto 2007), but the recommendations made as regards coastal forests were very basic. After seismic exploration was carried out, the cut-lines were “sealed” using cut branches to stop subsequent human access, and ditches were dug across access points (Fig. 24). However, this “sealing”, from what we could see, was not always adequate in areas away from the entrance points. In addition, as the dead branches rot away the tracks will become more accessible to bicycles and vehicles, although there is now also significant regeneration of woody plants from cut stumps.

Figure 23.  
Prospecting cut-lines,  
part of proposed Trans-  
frontier Conservation  
Area, and extension of  
Sensitive Area Zone,  
2008 (source: Artumas  
Exploration).



The conservation threat is not from the actual area cut, which is minimal, but from the fact that a number of forest and dense woodland areas are now becoming potentially accessible to settlement and hence are under threat of being cleared for fields. In addition, some tracks that were thought locally to be mined and dangerous were cleared.

Figure 20 shows another mining concession within the northern part of the study area. This is held by Rio Tinto but we have not been able to determine what mineral they may be interested in. That concession sits across the main area of pans and grassland, and extends in the north into good dense dry forest.





Figure 24.  
Prospecting cutline  
'sealed off' using bulldoz-  
ers and cut branches,  
Palma area.

Exploration operations have resulted in a small economic boom in Palma. But the associated development and population growth will put further pressure on the surrounding habitat as the need for charcoal and agricultural land increases.

## WILDFIRE

Despite relatively high humidity for much of the year, there is still a significant dry season when the risk of fire and fuel loads are high. Wildfires are very extensive across the study area, more so on the periphery of newer-settled localities, and result from uncontrolled burning associated with the slash & burn of newly-cleared fields and from fires set for hunting or to make travel through grassy areas easier. Fire is used widely and indiscriminately, and there appear to be no formal sanctions applied against those responsible, although it is technically illegal to set fires away from fields.

The vegetation of the area has evolved and developed with fire, but these fires were probably much less frequent and extensive in the past. Woodlands with their well-developed grassy layer are prone to burning, but are quite resilient to most fires in terms of species composition. Dry forest is unlikely to have evolved with fire as fuel loads are generally insufficient – fires cannot enter far into a patch unless there is a good litter layer. Whether dry forest was ever regularly subjected to fire, or what the effects of fire on it might be, needs further investigation.

What is notable is that the forest/woodland and woodland/grassland boundaries are becoming increasingly “hard” and fixed in the face of more frequent burning.

## Conservation Approach

The suggested approach to conservation taken here is two-fold. Firstly to try and build on existing areas that have some form of conservation or potential for conservation management, and secondarily to identify a range of sites across the study area within which a significant range of biodiversity could be protected. As mentioned earlier, there are some existing protected areas or areas where conservation management could be brought in under existing regulations. Existing protected areas are found in the Quirimbas National Park and the Maluane concession in Quiterajo, while there are various forest concessions across the area (Fig. 20) and at least one hunting concession in the Pundanhar–Nangade area. Although management of such areas is predicated on extraction or exploitation of renewable natural resources, this is meant to be sustainable and done under an approved and monitored management plan.

The second part has been done by using the model of Important Plant Areas (IPAs). IPAs (Plantlife International 2004) are based on the same concept as Important Bird Areas (IBAs), where the presence of species of global conservation significance, either due to threat status or restricted distribution, using various criteria, help select a “natural” or manageable area, e.g. an existing National Park.

Taking the idea of IPAs further, and once all zoological datas are available, it will be possible to identify Key Biodiversity Areas (KBAs, Langhammer *et al.* 2007). These are sites of global significance for biodiversity conservation and are identified using globally standard criteria and thresholds. They are based on the needs of biodiversity requiring safeguards at the site scale. The criteria are based on vulnerability and irreplaceability, both concepts used widely in systematic conservation planning. Area selection is rational, based on knowledge not supposition, is global in context, and the boundaries selected have to be practical for management. The areas can be large, but could also be quite small as long as the target species can be sustained. The idea of KBAs links species-based conservation with habitat-based conservation in a pragmatic way. Although area selection is triggered by species criteria, primarily the presence of globally threatened (CR, EN or VU) or range-restricted species, of which there are many in these coastal dry forests, the actual areas are often delimited by habitat criteria. The term ‘range-restricted’ has been interpreted in numerous ways, and for plants it has been suggested (IUCN 2008) that these are species with a global range of less than 50,000 km<sup>2</sup>, or even much smaller.

The study area is large, diverse, heavily impacted upon in places, and has a moderately large human population. It is also undergoing rapid development, with pressures on natural resources building up on a number of fronts. Hence any areas suggested for conservation need to be carefully selected so as to protect the widest range

of biodiversity within a limited area, in particular focussing on those vegetation types or areas that are unique or rare, in particular the patches of coastal dry forest that also support most of the endemic species or species of restricted coastal distribution. However, any area selected for conservation must also be viable, capable of supporting and allowing regeneration of the priority species it contains. It also needs to have boundaries that can be acceptable to local populations and that can be managed. For example, large areas such as the Quirimbas National Park, with over 50,000 people living inside, are very difficult to manage for their biodiversity attributes.

In the southern portion of the study area, given the fairly extensive transformation of the landscape that has already occurred, the best approach to vegetation and plant conservation is thought to be a selection of viable sites containing unique vegetation types and species assemblages. For coastal forests this is often possible as they tend to be fairly restricted in extent and occupy higher parts in the landscape, so are less threatened by human activities ‘upstream’. However, in the northern part of the study area, the dry forests, woodlands, termitaria and pans form a complex mosaic across a wider, gently undulating landscape, so there is both a necessity and possibility for landscape-level conservation, encompassing a range of interconnected habitats. This approach is also more appropriate for wide-ranging wildlife such as elephants, sable and roan antelope, and wild dogs. Management under such circumstances, however, is more difficult, but human use and activities – even settlement – are not necessarily precluded, as long as the ecological integrity of the landscape and habitats is not damaged. Hence our suggested approach to coastal forest conservation in Cabo Delgado is two-pronged.... site-level conservation in the southern sector, and larger area or landscape-level conservation in the north.

Below we provisionally identify a set of areas suitable for the conservation of both vegetation and plants across north-east Cabo Delgado. The selection is aimed at conserving a range of vegetation types, with particular reference to dry forests that support species of restricted distribution. Some level of prioritisation is also suggested. Area delimitation is based on available satellite imagery along with field knowledge. As we have physically not visited much of the entire study area, particularly the interior and up on the Mueda plateau, this selection must be considered preliminary. Further reconnaissance and field work may well identify better sites or additional areas.

## Proposed Conservation Areas

Although this report has focussed primarily on coastal dry forests, we do not intend to suggest that conservation of any other vegetation type is of lesser importance. However, it is generally true that other vegetation types will contain fewer plant species of restricted distribution. The dry forest areas listed here should be conserved as part of a mosaic or matrix of other associated vegetation types such as woodland. A number of the conservation priority areas suggested below contain a range of vegetation types, with area 14 in particular representing a whole landscape. It is not a case of just conserving dry forests across the study area.

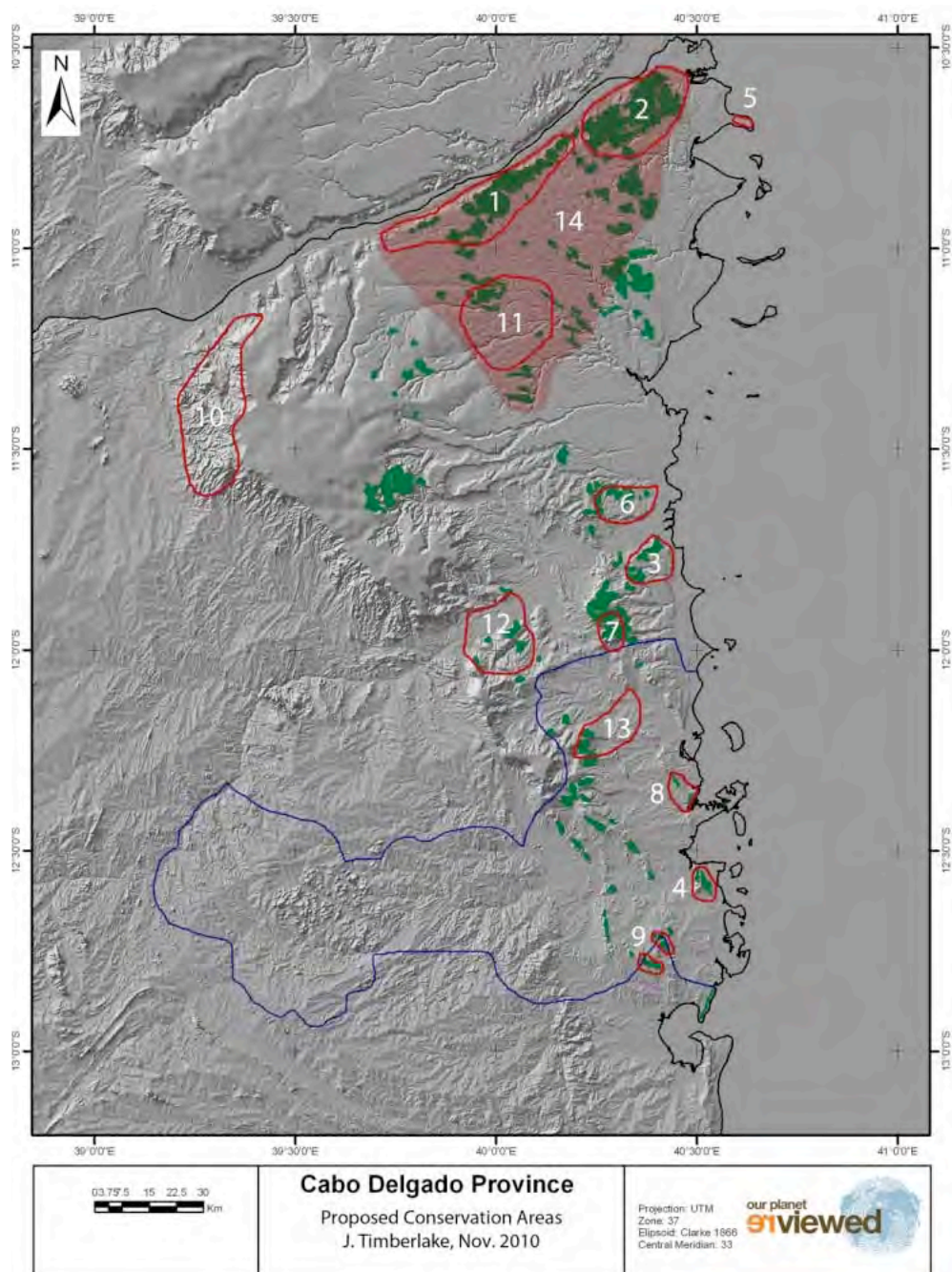


Figure 25.

Proposed areas for bio-diversity conservation in NE Cabo Delgado (see text below for numbered area descriptions). Quirimbas National Park boundary is shown in blue.



Nine proposed conservation sites were identified, four of which are considered to be of high priority. In addition five larger areas were delineated that encompass a range of vegetation types, and one large area is suggested for landscape-level conservation. All areas are shown in Fig. 25 and briefly described below.

It should be stressed that the nine sites at present are just candidate areas for evaluation as IPAs. Once species mapping has been finalised it will be possible to confirm their suitability under this designation.

## HIGH PRIORITY SITES

1. **Pundanhar–Nangade.** An elongated area (c. 450 km<sup>2</sup>) following the Rovuma rim and escarpment from 10 km east of Nangade to near Nhica do Rovuma. The area contains various types of dry forest, especially those dominated by *Scorodophloeus fischeri*, along with a number of restricted-range dry forest species. Six new species and 13 new Mozambique records were found here. It also contains a number of seasonal pans, miombo woodland, and open palm savanna on alluvium in the Rovuma valley. Part of it is included in an actively-managed hunting concession.

2. **Rio Macanga–Nhica do Rovuma.** A large (600 km<sup>2</sup>) block along the Rovuma escarpment from Nhica do Rovuma east almost to Quionga, centred on the Rio Macanga and its tributaries. This is possibly the largest contiguous block of dense vegetation in the study area and is still relatively undisturbed, probably owing to difficulties in access. There are a number of patches of dry forest within it, along with dense woodland, grassy drainage lines and dense mixed woodland to dry forest on the steep escarpment slopes. There were 17 new species found here (6 also elsewhere in the study area) and 30 new Mozambique records. The area also includes palm savanna and alluvial vegetation on the valley floor. No part of it is protected or managed for conservation or sustainable use.

3. **Quiterajo.** An interesting area of c. 125 km<sup>2</sup> within the Maluane concession containing a range of vegetation types including various types of dry forest, miombo woodland, mixed woodland, floodplain grassland, small lakes and grassy drainage lines. Much of this study was carried out in this area, which contains 16 new species (13 of which have not yet been found elsewhere) and 23 new records for Mozambique. There is a large 31 km<sup>2</sup> block (“The Banana”) of *Guibourtia schliebenii* dry forest, and a smaller area of *Micklethwaitia carvalhoi* forest near Gaza village, Lake Macungue.

4. **Lupangua.** A relatively small area (25 km<sup>2</sup>, of which c. 20 km<sup>2</sup> is dry forest) of intact dry forest on a low hill close to the coast inside the Quirimbas National Park,

near the village of Mahate south of Quissanga. The area has probably been protected by inaccessibility. It contains what is probably the largest population of the Mozambique endemic tree *Micklethwaitia carvalhoi* (Clarke 2010) on the calcareous clay-rich soils. There were 2 new Mozambique records found here and 1 new species (also in Quiterajo).

## SECOND PRIORITY SITES

5. **Cabo Delgado peninsula.** A small area (15 km<sup>2</sup>) at the end of the Cabo Delgado peninsula north of Palma, including the lighthouse. The vegetation is mostly dry coastal thicket on coral rag, a fairly widespread type along the East African coastline. Here it is in particularly good condition and, given its isolated geographical position, easier to conserve.

6. **Mbau.** An area of c.150 km<sup>2</sup> to the north of the Rio Messalo valley, from 10 km east of Mbau village to within 5 km of the sea and covering the southern tributaries of the Rio Bundaze. Although the area was not visited it is on Mikindani sandstone and appears very similar to the better-studied Quiterajo area south of the Rio Messalo, with a significant extent of dense vegetation up to the escarpment edge, including dry forest. It is relatively undisturbed.

7. **Sakaje plateau.** A relatively small area (46 km<sup>2</sup>) on the western and less disturbed part of the Sakaje plateau, 15 km east of Chai. Although attempts were made to reach the area this was not possible owing to lack of usable tracks, but it appears from satellite imagery and aerial survey to consist of thick vegetation with little clearance. There are likely to be patches of dry forest within it with a species composition similar to that found in Quiterajo to the north-east. The steep west-facing scarp, comprised of Mikindani sandstone or similar, protects the area from agricultural encroachment from Chai.

8. **Quissanga.** A small linear area (10 km<sup>2</sup>) near the sea next to the Rio Sivuco, 5 km north of Quissanga and opposite Ibo Island. Although not visited on the ground, from the air it has narrow strips of good dense vegetation on two ridges, probably with dry forest species. It appears to be on the same geological formation as the Lupangua area, so is likely to have similar vegetation.

9. **Napuda.** Two relatively small areas (totalling 15 km<sup>2</sup>) adjacent to the road leading into the Quirimbas National Park, just south of the Napuda entrance gate. Both comprise remnant dry forest and other dense vegetation on hill slopes of Mikindani sandstone. Although the hills are now being cleared, they have probably been protected by the comparatively steep terrain. In one area visited on the ground *Micklethwaitia carvalhoi* was common.

## AREAS WITH A RANGE OF VEGETATION TYPES

10. **Northern Mueda plateau.** An extensive area of around 700 km<sup>2</sup> on the north-western margins of the Mueda plateau, covering a small part of the plateau itself, the (apparently) least-disturbed parts of the west- and north-facing scarp, gullies and some of the footslopes. The vegetation up on the plateau appears to have mostly been cleared and is now open secondary woodland to wooded grassland, but there are probably a number of unusual species on the scarps and in thicker vegetation and woodland on the footslopes. The underlying geology is Mikindani sandstone with older rocks of the Macondes Formation at the scarp base. Although the area was not visited during the current survey, it is possible that some remnants of the original, apparently more mesic dry forest vegetation mentioned in Wild & Barbosa (1968) may still remain.

11. **Rio Uncundi.** An area of around 550 km<sup>2</sup> along the middle reaches of the Rio Uncundi, including part of the catchment of the Rio Injoma, where the districts of Nangade and Mocímboa da Praia meet, 40 km northwest of Mocímboa da Praia town. The vegetation covers a typical cross-section of the undulating landscape on Quaternary alluvium from dense miombo woodlands (probably with small patches of dry forest) on the upper well-drained sands, through more open miombo and similar woodland types to seasonally poorly-drained grassland and drainage lines. There are also a few seasonal pans present. From satellite imagery it appears little of the area has been cleared, but recent encroachment is likely.

12. **Rio Messalo.** An area of 380 km<sup>2</sup> straddling the Rio Messalo where it cuts through the southern part of the Mueda plateau. It covers a range of vegetation types from footslope thicket and dense woodland on dissected terrain of the Macondes Formation through to *Borassus* palm savanna on recent alluvium along the river. The palm stands seen from the air are particularly well-developed. The broken country in the south of the area still retains much vegetation cover and it is hoped that some remnants of the much moister tall forest once found on the slopes above the Rio Messalo around Chai and Chitunda, now logged almost to extinction, may still be found here.

