Darwin Initiative Award 2380: Balancing Conservation and Livelihoods in the Chimanimani Forest Belt, Mozambique

PLANT CONSERVATION IN COMMUNITIES ON THE CHIMANIMANI FOOTSLOPES, MOZAMBIQUE

April 2016

Jonathan Timberlake, Iain Darbyshire, Martin Cheek, Aurelio Banze, Valdemar Fijamo, João Massunde, Hercilia Chipanga and Daglasse Muassinar

Front cover: Rio Tave grasslands, Mpunga community (TT).
Frontispiece: Team at Thekeza homestead, Zomba (TT, top); Team collecting plants, Mpunga (TT, middle L); Woodland clearance for maize, Mahate (JT, middle R); Fruit of *Pterocarpus angolensis*, Mpunga (MC, bottom L); Forest stream, Maronga (JT, bottom R).
Photo credits: JT – Jonathan Timberlake TT – Tom Timberlake MC – Martin Cheek
ID – Iain Darbyshire

Suggested citation: Timberlake, J.R., Darbyshire, I., Cheek, M., Banze, A., Fijamo, V., Massunde, J., Chipanga H. and Muassinar, D. (2016). Plant conservation in communities on the Chimanimani footslopes, Mozambique. Report produced under the Darwin Initiative Award 2380. Royal Botanic Gardens, Kew, London. 69 pp.

LIST OF CONTENTS

SUMMARY

Field studies were carried out in 2015 in four communities on the eastern footslopes and pediments of the Chimanimani Mountains in Sussundenga District in central Mozambique – from north to south, Mahate, Mpunga, Zomba and Maronga. These communities lie inside the Buffer Zone of the Chimanimani Trans-Frontier Conservation Area (TFCA). The study objectives were to identify or justify areas for community conservation initiatives, identify plant species of particular concern and any threats to them, and to see if any species could support local economic enterprise on a sustainable basis. During fieldwork the main vegetation types were recorded, potential areas for community and/or biodiversity conservation were looked at, and plant species of economic potential or known Chimanimani endemics and range-restricted species identified.

The main findings and conclusions were:
1. Forests and some other habitats on the Chimanimani foothills and pediments contain regionally-significant biodiversity. Despite much clearance for agriculture, which has accelerated in recent years, and frequent burning there are a number of localities where the natural vegetation is still essentially intact. Most of these localities lie close to the Chimanimani TFCA Core Zone or are non-arable areas. A selection of these are here described and proposed for conservation. Much of the extent of areas suggested by Kew scientists has also been proposed by the local communities for community conservation. Outside the TFCA Core Zone the area proposed by Kew scientists totals 127.5 km^2 across seven sites.

2. The habitats of particular conservation interest are (a) moist and semi-deciduous forest, (b) woodland and similar vegetation on quartzite rock outcrops, (c) swamps and wetlands, (d) natural wet grasslands, and (e) fringing riverine forest which acts as both a conservation corridor and protects water quality. Areas of significance for conservation but not yet under any protection in the TFCA Core Zone are the swamps and riverine fringes in Zomba, and some riverine forests/ woodlands in Maronga, Zomba and Mahate that act as conservation corridors as well as helping ensure a reliable and clean water supply for people living downstream.

3. A total of 532 plant taxa (named species, subspecies and varieties) were recorded from the four community areas studied, although this list is by no means exhaustive. As far as can be determined, 13 of these represent new records for Mozambique. Five species appear to be endemic (i.e. confined globally) to lower altitude areas of the Chimanimani foothills, only in Mozambique or also across into Zimbabwe (*Ficus muelleriana*, *Otiophora lanceolata*, *Streptocarpus acicularis*, *Vepris drummondii*, *Vernonia muelleri* subsp. *muelleri*). A further three are suspected to be new undescribed species (*Crepidorhopalon whytei* '*flavum*', *Synsepalum* sp. near *kaessneri*, *Xyris* sp. nov.). A total of 24 species, including those mentioned above, were identified as being of particular conservation interest owing to being range-restricted or having a disjunct distribution.

Some of them are Chimanimani quartzite montane endemics that have established along rivers, presumably from washed-down seeds.

4. All species of conservation interest can be conserved within the appropriate habitat, and none need additional measures – the threats to them result from habitat clearance and modification, not from species-specific threats.

5. Of particular conservation concern is the invasive shrub or small tree, *Vernonanthura phosphorica*. This Brazilian species, introduced as a bee fodder, rapidly invades cleared areas, particularly those that were previously forest, often forming extensive tall stands that inhibit forest regeneration. As it is both readily flammable and regenerates rapidly after fire, infested areas tend to burn more frequently, further interfering with forest regeneration.

6. Plants with potential for sustainable economic use by the communities, compatible with the area being a TFCA Buffer Zone, were looked for. Only five species were thought to show particular promise, although there may well be others. They are the plumose seeds of the forest tree *Funtumia africana* for specialist paper-making; the fruits of the wild coffee *Coffea salvatrix* for specialist coffees; fruits of the woodland tree *Uapaca kirkiana* for food; and the stems of papyrus *Cyperus papyrus* and reed *Phragmites* sp. for making mats. Use of wood from trees such as *Khaya anthotheca* for small folding chairs is possible, although would probably be unsustainable.

7. The actual TFCA Core Zone–Buffer Zone boundary on the ground is not clear to the communities, and in a number of cases fields and homesteads appear to be a significant distance inside the latest (2013) designated boundary. This is also a limitation to developing community-ecotourism initiatives. Clearance and cultivation are now extending significantly into the protected Core Zone, which comprises fairly steep slopes leading up to the main Chimanimani massif. Such incursions, often associated with the indiscriminate use of fire for clearing, need to be controlled by the community and TFCA authorities.

8. Localities of possible ecotourism interest are identified but, apart from Ndzou Camp at Mpunga close to the main road, with the additional draw of elephant sightings, difficulties in access mean they are not easy to develop or promote. Multi-day walking treks may be the best option to develop at this stage, incorporating the Chimanimani Mountains, forested footslopes, rivers and waterfalls. As ecotourism for bird watchers is easier to promote, further investigation of the bird diversity in these areas present would be useful.

1. INTRODUCTION

Under the UK Government's Darwin Initiative Grant No. 2380, given to the Royal Botanic Gardens, Kew, UK and the Micaia Foundation, Chimoio, Mozambique in 2014, one of the specified outputs (Output 1) – and the responsibility of Kew – is baseline surveys in the Mahate, Moribane, Zomba and Maronga community forest reserves: "Forest surveys produced for each of 4 distinct forest areas, with a specific focus on useful plants identified by the communities (e.g. food and medicinal plants) and conservation priority species".

Specifically there are five activities:

Activity 1.1 – Carry out targeted plant surveys in each of the four forest areas, focussing on less-disturbed areas;
Activity 1.2 – Identify (at IIAM and Kew) botanical voucher specimens collected during survey work;
Activity 1.3 – Map vegetation types and habitat quality using field survey data and available spatial imagery;
Activity 1.4 – Compile summary botanical report for each of the four forest areas;
Activity 1.5 – Establish forest sample plots in two forest areas [3-4 plots in each area].

This report outlines the activities undertaken, the approach taken, and preliminary findings, in particular as regards community conservation.

2. STUDY AREA AND APPROACH

The study area covers four communities lying between 19°39' and 20°05' S on the footslopes of the eastern flanks of the Chimanimani Mountains in central Mozambique, all within Sussundenga District of Manica Province (Figures 1 and 2). According to earlier studies by Micaia (Bannerman 2010), Mahate community on the north-eastern slopes comprises around 190 households, Mpunga community flanks the new main road and comprises 441 households, Zomba lies in the middle section with 1156 households, while Maronga is in the far south, just north of the Lusitu River and comprises 494 households. Two communities – Mpunga (sometimes called Moribane) and Zomba – were visited by a team of botanists led by Kew in June–July 2015. The other two (Mahate and Maronga) were visited in November 2015. Full logistical and organisational support was provided by the Micaia Foundation in Chimoio.

In each community various activities were carried out: (a) general plant collecting in the area focusing on species that may be of particular conservation interest or potential economic value; (b) recording of vegetation plots to characterise the various vegetation types found; (c) in Mpunga and Maronga, recording of 25 × 25 m tree diameter plots (minimum size 8 cm dbh); (d) in Mpunga only, recording of detailed species composition in 25 × 25 m forest plots using a modified Hall & Swaine method (Hall & Swaine 1981); and (e) a general description of conservation threats and potentials. Detailed results and findings are given below, area by area.

A full description of the Chimanimani area covering physical geography, climate, geology and soils is available in Ghiurghi, Dondeyne & Bannerman (2010a), and for the botany and ecology in Timberlake *et al.* (2016, in prep.).