13. **Mucojo flats.** An area of around 250 km<sup>2</sup> within the Quirimbas National Park straddling the broad valley of the Rio Muàcámula between Macomia and Mucojo. The valley comprises clay-rich Pleistocene deposits, some derived from Tertiary sediments that are particularly calcium-rich, but extends on higher ground to include outcrops of Mikindani sandstone with dense woodland (probably including patches of dry forest). The vegetation across the valley is open *Acacia* woodland to grassland, including *Acacia seyal* and the endemic *Acacia latispina*. It is the largest extent of

clay soils within the study area and is unusual in northern Mozambique.

#### LANDSCAPE-LEVEL CONSERVATION AREA

14. **Pundanhhar–Rio Uncundi landscape.** This extensive area of approximately 4000 km<sup>2</sup> lies on the gently undulating plateau between Nangade, Diaca and Quionga up to the main Mocímboa–Palma road. It is underlain primarily by Quaternary deposits at an altitude of 80–140 m, but with soils derived from Mikindani sandstones to the east and south-east. Owing to the gentle undulations drainage is poor, with numerous seasonal pans present and seasonal drainage lines, together with high water-table grassland and open woodland. The vegetation consists mostly of miombo (*Brachystegia spiciformis*) and similar woodland types on slightly elevated or better-drained areas, and open *Parinari–Uapaca* woodland, grassland and pans where the water table is seasonally high with poor drainage and anaerobic conditions in the rooting zone. On better-drained and coarser-textured sandy soils derived from sandstone towards the Mocímboa–Palma road, denser woodland with patches of dry forest is found. Such areas are particularly well-developed in the north towards the Rovuma escarpment (conservation areas 1 and 2).

The area is only lightly settled, probably owing to difficulties in access, seasonal flooding and generally poor soils. It is said to be a major source of water supplies for the towns of Palma and Mocímboa, and is also known for good wildlife populations, including elephant, lion, roan and sable antelope and wild dog. Sport hunting is one form of land use practiced, while logging was common in the past but has not yet returned to previous levels.

Within this extensive area, much of the most interesting and special biodiversity in northern Cabo Delgado can be found, and it is important to retain the ecosystem functionality of the area. A particular danger is excessive drainage or rapid runoff due to agricultural expansion and extensive and regular burning, which would allow woody encroachment into the grasslands, a lowering of the water-table and hence a reduction in the ecosystem service of regular water supply to the coastal population centres.



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## CONCLUSIONS

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The main findings are summarised below, along with some preliminary observations.

1. Most (but not all) of the coastal forest patches seen in Cabo Delgado are dry 'sand' forests. The patches are dominated by a canopy of early-deciduous and late-leaving tree species, often from the legume sub-families Caesalpinioideae and Papilionoideae, with scattered early-deciduous emergents. There is a major and significant difference in both phenology, species composition and ecological processes from the more familiar moist forests of montane areas in Eastern Africa or lowland forest of West Africa.

2. Dry forest is here defined as a vegetation formation with a relatively tall, closed or almost closed, canopy mostly comprising deciduous species, with sclerophyllous evergreen species in the sub-canopy and a poorly developed herbaceous layer. The species composition is characteristically different at both species and genus-level from the surrounding woodland and grassland. The dominant species do not appear to be deep-rooted, unlike those common in the adjacent miombo woodland. Moist forest formations from the continental interior, even if they contain a few typically coastal species, are excluded.

3. Owing to the high turnover in species composition between forest patches (looked at over a scale of some hundreds of square kilometres), it is very difficult to define coastal dry forests solely on a particular species composition, except at a sub-District scale. The closest linking or common species in this regard in Cabo Delgado is probably *Pteleopsis myrtifolia* (Combretaceae) and perhaps *Manilkara sansibarensis*.

4. There appears to be a strong linkage between the distribution of dry forest and underlying geology and soils. In Cabo Delgado that linkage is to red-brown coarse-textured sandstones of the Mikindani Formation, dating to about 15–10 Mya, which gives rise to coarse-textured, apparently acid and nutrient-poor, moderately

deep, unstructured and well-drained sandy soils. These may well be causative factors. Although some smaller forest areas, for example that at Lupangua, seem to be on a calcareous mudstone formation, not sandstone (Tom Müller, pers. comm.), it seems that the dry forest formations are mostly confined to nutrient-deficient (low P and N) sandy soils, not clays. At a landscape level it is notable that most forest patches are in the upper parts of the catena, usually on the summits of slight rises or in more elevated areas.

5. Particularly in the Palma–Nhica area, dry forests occur in an intimate matrix with miombo woodland and grassland. Forest is found on the highest parts of the catena, woodland on the slopes, becoming increasingly more open as the water table gets closer (at least seasonally) to the surface and with much finer-textured sandy soils, while high water table-dependent (edaphic) grassland is found in the depressions along with scattered trees of *Uapaca nitida* and *Parinari curatellifolia*. Along grassy drainage lines a margin of denser woodland is found, comprising *Brachystegia spiciformis*, *Azelia quanzensis* and *Berlinia orientalis*. There is a marked difference in species composition, although not total exclusivity, between woodland and dry forest vegetation types.

6. Once dry forest vegetation is heavily disturbed, there is a tendency for some tree species to coppice, the shrub layer becomes thicker and the area becomes more thicket-like. This is in contrast to moist forest where coppicing does not normally occur.

7. Owing to major disturbance of forest patches in both past and recent times (logging, clearing for mine fields, cultivation), it is difficult to determine what the original distribution (or species composition) of forest might have been across Cabo Delgado. It is not clear whether dry forest was extensive across large areas of the sandstone plateau (which is not that likely), or whether it has always had a patchy distribution, being confined to specific soil/landscape conditions. There is also the issue of the possible extent and importance of secondary invasion by *Brachystegia* and other miombo woodland species into what were dry forest areas. But this is not thought to have been particularly significant.

8. In practical terms, and from the viewpoint of biodiversity values, the presence of dry forest is best determined by the presence of dry forest species assemblages, rather than by physical structure. As it is now difficult to suggest which areas were originally typical forest based on vegetation structure, it is far more useful to look for species assemblages, even if only of coppice growth, to indicate where dry forest areas were.

9. Based on landform and soils, the original extent of "dense vegetation", a combination of dry forest and dense woodland, was estimated at 6080 km<sup>2</sup> across the study area, with by far the greater proportion of this in the northern sector. Of this total, perhaps only 615 km<sup>2</sup> was ever what we now term dry forest.

10. Using satellite imagery it was calculated that only about 1180 km<sup>2</sup> of "dense vegetation" still remained in 2000, indicating a loss over the previous 100–150 years of over 80%. The area of greatest loss was the Mueda plateau (96%), with much lower losses in the north-eastern (Palma–Quionga) sector. The total extent of dry forest, which was only ever a small proportion of "dense vegetation", was estimated to be almost 400 km<sup>2</sup> in 2000, with two-thirds of this associated with the southern margin of the Rovuma valley in the Pundandar–Quionga–Palma area. Another important block was in the Quiterajo–Messalo area. However, observation on the ground in recent years suggests that this extent of dry forest has been significantly reduced since 2000, perhaps to only 300–350 km<sup>2</sup>.

11. Earlier estimates of the extent of coastal forest in Mozambique are confusing as broad and rather uncritical definitions were used. The best available figures are 4870 or 4180 km<sup>2</sup> (WWF and Conservation International). However, given that perhaps half of coastal forest in Mozambique was thought to lie within the present study area, this figure is much higher than our estimates of 400 km<sup>2</sup> still existing in the Cabo Delgado area would suggest.

12. A total of 738 plant taxa were been recorded from the study area by the 2008–2009 expeditions. Together with other collections from 2003 and 2005, 35 of these taxa are thought to be new or undescribed species, and a further 67 represent new records for Mozambique. The family Rubiaceae is the largest in terms of species number (83) and new species (13). The various legume families (Caesalpinioideae, Mimosoideae and Papilionoideae) are also very important.

13. A preliminary analysis of distribution patterns shows that a number of taxa are restricted to NE Mozambique and the Lindi area of SE Tanzania. There appears to be a Rovuma/ Lindi centre of plant endemism, as had been suggested earlier (Clarke 2001), but this needs to be investigated further.

14. A rapid study of forest species diversity in the Quiterajo area showed 46 woody species in 0.25 ha, with 35 species with at least one individual with a diameter greater than 6 cm. Stem density (>6 cm dbh) was 1328 stems/ha, the commonest being *Guibourtia schliebenii* with 284 stems/ha.

15. Given the dominance of forest patches by species of restricted distribution, confined globally to just hundreds or a few thousands of square kilometres, it is unlikely that the species composition of dry forest is secondary, a result of invasion by species previously not present. Dry forest species must have evolved in situ over hundreds of thousands or millions of years and in a similar environment to that found now. However, it could be that present patch dominance is a reflection of past disturbance, with the present dominant species having been present in these dry forests but not as abundant as before. It is interesting to speculate on what might be the causes of the relatively high levels of speciation in the eastern Africa coastal region, and also what might be the driving forces for the high turnover in composition between nearby areas. The substrates involved are not old (in contrast to "old landscapes" in granite areas, Chimanimani Mountains and the Cape) with long stable periods available for evolution to occur. Indeed, further south most coastal forests are on recent Quaternary deposits. To date this feature has not been satisfactorily explained.

16. The main threat to dry forest and other vegetation types of conservation interest is clearance for subsistence agriculture. This is exacerbated by improved access resulting from geophysical prospecting for oil and gas. Illegal logging is also an important threat, although in the northern sector logging was perhaps more damaging during colonial times. Frequent wild fires are a compounding factor in halting regeneration and restoration of dry forest. Once established dry forest is relatively immune to most fires.

17. Given that the major threat to these coastal dry forests is clearance for subsistence agriculture or logging, and improved access to what were hitherto almost inaccessible areas, a socio-economic study needs to be carried out to determine how extensive and strong these threats actually are and what might be the best way to overcome them. Some resource-sharing activities may be possible without destroying the ecological integrity of the selected conservation areas.

18. Fourteen areas of known or possible value for conservation of plant species, vegetation and ecological processes were identified – four high priority areas (Pundanhar–Nangade, Rio Macanga–Nhica do Rovuma, Quiterajo, Lupangua) that should qualify as Important Plant Areas, five smaller areas of second priority, four large areas covering a wide range of vegetation types and ecological processes, and a large area near the Rio Rovuma suitable for landscape-level conservation, including for wildlife populations. Although the selection focusses primarily on coastal dry forests and their species of restricted distribution, associated vegetation types and species should also form part of conservation planning.



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## RECOMMENDATIONS

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These are divided into two categories – recommendations for conservation and similar actions, and recommendations for future studies necessary for effective management.

### CONSERVATION

1. A network of areas across NE Cabo Delgado where the conservation of plant and animal diversity is of paramount importance needs to be identified. This has only been provisionally done in this study. Such areas – Important Plant Areas or Key Biodiversity Areas – need to be under Provincial or national government supervision. They must be manageable in practice and have politically-acceptable boundaries.
2. The Instituto de Investigação Agrária de Moçambique (IIAM) in Maputo should now take the initiative to identify potential conservation areas and carry out all necessary investigation and research. The mandate to do this was given in June 2009 by the Minister of Science and Technology in Mozambique.
3. Given that the major threat to these coastal dry forests is clearance for subsistence agriculture or logging, and improved access to what were hitherto almost inaccessible areas, a socio-economic study needs to be carried out to determine how extensive and strong these threats actually are and what might be the best way to overcome them. Some resource-sharing activities may be possible without destroying the ecological integrity of the selected conservation areas.

## FUTURE STUDIES

4. There should be further plant collecting at other times of year, particularly in January and May when more herbs and grasses will be fertile. Most survey work that has taken place was in the late dry season and very early rains and gives an incomplete picture.

5. Determine what causes the distribution of dry forest patches and species. This is likely to be a combination of landform and soil type, including particle size distribution, subsoil texture, drainage status, acidity and mineral exchange capacity, but needs to be investigated. Soil scientists and an evaluation of soil and geology are required.

6. Determine how unique the Mozambique dry forests are in terms of composition, structure and ecology compared to coastal forests in Tanzania and Kenya, and particularly to those in the Lindi area. This will involve the GIS mapping of selected individual species using geo-referenced species data, and will be initiated by RBG Kew.

7. Explore the relationship between the coastal dry forests of the East African Coastal Forest Ecoregion and the patchy but widely distributed dry sand forests and thickets across the continental interior to W Zambia (e.g. Itigi thickets in C Tanzania, Mweru-Wantipa thickets in N Zambia, "jesse bush" of the mid-Zambezi valley, *Androstachys* thickets of W Gaza Province, *Baikiaea* thickets of W Zambia and NW Zimbabwe, *Xylia* dry forests of NC Zimbabwe). There appears to be a strong similarity in terms of their structure, ecological determinants and landscape position. From this a greater appreciation of biogeography and regional conservation understanding should emerge.

8. Other research questions that should be addressed in order to guide conservation management are: (a) has the species composition of these forests and their coppicing ability led to their continued existence as forest (rather than thicket) in the face of historical logging and clearance; (b) are they more resilient in the face of fire, or are they essentially "fire-proof"; and (c) is what we see now the "original composition" or the result of past disturbance?

9. The present type of study should be extended to dry forests further south in Mozambique down to the Zambezi River, in particular to the Nacala–Mossuril area and along the coast between Angoche and Pebane. Survey and mapping of these southern areas, where dry forests are known to exist, would provide a firmer basis for a national coastal conservation programme and enable the Mozambican authorities to play a stronger role in regional conservation initiatives (such as the Eastern Africa Coastal Ecoregion Programme of WWF). It would also provide a clearer indication to global conservation bodies such as WWF, IUCN and Conservation International of the important contribution Mozambique provides to one recognised Global Hotspot. At present much of its importance and significance is assumed and not always based on clear evidence.

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## ANNEX 1.

### **List of persons involved in the botanical and vegetation study** (fieldwork and identification).

Plant identification was done by the RBG Kew Africa Drylands team and other specialists.

Tereza **Alves**, Forestry Research, IIAM, Maputo  
 Ana-Claudia **de Araujo**, Herbarium, RBG Kew, UK (Cyperaceae)  
 Aurelio **Banze**, Herbarium, IIAM, Maputo  
 Diane **Bridson**, Herbarium, RBG Kew, UK (Rubiaceae)  
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 Sandie **Burrows**, Buffelskloof Herbarium, Lydenberg, South Africa  
 Susan **Carter**, Herbarium, RBG Kew, UK (succulent *Euphorbia*)  
 Gillian **Challen**, Herbarium, RBG Kew, UK (Euphorbiaceae)  
 Martin **Cheek**, Herbarium, RBG Kew, UK (*Cola*)  
 G. Philip **Clarke**, independent botanist, Copenhagen, Denmark  
 Frances **Crawford**, Herbarium, RBG Kew, UK  
 Phillip **Cribb**, Herbarium, RBG Kew, UK (Orchidaceae)  
 Iain **Darbyshire**, Herbarium, RBG Kew, UK  
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 Barbara **Turpin**, independent botanist, Mpumulanga, South Africa  
 Paul **Wilkin**, Herbarium, RBG Kew, UK (monocots)



## ANNEX 2.

Checklist of plants collected or recorded during Pro-Natura International Cabo Delgado project expeditions in 2008–2009.