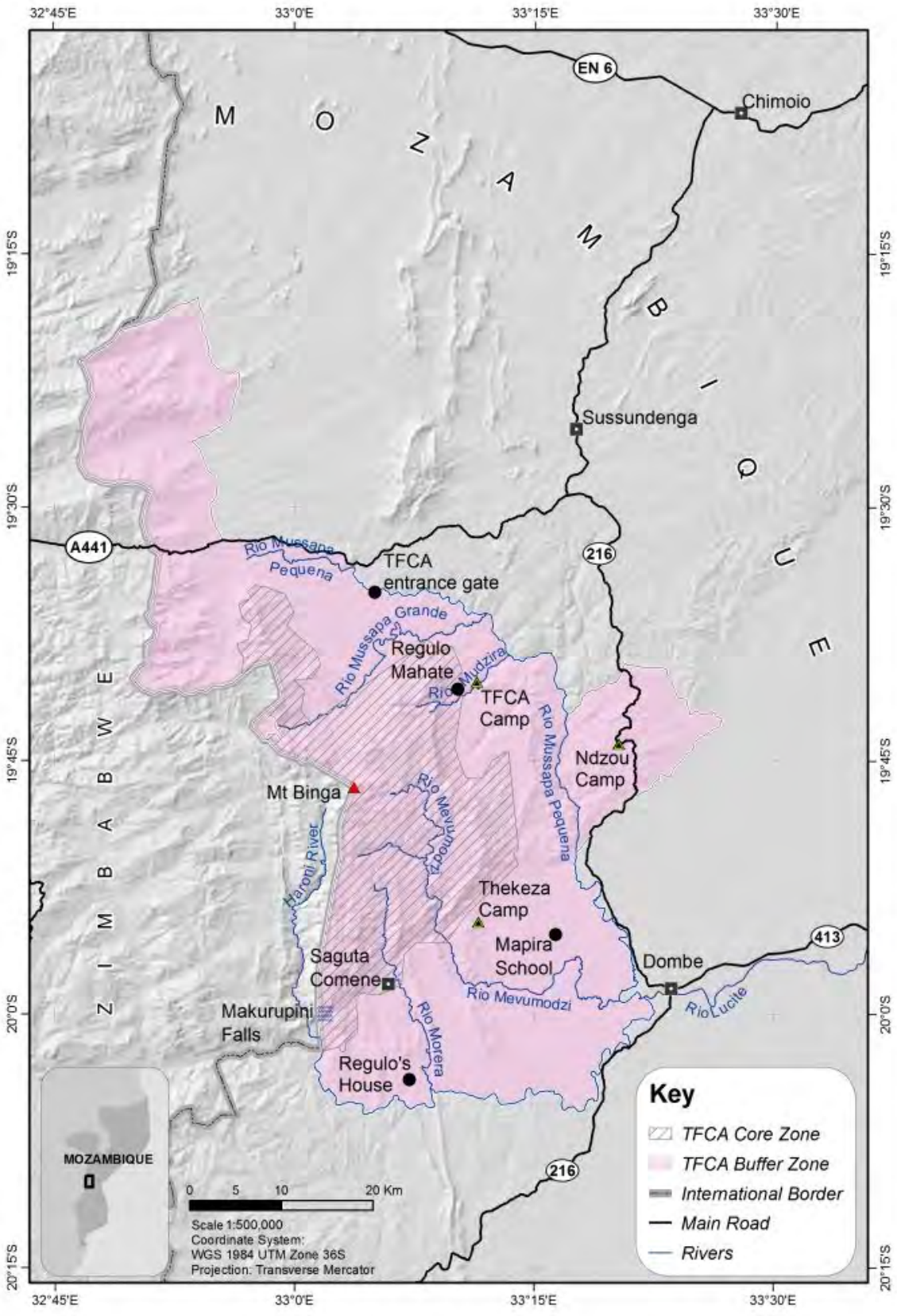

Fig. 1. Overview of the Chimanimani TFCA study area.

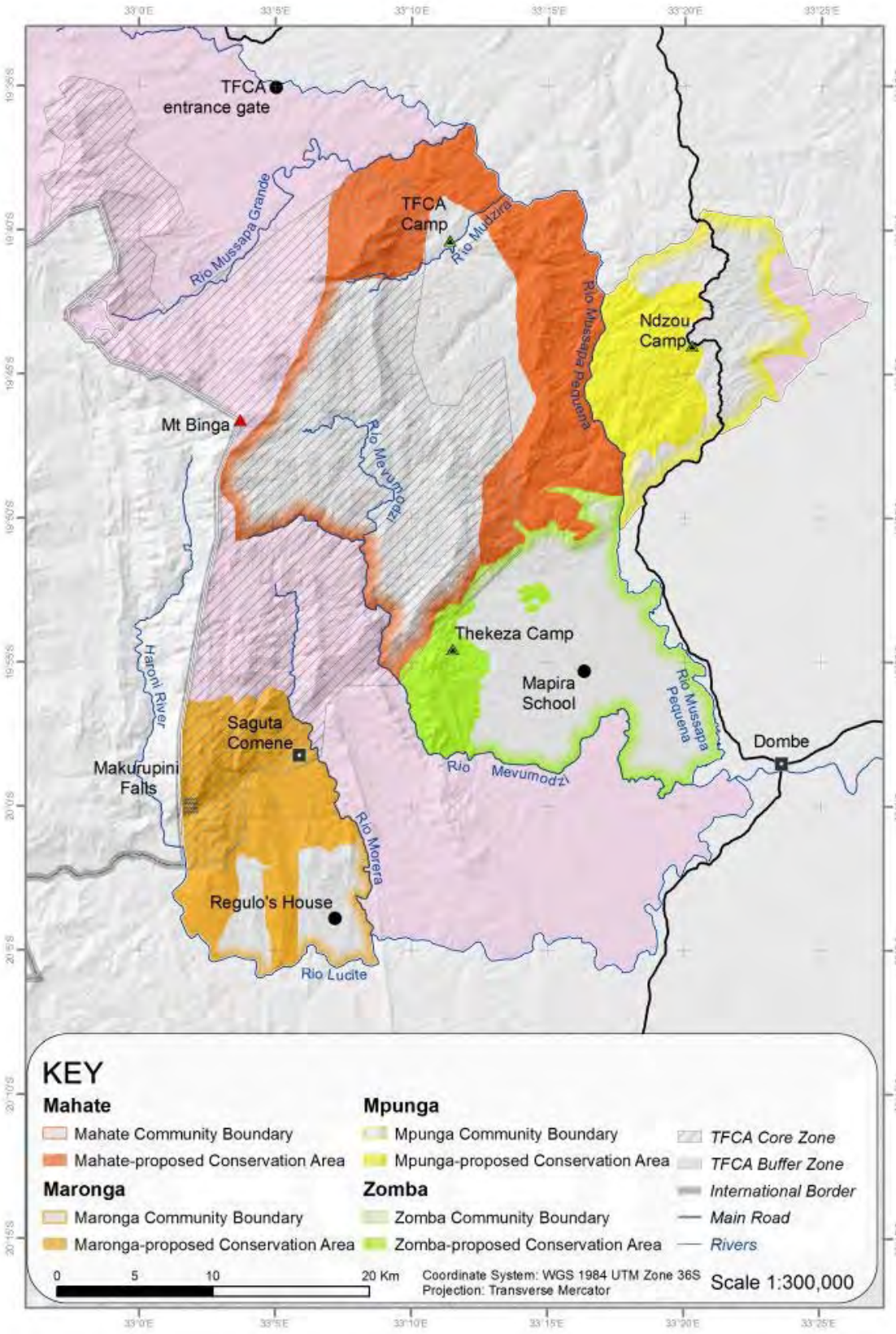

Fig. 2. Chimanimani community boundaries and areas selected by each community for conservation.

3. PREVIOUS STUDIES

There have been a number of studies focussing on the foothills of the Chimanimani Mountains in Mozambique, both botanical/forestry and socio-economic studies.

On the forestry side, the first study was probably that by Gomes e Sousa (1968) who outlined and very briefly described the three Forest Reserves gazetted on the forested Chimanimani footslopes and pediments. The three – Moribane (5300 ha), Zomba (2850 ha) and Maronga (8300 ha) – were established on 22 July 1953 as reserves for timber production, but possibly also for watershed protection (Müller *et al.* 2005; Ghiurghi *et al.* 2010a, vol. 1). Gomes e Sousa (1968) gives sketch maps of each along with dimensions and approximate limits, while Dutton & Dutton (1975) show each on a small-scale map of the whole Chimanimani area. Under current legislation (Forest and Wildlife Law, Article 12), Forest Reserves are considered as National Reserves where existing resources can be used, but only under licence; whether settlement is allowed inside is not clear.

Recent studies in these Forest Reserves done through the Forestry Department of the Universidade Eduardo Mondlane have shown the effects of altitude and soil variation in Moribane (Muhate 2004), while Guedes (2004) found more than 55 tree species with a dbh greater than 10 cm in Moribane and a Shannon-Weiner species diversity of 4, greater than that in both Zomba and Maronga.

A small area in Zomba, not far from the Rio Mussapa Pequena, is called Serração, presumably named after the presence of a sawmill in colonial times. In addition, the map of Maronga Forest Reserve (Gomes e Sousa 1968) shows a concession, presumably for logging, straddling the reserve's eastern boundary in the 1960s.

During his time developing the Chimanimani Management Plan, Stefan Dondeyne carried out additional studies in the forests of Moribane (September 2012) and Zomba, especially Mt Magorogodo (October 2013) linked with students from the Instituto Superior Politécnico de Manica. From these studies, partial checklists compiled by Bart Wursten are available on the Flora of Mozambique website (Hyde *et al.* 2015a,b). An earlier study (Monteiro *et al.* 2011) looked at tree composition and species diversity in forest gaps in Moribane forest.

More recently, João Massunde of the Micaia Foundation has compiled lists of plant species found in the four communities, along with their local names and uses. Into these he has incorporated findings from some previous studies, such as that by Camila da Sousa of IIAM on Mpunga/Moribane (de Sousa 2009).

However, the most significant study from our point of view was a detailed re-assessment of the Forest Reserves across Mozambique carried out under the auspices of WWF in 2005 (Müller, Sitoe & Mabunda 2005), including the three in Sussundenga District. The main findings from that assessment are outlined below.

In 2005 the Moribane Forest Reserve still showed signs of the devastating fire following the drought of 1992, with pioneer species such as *Macaranga capensis*, *Harungana madagascariensis* and *Trema orientalis* common, sometimes in pure stands of even-aged trees. A large part of the Reserve was in good condition with a closed-canopy and a woody understory mostly dominated by Rubiaceae and Apocynaceae. It may be the largest extent of lowland forest remaining in Mozambique. What Müller *et al.* called moist evergreen forest is dominated by *Newtonia buchananii*, with other canopy trees of *Blighia unijugata*, *Celtis gomphophylla*, *Celtis mildbraedii* [not found during the Darwin trips], *Erythrophleum*

suaveolens, *Millettia stuhlmannii*, *Morus mesozygia*, *Psydrax parviflora* subsp. *chapmanii*, *Synsepalum brevipes*, *Trichilia dregeana* [not knowingly seen during the Darwin trips], *Trilepisium madgascariensis* and occasionally *Milicia excelsa*, with *Khaya anthotheca* by watercourses. Gomes e Sousa (1968) also mentions large patches of "hygrophilic" and gallery forest with *Anthocleista grandiflora* in this reserve. The sub-canopy comprises *Aidia micrantha* and *Funtumia africana*, with *Rothmannia mangangae* [not knowingly seen during the Darwin trips], *Tabernaemontana ventricosa* and *Tarenna pavettoides* in the shrub layer, and the grass *Olyra latifolia* in the ground layer.

Zomba Forest Reserve has difficult access and a high population density, such that most of the area has been transformed with only small fragments of the original forest remaining, along with patches of regenerating forest and individual specimens of forest species. However, the southern section of the Reserve was in better condition, while the western side, closer to the Chimanimani foothills was said to be possibly "more interesting". Evergreen lowland rainforest has *Newtonia buchananii* dominant, also with *Albizia glaberrima*, *Blighia unijugata*, *Celtis gomphophylla*, *Milicia excelsa*, *Millettia stuhlmannii*, *Khaya anthotheca*, *Synsepalum brevipes* and *Trilepisium madagascariensis*. The sub-canopy and sapling layer comprises *Aidia micrantha*, *Aporrhiza [nitida] paniculata*, *Craterispermum schweinfurthii*, *Funtumia africana*, *Glenniea africana* and *Rothmannia mangangae*, with *Rinorea ferruginea*, *Coffea salvatrix*, *Dracaena mannii*, *Erythroxylum emarginatum*, *Tabernaemontana ventricosa* and *Tarenna pavettoides* in the shrub layer. *Afromomum* spp., *Costus afer*, *Olyra latifolia*, *Pseuderanthemum subviscosum* and *Psychotria peduncularis* are found in the lower shrub/herb layer. The main lianas are *Acacia pentagona*, *Keetia gueinzii* [or *K. venosa*?], *Landolphia kirkii* and *Saba comorensis*. Along some of the streams *Pandanus livingstonianus* swamp forest is found, with solitary trees of *Ficus bubu*, *Ficus lutea* and *Voacanga thouarsii*, and *Costus* and Cyperaceae in the herb layer.

Maronga Forest Reserve was the least disturbed of the reserves but is difficult of access, except from Zimbabwe. The vegetation has high variability associated with the steep and hilly terrain. Soils are mostly quartzite sands derived from the Chimanimani Mountains, with reddish clay loams in the hills to the south-east. Although much is covered with forest, there are significant areas of *Brachystegia spiciformis* woodland. Apart from *Brachystegia*, the dominant trees here are *Burkea africana*, with *Diplorhynchus condylocarpon*, *Maprounea africana*, *Millettia stuhlmannii*, *Pterocarpus angolensis* and *Uapaca kirkiana* common. Shrubs are mostly *Brackenridgea zanguebarica*, *Canthium ngonii* [not found during the Darwin trips], *Flacourtia indica*, *Hymenocardia* spp. and *Vernonia muelleri*. Evergreen trees along the drainage lines include *Craterispermum schweinfurthii*, *Erythroxylum emarginatum*, *Englerophytum magalismontanum*, *Erythrophleum suaveolens*, *Garcinia kingaensis* and *Synsepalum brevipes*, while *Uapaca lissopyrena* is common in wet places and along streams. The absence of *B. spiciformis* and the increase in *Burkea* and *Uapaca* in some areas suggests a previous low-intensity form of shifting agriculture.

Most of the area is covered by moist evergreen forest, which appears to be best developed between the Zimbabwe border and Makurupini Falls, totalling around 400 ha with 200 ha in Mozambique. The dominant tree is *Newtonia buchananii*, with *Maranthes goetzeniana* and *Xylopia aethiopica* also common; *Erythrophleum suaveolens* and *Khaya anthotheca* are locally frequent. *Funtumia africana* forms a high sub-canopy along with *Aporrhiza nitida*, *Blighia unijugata*, *Millettia stuhlmannii*, *Synsepalum brevipes* and *Trilepisium madagascariense*, similar to forests in the other reserves. Locally abundant shrubs in Maronga's forests include *Synsepalum kaessneri* [probably a new species, see later], *Drypetes arguta*, *Rinorea convallarioides*, *Rinorea ferruginea* [during the Darwin trips only *R. gazensis* was found], *Tabernaemontana ventricosa*, *Tricalysia pallens* and the rare *Vepris drummondii*.

There are many lianas including *Agelaea pentagyna*, *Acacia pentagona*, *Artabotrys monteiroae*, *Combretum paniculatum*, *Apodostigma* [*Hippocratea*] *pallens*, *Pristimeria* [*Hippocratea*] *andongensis* var. *volkensii*, *Keetia gueinzii* [probably *K. venosa*], *Landolphia kirkii*, *Oncinotis tenuiloba*, *Raphiostylis beniensis*, *Saba comorensis* and *Tiliacora funifera*.

Müller *et al.* (2005) suggested that the most important Forest Reserves are Moribane and Maronga, while Zomba may need to be de-gazetted, although the *Pandanus* swamp forests here are of particular interest. However, there are also likely to be patches of moist forest important for conservation closer to the base of the Chimanimani Mountains. Within the Maronga Reserve the Makurupini Falls are considered to be of particular scenic and ecotourism value. It was recommended that the important areas be incorporated into the (at that time) planned Chimanimani Trans-Frontier Conservation Area.

4. FINDINGS

Findings from the Darwin project are given below, along with a discussion of the particular conservation significance and values of each area.

4.1 Mpunga Community

Much of Mpunga community lies within what was the Moribane Forest Reserve, now bisected by the new tar road from Sussundenga to Dombe. Elephants are frequent in the area, resulting in the community deciding to draw a north–south boundary with elephants and conservation to the west (the "conservation area") and settlement and fields to the east, a line that can be seen fairly clearly on Google Earth imagery. This boundary line lies just west of the main road, and is meant to be maintained using a "bee fence". This consists of top-bar hives 80 m apart strung on wires between trees (Figure 3). When elephants touch these wires it aggravates the bees, which act as a deterrent. However, the bee-fence is not yet complete and does not always work as elephants frequently break the wires. Elephants are still raiding fields the other side, being especially damaging to bananas. The fence requires continual maintenance to be effective.

Fig. 3. Bee hive forming part of bee fence, Mpunga [TT].

The community-designated conservation area (Figure 2) consists of three forests – Mpunga Centro near Ndzou ecotourism camp in the centre-east, Mbiqueza Forest to the north of the Rio Tave swamp grassland, and forest in the Chikó area to the southeast. The area is moderately heavily dissected and appears to be underlain by mica schist and similar metamorphosed rocks. However, very little outcropping rock was seen. Soils seem fairly uniform, being generally deep (at least not obviously shallow) and loamy, but not clay-rich. Altitude ranges from around 200–250 m along the Rio Mussapa Pequeno in the far west to 400 m in the southeast to around 600 m on higher ground in the north.

Under the previous World Bank-funded TFCA (Trans-Frontier Conservation Area) project, tracks were made in the late 2000s to open up the area for tourism, some designed as footpaths ("forest trails") while others were partly motorable. These tracks tend to follow ridges and higher ground, so are not that representative of the vegetation across the area. Steeply dropping off these ridges numerous gullies or steep-sided side valleys can be found supporting denser forest.

A total of 198 plant specimens (excluding plot vouchers) were collected from the Mpunga area, and 17 vegetation characterisation plots were recorded along with four detailed 25 × 25 m forest plots and six 25 × 25 m tree diameter plots. The checklist in Annex 2 lists 188 species as being recorded from the area.

Vegetation types

Three main vegetation types were noted – (a) semi-deciduous forest with various facies and variants, verging on moist forest in places, (b) swamp grassland and ecotones, and (c) old clearings or fallow machambas (fields). By far the most widespread type was semi-deciduous forest. The latter is what has been termed seasonally dry forest by Lock (2006) with a complete or almost complete crown cover (often of trees from the legume family), no grass

layer, a presence of lianas and epiphytes, and an annual rainfall of less than 1600 mm of which at least 5–6 months have less than 100 mm. Fires are generally said to be rare.

a) Semi-deciduous forest

The most extensive type is semi-deciduous forest, which essentially has a forest structure (generally around 60% canopy + sub-canopy cover with little grass) but generally with a species composition more typical of woodland (Figure 5). The canopy is around 25 m high, but with emergents to 40 m high. The shrub layer is (8)10–15 m high with 25–40% cover. This type becomes less deciduous and more forest-like (in terms of the canopy tree species, subcanopy and forest floor) in sheltered especially south-facing gullies, becoming essentially closer to moist forest in areas with a bit more moisture and a bit less environmental stress, but with more woodland-like species on ridges and more exposed areas. The subcanopy mainly consists of moister forest/ evergreen elements such as *Funtumia africana* and various Rubiaceae (e.g. *Aidia micrantha*, *Tricalysia pallens*).

Common canopy trees on or near the ridges are *Newtonia buchananii* (common, ± evergreen), *Erythrophleum suaveolens* (common, evergreen), *Millettia stuhlmannii* (common, deciduous), *Albizia adianthifolia* (deciduous) and *Pteleopsis myrtifolia* (deciduous). While subcanopy trees consist of more evergreen or forest species and include *Funtumia africana* (very common, evergreen forest species), *Synsepalum brevipes* (evergreen forest species), *Aidia micrantha* (evergreen forest species), *Rawsonia lucida* (evergreen forest species), *Tabernaemontana ventricosa* (evergreen forest species), *Tabernaemontana stapfiana* (evergreen forest species), *Tabernaemontana elegans* (± evergreen, ± woodland species) and *Markhamia obtusifolia* (deciduous ± woodland species). The taller emergents are *Newtonia*, *Pteleopsis*, *Celtis gomphophylla* and *Albizia*, while *Erythrophleum* and *Parinari curatellifolia* have spreading but non-emergent canopies. The understorey often contains *Rinorea gazensis* as well as the various Rubiaceae shrubs mentioned above, with *Pseuderanthemum subviscosum*, *Olyra latifolia* and *Setaria megaphylla* in the herb layer.