Family	Name	Life form
PTERIDOPHYTES		
Azollaceae	<i>Azolla pinnata</i> R.Br.	Aq. fern
Blechnaceae	<i>Stenochlaena tenuifolia</i> (Desv.) T.Moore	Fern
Dennstaedtiaceae	<i>Blotiella natalensis</i> (Hook.) R.M.Tryon	Fern
Parkeriaceae	<i>Ceratopteris thalictroides</i> (L.) Brongn.	Aq. fern
MONOCOTS		
Amaryllidaceae	<i>Crinum aurantiacum</i> Lehmler	Geophyte
Amaryllidaceae	<i>Crinum stuhlmannii</i> Baker	Geophyte
Amaryllidaceae	<i>Scadoxus multiflorus</i> (Martyn) Raf. <i>subsp. multiflorus</i>	Geophyte
Anthericaceae	<i>Chlorophytum amplexicaule</i> Baker	Herb
Anthericaceae	<i>Chlorophytum blepharophyllum</i> Baker	Herb
Araceae	<i>Amorphophallus maximus</i> (Engl.) N.E.Br <i>subsp. fischeri</i> (Engl.) Govaerts & Frodin	Geophyte
Araceae	<i>Anchomanes abbreviatus</i> Engl.	Geophyte
Araceae	<i>Culcasia orientalis</i> Mayo	Vine
Araceae	<i>Gonatopus angustus</i> N.E.Br.	Geophyte
Araceae	<i>Gonatopus boivinii</i> (Decne.) Engl.	Geophyte
Araceae	<i>Gonatopus clavatus</i> Mayo	Geophyte
Araceae	<i>Gonatopus petiolulatus</i> (Peter) Bogner	Geophyte
Araceae	<i>Pistia stratiotes</i> L.	Aquatic
Araceae	<i>Stylochaeton borumensis</i> N.E.Br.	Geophyte
Araceae	<i>Stylochaeton euryphyllum</i> Mildbr.	Geophyte
Araceae	<i>Stylochaeton obliquinervis</i> Peter	Geophyte
Araceae	<i>Stylochaeton puberulus</i> N.E.Br.	Geophyte
Asparagaceae	<i>Asparagus</i> ? sp. nov.	Shrub
Asparagaceae	<i>Asparagus falcatus</i> L.	Shrub
Asparagaceae	<i>Asparagus flagellaris</i> (Kunth) Baker <i>sens. lat.</i> ( <i>A. pauli-guilelmii</i> Solms form)	Shrub
Asparagaceae	<i>Asparagus petersianus</i> Kunth	Shrub
Commelinaceae	<i>Aneilema aequinoctiale</i> (P.Beauv.) Loudon	Herb
Commelinaceae	<i>Aneilema indehiscens</i> Faden <i>subsp. lilacinum</i> Faden	Herb
Commelinaceae	<i>Aneilema pedunculatum</i> C.B.Clarke	Herb
Commelinaceae	<i>Aneilema petersii</i> (Hassk.) C.B.Clarke <i>subsp. petersii</i>	Herb
Commelinaceae	<i>Anthericosum</i> sp.	Herb
Commelinaceae	<i>Commelina</i> sp.	Herb

Family	Name	Life form
Commelinaceae	<i>Cyanotis</i> sp.	Herb
Commelinaceae	<i>Murdannia simplex</i> (Vahl) Brenan	Herb
Cyperaceae	<i>Bulbostylis</i> cf. <i>burchellii</i> (Ficalho & Hiern) C.B.Clarke	Herb
Cyperaceae	<i>Cyperus dives</i> Delile	Herb
Cyperaceae	<i>Cyperus exaltatus</i> Retz. (= <i>C. odoratus</i> L.)	Herb
Cyperaceae	<i>Cyperus</i> cf. <i>hemisphaericus</i> Boeckeler (= <i>C. macrocarpus</i> )	Herb
Cyperaceae	<i>Cyperus obtusiflorus</i> Vahl (= <i>C. niveus</i> var. <i>leucocephalus</i> )	Herb
Cyperaceae	<i>Cyperus prolifer</i> Lam.	Herb
Cyperaceae	<i>Cyperus vestitus</i> Krauss	Herb
Cyperaceae	<i>Cyperus zanzibarensis</i> C.B.Clarke	Herb
Cyperaceae	<i>Kyllinga</i> cf. <i>crassipes</i> Boeck.	Herb
Cyperaceae	<i>Rhynchospora candida</i> (Nees) Boeck.	Herb
Dioscoreaceae	<i>Dioscorea asteriscus</i> Burkill	Vine
Dioscoreaceae	<i>Dioscorea cochleari-apiculata</i> De Wild.	Vine
Dioscoreaceae	<i>Dioscorea sansibarensis</i> Pax	Vine
Dracaenaceae	<i>Dracaena mannii</i> Baker	Tree
Dracaenaceae	<i>Dracaena</i> ? <i>reflexa</i> Lam.	Tree
Dracaenaceae	<i>Sansevieria canaliculata</i> Carrière	Herb
Dracaenaceae	<i>Sansevieria hyacinthoides</i> (L.) Druce	Herb
Dracaenaceae	<i>Sansevieria</i> cf. <i>metallica</i> Gérôme & Labroy	Herb
Eriospermaceae	<i>Eriospermum abyssincum</i> Baker	Geophyte
Flagellariaceae	<i>Flagellaria guineensis</i> Schumach.	Vine
Hyacinthaceae	<i>Dipcadi longifolium</i> (Lindl.) Baker	Geophyte
Hyacinthaceae	<i>Dipcadi</i> ? <i>viride</i> (L.) Moench	Geophyte
Hyacinthaceae	<i>Drimia altissima</i> (L.f.) Ker Gawl.	Geophyte
Hyacinthaceae	<i>Drimiopsis burkei</i> Baker	Geophyte
Hyacinthaceae	<i>Ledebouria revoluta</i> (L.f.) Jessop	Geophyte
Hypoxidaceae	<i>Hypoxis angustifolium</i> Lam.	Geophyte
Hypoxidaceae	<i>Hypoxis niasica</i> Baker	Geophyte
Iridaceae	<i>Gladiolus decoratus</i> Baker	Geophyte
Orchidaceae	<i>Acampe pachyglossa</i> Rchb.f.	Epiphyte
Orchidaceae	<i>Eulophia acutilabra</i> Sommerh.	Geophyte
Orchidaceae	<i>Eulophia cucullata</i> (Sw.) Steud.	Geophyte
Orchidaceae	<i>Eulophia guineensis</i> Lindl.	Geophyte
Orchidaceae	<i>Eulophia livingstoneana</i> (Rchb.f.) Summerh.	Geophyte
Orchidaceae	<i>Eulophia longisepala</i> Rendle	Geophyte
Orchidaceae	<i>Eulophia penduliflora</i> Kraenzl.	Geophyte
Orchidaceae	<i>Microcoelia exilis</i> Lindl.	Epiphyte
Orchidaceae	<i>Microcoelia megalorrhiza</i> (Rchb.f.) Summerh.	Epiphyte
Orchidaceae	<i>Microcoelia physophora</i> (Rchb.f.) Summerh.	Epiphyte
Orchidaceae	<i>Nervilia bicarinata</i> (Blume) Schltr.	Geophyte

Family	Name	Life form
Palmae	<i>Hyphaene compressa</i> H.Wendl.	Palm
Palmae	<i>Hyphaene petersiana</i> Mart.	Palm
Tecophilaeaceae	<i>Kabuyea hostifolia</i> (Engl.) Brummitt	Geophyte
Zingiberaceae	<i>Siphonochilus aethiopicus</i> (Schweinf.) B.L.Burt	Geophyte
Zingiberaceae	<i>Siphonochilus kirkii</i> (Hook.f.) B.L.Burt	Geophyte

DICOTS		
Acanthaceae	<i>Barleria repens</i> Nees	Herb
Acanthaceae	<i>Barleria spinulosa</i> Klotzsch	Herb
Acanthaceae	<i>Blepharis affinis</i> Lindau	Herb
Acanthaceae	<i>Brillantaisia riparia</i> (Vollesen & Brummitt) Sidwell	Herb
Acanthaceae	<i>Crossandra puberula</i> Klotzsch	Herb
Acanthaceae	<i>Dicliptera aculeata</i> C.B.Clark	Herb
Acanthaceae	<i>Dicliptera heterostegia</i> Nees	Herb
Acanthaceae	<i>Elytraria acaulis</i> (L.f.) Lindau	Herb
Acanthaceae	<i>Hypoestes forskaolei</i> (Vahl) R.Br.	Herb
Acanthaceae	<i>Justicia anagalloides</i> (Nees) T.Anders.	Herb
Acanthaceae	<i>Justicia fittonioides</i> S.Moore	Herb
Acanthaceae	<i>Justicia stachytarphetoides</i> (Lindau) C.B.Clark	Herb
Acanthaceae	<i>Lankesteria alba</i> Lindau	Herb
Acanthaceae	<i>Lepidagathis plantaginea</i> Mildbr.	Herb
Acanthaceae	<i>Nelsonia canescens</i> (Lam.) Spreng.	Herb
Acanthaceae	<i>Neuracanthus africanus</i> S.Moore subsp. <i>africanus</i>	Herb
Acanthaceae	<i>Ruellia prostrata</i> Poir.	Herb
Acanthaceae	<i>Whitfieldia orientalis</i> Vollesen	Herb
Avicenniaceae	<i>Avicennia marina</i> (Forssk.) Vierh.	Tree
Amaranthaceae	<i>Celosia ? nervosa</i> C.C.Towns.	Herb
Amaranthaceae	<i>Celosia</i> sp. aff. <i>nervosa</i> C.C.Towns.	Herb
Anacardiaceae	<i>Lannea antiscorbutica</i> (Hiern) Engl.	Tree
Anacardiaceae	<i>Lannea schweinfurthii</i> (Engl.) Engl. var. <i>acutifolia</i> (Engl.) Kokwaro	Tree
Anacardiaceae	<i>Ozoroa insignis</i> Delile subsp. <i>reticulata</i> (Baker f.) Gillett	Shrub
Anacardiaceae	<i>Ozoroa obovata</i> (Oliv.) R.Fern.& A.Fern.	Tree
Anacardiaceae	<i>Rhus</i> cf. <i>chirindensis</i> Baker f.	Shrub
Anacardiaceae	<i>Sorindeia madagascariensis</i> DC.	Tree
Annonaceae	<i>Artabotrys brachypetalus</i> Benth.	Liana
Annonaceae	<i>Artabotrys modestus</i> Diels subsp. <i>macranthus</i> Verdc.	Liana
Annonaceae	<i>Cleistochlamys kirkii</i> (Benth.) Oliv.	Shrub
Annonaceae	<i>Dielsiothamnus divaricatus</i> (Diels) R.E.Fr.	Tree
Annonaceae	<i>Hexalobus mossambicensis</i> N.Robson	Tree
Annonaceae	<i>Letowianthus stellatus</i> Diels	Tree
Annonaceae	<i>Monanthes buchananii</i> (Engl.) Verdc.	Shrub

Family	Name	Life form
Annonaceae	<i>Monanthotaxis faulknerae</i> Verdc.	Suffrutex
Annonaceae	<i>Monanthotaxis trichantha</i> (Diels) Verdc.	Shrub
Annonaceae	<i>Monodora</i> cf. <i>grandidieri</i> Baill. – flowers v. small	Tree
Annonaceae	<i>Monodora grandidieri</i> Baill.	Tree
Annonaceae	<i>Monodora junodii</i> Engl.& Diels	Tree
Annonaceae	<i>Monodora minor</i> Engl.& Diels	Shrub
Annonaceae	<i>Ophrypetalum</i> cf. <i>odoratum</i> Diels	Tree
Annonaceae	<i>Sphaerocoryne gracilis</i> (Engl.& Diels) Verdc. subsp. <i>gracilis</i>	Tree
Annonaceae	<i>Uvaria acuminata</i> Oliv.	Shrub
Annonaceae	<i>Uvaria</i> cf. <i>angolensis</i> Oliv.	Shrub
Annonaceae	<i>Uvaria kirkii</i> Hook.f.	Tree
Annonaceae	<i>Xylopi aethiopica</i> (Dunal) A.Rich.	Tree
Annonaceae	<i>Xylopi collina</i> Diels	Shrub
Annonaceae	<i>Xylopi parviflora</i> (A.Rich.) Benth.	Shrub
Annonaceae	<i>Xylopi</i> sp. A of FTEA	Tree
Annonaceae	<i>Xylopi</i> sp. nov.	Tree
Apocynaceae	<i>Ancylobothrys petersiana</i> (Klotzsch) Pierre	Liana
Apocynaceae	<i>Ancylobothrys tayloris</i> (Stapf) Pichon	Liana
Apocynaceae	<i>Aspidoglossum biflorum</i> E.Mey.	Geophyte
Apocynaceae	<i>Baissea myrtifolia</i> (Benth.) Pichon	Liana
Apocynaceae	<i>Calotropis gigantea</i> (L.) W.T.Aiton	Shrub
Apocynaceae	<i>Carvalhoa campanulata</i> K.Schum.	Shrub
Apocynaceae	<i>Cryptolepis hypoglaucula</i> K.Schum.	Vine
Apocynaceae	<i>Cynanchum gerrardii</i> (Harv.) Liedtke	Vine
Apocynaceae	<i>Cynanchum viminalis</i> L. subsp. <i>suberosum</i> (Meve & Liedtke) Goyder	Vine
Apocynaceae	<i>Glossostelma carsonii</i> (N.E.Br.) Bullock	Geophyte
Apocynaceae	<i>Holarrhena pubescens</i> (Buch.-Ham.) G.Don	Tree
Apocynaceae	<i>Landolphia kirkii</i> R.A.Dyer	Liana
Apocynaceae	<i>Marsdenia cynanchoides</i> Schltr.	Vine
Apocynaceae	<i>Raphionacme splendens</i> Schltr.	Geophyte
Apocynaceae	<i>Rauvolfia</i> ? <i>caffra</i> Sond.	Tree
Apocynaceae	<i>Saba comorensis</i> (Bojer) Pichon	Liana
Apocynaceae	<i>Schizozygia coffaeoides</i> Baill.	Shrub
Apocynaceae	<i>Secamone parvifolia</i> (Oliv.) Bullock	Shrub
Apocynaceae	<i>Secamone retusa</i> N.E.Br.	Vine
Apocynaceae	<i>Stathmostelma pedunculatum</i> (Decne.) K.Schum.	Geophyte
Apocynaceae	<i>Strophanthus courmontii</i> Franch.	Liana
Apocynaceae	<i>Strophanthus kombe</i> Oliv.	Liana
Apocynaceae	<i>Strophanthus petersianus</i> Klotzsch	Liana
Apocynaceae	<i>Tabernaemontana elegans</i> Stapf	Tree
Apocynaceae	<i>Tacazzea apiculata</i> Oliv.	Vine



Family	Name	Life form
Apocynaceae	<i>Tylophora anomala</i> N.E.Br.	Vine
Apocynaceae	<i>Tylophora stenoloba</i> N.E.Br.	Vine
Apocynaceae	<i>Voacanga thouarsii</i> Roem.& Schult.	Tree
Araliaceae	<i>Cussonia zimmermannii</i> Harms	Tree
Balanitaceae	<i>Balanites maughamii</i> Sprague subsp. <i>acuta</i> Sands	Tree
Balanitaceae	<i>Balanites maughamii</i> Sprague subsp. <i>maughamii</i>	Tree
Balsaminaceae	<i>Impatiens walleriana</i> Hook.f.	Herb
Bignoniaceae	<i>Fernandoa magnifica</i> Seem.	Tree
Bignoniaceae	<i>Kigelia africana</i> (Lam.) Benth. subsp. <i>africana</i>	Tree
Bignoniaceae	<i>Markhamia obtusifolia</i> (Baker) Sprague	Tree
Bignoniaceae	<i>Markhamia zanzibarica</i> (DC.) Engl.	Tree
Bignoniaceae	? <i>Stereospermum kunthianum</i> Cham.	Tree
Bombacaceae	<i>Adansonia digitata</i> L.	Tree
Bombacaceae	<i>Bombax rhodognaphalon</i> K.Schum. var. <i>rhodognaphalon</i>	Tree
Bombacaceae	<i>Bombax rhodognaphalon</i> K.Schum. var. <i>tomentosum</i> A.Robyns	Tree
Boraginaceae	<i>Bourreria petiolaris</i> (Lam.) Thulin	Tree
Boraginaceae	<i>Coldenia procumbens</i> L.	Herb
Boraginaceae	<i>Cordia goetzei</i> Gürke	Tree
Boraginaceae	<i>Cordia subcordata</i> Lam.	Tree
Boraginaceae	<i>Ehretia amoena</i> Klotzsch	Tree
Boraginaceae	<i>Heliotropium indicum</i> L.	Herb
Boraginaceae	<i>Heliotropium ovalifolium</i> Forssk.	Herb
Burseraceae	<i>Commiphora africana</i> (A.Rich.) Engl. var. <i>africana</i>	Tree
Burseraceae	<i>Commiphora fulvotomentosa</i> Engl.	Tree
Burseraceae	<i>Commiphora karibensis</i> Wild	Tree
Burseraceae	<i>Commiphora pteleifolia</i> Engl.	Tree
Burseraceae	<i>Commiphora serrata</i> Engl.	Tree
Burseraceae	<i>Commiphora zanzibarica</i> (Baill.) Engl.	Tree
Capparaceae	<i>Boscia angustifolia</i> A.Rich. var. <i>corymbosa</i> (Gilg) DeWolf	Tree
Capparaceae	<i>Boscia mossambicensis</i> Klotzsch	Tree
Capparaceae	<i>Cadaba kirkii</i> Oliv.	Shrub
Capparaceae	<i>Capparis erythrocarpos</i> Iserl var. <i>rosea</i> (Klotzsch) DeWolf	Vine
Capparaceae	<i>Capparis seiparia</i> L. var. <i>stuhlmannii</i> (Gilg) DeWolf	Vine
Capparaceae	<i>Capparis tomentosa</i> Lam.	Vine
Capparaceae	<i>Capparis viminea</i> Oliv. var. <i>viminea</i>	Vine
Capparaceae	<i>Cladostemon kirkii</i> (Oliv.) Pax & Gilg	Shrub
Capparaceae	<i>Maerua acuminata</i> Oliv.	Shrub
Capparaceae	<i>Maerua aethiopica</i> (Fenzl) Oliv.	Shrub
Capparaceae	<i>Maerua andradae</i> Wild	Suffrutex
Capparaceae	<i>Maerua angolensis</i> DC.	Tree
Capparaceae	<i>Maerua bussei</i> (Gilg & Gilg-Ben.) Wilczek	Tree