Trees occasionally seen that are more typical of moist forest include *Schrebera alata*, *Milicia excelsa*, *Macaranga capensis*, *Xylopia parvifolia*, *Blighia unijugata* and especially *Celtis gomphophylla*, a large, buttressed canopy tree that effectively defines moist forest patches within this mosaic. Typical woodland canopy elements that are occasionally seen include large scattered trees of *Pterocarpus angolensis*, *Pericopsis angolensis* and *Parinari curatellifolia*, along with smaller trees of *Diplorhynchus condylocarpon* and *Schrebera trichoclada*.

Results from the plot data shows that basal area of trees 8.0 cm dbh or greater ranges from 18.3 m^2/ha to 62.3 m^2/ha, with a mean of 31.4 m^2/ha (n=9). Forest plots with much *Funtumia*, and especially those with a number of *Newtonia* trees, had much higher basal areas compared to the drier woodland plots dominated by *Millettia*.

Plot data also gives the following general sizes and distributions for the main species:

Albizia adianthifolia is a forest margin tree to 20–25 m high with a spreading canopy, often associated with forest gaps. Larger ones are 90–95 cm dbh. Owing to its scattered habit it is not often encountered in plots; where it does it can contribute up to 25% of plot basal area.

Celtis gomphophylla is up to 40 m high and mostly only in denser forest. Diameters are around 30–50 cm dbh, but large specimens to 90 cm. Usually 1–3 trees per plot, comprising 5–50% of plot basal area.

Combretum zeyheri is a species 10–20 m high of more open woodland and areas that have been previously disturbed. It was not encountered in any plots. Diameters are from 20–55 cm dbh, with most individuals around 30–40 cm.

Ekebergia capensis is a scarce but large tree. One large individual was 20 m high and 103 cm dbh.

Erythrophleum suaveolens is frequently found but is scattered so that it is not often encountered in smaller plots. Trees are generally 25–35 m high and around 40 cm dbh, with larger ones 70–100 cm.

Funtumia africana is a common forest understory tree, 10–20 m high, found across all forest types. Diameters are mostly 8–15 cm dbh, with larger ones to 40 cm. Generally 10–30 trees per plot, comprising 6–30% of plot basal area.

Milicia excelsa is a scarce and scattered forest tree, 20–25 m high, with only a few individuals found. Diameters range from 20 to 90 cm dbh.

Millettia stuhlmannii is more common (2–5 trees per plot, occasionally to 25) in drier and more open vegetation that verges towards dense woodland. Mostly 15–20 m high and 10–60 cm dbh, with larger ones to 105 cm dbh. It comprises 8–20% of plot basal area, but up to 60% in drier plots.

Newtonia buchananii is a fairly common, often locally abundant, especially in moister forest types, but with few (1–8) large trees per plot. It is often found as an emergent to 40 m high. Generally 10–30 cm dbh, with emergents sometimes exceeding 100 cm dbh, comprising 5–50% of plot basal area.

Parinari curatellifolia is mostly a scattered woodland tree. Large individuals can reach 20–25 m high and 45–55 cm dbh.

Pteleopsis myrtifolia is only occasionally seen in drier plots (2–5 trees per plot) with *Millettia*, but is generally an emergent (20–30 m high) and a larger tree (30–75 cm dbh).

Synsepalum brevipes is often found in the forest understory but is generally very scattered and at low density. It is generally a smaller tree (10–15 m high, 8–20 cm dbh), although larger ones reach 25 m in height and 60 cm dbh.

Tabernaemontana ventricosa is a common forest subcanopy tree 4–10(15) m high and 8–15(18) cm dbh. Owing to its small size it has a very low basal area (1–4 trees per plot, less than 2% of plot basal area).

Trilepisium madagascariensisis is a forest tree generally present in low numbers, but can reach 8 trees per plot and 33% of plot basal area. Generally 15–25 m high and 15–50 cm dbh.

Vitex doniana is an occasional large tree of more open woodland areas, not often found in plots. One large individual was 17 m high and 54 cm dbh.

The main canopy trees across much of the area are deciduous with mostly wind-dispersed seeds. There are not many tree species with fruits (only *Milicia*, *Synsepalum*, *Aidia*, *Bridelia*, *Tabernaemontana*, *Xylopia*, *Celtis*) and surprisingly few figs, a possible explanation for the low number of hornbills seen in what might be termed a forest area.

There are quite a few woody lianas. The most common is probably *Acacia pentagona*, and also a fern *Lygodium kerstenii* and *Landolphia buchananii*. Epiphytes are not particularly common as the forest presumably lies below the mist or low cloud belt. There are a few scattered *Platycerium* ferns about 10 m up, and occasional *Microsorium* ferns in forks on trunks. There were few orchids, all from the drier end of epiphyte development.

In denser moister forest patches, the forest floor is very open with *Olyra latifolia* and *Setaria megaphylla* in gaps and a poorly-developed shrub layer. Horizontal visibility is noticeably greater, there are fewer herbs (except in small gaps), and it is considerably darker. There are fewer stems per hectare over 8 cm dbh compared to the more open or regenerating areas.

Fig. 5. Understorey of semi-deciduous forest, Mpunga [JT].

Fig. 6. Swamp grassland, Rio Tave, Mpunga [MC].

The litter layer is mostly quite dry, with much termite activity seen, rather than the fungal breakdown one would expect in proper moist forest. Decomposition seems to be primarily by termites suggesting a drier, woodland ecology rather than moist forest.

There is an apparent "tension" between the forest and woodland elements across this main vegetation type, with forest elements dominating in moister or less-stressed gullies but woodland elements dominating in more exposed or drier sites. This is presumably a fairly dynamic tension such that distribution of the species can change depending on climate (e.g. a series of wetter or drier years) or with fire or cyclones. A large fire in 1992 followed a particularly bad drought year (1991-92) and destroyed a large part of the forest area. Much evidence of this can still be seen in the form of burnt tree bases and stumps, burn scars and fallen burnt trees. The effects can also be seen in areas with cohorts or regeneration of *Newtonia* or *Funtumia* that came in afterwards. The fire was followed by Cyclone Eline in February 2000 which probably felled quite a few of the larger trees, already weakened and exposed by the fire 8 years earlier. This combination of events would probably help push a moister forest area towards woodland, from which it is perhaps only now moving slowly back to greater dominance by forest elements.

b) Swamp grassland

Swamp grassland is dominated by the broadleaved grass *Ischaemum* sp. to 1 m high with lots of the swamp fern (*Cyclosorus interruptus*) on peaty soils (Figure 6). There are very few isolated woody plants, such as *Voacanga thouarsii* and the introduced invasive shrub or small tree *Vernonanthura phosphorica*. Many herbaceous species were seen, especially along the swamp/forest ecotone. This vegetation type, generally up to 100 m wide, dissects the forest areas so is particularly important ecologically. It is especially notable along the Rio Tave where it would be of interest for ecotourism. This area is also an important drinking place for elephants, although surprisingly it is apparently not much used by them for feeding.

c) Fallows and clearings

Old agricultural or homestead clearings are seen where the tree canopy is missing or consists of only a few larger trees. Patches are generally 0.5 to 2 ha in extent. Sometimes the tree *Trema orientalis* is found, very occasionally bamboo (*Oxytenanthera abyssinica*), *Combretum zeyheri* and *Combretum molle* (both of which are sometimes also found in forest) and *V. phosphorica*.

Wildlife
Apart from much evidence of elephant, other wildlife heard or noted included Samango monkey, baboon, Blue duiker and Sacred Ibis. Birdlife was not as evident as would have been thought, with a surprisingly low number of fruit-eaters such as hornbills.

Economic species
The only species noted that may have some economic value to the community on a sustained basis (i.e. not as the basis of a solely extractive industry) was *Funtumia africana*, an understorey tree that is very common across the semi-deciduous forest. It is reported that the fibres from the large seed pods have been used as an added ingredient in high-quality paper manufacture in West Africa (M. Cheek, pers. comm.), discussed more fully later. The quantities available might allow for economic extraction.

Conservation
In conclusion, in species composition and appearance the Mpunga forests do not appear to be moist forest or have any elements of cloud forest as found on the slopes of Mt Gorongosa, Chirinda near Espungabera, or in higher altitude areas (1000–1800 m) of the Zimbabwe/ Mozambique border highlands, but are a drier semi-deciduous forest type. As the canopy is mostly over 80% cover and with a poorly developed grass layer, neither is it true woodland, but a mixed vegetation type with essentially a dense woodland canopy and forest understorey.

The proposed forest conservation area in the west of the Mpunga community is appropriate and of good value for both conservation and the development of ecotourism. It is sufficiently large and diverse to be viable and allow for the development of a series of forest trails and provide a "forest experience", while the dissection of the area by the swamp grasslands of the Rio Tave provides a significantly greater level of ecological diversity, both for plants and wildlife. Of particular importance is the ecological role that elephants are likely to be performing by opening up areas of forest and increasing plant diversity, particularly in the swamp area. Elephants are valuable from an ecological viewpoint as well as for tourism, and it may well be the impacts of elephants that is stopping encroachment by woody plants.

4.2 Zomba Community

The Zomba community is fairly extensive with three proposed community conservation areas – the Muranga forest area by the Thekeza homestead on the lower foothills of the Chimanimani Mountains (altitude from 200 m, but primarily the area above 400 m), the Mapira Swamp area that is actually more open grassland with a riverine forest strip, and the Zomba Centro Swamp area that comprises moist forest, *Pandanus* swamp and proper perennial swamp with papyrus.

The three areas were presumably selected by the community at meetings on the basis that they were not heavily-settled with very few households and there were no immediate plans to use them; in some regards they were selected more by default than for any particular biodiversity they may support. As described later, this has led to a mismatch at lower altitudes and on more level ground between suggested conservation areas and areas appropriate for conservation on biodiversity grounds. This is not the case in the higher altitude areas of the Chimanimani footslopes.

A total of 163 plant specimens (excluding plot vouchers) were collected from the Zomba area, and 13 vegetation characterisation plots were recorded along with three detailed 25 × 25 m forest plots and five 25 × 25 m tree diameter plots. The checklist in Annex 2 lists 223 species as being recorded from the area.

Muranga/Thekeza forest

This area is situated on the foothills/ lower slopes of Chimanimani Mountains, just where clouds start to form and moist air precipitates. It is situated inside the community-proposed conservation area at the edge of the Chimanimani National Reserve buffer zone with the Core Zone, but one family in particular living inside does not wish to move. The community-accepted idea is that there should be no cultivation in this area and no extractive or destructive use (e.g. clearance for agriculture, timber or pole/firewood extraction).

In general, the forest has a similar structure and composition to that seen in the Mpunga area. However, the forested area here is on generally far more dissected terrain, so the shift between forest and woodland is more sudden and the 'end members' are more marked. The forest can be more forest-like in terms of canopy, tree species and understorey, while the woodland can be more miombo-like with *Brachystegia tamarindoides*.

Forest structure is particularly good near valley or ravine bottoms. Some plots had hardly any *Newtonia* or *Millettia* in them, just forest canopy trees such as *Celtis gomphophylla*, *Maranthes goetzeniana*, *Trilepisium madagascariense* and *Xylopia parvifolia*, as well as a well-developed forest understorey of dark green leathery leaved shrubs such as *Rinorea gazensis*, *Drypetes arguta*, *Rawsonia lucida* and *Xylopia aethiopica*, and subcanopy trees of *Tabernaemontana ventricosa*, *Synsepalum brevipes*, *Englerophytum magalismontanum* and *Aidia micrantha*. There are many woody lianas, with at least three species common. Much *Leptaspis zeylanica* is seen on the forest floor, with the tall fleshy herb *Costus afer* to 1.5 m in wetter areas near streams.

Of particular interest, and probably repeated along these footslopes, was a quartzite hill near the Thekeza homestead that rises up 70 to 100 m above the surrounding area. About two-thirds the way up vegetation changes from disturbed or old machamba vegetation to a narrow belt of *Parinari curatellifolia* woodland, then abruptly into a fairly open *Brachystegia tamarindoides* (=*B. microphylla*) miombo woodland (Figure 8). Commonly seen is a ground orchid, *Polystachya modesta* spreading between the quartzite rocks, along with some lithophytic and epiphytic orchids, mosses and lichens. Apparently in the saddle beyond the vegetation changes into woodland then into good forest with *Drypetes*, *Rinorea* and *Rawsonia* in the understorey. Three species of Sapotaceae are seen as small trees, with *Synsepalum brevipes* to 20 m high. This occurrence is possibly related to a change in substrate as soils are deeper, red and more clay-rich.

Regarding species of particular economic interest, there is less *Funtumia* than at Mpunga, as well as a greater difficulty of access and extraction. The potentials for resource utilization appear to be less. However, there are some forest species there of conservation interest, including the large trees *Maranthes goetzeniana* and *Ficus mucoso*, an unknown species of shrub which may turn out to be new (?*Baphia* sp.), and the small tree *Synsepalum* sp. cf. *kaesneri* which is almost certainly a new species, although it has been found across the Chimanimani area (see Section 5.1).

Given the existing and past extent of cultivation in the Muranga area, it is recommended that any conservation area should only include forests west of the present limit of clearance, approximately 33°11'45"E at Thekeza but around 33°12'30"E further south. Given the existing extent of woodland/ forest stretching up into the main Chimanimani Reserve, there is little conservation value in including areas that have already been partially transformed (Figure 7).

There is a much greater diversity of habitats and species in the Thekeza area compared to Mpunga, but obviously much less wildlife interest as there are no elephants. Some hunting does occur in Thekeza forest for Blue Duiker and Bushbuck. Buffalo have been seen occasionally (although these are said to be not hunted), eland and wildebeest. The latter two species are possibly coming into the forest on the Chimanimani foothills as a refuge from hunting by small-scale miners ("gariemperos") up on the Chimanimani massif. People do not hunt monkeys or baboons, except to stop them raiding crops.

A small freshwater crab was noted in some of the forest streams in the Thekeza area. This was identified by Prof Savel Daniels (University of Western Cape) using DNA sequencing as *Potamonautes mutariensis* E.E. Phiri & S.R. Daniels, a species that had previously been considered endemic to higher altitude (1350–1750 m) parts of the Mutare and Nyanga areas of eastern Zimbabwe. This shows the potential of novel findings in other biodiversity groups.

Thekeza forest has a greater diversity in both topography and views, and is much better suited to ecotourism trekking than forests in Mpunga. However, against this is the far greater distance to get there from the main road, whereas the Mpunga area can be reached within one hour from the tar road.

Zomba Centro Swamp
This area was rather ill-defined in discussions, and not all parts were visited. However, there appear to be at least three significant habitats – semi-deciduous forest to moist forest (Maurani Forest) which extends some way upstream, *Pandanus* swamp fringing some watercourses, and true papyrus swamp. The latter two vegetation types appear to fall outside any designated community-conservation area, yet are unusual and threatened habitats.

The moist forest patch, part of which is a traditional cemetery, apparently extends along the Rio Chindore up to the Thekeza area. The main canopy trees are *Newtonia buchananii* and *Millettia stuhlmannii*, with *Synsepalum brevipes*, *Funtumia africana* and *Tabernaemontana ventricosa* in the subcanopy layer. The shrub or small tree layer comprises a fairly dense cover of *Rinorea gazensis* with an Acanthaceae in the herb layer. Shrubs of the wild coffee *Coffea salvatrix* were also found here, along with the strange forest herb *Dorstenia psilurus*. The forest is quite heavily cut for poles in places, but still fairly diverse and with a good species composition.

Pandanus swamp consists of tall strange-looking trees of *Pandanus livingstonianus* in a fringing strip about 5–10 m wide on each side of perennial watercourses such as the Rio Chindore (Figure 9). It appears to be quite localised, but it is possible there are many stands along the various tributaries of the Rio Mucutuco that drain the Chimanimani footslopes and flow into the Rio Mussapa Pequena closer to Dombe. This species of *Pandanus* is listed as probably Vulnerable in Flora Zambesiaca. Associated species include large tall trees of *Khaya anthotheca* (many of which appear to have been killed), *Phragmites* reeds, the sedge *Miscanthium* and various river-margin species such as *Ficus capreifolia*. It is heavily cut in places and is being encroached upon for agriculture. The area is apparently not protected nor is it proposed for community conservation.

Fig. 7. Secondary vegetation with semi-deciduous forest behind, Zomba [JT].

Fig. 8. *Brachystegia* woodland on sandstone hill, Zomba [TT].

Fig. 9 *Pandanus* along small stream, Zomba [JT].

Nearby (19°53'30"S, 33°16'00"E), a large area of perennial swamp dominated by *Cyperus papyrus* was seen. The area is used as a water source and for bathing, but was not mentioned as a possible area for conservation or sustainable management. Patches of open, slow or stationary water with *Nymphaea* sp., *Potamogeton octandrus* and *Azolla* cf. *nilotica* were noted. Such permanent swamp is an important habitat for birds as well as specialised, although often widely distributed, plants. It also has a major significance as a local water supply, both for drinking and washing, and should have some form of conservation measures in place for the provision of ecosystem services as well as for its intrinsic biodiversity.

Mapira Swamp

Owing to lack of time, the other 'swamp forest' (which hardly merits that name) was only briefly visited on the way back to the road. Some *Pandanus* was noted along perennial watercourses, along with some small forest patches and grassland areas. The grassland is possibly mostly fallow with secondary woodland species, but some interesting grassland herbs were noted. It looks of possible conservation interest owing to the *Pandanus* and fringing riverine forest.

Economic species

No particular species of potential economic value were noted, other than the extensive stand of papyrus swamp, and the wild coffee in Maurani Forest which may be of interest for export. Locally, papyrus is being used by one or two families to make mats for sale. It would seem that the stand is sufficiently large, given that papyrus can regrow rapidly, to support sustainable harvesting of papyrus and the establishment of a local craft industry.

Conservation

The Kew-proposed community conservation areas lie outside the present boundaries of the TFCA Core Zone. Suggested areas are outlined in Section 7.3. Based on assumed biodiversity values and intactness of vegetation, the Thekeza–Muranga area proposed by Kew, lying adjacent to the Core Zone (Figure 29), is somewhat smaller than that proposed by the community as it excludes larger cleared areas. It covers forested footslopes and the north-south sandstone rock spur/hills. The extent of Maurini Forest is very similar to that proposed by the community. This would appear to be the core of the old Zomba Forest Reserve, much of the rest now having been cleared for agriculture.

In addition to the forested foothills and sandstone outcrops, there is a strong need to incorporate at least some stretches of *Pandanus* swamp and a viable extent of papyrus swamp into a community conservation area if the full range of biodiversity and threatened habits is to be conserved. However, the Kew-proposed area covering a large expanse of papyrus swamp has not been suggested by the community for conservation.

As regards ecosystem services, the conservation of watercourses is of great significance. All watercourses that we saw were under severe pressure and likely to be eroding and reducing water quality. Their conservation would help ensure a reliable supply of clean water as well as conserve the *Pandanus*.