Family	Name	Life form
Capparaceae	<i>Maerua grantii</i> Oliv.	Shrub
Capparaceae	<i>Maerua kirkii</i> (Oliv.) F.White	Tree
Capparaceae	<i>Maerua</i> sp. aff. <i>filiformis</i>	Vine
Capparaceae	<i>Ritchiea capparoides</i> (Andrews) Britten var. <i>capparoides</i>	Liana
Capparaceae	<i>Ritchiea pygmaea</i> (Gilg) DeWolf	Suffrutex
Capparaceae	? <i>Thilachium africanum</i> Lour.	Shrub
Caryophyllaceae	<i>Polycarpon prostratum</i> (Forssk.) Aschers.& Schweinf.	Herb
Celastraceae	<i>Brexia madagascariensis</i> (Lam.) Ker-Gawl.	Shrub
Celastraceae	<i>Elaeodendron buchananii</i> (Loes.) Loes.	Tree
Celastraceae	<i>Maytenus heterophylla</i> (Eckl.& Zeyh.) N.Robson	Shrub
Celastraceae	<i>Maytenus mossambicensis</i> (Klotzsch) Blakelock var. <i>mossambicensis</i>	Shrub
Celastraceae	<i>Maytenus senegalensis</i> (Lam.) Exell	Shrub
Celastraceae	<i>Maytenus undata</i> (Thunb.) Blakelock	Tree
Celastraceae	<i>Mystroxydon aethiopicum</i> (Thunb.) Loes.	Tree
Celastraceae	<i>Pleurostylia</i> ? sp. nov. aff. <i>serrulata</i> Loes.	Shrub
Celastraceae	<i>Pristimera andongensis</i> (Oliv.) N.Hallé var. <i>volkensii</i> (Loes.) N.Hallé & B.Mathew	Shrub
Celastraceae	? <i>Reissantia indica</i> (Willd.) N.Hallé	Shrub
Celastraceae	<i>Salacia</i> ? <i>leptoclada</i> Tul.	Shrub/lian
Celastraceae	<i>Salacia madagascariensis</i> (Lam.) DC.	Shrub/lian
Celastraceae	<i>Salacia orientalis</i> N.Robson	Shrub/lian
Celastraceae	<i>Salacia stuhlmanniana</i> Loes.	Shrub/lian
Ceratophyllaceae	<i>Ceratophyllum demersum</i> L.	Aquatic
Chenopodiaceae	<i>Suaeda monoica</i> J.F.Gmel.	Shrub
Chrysobalanaceae	<i>Hirtella zanzibarica</i> Oliv. subsp. <i>zanzibarica</i>	Tree
Chrysobalanaceae	<i>Parinari curatellifolia</i> Benth.	Tree
Clusiaceae	<i>Garcinia acutifolia</i> N.Robson	Shrub
Clusiaceae	<i>Garcinia livingstonei</i> T.Anders.	Shrub
Clusiaceae	<i>Harungana madagascariensis</i> Poir.	Tree
Clusiaceae	<i>Psorospermum febrifugum</i> Spach	Shrub
Clusiaceae	<i>Vismia</i> ? sp. nov.	Tree
Clusiaceae	<i>Vismia orientalis</i> Engl.	Shrub
Clusiaceae	<i>Vismia pauciflora</i> Milne-Redh.	Shrub
Combretaceae	<i>Combretum andradae</i> Exell & J.G.Garcia	Liana
Combretaceae	<i>Combretum butyrosom</i> (Bertol.f.) Tul.	Liana
Combretaceae	<i>Combretum constrictum</i> (Benth.) M.A.Lawson	Shrub/lian
Combretaceae	<i>Combretum hereroense</i> Schinz var. <i>hereroense</i>	Shrub
Combretaceae	<i>Combretum holstii</i> Engl.	Liana
Combretaceae	<i>Combretum illairii</i> Engl.	Liana
Combretaceae	<i>Combretum paniculatum</i> Vent.	Liana
Combretaceae	<i>Combretum pentagonum</i> M.A.Lawson	Liana

Family	Name	Life form
Combretaceae	<i>Combretum pisoniiflorum</i> (Klotzsch) Engl.	Liana
Combretaceae	<i>Combretum stocksii</i> Sprague	Liana
Combretaceae	<i>Combretum xanthothyrsus</i> Engl.& Diels	Liana
Combretaceae	<i>Combretum zeyheri</i> Sond.	Tree
Combretaceae	<i>Pteleopsis barbosa</i> Exell	Tree
Combretaceae	<i>Pteleopsis myrtifolia</i> (M.A.Lawson) Engl.& Diels	Tree
Combretaceae	<i>Terminalia boivinii</i> Tul.	Shrub
Combretaceae	<i>Terminalia kaiserana</i> F.Hoffm. ?	Tree
Combretaceae	<i>Terminalia sambesiaca</i> Engl.& Diels	Tree
Compositae	<i>Blumea axillaris</i> (Lam.) DC.	Herb
Compositae	<i>Dicoma</i> sp.	Herb
Compositae	<i>Eclipta prostrata</i> (L.) L.	Herb
Compositae	<i>Lactuca inermis</i> Forssk.	Herb
Compositae	<i>Nidorella auriculata</i> DC.	Herb
Compositae	<i>Sphaeranthus africanus</i> L.	Herb
Compositae	<i>Vernonia</i> ? sp. nov. aff. <i>inhacensis</i> G.V.Pope	Vine
Compositae	<i>Vernonia amygdalina</i> Delile	Tree
Compositae	<i>Vernonia colorata</i> (Willd.) Drake subsp. <i>colorata</i>	Shrub
Compositae	<i>Vernonia steetziana</i> Oliv.& Hiern.	Herb
Compositae	<i>Vernonia zanzibarensis</i> Less.	Shrub
Connaraceae	<i>Agelaea pentagyna</i> (Lam.) Baill.	Tree
Connaraceae	<i>Rourea coccinea</i> (Schumach.& Thonn.) Benth. subsp. <i>boiviniana</i> (Baill.) Jongkind	Tree
Connaraceae	<i>Rourea orientalis</i> Baill.	Tree
Connaraceae	<i>Vismianthus punctatus</i> Mildbr.	Shrub
Convolvulaceae	<i>Bonamia mossambicensis</i> (Klotzsch) Hall.f.	Herb
Convolvulaceae	<i>Hewittia malabarica</i> (L.) Suresh	Herb
Convolvulaceae	<i>Ipomoea aquatica</i> Forssk.	Herb
Convolvulaceae	<i>Ipomoea shirambensis</i> Baker	Vine
Convolvulaceae	<i>Xenostegia media</i> (L.) Austin & Staples	Vine
Convolvulaceae	<i>Xenostegia tridentata</i> (L.) Austin & Staples	Vine
Crassulaceae	<i>Kalanchoe</i> sp.	Herb
Cucurbitaceae	<i>Coccinea subglabra</i> C.Jeffrey	Vine
Cucurbitaceae	<i>Cucumis hirsutus</i> Sond.	Vine
Cucurbitaceae	<i>Eureiandra fasciculata</i> (Cogn.) C.Jeffrey	Vine
Cucurbitaceae	<i>Luffa cylindrica</i> (L.) M.J.Roem.	Vine
Cucurbitaceae	<i>Momordica trifoliolata</i> Hook.f.	Vine
Cucurbitaceae	<i>Peponium leucanthum</i> (Gilg) Cogn.	Vine
Cucurbitaceae	<i>Trochomeria macrocarpa</i> (Sond.) Hook.f.	Vine
Dichapetalaceae	<i>Dichapetalum barbosa</i> Torre	Shrub
Dichapetalaceae	<i>Dichapetalum deflexum</i> (Klotzsch) Engl.	Shrub

Family	Name	Life form
Dichapetalaceae	<i>Dichapetalum edule</i> Engl.	Shrub
Dichapetalaceae	<i>Dichapetalum macrocarpum</i> Engl.	Shrub
Dichapetalaceae	<i>Dichapetalum mossambicense</i> (Klotzsch) Engl.	Shrub
Dichapetalaceae	<i>Dichapetalum stuhlmannii</i> Engl.	Shrub
Dilleniaceae	<i>Tetracera boiviniana</i> Baill.	Shrub
Ebenaceae	<i>Diospyros abyssinica</i> (Hiern) F.White subsp. <i>abyssinica</i>	Tree
Ebenaceae	<i>Diospyros consolatae</i> Chiov.	Tree
Ebenaceae	<i>Diospyros ferrea</i> (Willd.) Bakh.	Tree
Ebenaceae	<i>Diospyros kabuyeana</i> F.White	Tree
Ebenaceae	<i>Diospyros kirkii</i> Hiern	Tree
Ebenaceae	<i>Diospyros loureiriana</i> G.Don subsp. <i>loureiriana</i>	Tree
Ebenaceae	<i>Diospyros mafiensis</i> F.White	Tree
Ebenaceae	<i>Diospyros magogoana</i> F.White	Tree
Ebenaceae	<i>Diospyros natalensis</i> (Harv.) Brenan	Tree
Ebenaceae	<i>Diospyros shimbaensis</i> F.White	Tree
Ebenaceae	<i>Diospyros verrucosa</i> Hiern	Tree
Ebenaceae	<i>Euclea natalensis</i> A.DC. subsp. <i>obovata</i> F.White	Tree
Erythroxylaceae	<i>Erythroxylum emarginatum</i> Thonn.	Tree
Erythroxylaceae	<i>Erythroxylum platyclados</i> Boj.	Tree
Erythroxylaceae	<i>Nectaropetalum ? carvalhoi</i> Engl.	Shrub
Euphorbiaceae	<i>Acalypha racemosa</i> Baill.	Shrub
Euphorbiaceae	<i>Alchornea laxiflora</i> (Benth.) Pax & K.Hoffm.	Shrub
Euphorbiaceae	<i>Antidesma venosum</i> Tul.	Shrub
Euphorbiaceae	<i>Antidesma vogelianum</i> Müll.Arg.	Tree
Euphorbiaceae	<i>Bridelia duvigneaudii</i> J.Léonard	Tree
Euphorbiaceae	<i>Caperonia stuhlmannii</i> Pax	Herb
Euphorbiaceae	<i>Cleistanthus schlechteri</i> (Pax) Hutch	Tree
Euphorbiaceae	<i>Cleistochlamys kirkii</i> (Benth.) Oliv.	Tree
Euphorbiaceae	<i>Croton kilwae</i> Radcl.-Sm.	Shrub
Euphorbiaceae	<i>Croton megalocarpus</i> Hutch.	Tree
Euphorbiaceae	<i>Croton menyarthii</i> Pax	Shrub
Euphorbiaceae	<i>Croton polytrichus</i> Pax subsp. <i>polytrichus</i>	Shrub
Euphorbiaceae	<i>Croton pseudopulchellus</i> Pax	Tree
Euphorbiaceae	<i>Drypetes arguta</i> (Müll.Arg.) Hutch.	Tree
Euphorbiaceae	<i>Drypetes natalensis</i> (Harv.) Hutch.	Tree
Euphorbiaceae	<i>Drypetes sclerophylla</i> Mildbr.	Tree
Euphorbiaceae	<i>Erythrocca menyarthii</i> (Pax) Prain	Shrub
Euphorbiaceae	<i>Euphorbia ?</i> sp. nov. aff. <i>ambroseae</i> L.C.Leach var. <i>spinosa</i> L.C.Leach	Succ.
Euphorbiaceae	<i>Euphorbia lividiflora</i> L.C.Leach	Succ.tree
Euphorbiaceae	<i>Hymenocardia ulmoides</i> Oliv.	Tree
Euphorbiaceae	<i>Maprounea africana</i> Müll.Arg.	Tree



Family	Name	Life form
Euphorbiaceae	<i>Margaritaria discoidea</i> (Baill.) G.L.Webster var. <i>nitida</i> (Pax) Radcl.-Sm.	Tree
Euphorbiaceae	<i>Margaritaria discoidea</i> (Baill.) G.L.Webster var. <i>triphosphaera</i> Radcl.-Sm. <i>forma glabra</i> Radcl.-Sm.	Tree
Euphorbiaceae	<i>Mildbraedia carpinifolia</i> (Pax) Hutch. var. <i>strigosa</i> Radcl.-Sm.	Shrub
Euphorbiaceae	<i>Oldfieldia somalensis</i> (Chiov.) Milne-Redh.	Tree
Euphorbiaceae	<i>Omphalea mansfieldiana</i> Mildbr.	Liana
Euphorbiaceae	<i>Phyllanthus engeri</i> Pax	Shrub
Euphorbiaceae	<i>Phyllanthus paxii</i> Hutch.	Herb
Euphorbiaceae	<i>Phyllanthus pinnatus</i> (Wight) G.L.Webster	Herb
Euphorbiaceae	<i>Phyllanthus reticulatus</i> Poir. var. <i>reticulatus</i>	Tree
Euphorbiaceae	<i>Pseudolachnostylis maprouneifolia</i> Pax	Tree
Euphorbiaceae	<i>Ricinodendron heudelotii</i> (Baill.) Hechel subsp. <i>africanum</i> (Müll.Arg.) J.Léonard var. <i>tomentellum</i> (Hutch.& E.A.Bruce) Radcl.-Sm.	Tree
Euphorbiaceae	<i>Schinziophyton rautanenii</i> (Schinz) Radcl.-Sm.	Tree
Euphorbiaceae	? <i>Shirakiopsis armatum</i> (Pax & K.Hoffm.) Esser	Tree
Euphorbiaceae	<i>Spirostachys africana</i> Sond.	Tree
Euphorbiaceae	<i>Suregada zanzibariensis</i> Baill.	Shrub
Euphorbiaceae	<i>Synadenium ?pereskiaefolium</i> (Baill.) Guill.	Shrub
Euphorbiaceae	<i>Tannodia tenuifolia</i> (Pax) Prain	Herb
Euphorbiaceae	<i>Thecacoris spathulifolia</i> (Pax) Leandri var. <i>spathulifolia</i>	Shrub
Euphorbiaceae	<i>Uapaca nitida</i> Müll.Arg.	Tree
Euphorbiaceae	<i>Uapaca sansibarica</i> Pax	Tree
Flacourtiaceae	<i>Bivinia jalbertii</i> Tul.	Tree
Flacourtiaceae	<i>Buchnerodendron lasiocalyx</i> (Oliv.) Gilg	Shrub
Flacourtiaceae	<i>Caloncoba welwitschii</i> (Oliv.) Gilg	Tree
Flacourtiaceae	<i>Casearia gladiiformis</i> Mast.	Tree
Flacourtiaceae	<i>Casearia</i> sp. nov. (= Timberlake et al. 5665)	Shrub
Flacourtiaceae	<i>Dovyalis hispidula</i> Wild	Tree
Flacourtiaceae	<i>Flacourtia indica</i> (Burm.f.) Merr.	Tree
Flacourtiaceae	<i>Homalium abdessammadii</i> Asch.& Schweinf.	Tree
Flacourtiaceae	<i>Xylothea tettensis</i> (Klotzsch) Gilg	Shrub
Icacinaceae	<i>Leptaulus</i> sp.	Tree
Icacinaceae	<i>Pyrenacantha kaurabassana</i> Baill.	Vine
Ixonanthaceae	<i>Phyllocosmus lemaireanus</i> (De Wild.& T.Durand) T.& H.Durand	Tree
Labiatae	<i>Basilicum polystachyon</i> (L.) Moench.	Herb
Labiatae	<i>Clerodendrum cephalanthum</i> Oliv. subsp. <i>swynnertonii</i> (S.Moore) Verdc.	Shrub
Labiatae	<i>Clerodendrum lutambense</i> Verdc.	Suffrutex
Labiatae	<i>Clerodendrum robustum</i> Klotzsch var. <i>robustum</i>	Shrub
Labiatae	<i>Endostemon albus</i> A.J.Paton & Harley	Herb

Family	Name	Life form
Labiatae	<i>Hoslundia opposita</i> Vahl	Shrub
Labiatae	<i>Hyptis suaveolens</i> (L.) Poit.	Herb
Labiatae	<i>Ocimum obovatum</i> Benth. subsp. <i>obovatum</i> var. <i>obovatum</i>	Suffrutex
Labiatae	<i>Orthosiphon scedastophyllus</i> A.J.Paton	Herb
Labiatae	<i>Orthosiphon schimperi</i> Benth.	Herb
Labiatae	<i>Orthosiphon thymiflorus</i> (Roth) Sleesen	Herb
Labiatae	<i>Plectranthus gracillimus</i> (T.C.E.Fries) Hutch.& Dandy	Herb
Labiatae	<i>Premna gracillima</i> Verdc.	Shrub
Labiatae	<i>Premna hans-joachimii</i> Verdc.	Shrub
Labiatae	<i>Premna schliebenii</i> Werderm.	Shrub
Labiatae	<i>Premna serratifolia</i> L.	Shrub
Labiatae	<i>Premna velutina</i> Gürke	Shrub
Labiatae	<i>Rotheca aurantiaca</i> (Baker) R.Fern. forma <i>aurantiaca</i>	Herb
Labiatae	<i>Rotheca incisa</i> (Klotzsch) Steane & Mabb.	Shrub
Labiatae	<i>Rotheca myricoides</i> (Hochst.) Steane & Mabb. var. <i>discolor</i> (Klotzsch) Verdc.	Shrub
Labiatae	<i>Tinnea aethiopica</i> Hook.f. subsp. <i>stolzii</i> (Robyns & Lebrun) Vollesen	Shrub
Labiatae	<i>Vitex</i> ? sp. nov. aff. <i>buchananii</i>	Shrub
Labiatae	<i>Vitex carvalhi</i> Gürke	Tree
Labiatae	<i>Vitex doniana</i> Sweet	Tree
Labiatae	<i>Vitex mombassae</i> Vatke	Tree
Labiatae	<i>Vitex mossambicensis</i> Gürke	Tree
Labiatae	<i>Vitex</i> cf. <i>mossambicensis</i> Gürke - but corolla very large	Tree
Labiatae	<i>Vitex payos</i> (Lour.) Merrill	Tree
Lecythidaceae	<i>Barringtonia racemosa</i> (L.) Spreng.	Tree
Leg.: Caesalpinioideae	<i>Azelia quanzansis</i> Welw.	Tree
Leg.: Caesalpinioideae	<i>Bauhinia tomentosa</i> L.	Shrub
Leg.: Caesalpinioideae	<i>Berlinia orientalis</i> Brenan	Tree
Leg.: Caesalpinioideae	<i>Brachystegia allenii</i> Hutch.& Burt Davy	Tree
Leg.: Caesalpinioideae	<i>Brachystegia boehmii</i> Taub.	Tree
Leg.: Caesalpinioideae	<i>Brachystegia</i> cf. <i>manga</i> De Wild.	Tree
Leg.: Caesalpinioideae	<i>Brachystegia microphylla</i> Harms	Tree
Leg.: Caesalpinioideae	<i>Brachystegia spiciformis</i> Benth.	Tree
Leg.: Caesalpinioideae	<i>Brachystegia tamarindoides</i> Benth. subsp. <i>microphylla</i> (Harms) Chikuni	Tree
Leg.: Caesalpinioideae	<i>Brachystegia utilis</i> Hutch.& Burt Davy	Tree
Leg.: Caesalpinioideae	<i>Burkea africana</i> Hook.	Tree
Leg.: Caesalpinioideae	<i>Cassia afrofistula</i> Brenan	Shrub
Leg.: Caesalpinioideae	<i>Cassia angolensis</i> Hiern	Tree
Leg.: Caesalpinioideae	<i>Dialium holtzii</i> Harms	Tree
Leg.: Caesalpinioideae	<i>Erythrophleum suaveolens</i> (Guill.& Perr.) Brenan	Tree