4.3 Mahate Community

The boundaries of Mahate community are very extensive, ranging from the Rio Mussapa in the north to the Rio Mufomodzi and Zomba area in the south and westwards to the Zimbabwe border. It incorporates a significant part (almost half) of the Chimanimani massif inside the Chimanimani National Reserve Core Protection Zone. In the eastern parts, adjacent to Mpunga, elephants commonly pass through and would appear to be a significant constraint to agricultural production. We had the very knowledgeable Simon Chimelela as a guide. He was brought up in this area and has worked with various researchers such as Richard Bell, Jessica Schafer and Roger Bills over the last 20 years.

The topography is rugged with the only motorable track being that coming from the Chimanimani TFCA entrance camp in the north, over the Rio Musapa and Rio Nhamahare to the small camp of fiscais (scouts) established under the TFCA project above the Rio Mudzira. Rivers are not passable during the rains.

It appears that some commercial logging – mostly of mukarati (*Erythrophleum suaveolens*) – took place in the north of Mahate in Matenga forest close to the sacred Mbhanha Mountain in colonial times (Simon Chimelela, pers. comm.), the extracted timber going to a sawmill at Rotunda. The old logging track is still visible. Otherwise there appears to have been no colonial settlement or evidence of physical economic development.

The conservation area as selected by the Mahate community through Micaia, but modified slightly to exclude the Core Zone of the Chimanimani and some outlying cultivated areas, covers an area of 155 km^2 (Figure 26) This is by far the largest community-designated conservation area among the project communities, and represents most of the Mahate area that is not presently under cultivation or outside the Core Protection Zone, and more than a third of the total extent of Mahate. This is probably because of the higher risks associated with settlement in these areas owing to incursions by elephant.

A total of 81 plant specimens (excluding plot vouchers) were collected, and 11 vegetation plots recorded. As well as investigating miombo woodland and vegetation along the rivers, the limits of the community zone where it abuts the Core Protected Area and the typical white Chimanimani sandstones starts to appear and rise up to the massif above, were also visited. The checklist in Annex 2 lists 157 species as being recorded from the area.

Vegetation types

Four main vegetation types were noted: (a) miombo woodland of various types on schists and similar rocks – by far the more extensive type, (b) open miombo woodland (*Brachystegia microphylla*) on hills and outcrops of white Chimanimani sandstone and along the margin of the main Chimanimani massif, (c) riverine fringing woodland/ forest, and (d) cultivated areas, old and recent fallow fields. Each is described in more detail below.

a) Miombo woodland

This is the most widespread vegetation type in Mahate, and is also quite variable being found across probably 90% of the community area outside of the Core Protected area of the National Reserve. Typically the canopy is 10–15 m high with 60–70% cover (Figures 10, 11). In most cases miombo woodland is found on reddish, well-drained loamy soils derived from schists and mica-schists, and there is much evidence of frequent burning (Figure 16). Variability seems to depend on soil type and position in the landscape.

Fig. 10. Miombo woodland, Mahate [JT].

On deeper soils on the tops of interfluves the woodland is dominated by tall (to 15 m) thin-trunked trees of *Brachystegia utilis*, with *B. boehmii* becoming more dominant on shallower soils or on gentle slopes. *Brachystegia spiciformis* is generally found on what are possibly deeper and more fertile soils, such as close to streams and small rivers, or on steeper rocky slopes, possibly with higher moisture availability at depth. The most characteristic species

Fig. 11. Miombo and denser woodland on Chimanimani footslopes, Mahate [JT].

Fig. 12. Fringing riverine woodland, Rio Mudzira, Mahate [JT].

along larger watercourses are large trees of *Breonadia salicina* and smaller trees or shrubs of *Pandanus livingstonii* (Figure 12).

On the shallowest soils, *Julbernardia globiflora* is common. Other associated species are *Albizia versicolor*, *Pericopsis angolensis*, *Pterocarpus angolensis*, *Pseudolachnostylis maprouneifolia*, with *Psorospermum febrifugum* and *Olax dissitiflora* in the understorey. Dense stands of *Uapaca kirkiana* are seen on some gentle slopes.

Surprisingly, *Millettia stuhlmannii* was not at all common in this area. However, it starts to appear more frequently as one gets close to the Chimanimani massif and the sandstones. Whether this relates to changes in soil properties, or whether *Millettia* struggles to compete in true miombo woodland, is not known.

Bamboo (*Oxytenanthera abyssinica*) occurs in old fallows. Most of what was seen in November 2015 was young growth to 1 m as apparently most of the bamboo flowered and died about 2 years ago.

Closer to the Chimanimani footslopes south of the Rio Mudzira (e.g. 19°42'25"S, 33°10'10"E), a somewhat different vegetation type is seen locally. This is an open wooded grassland with many saplings or small trees of *Parinari curatellifolia*, along with *Pterocarpus rotundifolius*, *Strychnos spinosa*, *Securidaca longepedunculata*, *Diplorhynchus condylocarpon*, *Vitex payos* and *V. doniana* on what appears to be brownish loam soils derived from Umkondo sandstone. The grass *Themeda triandra* is common and is cut for thatching.

b) Chimanimani sandstone outcrops

Where the main white Chimanimani sandstones outcrop, both at the edge of the Chimanimani massif (e.g. Mt Mbanhe) and in relict outcropping hills to the east (Mt Chisukuro), a very different woodland type is found. Here an open woodland of *Brachystegia tamarindoides* subsp. *microphylla* is found with *Pterocarpus angolensis*, and *Uapaca kirkiana* and *Brachystegia spiciformis* on the more gentle slopes. On steep, rocky slopes at the edge of the massif species more typical of the Chimanimani Mountains are found.

This situation is more marked in Maronga where the Chimanimani sandstone outcrops are prominent, forming long (10–12 km) north–south spurs from the massif.

Conservation

Around one-third of the total Mahate area was identified by the community as a community conservation zone, representing more than half of the Mahate area outside the protected Chimanimani TFCA Core Zone (see Figure 26). However, nearly all of this proposed conservation area is miombo woodland of various types, which, although interesting and generally in good condition (apart from frequent fires), is not an important conservation priority at a national or international level. Of greater significance for biodiversity are the much denser semi-deciduous forests verging on moist forest associated with the steeper areas situated at the foot of the Chimanimani scarp or massif.

From a botanical perspective, the areas of significance for conservation identified by Kew lie almost entirely within the TFCA Core Zone boundary, with just a small extent outside in Zona Mabhika (Figure 27). These areas cover the main Chimanimani footslopes and associated semi-deciduous forests. However, if the gazetted TFCA Core Zone boundary is later shifted to the west, closer to the main massif, this area of significance will need to be revisited.

Wildlife
Little wildlife was seen, other than evidence of elephant, especially north of Rio Madzira. National Parks staff mentioned that quite a few sable and eland come to drink in parts of the area. Baboons and vervet monkeys were not uncommon, while both Crested and Helmeted Guinea-fowl were seen in the miombo woodland.

Economic Species
There were no particular species noted that could form the basis of a non-timber industry on a sustainable basis, with the possible exception of *Uapaca kirkiana* (mzanze). The edible fruits of this miombo tree, which locally form dense stands, fruit prolifically. Fruits could be harvested and sold locally in places such as Chimoio.

Mature stands of bamboo (*Oxytenanthera abyssinica*) were scarce, but this may be related to their flowering and subsequent death in this area two years ago. New stands will probably develop.

4.4 Maronga Community

The Maronga area lies north and east of the Rio Lucite up to the Chimanimani footslopes, and historically the people here moved freely across the Zimbabwe border to the Rusitu [Lucite] valley (see Magness 1973, Hughes 2001). There has been less interaction between this community and the TFCA authorities than elsewhere, mostly due to distance for access. A significant part of the area adjacent to the Rio Lucite was designated in 1953 as the Maronga Forest Reserve (8300 ha), probably for timber extraction rather than conservation. In addition, old colonial maps (Gomes e Sousa 1968) show a 'concession', presumably for logging, straddling the reserve's eastern boundary.

Recently the community under Chief Maronga has identified a large area, 129 km^2, as a potential conservation area (Figure 26), almost half of which, however, appears to lie in the newly-designated TFCA Core Zone. There is also a significant presence of small-scale gold panners along the Rio Mussapo (not Mussapa) that can be seen on Google Earth imagery (19°59'33"S, 33°03'29"E, 480 m), although this area was not visited.

Much of the Maronga area has been cleared for agriculture over the years, with the best remaining forest areas along the Chimanimani footslopes within the TFCA Core Zone. Dense woodland and miombo woodland occur on the rocky sandstone ridges radiating out from the massif. From remaining vegetated patches in the southern sector, it appears that much of the original vegetation comprised some type of moist forest, in contrast to Müller's statement (Müller *et al.* 2005) that the area was primarily woodland with *Brachystegia spiciformis* and *Burkea africana*.

A total of 188 plant specimens (excluding plot vouchers) were collected, while 10 vegetation characterisation plots were recorded along with three detailed 25 × 25 m forest plots. The checklist in Annex 2 lists 287 species as being recorded from the area.

a) Evergreen and semi-deciduous moist forest
This is the main vegetation type found, at least in the area where fieldwork was carried out, close to the Chimanimani massif. Generally there appeared to be more moist forest than in Mpunga, and fewer individuals of species typical of semi-deciduous forest (e.g. *Millettia stuhlmannii*, *Pteleopsis myrtifolia*). Forest cover at higher elevations than the footslope base was generally intact, with little evidence of present or past clearance, except in a few places.

Moisture levels are presumably high, both from precipitation and from streams and water flow off the mountains.