Family	Name	Life form
Leg.: Caesalpinioideae	<i>Guibourtia schliebenii</i> (Harms) J.Léonard	Tree
Leg.: Caesalpinioideae	<i>Hymenaea verrucosa</i> Gaertn.	Tree
Leg.: Caesalpinioideae	<i>Julbernardia globiflora</i> (Benth.) Troupin	Tree
Leg.: Caesalpinioideae	<i>Mezoneuron angolense</i> Oliv.	Liana
Leg.: Caesalpinioideae	<i>Micklethwaitia carvalhoi</i> (Harms) G.P.Lewis & Schrire	Tree
Leg.: Caesalpinioideae	<i>Piliostigma thonningii</i> (Schumach.) Milne-Redh.	Tree
Leg.: Caesalpinioideae	<i>Scorodophloeus fischeri</i> (Taub.) J.Léonard	Tree
Leg.: Caesalpinioideae	<i>Senna auriculata</i> (L.) Roxb.	Shrub
Leg.: Caesalpinioideae	<i>Tamarindus indica</i> L.	Tree
Leg.: Mimosoideae	<i>Acacia adenocalyx</i> Brenan & Exell	Shrub
Leg.: Mimosoideae	<i>Acacia galpinii</i> Burt Davy	Tree
Leg.: Mimosoideae	<i>Acacia gerrardii</i> Benth.	Tree
Leg.: Mimosoideae	<i>Acacia latispina</i> J.E.Burrows & S.M.Burrows	Tree
Leg.: Mimosoideae	<i>Acacia latistipulata</i> Harms	Shrub
Leg.: Mimosoideae	<i>Acacia nigrescens</i> Oliv.	Tree
Leg.: Mimosoideae	<i>Acacia nigrescens</i> Oliv.	Tree
Leg.: Mimosoideae	<i>Acacia polyacantha</i> Willd. subsp. <i>campylacantha</i> (A.Rich.) Brenan	Tree
Leg.: Mimosoideae	<i>Acacia robusta</i> Burch. subsp. <i>usambarensis</i> (Taub.) Brenan	Tree
Leg.: Mimosoideae	<i>Acacia royumae</i> Oliv.	Tree
Leg.: Mimosoideae	<i>Acacia senegal</i> (L.) Willd. var. <i>senegal</i>	Tree
Leg.: Mimosoideae	<i>Acacia seyal</i> Delile var. <i>fistula</i> (Schweinf.) Oliv.	Tree
Leg.: Mimosoideae	<i>Acacia sieberiana</i> DC. var. <i>sieberiana</i>	Tree
Leg.: Mimosoideae	<i>Acacia sieberiana</i> DC. var. <i>vermoeseni</i> (De Wild.) Keay & Brenan	Tree
Leg.: Mimosoideae	<i>Albizia adianthifolia</i> (Schumach.) W.Wight	Tree
Leg.: Mimosoideae	<i>Albizia forbesii</i> Benth.	Tree
Leg.: Mimosoideae	<i>Albizia isenbergiana</i> (A.Rich.) E.Fourn.	Tree
Leg.: Mimosoideae	<i>Albizia petersiana</i> (Bolle) Oliv. subsp. <i>petersiana</i>	Tree
Leg.: Mimosoideae	<i>Albizia versicolor</i> Welw.	Tree
Leg.: Mimosoideae	<i>Albizia zimmermannii</i> Harms	Tree
Leg.: Mimosoideae	<i>Amblygonocarpus andongensis</i> (Oliv.) Exell & Torre	Tree
Leg.: Mimosoideae	<i>Dichrostachys cinerea</i> (L.) Wight & Arn. subsp. <i>forbesii</i> (Benth.) Brenan & Brummitt	Tree
Leg.: Mimosoideae	<i>Elephantorrhiza goetzei</i> (Harms) Harms	Tree
Leg.: Mimosoideae	<i>Entada rheedii</i> Spreng.	Liana
Leg.: Mimosoideae	<i>Entada stuhlmannii</i> (Taub.) Harms	Vine
Leg.: Mimosoideae	<i>Mimosa busseana</i> Harms	Shrub
Leg.: Mimosoideae	<i>Mimosa pigra</i> L.	Shrub
Leg.: Mimosoideae	<i>Newtonia paucijuga</i> (Harms) Brenan	Tree
Leg.: Mimosoideae	<i>Pseudoprosopis euryphylla</i> Harms	Liana
Leg.: Papilionoideae	<i>Abrus precatorius</i> L. subsp. <i>africanus</i> Verdc.	Vine
Leg.: Papilionoideae	<i>Aeschynomene cristata</i> Vatke var. <i>cristata</i>	Shrub

Family	Name	Life form
Leg.: Papilionoideae	<i>Baphia</i> ? sp. nov.	Tree
Leg.: Papilionoideae	<i>Baphia macrocalyx</i> Harms	Tree
Leg.: Papilionoideae	<i>Cordyla africana</i> Lour.	Tree
Leg.: Papilionoideae	<i>Craibia zimmermannii</i> (Harms) Dunn	Tree
Leg.: Papilionoideae	<i>Crotalaria goodiiformis</i> Vatke	Herb
Leg.: Papilionoideae	<i>Crotalaria goreensis</i> Guill.& Perr.	Herb
Leg.: Papilionoideae	<i>Dalbergia arbutifolia</i> Baker subsp. <i>arbutifolia</i>	Liana
Leg.: Papilionoideae	<i>Dalbergia armata</i> E.Mey.	Liana
Leg.: Papilionoideae	<i>Dalbergia boehmii</i> Taub. subsp. <i>boehmii</i>	Tree
Leg.: Papilionoideae	<i>Dalbergia bracteolata</i> Baker	Liana
Leg.: Papilionoideae	<i>Dalbergia fischeri</i> Taub.	Liana
Leg.: Papilionoideae	<i>Dalbergia lactea</i> Vatke	Liana
Leg.: Papilionoideae	<i>Dalbergia melanoxydon</i> Guill.& Perr.	Tree
Leg.: Papilionoideae	<i>Derris trifoliata</i> Lour.	Liana
Leg.: Papilionoideae	<i>Eriosema parviflorum</i> E.Mey.	Herb
Leg.: Papilionoideae	<i>Eriosema pauciflorum</i> Klotzsch	Herb
Leg.: Papilionoideae	<i>Eriosema psoraleoides</i> (Lam.) G.Don	Herb
Leg.: Papilionoideae	<i>Erythrina haerdii</i> Verdc.	Tree
Leg.: Papilionoideae	<i>Erythrina livingstoneana</i> Baker	Tree
Leg.: Papilionoideae	<i>Erythrina saclexii</i> Hua	Tree
Leg.: Papilionoideae	<i>Erythrina</i> sp. not matched at K (=Crawford 723)	Tree
Leg.: Papilionoideae	<i>Flemingia grahamiana</i> Wight & Arn.	Herb
Leg.: Papilionoideae	<i>Indigofera drepanocarpa</i> Taub.	Herb
Leg.: Papilionoideae	<i>Indigofera schimperi</i> Jaub.& Spach var. <i>schimperi</i>	Herb
Leg.: Papilionoideae	<i>Millettia eetveldiana</i> (Micheli) Hauman	Tree
Leg.: Papilionoideae	<i>Millettia impressa</i> Harms subsp. <i>goetzeana</i> (Harms) J.B.Gillett	Liana
Leg.: Papilionoideae	<i>Millettia makondensis</i> Harms	Suffrutex
Leg.: Papilionoideae	<i>Millettia stuhlmannii</i> Taub.	Tree
Leg.: Papilionoideae	<i>Millettia usaramensis</i> Taub. subsp. <i>usaramensis</i> var. <i>usaramensis</i>	Tree
Leg.: Papilionoideae	<i>Mundulea sericea</i> (Willd.) A.Chev.	Shrub
Leg.: Papilionoideae	<i>Ormocarpum kirkii</i> S.Moore	Tree
Leg.: Papilionoideae	<i>Ormocarpum schliebenii</i> Harms	Shrub
Leg.: Papilionoideae	<i>Ormocarpum sennoides</i> (Willd.) DC. subsp. <i>zanzibaricum</i> Brenan & J.B.Gillett	Shrub
Leg.: Papilionoideae	<i>Pericopsis angolensis</i> (Baker) Meewen	Tree
Leg.: Papilionoideae	<i>Philenoptera bussei</i> (Harms) Schrire	Tree
Leg.: Papilionoideae	<i>Platysepalum inopinatum</i> Harms	Tree
Leg.: Papilionoideae	<i>Pterocarpus megalocarpus</i> Harms	Tree
Leg.: Papilionoideae	<i>Swartzia madagascariensis</i> Desv.	Tree
Leg.: Papilionoideae	<i>Tephrosia noctiflora</i> Baker	Shrub
Leg.: Papilionoideae	<i>Vigna luteola</i> (Jacq.) Benth.	Vine



Family	Name	Life form
Leg.: Papilionoideae	<i>Xeroderris stuhlmannii</i> (Taub.) Mendonça & E.P.Sousa	Tree
Linaceae	<i>Hugonia busseana</i> Engl.	Shrub
Linaceae	<i>Hugonia grandiflora</i> N.Robson	Shrub
Linaceae	<i>Hugonia orientalis</i> Engl.	Shrub
Loganiaceae	<i>Mostuea brunonis</i> Didr.	Shrub
Loganiaceae	<i>Mostuea microphylla</i> Gilg	Shrub
Loganiaceae	<i>Strychnos cocculoides</i> Baker	Tree
Loganiaceae	<i>Strychnos henningsii</i> Gilg	Tree
Loganiaceae	<i>Strychnos madagascariensis</i> Poir.	Tree
Loganiaceae	<i>Strychnos myrtooides</i> Gilg & Busse	Shrub
Loganiaceae	<i>Strychnos panganensis</i> Gilg	Liana
Loganiaceae	<i>Strychnos</i> cf. <i>spinosa</i> Lam.	Tree
Loganiaceae	<i>Strychnos xylophylla</i> Gilg	Tree
Loranthaceae	<i>Agelanthus</i> cf. <i>zizyphifolius</i> (Engl.) Polh.& Wiens	Parasite
Loranthaceae	<i>Englerina inaequilatera</i> (Engl.) Gilli	Parasite
Loranthaceae	<i>Erianthemum lindense</i> (Sprague) Danser	Parasite
Loranthaceae	<i>Helixanthera kirkii</i> (Oliv.) Danser	Parasite
Lythraceae	<i>Ammannia auriculata</i> Willd.	Herb
Malpigiaceae	<i>Acridocarpus chloropterus</i> Oliv.	Shrub
Malpigiaceae	<i>Acridocarpus natalitius</i> A.Juss. var. <i>natalitius</i>	Shrub
Malvaceae	<i>Gossypoides kirkii</i> (Mast.) J.B.Hutch.	Shrub
Malvaceae	<i>Hibiscus migeodii</i> Exell	Herb
Malvaceae	<i>Hibiscus platycalyx</i> Mast.	Shrub
Malvaceae	<i>Hibiscus surattensis</i> L.	Herb
Malvaceae	<i>Hibiscus zanzibaricus</i> Cufod.	Herb
Malvaceae	<i>Pavonia leptocalyx</i> (Sond.) Ulbr.	Herb
Malvaceae	<i>Thespesia mossambicensis</i> (Exell & Hillc.) Fryxell	Shrub
Malvaceae	<i>Urena lobata</i> L. var. <i>lobata</i>	Shrub
Melastomataceae	<i>Antherotoma debilis</i> (Sond.) Jacq.-Fél.	Herb
Melastomataceae	<i>Memecylon flavovirens</i> Baker	Shrub
Melastomataceae	<i>Memecylon natalense</i> Markgr.	Shrub
Melastomataceae	<i>Memecylon torrei</i> A.Fern.& R.Fern.	Shrub
Melastomataceae	<i>Warneckea sansibarica</i> (Taub.) Jacq.-Fél.	Tree
Melastomataceae	<i>Warneckea</i> cf. <i>sessilicarpa</i> (A.Fern.& R.Fern.) Jacq.-Fél.	Shrub
Melastomataceae	<i>Warneckea sousae</i> (A.Fern.& R.Fern.) A.E.van Wyk	Tree
Melastomataceae	<i>Warneckea</i> sp. nov.	Shrub
Meliaceae	<i>Ekebergia capensis</i> Sparrm.	Tree
Meliaceae	<i>Pseudobersama mossambicensis</i> (Sim) Verdc.	Tree
Meliaceae	<i>Trichilia</i> ? sp. nov.	Shrub
Meliaceae	<i>Trichilia emetica</i> Vahl	Tree
Meliaceae	<i>Turraea robusta</i> Gürke	Tree

Family	Name	Life form
Meliaceae	<i>Turraea wakefeldii</i> Oliv.	Tree
Meliaceae	<i>Xylocarpus granatum</i> J.Köenig	Tree
Menispermaceae	<i>Jateorhiza palmata</i> (Lam.) Miers	Vine
Menispermaceae	<i>Triclisia sacleuxii</i> (Pierre) Diels	Vine
Molluginaceae	<i>Glinus lotoides</i> L. var. <i>lotoides</i>	Herb
Molluginaceae	<i>Glinus oppositifolius</i> (L.) DC. var. <i>lanatus</i> Hauman	Herb
Montiniaceae	<i>Grevea eggelingii</i> Milne-Redh. var. <i>echinocarpa</i> Mendes	Shrub
Moraceae	<i>Bosqueiopsis gillettii</i> De Wild.& T.Durand	Shrub
Moraceae	<i>Dorstenia psilurus</i> Welw. var. <i>psilurus</i>	Geophyte
Moraceae	<i>Ficus capreifolia</i> Delile	Tree
Moraceae	<i>Ficus ingens</i> Miq.	Tree
Moraceae	<i>Ficus sycomorus</i> L. subsp. <i>sycomorus</i>	Tree
Moraceae	<i>Maclura africana</i> (Bureau) Corner	Shrub
Myrtaceae	<i>Eugenia capensis</i> (Eckl.& Zeyh.) Sond. subsp. <i>multiflora</i> Verdc.	Shrub
Myrtaceae	<i>Syzygium guineense</i> (Willd.) DC. subsp. <i>guineense</i>	Tree
Ochnaceae	<i>Brackenridgea zanguebarica</i> Oliv.	Tree
Ochnaceae	<i>Ochna</i> ? sp. nov.	Suffrutex
Ochnaceae	<i>Ochna kirkii</i> Oliv.	Tree
Ochnaceae	<i>Ochna mossambicensis</i> Klotzsch	Shrub
Ochnaceae	<i>Ochna ovata</i> F.Hoffm.	Shrub
Ochnaceae	<i>Ochna polyneura</i> Gilg	Tree
Ochnaceae	<i>Ochna</i> cf. <i>puberula</i> N.K.B.Robson	Tree
Ochnaceae	<i>Ochna</i> cf. <i>rovumensis</i> Gilg	Tree
Olacaceae	<i>Olax dissitiflora</i> Oliv.	Shrub
Olacaceae	<i>Olax pentandra</i> Sleumer	Tree
Olacaceae	<i>Ximenia caffra</i> Sond. var. <i>natalensis</i> Sond.	Shrub
Oleaceae	<i>Jasminum stenolobum</i> Rolfe	Shrub
Oleaceae	<i>Schrebera trichoclada</i> Welw.	Tree
Onagraceae	<i>Ludwigia</i> cf. <i>stolonifera</i> (Guill.& Perr.) Raven	Herb
Onagraceae	<i>Ludwigia leptocarpa</i> (Nutt.) Hara	Herb
Opiliaceae	<i>Opilia amentacea</i> Roxb.	Liana
Opiliaceae	<i>Opilia celtidifolia</i> (Guill.& Perr.) Walp.	Liana
Opiliaceae	<i>Pentarrhopalopilia umbellulata</i> (Baill.) Hiepko	Shrub
Passifloraceae	<i>Adenia gummifera</i> (Harv.) Harms var. <i>gummifera</i>	Vine
Passifloraceae	<i>Adenia kirkii</i> (Mast.) Engl.	Vine
Passifloraceae	<i>Adenia panduriformis</i> Engl.	Vine
Passifloraceae	<i>Paropsia braunii</i> Gilg	Tree
Passifloraceae	<i>Schlechterina mitostemmatoides</i> Harms	Vine
Pedaliaceae	<i>Dicerocaryum zanguebaricum</i> (Lour.) Merr.	Herb
Polygalaceae	<i>Carpolobia goetzei</i> Gürke	Shrub
Polygalaceae	<i>Polygala goetzei</i> Gürke	Herb

Family	Name	Life form
Polygalaceae	<i>Polygala sansibarensis</i> Gürke	Herb
Polygalaceae	<i>Polygala stenopetala</i> Klotzsch subsp. <i>stenopetala</i>	Herb
Polygalaceae	<i>Securidaca longepedunculata</i> Fresen.	Shrub
Polygonaceae	<i>Oxygonum buchananii</i> (Dammer) J.B.Gillett	Herb
Polygonaceae	<i>Persicaria madagascariensis</i> (Meisn.) S.Ortiz & Paiva	Herb
Portulacaceae	<i>Talinum tenuissimum</i> Dinter	Geophyte
Portulacaceae	<i>Talinum crispatum</i> Dinter	Geophyte
Ptaeroxylaceae	<i>Ptaeroxylon obliquum</i> (Thunb.) Radlk.	Tree
Rhamnaceae	<i>Berchemia discolor</i> (Klotzsch) Hemsl.	Tree
Rhamnaceae	<i>Colubrina asiatica</i> (L.) Brongn. var. <i>asiatica</i>	Liana
Rhamnaceae	<i>Gouania scandens</i> (Gaertn.) R.B.Drumm.	Liana
Rhizophoraceae	<i>Bruguiera gymnorhiza</i> (L.) Lam.	Tree
Rhizophoraceae	<i>Cassipourea</i> cf. <i>euryoides</i> Alston	Tree
Rhizophoraceae	<i>Cassipourea mossambicensis</i> (Brehmer) Alston	Tree
Rhizophoraceae	<i>Ceriops tagal</i> (Perr.) C.B.Rob.	Tree
Rhizophoraceae	<i>Rhizophora mucronata</i> Lam.	Tree
Rubiaceae	<i>Afrocanthium lactescens</i> (Hiern) Lantz	Shrub
Rubiaceae	<i>Afrocanthium racemulosum</i> (S.Moore) Lantz	Shrub
Rubiaceae	<i>Afrocanthium pseudoverticillatum</i> (S.Moore) Lantz	Shrub
Rubiaceae	<i>Agathisanthemum bojeri</i> Klotzsch subsp. <i>bojeri</i>	Herb
Rubiaceae	<i>Bullockia setiflora</i> (Hiern) Razafin.	Shrub
Rubiaceae	? <i>Canthium mombazense</i> Baill.	Tree
Rubiaceae	<i>Caturanegam</i> cf. <i>stenocarpa</i> Bridson =Nuvunga 684	Tree
Rubiaceae	<i>Catunaregam</i> ? <i>swynnertonii</i> (S.Moore) Bridson	Shrub
Rubiaceae	<i>Catunaregam stenocarpa</i> Bridson	Tree
Rubiaceae	<i>Chassalia umbraticola</i> Vatke	Shrub
Rubiaceae	<i>Chazaliella abrupta</i> (Hiern) E.M.A.Petit & Verdc.	Shrub
Rubiaceae	<i>Coffea</i> ( <i>Psilanthus</i> ) sp. A of FTEA	Shrub
Rubiaceae	<i>Coffea schliebenii</i> Bridson	Shrub
Rubiaceae	<i>Coptosperma littorale</i> (Hiern) Degreef	Tree
Rubiaceae	<i>Coptosperma nigrescens</i> Hook.f.	Tree
Rubiaceae	<i>Coptosperma supra-axillare</i> (Hemsl.) Degreef	Shrub
Rubiaceae	<i>Craterispermum schweinfurthii</i> Hiern	Tree
Rubiaceae	<i>Cremaspora triflora</i> (Thonn.) K.Schum. subsp. <i>confluens</i> (K.Schum.) Verdc.	Shrub
Rubiaceae	<i>Crossopteryx febrifuga</i> (G.Don) Benth.	Tree
Rubiaceae	<i>Cuviera semsei</i> Verdc.	Tree
Rubiaceae	<i>Didymosalpinx callianthus</i> J.E.Burrows & S.M.Burrows sp. nov.	Shrub
Rubiaceae	<i>Gardenia ternifolia</i> Schumach.& Thonn. subsp. <i>jovis-tonantis</i> (Welw.) Verdc. var. <i>jovis-tonantis</i> (Welw.) Aubrév.	Tree
Rubiaceae	<i>Gardenia transvenulosa</i> Verdc.	Shrub

Family	Name	Life form
Rubiaceae	<i>Heinsia crinita</i> (Afzel.) G.Taylor subsp. <i>parviflora</i> (K.Schum.& K.Krause) Verdc.	Shrub
Rubiaceae	<i>Heinsia zanzibarica</i> (Bojer) Verdc.	Shrub
Rubiaceae	<i>Hymenodictyon parvifolium</i> Oliv. subsp. <i>parvifolium</i>	Tree
Rubiaceae	<i>Ixora narcissodora</i> K.Schum.	Shrub
Rubiaceae	<i>Keetia gueinzii</i> (Sond.) Bridson	Shrub
Rubiaceae	<i>Keetia zanzibarica</i> (Klotzsch) Bridson subsp. <i>zanzibarica</i>	Tree
Rubiaceae	<i>Kraussia kirkii</i> (Hook.f.) Bullock	Tree
Rubiaceae	<i>Leptactina delagoensis</i> K.Schum. subsp. <i>delagoensis</i>	Shrub
Rubiaceae	<i>Leptactina papyrophloea</i> Verdc.	Shrub
Rubiaceae	<i>Multidentia exserta</i> Bridson subsp. <i>exserta</i>	Tree
Rubiaceae	<i>Mussaenda arcuata</i> Poir.	Tree
Rubiaceae	<i>Oxyanthus biflorus</i> J.E.Burrows & S.M.Burrows sp. nov.	Shrub
Rubiaceae	<i>Oxyanthus</i> sp. A of FZ	Shrub
Rubiaceae	<i>Oxyanthus zanguebaricus</i> (Hiern) Bridson	Shrub
Rubiaceae	<i>Pavetta decumbens</i> K.Schum.& K.Krause	Shrub
Rubiaceae	<i>Pavetta lindina</i> Bremek.	Shrub
Rubiaceae	<i>Pavetta lutambensis</i> Bremek.	Shrub
Rubiaceae	<i>Pavetta macrosepala</i> Hiern var. <i>macrosepala</i>	Tree
Rubiaceae	<i>Pavetta uniflora</i> Bremek.	Shrub
Rubiaceae	<i>Pentodon pentandrus</i> (Schumach.& Thonn.) Vatke var. <i>minor</i> Bremek.	Herb
Rubiaceae	<i>Polysphaeria</i> cf. <i>lanceolata</i> Hiern subsp. <i>lanceolata</i> / <i>P. multiflora</i> Hiern subsp. <i>pubescens</i> Verdc.	Tree
Rubiaceae	<i>Polysphaeria multiflora</i> Hiern <i>vel</i> aff.	Shrub
Rubiaceae	<i>Polysphaeria</i> ? sp. nov.	Shrub
Rubiaceae	<i>Psilanthus</i> sp. nov. cf. sp. A of FTEA (especially Luke 10197)	Shrub
Rubiaceae	<i>Psychotria capensis</i> (Eckl.) Vatke subsp. <i>riparia</i> (K.Schum.& Krause) Verdc. var. <i>riparia</i>	Tree
Rubiaceae	<i>Psychotria kirkii</i> Hiern (if distinct from <i>P. punctata</i> )	Shrub
Rubiaceae	<i>Psychotria linearisepala</i> Petit	Shrub
Rubiaceae	<i>Psychotria mahonii</i> C.H.Wright	Shrub
Rubiaceae	<i>Psychotria pumila</i> Hiern var. <i>pumila</i>	Shrub
Rubiaceae	<i>Psydrax kaessneri</i> (S.Moore) Bridson	Tree
Rubiaceae	<i>Psydrax livida</i> (Hiern) Bridson	Tree
Rubiaceae	<i>Psydrax</i> ? <i>martinii</i> (Dunkley) Bridson	Tree
Rubiaceae	<i>Psydrax micans</i> (Bullock) Bridson	Tree
Rubiaceae	<i>Psydrax obovata</i> (Eckl.& Zeyh.) Bridson	Tree
Rubiaceae	<i>Pyrostria bibracteata</i> (Baker) Cavaco	Shrub
Rubiaceae	<i>Pyrostria</i> cf. <i>phyllanthoidea</i> (Baill.) Bridson	Shrub
Rubiaceae	<i>Pyrostria</i> sp. D of FTEA	Shrub
Rubiaceae	<i>Pyrostria</i> ? sp. nov. = Luke 9724 (Tanzania)	Shrub



Family	Name	Life form
Rubiaceae	<i>Rhodopentas parvifolia</i> (Hiern) Kårehed & B.Bremer	Shrub
Rubiaceae	<i>Rothmannia macrosiphon</i> (Engl.) Bridson ( <i>probably - in bud</i> )	Shrub
Rubiaceae	<i>Rothmannia manganjae</i> (Hiern) Keay	Tree
Rubiaceae	<i>Rutidea fuscescens</i> Hiern subsp. <i>fuscescens</i>	Shrub
Rubiaceae	<i>Rytigynia celastroides</i> (Baill.) Verdc.	Shrub
Rubiaceae	<i>Rytigynia</i> cf. <i>umbellulata</i> (Hiern) Robyns =de Koning et al. 9759 of FZ	Tree
Rubiaceae	<i>Tarenna junodii</i> (Schinz) Bremek.	Shrub
Rubiaceae	<i>Tarenna pavettoides</i> (Harv.) Sim subsp. <i>affinis</i> (K.Schum.) Bridson	Tree
Rubiaceae	<i>Tarenna pembensis</i> J.E.Burrows	Shrub
Rubiaceae	<i>Tarenna</i> sp. 53 of Degreef =Bidgood et al. 1357	Tree
Rubiaceae	<i>Triainolepis africana</i> Hook.f. subsp. <i>africana</i>	Shrub
Rubiaceae	<i>Triainolepis africana</i> Hook.f. subsp. <i>hildebrandtii</i> (Vatke) Verdc.	Shrub
Rubiaceae	<i>Tricalysia coriacea</i> (Benth.) Hiern subsp. <i>nyassae</i> (Hiern) Bridson	Tree
Rubiaceae	<i>Tricalysia pallens</i> Hiern	Tree
Rubiaceae	<i>Tricalysia schliebenii</i> Robbr.	Shrub
Rubiaceae	<i>Tricalysia semidecidua</i> Bridson	Shrub
Rubiaceae	<i>Tricalysia</i> sp. A of FZ	Tree
Rubiaceae	<i>Tricalysia</i> sp. B of FZ	Shrub
Rubiaceae	<i>Vangueria</i> cf. <i>randii</i> S.Moore =Torre & Paiva 11706 ( <i>not at K</i> )	Tree
Rubiaceae	<i>Vangueria</i> cf. <i>randii</i> S.Moore subsp. <i>vollesenii</i> Verdc.	Tree
Rubiaceae	<i>Vangueria infausta</i> Burch. subsp. <i>infausta</i>	Tree
Rubiaceae	<i>Vangueriopsis lancifolia</i> (Hiern) Robyns	Tree
Rutaceae	<i>Clausena anisata</i> (Willd.) Benth.	Shrub
Rutaceae	<i>Vepris</i> cf. <i>allenii</i> I.Verd.	Tree
Rutaceae	<i>Vepris lanceolata</i> (Lam.) G.Don	Tree
Rutaceae	<i>Vepris sansibarensis</i> (Engl.) Mziray	Tree
Rutaceae	<i>Vepris</i> cf. <i>stolzii</i> I.Verd.	Tree
Rutaceae	<i>Vepris</i> ? sp. nov.	Tree
Rutaceae	<i>Zanthoxylum holtzianum</i> (Engl.) P.G.Waterman var. <i>holtzianum</i>	Tree
Rutaceae	<i>Zanthoxylum lepreurii</i> Guill.& Perr.	Tree
Rutaceae	<i>Zanthoxylum lindense</i> (Engl.) Kokwaro	Tree
Salvadoraceae	<i>Dobera loranthifolia</i> (Warb.) Harms	Tree
Salvadoraceae	<i>Salvadora persica</i> L. var. <i>persica</i>	Shrub
Sapindaceae	<i>Allophylus africanus</i> P.Beauv. var. <i>africanus</i>	Shrub
Sapindaceae	<i>Allophylus rubifolius</i> (A.Rich.) Engl. var. <i>alnifolius</i> (Baker) Friis & Vollesen	Shrub
Sapindaceae	<i>Allophylus tanzaniensis</i> F.G.Davies	Shrub
Sapindaceae	<i>Blighia unijugata</i> Baker	Tree
Sapindaceae	<i>Cardiospermum halicacabum</i> L.	Vine
Sapindaceae	<i>Deinbollia</i> ? sp. nov.	Shrub

Family	Name	Life form
Sapindaceae	<i>Glennia africana</i> (Radkl.) Leenh.	Tree
Sapindaceae	<i>Haplocoelum inoploeum</i> Radlk.	Tree
Sapindaceae	<i>Lepisanthes senegalensis</i> (Poir.) Leenh.	Tree
Sapindaceae	<i>Macphersonia gracilis</i> O.Hoffm. var. <i>hildebrandtii</i> (O.Hoffm.) Capuron	Tree
Sapindaceae	<i>Pancovia golungensis</i> (Hiern) Exell & Mendonça – bijugate form	Shrub
Sapindaceae	<i>Pancovia holtzii</i> Radlk. subsp. <i>holtzii</i>	Shrub
Sapotaceae	<i>Inhambanella henriquesii</i> (Engl.& Warb.) Dubard	Tree
Sapotaceae	<i>Manilkara discolor</i> (Sond.) J.H.Hemsl.	Tree
Sapotaceae	<i>Manilkara mochisia</i> (Baker) Dubard	Tree
Sapotaceae	<i>Manilkara sansibarensis</i> (Engl.) Dubard	Tree
Sapotaceae	<i>Mimusops obtusifolia</i> Lam.	Tree
Sapotaceae	<i>Synsepalum brevipes</i> (Baker) T.D.Penn.	Tree
Sapotaceae	<i>Vitellariopsis kirkii</i> (Baker) Dubard	Tree
Scrophulariaceae	<i>Alectra orobanchoides</i> Benth. – ?aberrant form	Herb
Scrophulariaceae	<i>Buchnera leptostachya</i> Benth.	Herb
Scrophulariaceae	<i>Scoparia dulcis</i> L.	Herb
Scrophulariaceae	<i>Striga forbesii</i> Benth.	Herb
Scrophulariaceae	<i>Striga pubiflora</i> Klotzsch	Herb
Scrophulariaceae	<i>Torenia thouarsii</i> (Cham.& Schltdl.) Kuntze	Herb
Simaroubaceae	<i>Harrisonia abyssinica</i> Oliv.	Tree
Solanaceae	<i>Solanum catombelense</i> Peyr.	Herb
Solanaceae	<i>Solanum richardii</i> Dunal	Herb
Sonneratiaceae	<i>Sonneratia alba</i> Sm.	Tree
Sterculiaceae	<i>Cola ? discoglypsemnophylla</i> Brenan & A.P.D.Jones	Tree
Sterculiaceae	<i>Cola ?</i> sp. nov. 1 aff. <i>clavata</i> Mast.	Tree
Sterculiaceae	<i>Cola ?</i> sp. nov. 2 aff. <i>clavata</i> Mast.	Tree
Sterculiaceae	<i>Dombeya acutangula</i> Cav.	Tree
Sterculiaceae	<i>Dombeya kirkii</i> Mast	Tree
Sterculiaceae	<i>Dombeya shupangae</i> K.Schum.	Tree
Sterculiaceae	<i>Hildegardia migeodii</i> (Exell) Kosterm.	Tree
Sterculiaceae	<i>Melochia corchorifolia</i> L.	Herb
Sterculiaceae	<i>Sterculia africana</i> (Lour.) Fiori	Tree
Sterculiaceae	<i>Sterculia quinqueloba</i> (Garcke) K.Schum.	Tree
Sterculiaceae	<i>Sterculia schliebenii</i> Mildbr.	Tree
Thymelaeaceae	<i>Synaptolepis alternifolia</i> Oliv.	Shrub
Thymelaeaceae	<i>Synaptolepis kirkii</i> Oliv.	Shrub
Thymelaeaceae	<i>Synaptolepis oliveriana</i> Gilg	Liana
Tiliaceae	<i>Carpodiptera africana</i> Mast.	Tree
Tiliaceae	<i>Grewia conocarpa</i> K.Schum.	Tree
Tiliaceae	<i>Grewia forbesii</i> K.Schum.	Shrub
Tiliaceae	<i>Grewia glandulosa</i> Vahl	Shrub

Family	Name	Life form
Tiliaceae	<i>Grewia holstii</i> Burret	Shrub
Tiliaceae	<i>Grewia</i> cf. <i>holtzii</i> Burret	Tree
Tiliaceae	<i>Grewia leptopus</i> Ulbr.	Tree
Tiliaceae	<i>Grewia limae</i> Wild	Tree
Tiliaceae	<i>Grewia microcarpa</i> K.Schum.	Shrub
Tiliaceae	<i>Grewia stuhlmannii</i> K.Schum.	Shrub
Tiliaceae	<i>Grewia vauhanii</i> Exell	Tree
Tiliaceae	<i>Triumfetta</i> cf. <i>rhomboidea</i> Jacq.	Herb
Turneraceae	<i>Tricliceras brevicaule</i> (Urb.) R.Fern. var. <i>rosulatum</i> (Urb.) R.Fern.	Herb
Turneraceae	<i>Tricliceras longepedunculatum</i> (Mast.) R.Fern.	Herb
Ulmaceae	<i>Trema orientalis</i> (L.) Blume	Tree
Umbelliferae	<i>Centella asiatica</i> (L.) Urb.	Herb
Verbenaceae	<i>Lippia javanica</i> (Burm.f.) Spreng.	Shrub
Verbenaceae	<i>Phyla nodiflora</i> (L.) Greene	Herb
Violaceae	<i>Hybanthus enneaspermum</i> (L.) F.Müll. var. cf. <i>caffer</i> (Sond) N.Robson	Herb
Violaceae	<i>Rinorea angustifolia</i> (Thouars) Baill. subsp. <i>ardisiiflora</i> (Oliv.) Grey-Wilson	Tree
Violaceae	<i>Rinorea arborea</i> (Thouars) Baill.	Tree
Violaceae	<i>Rinorea elliptica</i> (Oliv.) Kuntze	Tree
Violaceae	<i>Rinorea ferruginea</i> Engl.	Tree
Violaceae	<i>Rinorea ilicifolia</i> (Oliv.) Kuntze var. <i>ilicifolia</i>	Shrub
Violaceae	<i>Rinorea welwitschii</i> (Oliv.) Kuntze subsp. <i>tanzanica</i> Grey-Wilson	Shrub
Viscaceae	<i>Viscum gracile</i> Polh.& Wiens	Parasite
Vitaceae	<i>Ampelocissus obtusata</i> (Baker) Planch. subsp. <i>kirkiana</i> (Planch.) Wild & R.B.Drumm.	Vine
Vitaceae	<i>Cissus integrifolia</i> (Baker) Planch.	Vine
Vitaceae	<i>Cissus phymatocarpa</i> Masinde & L.E.Newton	Vine
Vitaceae	<i>Cissus</i> sp. aff. <i>quadrangularis</i> L.	Vine
Vitaceae	<i>Cissus sylvicola</i> Masinde & L.E.Newton	Vine
Vitaceae	<i>Rhoicissus tridentata</i> (L.f.) Wild & R.B.Drumm. subsp. <i>cuneifolia</i> (Eckl.& Zeyh.) Orton	Vine

### ANNEX 3.

New plant species and records resulting from recent coastal forest collections, with indications of distribution pattern and endemism. Taxa that were first recorded from collections not directly associated with the "Our Planet Reviewed" project are marked with an asterisk.