Forest structure and composition was similar to that found on the footslopes at Zomba (Muranga/Thekeza forest). However, the large tree *Maranthes goetzeniana* appeared to be more common. Forests were generally fairly dense with a 20–35 m high canopy comprising *Newtonia buchananii* and *Maranthes goetzeniana*. Also prominent in places were *Albizia adianthifolia* and *Macaranga capensis*. The subcanopy or understorey was of low diversity containing *Uapaca lissopyrena*, *Funtumia africana*, *Englerophytum magalismonatnum*, *Synsepalum brevipes*, *Drypetes arguta* (sometimes dominant in the shrub layer), *Alchornea hirtella*, *Rinorea ilicifolia*, *Tabernaemontana ventricosa* and *Trilepisium magadgascariense*. An unknown tall tree might be *Burkea africana*, although it would be strange to find this in moist forest. *Uapaca lissopyrena* with its stilt roots was particularly noticeable, and occasionally dominant, closer to watercourses on older, more clay-rich alluvium on the first levee. In more marginal area, *Millettia stuhlmannii* and *Parinari curatellifolia* were seen; surprisingly *Pteleopsis myrtifolia* was seldom noted. The herb layer was low in diversity, often dominated by *Pseuderanthemum subviscosum*, *Psychotria peduncularis* var. *nyassana* and, in moister areas, the fern *Nephrolepis biserrata*. Other common herbs and shrublets included *Olyra latifolia*, *Zamioculcas zamiifolia* and a non-spiny form of *Carissa bispinosa*.

Basal area of the three plots recorded (trees of 8.0 cm dbh and above) ranged from 37.9 to 53.9 m^2/ha, more than that found in Mpunga. In part this may be due to the fact that all Maronga plots contained large trees of *Newtonia* and/or *Maranthes goetzeniana*.

Some of the more significant forest species were:

Newtonia buchananii – widely distributed and often very large trees; 40 to 68% of plot basal area.

Maranthes goetzeniana – 6 to 26% of basal area (Figure 19); see Section 5.1.

Uapaca lissopyrena – common in some places and plots, particularly on old levees close to larger streams and rivers; the stilt roots are most distinctive (Figure 18). Can form 11.5% of plot basal area.

Caesalpinioideae – an unknown species (possibly *Burkea africana*) but a not infrequent large tree.

Craterispermum schweinfurthii – common in one plot, with up to 4.3% of basal area.

Englerophytum magalismontanum – understorey tree in some plots, up to 2.6% basal area.

Funtumia africana – understorey tree, often very common; up to 7% of basal area.

Garcinia kingaensis – common in one plot, basal area 4.5%.

Millettia stuhlmannii – generally comes in towards woodland margins.

Along the river fringes, there are frequent outcrops of Chimanimani sandstone and shaded dry rocky river channels supporting a characteristic set of shrub and small tree forest species including *Mascarenhasia arborescens*, *Nuxia oppositifolia*, *Cleistanthus polystachyus* subsp. *milleri*, *Podocarpus elongatus*, *Diospyros natalensis*, *Erythroxylum emarginatum* and *Tricalysia coriacea* subsp. *angustifolia*.

b) Moist grassland

Scattered through that part of Maronga close to the Chimanimani massif, and clearly visible on Google Earth imagery, are some larger grassland patches, sometimes with clumps of moist or swamp forest within them. They appear to be natural, probably owing to perennial seepages from the mountains above and, in some cases at least, nutrient-poor soils consisting of not much more than white sand. These areas are regularly burnt, although where the grass

is protected from fire it is cut for thatching. The areas are also an important water source for people and goats.

The grass is of medium height (0.5–1.5 m) and patches are variously dominated by *Hyparrhenia* species, *Themeda triandra*, *Panicum dregeanum*, *Ischaemum* sp. and *Imperata cylindrica*. The first two are often cut for thatch. Scattered throughout, depending on the degree of wetness, woody herbs or small shrubs of *Aeschynomene nodulosa*, *Dissotis princeps*, *Eriosema psoraleoides* and *Voacanga africana* can be found. In areas that are permanently moist, the small papyrus-like *Cyperus prolifer* dominates together with other sedge species. The "eye" of each grassland appears to be a permanently wet, but the surrounding areas are obviously seasonally-dry, at least in the surface layers. An interesting assemblage of herbaceous species is found in the wetter areas including *Xyris* species (one of which is potentially new to science, see Section 5), *Burmannia madagascariensis*, *Oldenlandia angolensis* and *Crepidorhopalon whytei 'flavum'* (a potential narrow endemic), amongst others.

In some places (e.g. 19°58'07"S, 33°06'09"E) small patches of swamp forest are found within the grasslands with *Uapaca lissopyrena*, *Aporrhiza paniculata*, *Gardenia imperialis* and *Voacanga thouarsii*, with a dense undergrowth of a swamp fern (Figure 13).

On the drier margins, encroachment from woody shrubs of *Parinari curatellifolia*, *Maprounea africana*, *Annona senagalensis*, *Hymenocardia acida* and *Syzygium guineense* can be seen. Otherwise the grassland patches abruptly border semi-deciduous or moist forest situated on slightly more elevated areas (Figure 14).

Fig. 13. Swamp forest patch in grassland, Maronga [JT].

Fig. 14. Grassland patch surrounded by moist forest, Maronga [JT].

c) Chimanimani sandstone outcrops

Where the main white Chimanimani sandstones outcrop, generally on long rocky spurs running north-south from the massif, a very different vegetation type is found. Here an open woodland of *Brachystegia tamarindoides* subsp. *microphylla* is found with *Syzygium guineense*, *Uapaca kirkiana*, *Diplorhynchus condylocarpon*, *Englerophytum magalismontanum*, *Pterocarpus angolensis*, *Vangueria infausta* and others as associates (Figure 15). In the more rocky areas species more typical of the Chimanimani Mountains are found, such as *Plectranthus sanguineus*, *Chlorophytum blepharophyllum*, *Otiophora*

lanceolata and two *Aloe* species. The tussock sedge *Coleochloa setifera* is common on rocks. Despite the relatively low elevation (380 m), it is confirmed that such sandstone outcrops support some of the endemic Chimanimani herbs, typically only found in montane areas above 1000 m (e.g. *Gutenbergia westii*), as well as some other narrow endemic species (see Section 5).

Unfortunately, we visited this site late in the dry season which is far from ideal for recording the full species diversity. It is likely that this habitat will contain further interesting species and a visit at the onset of the dry season is recommended.

Fig. 15. *Brachystegia* woodland on Chimanimani sandstone ridge, Maronga [JT].

Conservation

The Maronga Forest Reserve was gazetted in 1953 and covered much of the present settled Maronga area up to the Chimanimani slopes. However, there is no sign of any protection being practiced now, and on most of the area away from rocky slopes forest cover has been cleared or heavily disturbed (Figure 17). Given the extent of clearance, and the current population pressures, it is unlikely that much can easily be done now to restore forest cover here.

Almost half of the extensive area for community conservation proposed by the Maronga community falls inside the newly-gazetted TFCA Core Zone. The conservation area proposed by Kew is much smaller as it includes only the area outside the Core Zone (Figure 27). Otherwise it covers similar areas, although not the north-eastern section proposed by the community; this section is already settled with many fields. In addition to the few forested footslopes lying outside the present Core Zone, the Kew area covers the north-south sandstone ridges with *Brachystegia* woodland and some of the open grassland areas. This *Brachystegia* woodland not only supports a relatively restricted vegetation type, but also some of the Chimanimani endemics. Riverine forest areas are also included.

Wildlife

Very few mammals were seen, possibly owing to snaring and hunting for bushmeat. Bows and arrows were noted in some huts. Along the more heavily-forested rivers, troops of Blue monkey were observed feeding on fruits of *Uapaca lissopyrena*.

A range of birdlife was evident in the forests but, as typical for forest avifauna, was difficult to observe whilst botanising. The Chimanimani Mountains (Mozambique) Important Bird Area (Parker 2001, http://www.birdlife.org/datazone/sitefactsheet.php?id=6690), covers a large area of both the highlands and surrounding lowlands and includes five globally threatened or near-threatened species, of which the Near Threatened Southern Banded Snake-eagle and Plain-backed Sunbird are both inhabitants of lowland forest. Although neither were seen on this trip, the forest habitat at Maronga looks suitable. Species of interest noted during the 2015 survey included Crowned Eagle, Red-throated Twinspot, African Firefinch, Livingstone's Turaco and Half-collared Kingfisher along the River Murere amongst others.

Economic Species

There were no particular species noted that could form the basis of a non-timber industry on a sustainable basis, particularly given the long distance from any transport links.

Mats made from reeds (*Phragmites* sp.) growing along the edges of some sandy river beds were seen, and small folding chairs made from the wood of *Khaya anthotheca* were often seen in homesteads.

Fig. 16. Woodland clearance for fields, Mahate [JT].

Fig. 17. Forest clearance for fields, Maronga [JT].

Fig. 18. *Uapaca lissopyrena* trees near river, Maronga [JT].

Fig. 19. *Maranthes goetzeniana* leaf and fruits, Maronga [JT].

5. SPECIES OF PARTICULAR INTEREST

The botanical surveys across the four communities revealed that, whilst plant diversity is generally low in this region and the majority of species are widespread and not threatened, there are a number of noteworthy species, including species of conservation concern, species of biogeographical interest and new records for Mozambique. These are discussed below under the main habitat types. Specimen citations (*collector* & number) are provided to facilitate future verification.

5.1 Evergreen & Semi-deciduous Forest

The large majority of forest species in the study area are widespread tropical African forest species, many reaching the south-eastern edge of their ranges in this area. However, there are several range-restricted species of high conservation concern and also a number of species of biogeographical interest, since these forests contain isolated populations of species with core distributions in variously West Africa, South Africa and the Indian Ocean fringe.

Vepris drummondii (Figure 22a) – a shrub of riverine forest confined to the lowlands of SW Chimanimani, mainly in the Haroni–Rusitu area of Zimbabwe and in hills to the west of there. It is confirmed for the first time in Mozambique here, being found along the Rio Murere, Maronga (*Darbyshire* 946) where it was seen several times, but only as individual plants. It is likely to be highly threatened by habitat loss. It has recently been provisionally assessed as **Vulnerable B1, B2** (Darbyshire *et al.*, in prep.).