Localities: HC=Hunters' Concession; Lup=Lupangua; MRov=Mocímboa do Rovuma; Nang=Nangade; Nego=Negomano; NR=Nhica do Rovuma; Pal=Palma; Pund=Pundandar; Q=Quiterajo

#### NEW/UNDESCRIBED SPECIES (35)

ANNONACEAE	<i>Xylopia</i> sp. nov.	Q, Pal
ANNONACEAE	<i>Xylopia</i> sp. A of FTEA *	Pal, HC
ARACEAE	<i>Stylochaeton</i> sp. not matched (uncertain status)	Q
ASPARAGACEAE	<i>Asparagus</i> ?sp. nov.	Q
CELASTRACEAE	<i>Pleurostylia</i> ?sp. nov. aff. <i>serrulata</i> Loes.	Pal, NR
COMPOSITAE	<i>Vernonia</i> ?sp. nov. aff. <i>inhacensis</i> G.V.Pope	Pal
COMPOSITAE	<i>Vernonia</i> ?sp. nov. 2	NR
CONVOLVULACEAE	<i>Ipomoea</i> ?sp. nov.	NR
EUPHORBIACEAE	<i>Euphorbia</i> ?sp. nov. aff. <i>ambrosae</i> L.C.Leach var. <i>spinosa</i> L.C.Leach	Q
FLACOURTIACEAE	<i>Casearia</i> ?sp. nov.	NR
LABIATAE	<i>Vitex</i> ?sp. nov. aff. <i>buchananii</i>	Pal, NR, Pund
LABIATAE	<i>Vitex</i> cf. <i>mossambicensis</i> Gürke but corolla v. large	Q
LEG: PAPILION	<i>Baphia</i> ?sp. nov.	Pa
LEG: PAPILION	<i>Erythrina</i> ?sp. nov. not matched at K in FTEA/FZ regions	Q, Lup
MELASTOMATACEAE	<i>Warneckea</i> sp. nov.	Q
MELIACEAE	<i>Trichilia</i> ?sp. nov.	Nang, Pund
OCHNACEAE	<i>Ochna</i> ?sp. nov.	Pal, NR
RUBIACEAE	? <i>Chassalia</i> cf. <i>umbraticola</i> Vatke thickened inflorescence axis	Pal
RUBIACEAE	<i>Didymosalpinx callianthus</i> J.E.& S.M.Burrows, sp. nov.	NR
RUBIACEAE	<i>Oxyanthus</i> sp. A of FZ *	Q, Pal
RUBIACEAE	<i>Oxyanthus biflorus</i> J.E.& S.M.Burrows, sp. nov. * (= <i>Oxyanthus</i> cf. sp. A of FTEA)	NR
RUBIACEAE	<i>Polysphaeria</i> ?sp. nov.	NR
RUBIACEAE	<i>Psilanthus</i> ?sp. nov. cf. sp. A of FTEA, esp. Luke 10197 genus new to Moz and FZ, but to be sunk in <i>Coffea</i>	Q
RUBIACEAE	<i>Pyrostria</i> sp. B of FZ *	Q
RUBIACEAE	<i>Pyrostria</i> sp. D of FTEA *	NR, Nang
RUBIACEAE	<i>Pyrostria</i> ?sp. nov. = Luke 9724 (Tanzania) *	Nang
RUBIACEAE	<i>Rytigynia</i> cf. <i>umbellulata</i> (Hiern) Robyns * = de Koning et al. 9759 of FZ	Q



RUBIACEAE	<i>Tarenna</i> sp. 53 of Degreeef *	Q
	= Bidgood et al. 1357	
RUBIACEAE	<i>Tricalysia</i> sp. A of FZ *	Q
RUBIACEAE	<i>Tricalysia</i> sp. B of FZ *	Q
RUTACEAE	<i>Vepris</i> sp. nov. *	Q
	(= Müller & Pope 1935 from Zambezia)	
RUTACEAE	<i>Zanthoxylum lepreurii</i> Guill. & Perr.	Q
	?var./subsp. nov.	
SAPINDACEAE	<i>Deinbollia</i> ?sp. nov. *	Q
	(= Luke et al. 10131 from Mueda)	
STERCULIACEAE	<i>Cola</i> sp. nov. 1 aff. <i>clavata</i> Mast.	HC
STERCULIACEAE	<i>Cola</i> ?sp. nov. 2 aff. <i>clavata</i> Mast.	HC

#### NEW RECORDS: MOZAMBIQUE (67)

ACANTHACEAE	<i>Lepidagathis plantaginea</i> Mildbr.	Ngapa-Nego
ACANTHACEAE	<i>Whitfieldia orientalis</i> Vollesen	Nhica/Mueda
AMARYLLIDACEAE	<i>Crinum aurantiacum</i> Lehmillier	Q
ANACARDIACEAE	<i>Lannea schweinfurthii</i> (Engl.) Engl.	Q
	var. <i>acutifolia</i> (Engl.) Kokwaro	
ANNONACEAE	<i>Artabotrys modestus</i> Diels	Q
	subsp. <i>macranthus</i> Verdc.	
ANNONACEAE	<i>Letowianthus stellatus</i> Diels	Q
	new genus record for Moz & FZ	
ANNONACEAE	<i>Monanthotaxis faulknerae</i> Verdc.	Pal
ANNONACEAE	<i>Monanthotaxis trichantha</i> (Diels) Verdc.	Pal
ANNONACEAE	<i>Monodora minor</i> Engl. & Diels *	Pal
ANTHERICACEAE	<i>Chlorophytum amplexicaule</i> Baker	Lup
	(if distinct from <i>C. blepharophyllum</i> )	
APOCYNACEAE	<i>Baissea myrtifolia</i> (Benth.) Pichon *	Nang
APOCYNACEAE	<i>Cryptolepis hypoglaucia</i> K.Schum.	Q
ARACEAE	<i>Anchomanes abbreviatus</i> Engl.	Macomia, HC
ARACEAE	<i>Culcasia orientalis</i> Mayo	NR
ARACEAE	<i>Stylochaeton euryphyllum</i> Mildbr. *	Q
ARECACEAE	<i>Hyphaene petersiana</i> Mart.	Ngapa-Nego
BALANITACEAE	<i>Balanites maughamii</i> Sprague	Pal, NR
	subsp. <i>acuta</i> Sands	
BURSERACEAE	<i>Commiphora fulvotomentosa</i> Engl. *	Q
BURSERACEAE	<i>Commiphora pteleifolia</i> Engl.	NR
CAPPARACEAE	<i>Maerua bussei</i> (Gilg & Gilg-Ben) Wilczek *	HC
CAPPARACEAE	<i>Ritchiea capparoides</i> (Andr.) Britton	Q, Pal
	var. <i>capparoides</i>	
CELASTRACEAE	<i>Elaeodendron buchananii</i> (Loes.) Loes.	Mucojo-Macomia
COMPOSITAE	<i>Vernonia zanzibarensis</i> Less.	Mueda
CONNARACEAE	<i>Vismianthus punctatus</i> Mildbr. *	Mueda, Q
CUCURBITACEAE	<i>Peponium leucanthum</i> (Gilg) Cogn.	Pund

DRACAENACEAE	<i>Sansevieria</i> cf. <i>metallica</i> Gérôme & Labroy	Pal
EBENACEAE	<i>Diospyros kabuyana</i> F.White *	Pal, NR, Pund
EBENACEAE	<i>Diospyros magogoana</i> F.White	Pal
EBENACEAE	<i>Diospyros shimbaensis</i> F.White	Pal
EUPHORBIACEAE	<i>Croton polytrichus</i> Pax subsp. <i>polytrichus</i>	Pal
EUPHORBIACEAE	<i>Drypetes sclerophylla</i> Mildbr.	Q
EUPHORBIACEAE	<i>Omphalea mansfieldiana</i> Mildbr.	Q
LABIATAE	<i>Orthosiphon scedastophyllus</i> A.J.Paton	Q
LABIATAE	<i>Premna gracillima</i> Verdc.	Q
LABIATAE	<i>Premna hans-joachimii</i> Verdc. ? plot voucher 2008	HC, Nang
LEG: CAESALP	<i>Scorodophloeus fischeri</i> (Taub.) J.Léonard	HC, Nang
LEG: CAESALP	<i>Senna auriculata</i> (L.) Roxb.	Pal
LEG: MIMOSOID	<i>Newtonia paucijuga</i> (Harms) Brenan	Q
LEG: PAPILION	<i>Dalbergia lactea</i> Vatke	Pal
LEG: PAPILION	<i>Erythrina haerdii</i> Verdc.	Dica
LEG: PAPILION	<i>Erythrina saculeuxii</i> Hua	Pal
LOGANIACEAE	<i>Strychnos xylophylla</i> Gilg	Q
MYRTACEAE	<i>Eugenia capensis</i> (Eckl. & Zeyh.) Sond. subsp. <i>multiflora</i> Verdc.	Pal, NR
OCHNACEAE	<i>Ochna ovata</i> F.Hoffm.	Lup
ORCHIDACEAE	<i>Eulophia acutilabra</i> Summerh.	Pal
ORCHIDACEAE	<i>Eulophia guineensis</i> Lindl.	Pal
ORCHIDACEAE	<i>Microcoelia megalorrhiza</i> (Rchb.f.) Summerh.	Q
ORCHIDACEAE	<i>Microcoelia physophora</i> (Rchb.f.) Summerh.	Q
ORCHIDACEAE	<i>Nervilia bicarinata</i> (Blume) Schltr.	Q
PASSIFLORACEAE	<i>Adenia kirkii</i> (Mast.) Engl.	Q
RUBIACEAE	<i>Coffea schliebenii</i> Bridson ( <i>Coffea</i> sp. D of FTEA)	NR
RUBIACEAE	<i>Gardenia transvenulosa</i> Verdc. *	Q, Nang, NR, Pal
RUBIACEAE	<i>Kraussia kirkii</i> (Hook.f.) Bullock	Q, NR
RUBIACEAE	<i>Leptactina papyrophloea</i> Verdc. *	Pal, Q
RUBIACEAE	<i>Pavetta lindina</i> Bremek.	Q, Pal
RUBIACEAE	<i>Rhodopentas parvifolia</i> (Hiern) Kårehed & B.Bremer	Pund, Nang
RUBIACEAE	<i>Rothmannia macrosiphon</i> (Engl.) Bridson *	Pal
RUBIACEAE	<i>Vangueria</i> cf. <i>randii</i> S.Moore subsp. <i>vollesenii</i> Verdc.	NR
RUTACEAE	<i>Vepris sansibarensis</i> (Engl.) Mziray	Q
RUTACEAE	<i>Zanthoxylum lindense</i> (Engl.) Kokwaro	Pal, Q
SAPINDACEAE	<i>Haplocoelum inoploeum</i> Radlk.	Q
THYMELAEACEAE	<i>Synaptolepis kirkii</i> Oliv. sensu stricto	Q, NR
TILIACEAE	<i>Grewia stuhlmannii</i> K.Schum.	Macomia, HC
VIOLACEAE	<i>Rinorea welwitschii</i> (Oliv.) Kuntze subsp. <i>tanzanica</i> Grey-Wilson	Nang-Mueda
VISCACEAE	<i>Viscum gracile</i> Polh. & Wiens	Pal
VITACEAE	<i>Cissus phymatocarpa</i> Masinde & L.E.Newton	Mucojo-Macomia
VITACEAE	<i>Cissus sylvicola</i> Masinde & L.E.Newton	Q

**NEW RECORDS: MOZAMBIQUE – CABO DELGADO (37)**

ACANTHACEAE	<i>Justicia anagalloides</i> (Nees) T.Anders.	Q
ANNONACEAE	<i>Xylopia aethiopica</i> (Dunal) A.Rich.	Mueda
APOCYNACEAE	<i>Aspidoglossum biflorum</i> E.Mey.	Pal
APOCYNACEAE	<i>Cynanchum viminale</i> L.	HC
	subsp. <i>suberosum</i> (Meve & Liede) Goyder	
APOCYNACEAE	<i>Marsdenia cynanchoides</i> Schltr.	Q, Pal
APOCYNACEAE	<i>Schizogygia coffaeoides</i> Baill.	Pund
APOCYNACEAE	<i>Tacazzea apiculata</i> Oliv.	Pal
ARACEAE	<i>Gonatopus petiolulatus</i> (Peter) Bogner *	HC
BORAGINACEAE	<i>Coldenia procumbens</i> L.	Q, Rovuma
BURSERACEAE	<i>Commiphora africana</i> (A.Rich.) Engl.	Q
	var. <i>africana</i>	
CARYOPHYLLACEAE	<i>Polycarpon prostratum</i> (Forssk.)	Pal
	Aschers.& Schweinf.	
CELASTRACEAE	<i>Brexia madagascariensis</i> (Lam.) Ker-Gawl.	Pal
COMBRETACEAE	<i>Combretum butyrosum</i> (Bertol.f.) Tul	Q
COMBRETACEAE	<i>Pteleopsis barbosa</i> Exell	Macomia-Mucojo
	(new to CD)	
DENNSTAEDTIACEAE	<i>Blotiella natalensis</i> (Hook.) R.M.Tryon	Mueda
EUPHORBIACEAE	<i>Caperonia stuhlmannii</i> Pax	NR
EUPHORBIACEAE	<i>Croton menyarthii</i> Pax	Nego, Q
EUPHORBIACEAE	<i>Drypetes arguta</i> (Müll.Arg.) Hutch.	Q
EUPHORBIACEAE	<i>Euphorbia ambroseae</i> L.C.Leach	Q
	var. <i>spinosa</i> L.C.Leach	
EUPHORBIACEAE	<i>Oldfieldia somalensis</i> (Chiov.) Milne-Redh.	Nang/HC
EUPHORBIACEAE	<i>Phyllanthus pinnatus</i> (Wight) G.L.Webster	Nego
LEG: MIMOSOID	<i>Albizia zimmermannii</i> Harms	Mueda
LEG: PAPILION	<i>Vigna luteola</i> (Jacq.) Benth.	Q
LOGANIACEAE	<i>Strychnos panganensis</i> Gilg	Q
LORANTHACEAE	<i>Englerina inaequilatera</i> (Engl.) Gilli	Pal
MALPHIGIACEAE	<i>Acridocarpus natalitius</i> A.Juss.	NR
	var. <i>natalitius</i>	
MELIACEAE	<i>Pseudobersama mossambicensis</i> (Sim) Verde.	Pal
MENISPERMACEAE	<i>Jateorhiza palmata</i> (Lam.) Miers	Q
POLYGALACEAE	<i>Polygala sansibarensis</i> Gürke	NR
PTAEROXYLACEAE	<i>Ptaeroxylon obliquum</i> (Thunb.) Radkl.	Pal
RUBIACEAE	<i>Pavetta uniflora</i> Bremek.	Q
RUTACEAE	<i>Vepris lanceolata</i> (Lam.) G.Don	Pal
SAPINDACEAE	<i>Macphersonia gracilis</i> O.Hoffm.	Pal
	var. <i>hildebrandtii</i> (O.Hoffm.) Capuron	
SOLANACEAE	<i>Solanum catombelense</i> Peyr.	Q
STERCULIACEAE	<i>Hildegardia migeodii</i> (Exell) Kosterm.	Lup
VIOLACEAE	<i>Rinorea ferruginea</i> Engl. *	Mueda
VITACEAE	<i>Ampelocissus obtusata</i> (Baker) Planch.	Q
	subsp. <i>kirkiana</i> (Planch.) Wild & R.B.Drumm.	

**LOCAL ENDEMICS – MOZAMBIQUE: N ONLY (31)**

ANNONACEAE	<i>Hexalobus mossambicensis</i> N.Robson	HC
ANNONACEAE	<i>Xylopi</i> sp. nov.	Q, Pal
APOCYNACEAE	<i>Carvalhoa campanulata</i> K.Schum. sensu stricto endemic local form with auriculate base to leaf	Pal
ARACEAE	<i>Stylochaeton</i> sp. not matched (uncertain status)	Q
ASPARAGACEAE	<i>Asparagus</i> ?sp. nov.	Q
CAPPARACEAE	<i>Maerua andradae</i> Wild	Dica, Macomia
CELASTRACEAE	<i>Pleurostylia</i> ?sp. nov. aff. <i>serrulata</i> Loes.	Pal, NR
COMBRETACEAE	<i>Combretum stocksii</i> Sprague	Nang, Mueda
COMBRETACEAE	<i>Pteleopsis barbosa</i> Exell	Macomia-Mucojo
COMPOSITAE	<i>Vernonia</i> ?sp. nov. aff. <i>inhacensis</i> G.V.Pope	Pal
CONVOLVULACEAE	<i>Ipomoea</i> ?sp. nov.	NR
CUCURBITACEAE	<i>Coccinea subglabra</i> C.Jeffrey	HC
ERYTHROXYLACEAE	<i>Nectaropetalum</i> ? <i>carvalhoi</i> Engl. if so, then 2nd record, and fls with long style	Q
FLACOURTIACEAE	<i>Casearia</i> ?sp. nov.	NR
LABIATAE	<i>Vitex</i> ?sp. nov. aff. <i>buchananii</i>	Pal, NR, Pund
LABIATAE	<i>Vitex</i> cf. <i>mossambicensis</i> Gürke, but corolla v. large	Q
LEG: CAESALP	<i>Micklethwaitia carvalhoi</i> (Harms) G.P.Lewis & Schrire	Q
LEG: PAPILION	<i>Baphia</i> ?sp. nov.	Pal
LEG: PAPILION	<i>Erythrina</i> ?sp. nov. not matched at K	Q, Lup
MALVACEAE	<i>Thespesia mossambicensis</i> (Exell & Hillc.) Fryxell	Q
MELASTOMATACEAE	<i>Warneckea</i> sp. nov.	Q
MELIACEAE	<i>Trichilia</i> ?sp. nov.	Nang-Pund
OCHNACEAE	<i>Ochna</i> ?sp. nov.	Pal, NR
RUBIACEAE	<i>Psilanthus</i> sp. nov. cf. sp. A of FTEA (especially Luke 10197)	Q
RUBIACEAE	<i>Pyrostria</i> sp. B of FZ	Q
RUBIACEAE	<i>Tarenna pembensis</i> J.E.Burrows	Pemba, Macomia, Mossuril
RUBIACEAE	<i>Tricalysia</i> sp. A of FZ	Q (and Moz Z)
RUBIACEAE	<i>Tricalysia</i> sp. B of FZ	Q
RUTACEAE	<i>Zanthoxylum lepreurii</i> Guill.& Perr. var./subsp. nov.?	Q
SAPINDACEAE	<i>Deinbollia</i> ?sp. nov. (= Luke et al. 10131 from Mueda)	Q
TILIACEAE	<i>Grewia limae</i> Wild	Q, NR

**LOCAL ENDEMICS – MOZAMBIQUE: N & TANZANIA T8 (53)**

ANNONACEAE	<i>Dielsiothamnus divaricatus</i> (Diels) R.E.Fr.	Mueda (T8, SMal)
ANNONACEAE	<i>Monanthotaxis trichantha</i> (Diels) Verdc.	Pal
ANNONACEAE	<i>Monodora minor</i> Engl. & Diels	Mueda, Pal (T6,8)
ANNONACEAE	<i>Xylopi collina</i> Diels	Pal
ANNONACEAE	<i>Xylopi</i> sp. A of FTEA	Pal, HC



APOCYNACEAE	<i>Carvalhoa campanulata</i> K.Schum. (sensu stricto, but delimitation dubious)	Q, Pal (1 coll T8)
ARACEAE	<i>Stylochaeton euryphyllum</i> Mildbr.	Q
BURSERACEAE	<i>Commiphora fulvotomentosa</i> Engl.	Q (T6,8)
CAPPARACEAE	<i>Maerua acuminata</i> Oliv.	Pal, Nang, Pund
CAPPARACEAE	<i>Ritchiea pygmaea</i> (Gilg) DeWolf (also reported from Katanga)	HC
CELASTRACEAE	<i>Salacia orientalis</i> N.Robson	Mueda
CLUSIACEAE	<i>Garcinia acutifolia</i> N.Robson	Pal, NR
CLUSIACEAE	<i>Vismia pauciflora</i> Milne-Redh.	Q, Nang
COMBRETACEAE	<i>Combretum andradae</i> Exell & J.G.Garcia	MRov
CONNARACEAE	<i>Vismianthus punctatus</i> Mildbr.	Q, Pal, Mueda
CUCURBITACEAE	<i>Peponium leucanthum</i> (Gilg) Cogn.	Pund (T6,8)
DICHAPETALACEAE	<i>Dichapetalum edule</i> Engl.	Q
DICHAPETALACEAE	<i>Dichapetalum macrocarpum</i> Engl.	NR
EBENACEAE	<i>Diospyros magogoana</i> F.White	Pal
EUPHORBIACEAE	<i>Croton kilwae</i> Radcl.-Sm.	Q
EUPHORBIACEAE	<i>Drypetes sclerophylla</i> Mildbr.	Q
LABIATAE	<i>Clerodendrum lutambense</i> Verdc.	Pal
LABIATAE	<i>Orthosiphon scedastophyllus</i> A.J.Paton	Q
LABIATAE	<i>Premna hans-joachimii</i> Verdc., ? plot voucher	
LABIATAE	<i>Vitex mossambicensis</i> Gürke	Q, Pal
LEG: CAESALP	<i>Berlinia orientalis</i> Brenan	Q, Pal, NR
LEG: MIMOSOID	<i>Entada stuhlmannii</i> (Taub.) Harms	Q
LEG: MIMOSOID	<i>Mimosa busseana</i> Harms	Q
LEG: MIMOSOID	<i>Pseudoprosopis euryphylla</i> Harms	Q
LEG: PAPILION	<i>Baphia macrocalyx</i> Harms	Pal
LEG: PAPILION	<i>Baphia</i> ?sp. nov.	Pal
LEG: PAPILION	<i>Millettia makondensis</i> Harms	Pal, NR
LEG: PAPILION	<i>Ormocarpum schliebenii</i> Harms	Q
LEG: PAPILION	<i>Pterocarpus megalocarpus</i> Harms	HC (& T6)
LINACEAE	<i>Hugonia grandiflora</i> N.Robson	Mueda
LORANTHACEAE	<i>Erianthemum lindense</i> (Sprague) Danser	Pal
OLACACEAE	<i>Olex pentandra</i> Sleumer	Q, Nang, Macomia (T6,8)
RUBIACEAE	<i>Catunaregam stenocarpa</i> Bridson	Q (& Moz: Z)
RUBIACEAE	<i>Coffea schliebenii</i> Bridson	NR
RUBIACEAE	<i>Cuviera semsei</i> Verdc. (also in S Malawi)	Q
RUBIACEAE	<i>Didymosalpinx callianthus</i> J.E. & S.M.Burrows, sp. nov.	NR
RUBIACEAE	<i>Leptactina papyrophloea</i> Verdc.	Q, Pal
RUBIACEAE	<i>Oxyanthus</i> sp. A of FZ	Q, Pal
RUBIACEAE	<i>Oxyanthus</i> sp. = Bidgood et al. 1341, 1364 & Clark 29 (=Oxyanthus cf. sp. A of FTEA)	NR
RUBIACEAE	<i>Pavetta lindina</i> Bremek.	Q, Pal
RUBIACEAE	<i>Pavetta lutambensis</i> Bremek.	Macomia/Mucojo (T6,8)
RUBIACEAE	<i>Pavetta macrosepala</i> Hiern var. <i>macrosepala</i>	NR
RUBIACEAE	<i>Pyrostria</i> sp. D of FTEA	NR, Nang
RUBIACEAE	<i>Tarenna</i> sp. 53 of Degreef = Bidgood et al. 1357	Q

RUBIACEAE	<i>Tricalysia schliebenii</i> Robbr.	Q, NR
RUBIACEAE	<i>Tricalysia semidecidua</i> Bridson	Q, Pal, NR
RUTACEAE	<i>Zanthoxylum lepreurii</i> Guill. & Perr. var./subsp. nov.?	Q
STERCULIACEAE	<i>Cola</i> ? <i>discoglypsemnophylla</i> Brenan & A.P.D. Jones	Q (T8, ?6)

#### REGIONAL ENDEMICS – CENTRAL/NORTHERN MOZAMBIQUE TO CENTRAL TANZANIA

ANNONACEAE	<i>Dielsiothamnus divaricatus</i> (Diels) R.E. Fr. (also in Malawi)	Q
APOCYNACEAE	<i>Marsdenia cynanchoides</i> Schltr.	Q, Pal
BURSERACEAE	<i>Commiphora serrata</i> Engl.	Q
DICHAPETALACEAE	<i>Dichapetalum mossambicense</i> (Klotzsch.) Engl.	Q
FLACOURTIACEAE	<i>Buchnerodendron lasiocalyx</i> (Oliv.) Gilg.	Q
MORACEAE	<i>Bosqueiopsis gillettii</i> De Wild. & T. Durand E African form (?subsp. nov.)	Pemba, Q
LEG: CAESALP	<i>Guibourtia schliebenii</i> (Harms) J. Léonard	Q
LEG: PAPILION	<i>Millettia impressa</i> Harms subsp. <i>goetzeana</i> (Harms) Gillett	Q, Pal
RUBIACEAE	<i>Pavetta decumbens</i> K. Schum. & K. Krause	Q
TECOPHILAEACEAE	<i>Kabuyea hostifolia</i> (Engl.) Brummitt	Q
VISCACEAE	<i>Viscum gracile</i> Polh. & Wiens	Pal

#### PLANTS AT SOUTHERN LIMIT OF E AFRICAN COASTAL (SWAHELIAN) DISTRIBUTION

ACANTHACEAE	<i>Whitfieldia orientalis</i> Vollesen	Nhica-Mueda
ANNONACEAE	<i>Artabotrys modestus</i> Diels subsp. <i>macranthus</i> Verdc.	Q
ANNONACEAE	<i>Letowianthus stellatus</i> Diels	Q
ANNONACEAE	<i>Monanthotaxis faulknerae</i> Verdc.	Pal
ANNONACEAE	<i>Uvaria acuminata</i> Oliv.	Q, Pal
ANNONACEAE	<i>Uvaria kirkii</i> Oliv.	Q
APOCYNACEAE	<i>Ancylobothrys tayloris</i> (Stapf) Pichon (+ 1 coll. Mulanje)	Q
ARALIACEAE	<i>Cussonia zimmermannii</i> Harms	NR
BALANITACEAE	<i>Balanites maughamii</i> Sprague subsp. <i>acuta</i> Sands	Pal, NR
CLUSIACEAE	<i>Vismia orientalis</i> Engl.	Q
CAPPARACEAE	<i>Maerua grantii</i> Oliv.	MRov
COMBRETACEAE	<i>Combretum constrictum</i> (Benth.) Laws.	Q
COMBRETACEAE	<i>Combretum illairii</i> Engl.	Q
COMBRETACEAE	<i>Combretum xanthothyrsus</i> Engl. & Diels	NR
CONNARACEAE	<i>Rourea coccinea</i> (Schumacher & Thonn.) Hook. f. subsp. <i>boiviniana</i> (Baill.) Jongkind	Q, Pal
DICHAPETALACEAE	<i>Dichapetalum stuhlmannii</i> Engl.	Macomia
EBENACEAE	<i>Diospyros kabuyana</i> F. White	Pal, NR
EBENACEAE	<i>Diospyros shimbaensis</i> F. White	Pal

EUPHORBIACEAE	<i>Drypetes arguta</i> (Müll.Arg.) Hutch.	Q
EUPHORBIACEAE	<i>Oldfieldia somalensis</i> (Chiov.) Milne-Redh. (also Moz: Z)	Nang/HC
EUPHORBIACEAE	<i>Ricinodendron heudelotii</i> (Baill.) Hechel subsp. <i>africanum</i> (Mull.Arg.) J.Léonard var. <i>tomentellum</i> (Hutch.& E.A.Bruce) Radcl.-Sm.	NR
LABIATAE	<i>Endostemon albus</i> A.J.Paton & Harley	Pal
LABIATAE	<i>Premna gracillima</i> Verdc.	Q
LABIATAE	<i>Premna schliebenii</i> Werderm.	Q
LEG: CAESALP	<i>Dialium holtzii</i> Harms	Q, NR
LEG: PAPILION	<i>Dalbergia bracteolata</i> Baker	Q, Pal
LEG: PAPILION	<i>Erythrina sacleuxii</i> Hua	Pal
LOGANIACEAE	<i>Strychnos xylophylla</i> Gilg	Q
MYRTACEAE	<i>Eugenia capensis</i> (Eckl.& Zeyh.) Sond. subsp. <i>multiflora</i> Verdc.	NR
ORCHIDACEAE	<i>Microcoelia physophora</i> (Rchb.f.) Summerh.	Q
PASSIFLORACEAE	<i>Adenia kirkii</i> (Mast.) Engl.	Q
POLYGALACEAE	<i>Polygala sansibarensis</i> Gürke	NR
RUBIACEAE	<i>Chassalia umbraticola</i> Vatke	Q
RUBIACEAE	<i>Gardenia transvenulosa</i> Verdc.	Q, Pal
RUBIACEAE	<i>Heinsia zanzibarica</i> (Bojer) Verdc.	Pal
RUBIACEAE	<i>Kraussia kirkii</i> (Hook.f.) Bullock	Q, NR
RUBIACEAE	<i>Psydrax kaessneri</i> (S.Moore) Bridson	Q
RUBIACEAE	<i>Rothmannia macrosiphon</i> (Engl.) Bridson (probably - in bud)	Pal
RUTACEAE	<i>Zanthoxylum holtzianum</i> (Engl.) Waterm. subsp. <i>holtzianum</i>	Q, Pal, NR
SAPINDACEAE	<i>Haplocoelum inophloeum</i> Radkl.	Q
STERCULIACEAE	<i>Sterculia schliebenii</i> Mildbr.	Q, Pal
THYMELAEACEAE	<i>Synaptolepis kirkii</i> Oliv. sensu stricto	Q, NR
TILIACEAE	<i>Grewia holstii</i> Burret	Pal
TILIACEAE	<i>Grewia stuhlmannii</i> K.Schum.	Macomia, HC
VITACEAE	<i>Cissus sylvicola</i> Masinde & L.E.Newton	Q

## ANNEX 4.

Summary of findings from species-richness plot, Quiterajo, 25 Nov 2009.

Species	subplots				total	Note: Numbers refer to stems 6 cm dbh or greater; dot signifies presence of smaller sizes.
	A	B	C	D		
Acacia adenocalyx	•	•	•	4	4	
Caloncoba welwitschii			1		1	
Carpolobia goetzei	2				2	
Combretum illairii	•					
Combretum sp.				•		
?Combretum (climber, yellow flowers)		•	4		4	
Commiphora sp.			1		1	
Croton pseudopulchellus	•		3	•	3	
Deinbollia sp. nov.	4	3	•	3	10	
Dichapetalum sp.		•				
Diospyros abyssinica subsp. abyssinica	3	1	4	6	14	
?Drypetes (tree, sclerophyllous leaves)	4	•	1	1	6	
Euphorbia lividiflora			•			
?Flacourtiaceae (tree, to canopy)	•	1		1	2	
Grewia sp.	•					
Guibourtia schliebenii	23	17	11	20	71	
Holarrhena pubescens		2	3		5	
Lannea antiscorbutica	1		1		2	
Manilkara discolor	3				3	
Memecylon natalense / flavovirens	5	4		14	23	
Memecylon torrei	•		•	3	3	
Millettia impressa subsp. goetziana	•	•	3	2	5	
Mostuea brunonis	•	3	1	3	7	
Ophrypetalum cf. odoratum			1	1	2	
Oxyanthus sp. A of FZ		1			1	
Premna gracillima			5	3	8	
Pseudoprosopis euryphylla	•	•	4	4	8	
Pteleopsis myrtifolia	3	2			5	
Pyrostria ?		•				
Rinorea angustifolia subsp. ardisiiflora	10	9	5	8	32	
Rotheca incisa			2	2	4	
Rubiaceae 1	•					
?Rubiaceae (tree, green peeling bark)		•				
Rytigynia ?	•	2		1	3	
Salacia cf. leptoclada	•	•		•		
Schlechterina mitostemmatoides	•					
Strophanthus petersiana	•	1	1		2	
Strychnos henningsii		3	1		4	
Synaptolepis kirkii		•	•			
Vismianthus punctatus	•	•		1	1	
Vitex mossambicensis	6	5	4	3	18	
Warneckea sansibarica	5	9	11	10	35	
Warneckea sousae	•	4	4	3	11	
Xeroderris stuhlmannii			1		1	
Xylopia sp. nov.	6	8	6	10	30	
Zanthoxylum sp.				1	1	