Synsepalum sp. cf. *kaessneri* – this small understorey tree is frequently encountered at Maronga (e.g. waypoint 021/1, *Darbyshire*, pers. obs.) and also recorded at Thekeza, Zomba (*Cheek* 17963). True *S. kaessneri* is a rare species of lowland forest in the Eastern Arc and adjacent lowlands of Kenya and Tanzania. The Chimanimani taxon is believed to be distinct, restricted to the lowland forests of Haroni-Rusitu through to Zomba. Taxonomic studies are ongoing by I. Darbyshire & B. Wursten.

Maranthes goetzeniana (Figure 19) – this large forest tree (previously known as *Maranthes polyandra* or *Parinari goetzeniana*) is of particular interest in the forests on the Chimanimani footslopes. It can be the second largest contributor to total basal area in forest patches in Maronga after *Newtonia*. The species was particularly common in Maronga (*Timberlake* 6139), but was also recorded from forests in Thekeza, Zomba (*Timberlake* 6105). Globally, it is only known from low and medium-altitude forests (to 1100 m) in eastern Zimbabwe (Haroni–Rusitu, Vumba, lower Nyangani), central Mozambique (Chimanimani, Serrra Choa, Mt Mabu) and southern Tanzania, where it is generally recorded as scattered individuals, e.g. one individual only known from Chirinda Forest, and scattered trees on Mt Mabu. Surprisingly, it is not mentioned in Gomes e Sousa's study of Mozambican trees (Gomes e Sousa 1967), or in other similar publications (e.g. Sim 1909). In Maronga, however, extensive stands are found, with the species often being locally dominant. Regeneration is good, as seen in the numerous small trees and saplings. These stands along the eastern and southern Chimanimani footslopes are possibly the best stands known.

Coffea salvatrix – this coffee is an undershrub of moist forest, recorded from Maurami Forest, Zomba (*Cheek* 18053, *Timberlake* 6116). It has a restricted distribution, being known only from SE Zimbabwe (Chirinda), the Chimanimani lowlands of Mozambique and in S Malawi with a tentative record from S Tanzania. It has previously been cultivated and has some potential as a specialist coffee (see Section 6).

Phyllanthus myrtaceus – this shrub was uncommon along the Rio Murere, Maronga in riverine forest amongst sandstone boulders (*Darbyshire* 980). It is only known from the Chimanimani region in tropical Africa but also from eastern South Africa.

Ficus mucuso – a small to large forest tree, recorded at Thekeza, Zomba (*Cheek* 18035, *Timberlake* 6113). It was first recorded in Moribane Forest (Mpunga community) by J. & S. Burrows in 2010; it has yet to be recorded in Zimbabwe. It is otherwise known from West Africa where widespread in Guineo-Congolian forest, with an outlier in the Usambara Mountains of Tanzania; its presence in Chimanimani is a major range disjunction (see also *Raphidiocystis chrysocoma*).

Raphidiocystis chrysocoma – this climbing herb of moist forest is known in southern Africa only from Chimanimani. It was recorded from swamp forest at Mpunga (*Cheek* 17842) and was frequent in forest at Maronga (*Darbyshire*, sight record). Like *Ficus mucuso*, it is otherwise a West African species, extending to Tanzania and N Angola. The Chimanimani population is highly isolated.

Dianella ensifolia – this species is frequent in the forests in Maronga (*Darbyshire* 877) and at Thekeza, Zomba (*Massunde* 013). It is interesting from a biogeographical point of view as it has a disjunct distribution, being known mainly from the Indian Ocean fringe, and in continental Africa is restricted to Chimanimani and Mt Mabu. It is an attractive shade-loving herb, cultivated as an ornamental.

Baphia sp. ?nov**.** – a collection without flowers and fruits from Thekeza, Zomba (*Cheek* 18038) has not been matched with any known species in the genus but flowers and fruits are required to draw any firm conclusions.

5.2 Chimanimani Sandstone Outcrops, Including Along Rivers

Chimanimani sandstone and quartzite outcrops both on ridges and along river valleys along the Chimanimani footslopes, but most frequently at Maronga. These areas support a number of rare and/or endemic species.

Ficus muelleriana – this is a very unusual climbing fig which clings to quartzite rock outcrops and only grows to be a small shrub. It is a narrow endemic of the low altitude quartzite outcrops at the southern end of Chimanimani Mountains in Mozambique, currently known only from Makurupini Falls and Maronga with only four collections recorded. In Maronga (*Darbyshire* 960) it was quite frequent, but its habitat is potentially threatened by excessive burning of the *Brachystegia tamarindoides* subsp. *microphylla* woodland there. It has recently been provisionally assessed as **Endangered B1** (Darbyshire *et al.*, in prep.).

Otiophora lanceolata (Figure 21c) – this species is endemic to the lowland quartzite outcrops of southern Chimanimani in both Zimbabwe and Mozambique, usually at under 1000 m altitude. It was collected at an isolated quartzite outcrop near Thekeza homestead (*Cheek* 18012), and also at Maronga (*Darbyshire* 959) where it was one of the most characteristic species of the habitat and locally abundant. It is probably found on all lowland quartzite outcrops that support *Brachystegia tamarindoides* woodland, but is potentially threatened by excessive burning. It has recently been provisionally assessed as **Vulnerable B1, B2** (Darbyshire *et al.*, in prep.).

Streptocarpus acicularis – this species, which favours rock outcrops along rivers, was described in 2014 and has only been found once, at the confluence of the Nazengwe and Mevumozi rivers to the NE of Maronga community at an altitude of 280 m. It was hoped that

this species, assessed as **Critically Endangered** (Darbyshire *et al.*, in prep.) could be located along the Rio Murere, but despite searching in seemingly suitable habitat it was not found. It is possible that it will be found within the Maronga forest belt.

Danthoniopsis chimanimaniensis – this is a Chimanimani endemic grass species, largely restricted to sandstone/quartzite outcrops along rivers and streams. It was recorded in Mahate (*Banze* 343) and Maronga (*Darbyshire* 876); in the latter location it was fairly frequent on large rock outcrops along the Rio Murere. Whilst it seems to be secure at that site, small-scale mining activity in the Rio Mussapo system to the west (and elsewhere within its range) is almost certain to have had an impact on this species. It has been assessed as globally **Endangered** (Darbyshire *et al.* in prep.).

Gutenbergia westii (Figure 23c) – this herb is a Chimanimani near-endemic, extending to the Chimanimani farmlands in Zimbabwe, Serra Macuta and Chipinge. It was recorded from an unforested gully at Thekeza, Zomba (*Cheek* 17972) and was also found to be frequent at Maronga on quartzite rock outcrops in miombo woodland (*Darbyshire*, sight record). In the latter sight, this species appeared to be impacted by excessive burning. It has been assessed as globally **Vulnerable** (Darbyshire *et al.* in prep.).

Sericanthe 'sp. B (Chimanimani taxon)' of Flora Zambesiaca (Figure 23b) – this undescribed species is mainly found at higher altitude in the Chimanimani Mountains but was recorded in *Brachystegia tamarindoides* woodland over rock near Thekeza, Zomba (*Cheek* 18030, *Massunde* 006) associated with Chimanimani sandstone. This species is currently being investigated by B. Wursten and P. de Block at the Meise Herbarium, Belgium.

Syncolostemon flabellifolius – this shrubby member of the mint family is a Chimanimani Mountains endemic, otherwise known only from the high altitude sandstones of northern and central Chimanimani, but it was found along the Rio Murere, Marongo amongst riverside boulders (*Darbyshire* 979), presumably due to seed having been washed down from the high plateau. Only a single plant was seen but it was mature and had flowered. It has been provisionally assessed as Least Concern (Darbyshire *et al.*, in prep.).

Vernonia muelleri subsp. *muelleri* – this subspecies is endemic to the Chimanimani Mountains, with several previous records from the Makurupini area. It was recorded on riverside boulders along the Rio Murere, Maronga (*Darbyshire* 974) alongside *Syncolostemon flabellifolius*, where it was fairly frequent. The sandstone outcrops on these lowland rivers appear to be key sites for this taxon.

Podocarpus elongatus (Figure 21a) – this shrub or treelet *Podocarpus* is fairly frequent in rock outcrops and stony dry riverbeds along the Rio Murere, Maronga (*Banze* 352). In tropical Africa, it is otherwise restricted to the higher altitude Chimanimani (it was first recorded in Mozambique in 2014) and with an isolated population in N Malawi/Zambia border region. Elsewhere, it is more widespread in the Cape Province of South Africa.

Sclerochiton caeruleus (Figure 21b) – this shrubby Acanthaceae with striking blue flowers is fairly frequent on the quartzite outcrops with *Brachystegia tamarindoides* woodland in Maronga (*Darbyshire* 948), and also recorded from the isolated quartzite outcrop near Thekeza homestead (*Cheek* 18024). Elsewhere it is a scarce species, scattered in Mozambique and extending only to the Haroni–Rusitu area (Chimanimani) in Zimbabwe.

5.3 Moist Grasslands

The small areas of natural, seasonally moist grasslands at Maronga contain an interesting assemblage of herbaceous species, mostly widespread but with a number of more restricted taxa.

Crepidorhopalon whytei '*flavum*' (Figure 23a) – this trailing herb of moist grassland was common in the small areas of natural grassland in Maronga (*Darbyshire* 895). These plants have bright yellow flowers whilst typical *C. whytei* has blue to purple flowers. The yellow-flowered form appears to be restricted to the lowland southern Chimanimani region and should be recognised as a distinct species or subspecies – it has an existing name *Lindernia flava*, described from a Swynnerton collection. It is likely to be threatened due to disturbance and habitat loss in parts of its restricted range.

Mesanthemum africanum – this rosette-forming herb is essentially a Chimanimani Mountains endemic found mainly in wet open areas in the high mountains, although occasional plants have been found further away, presumably arising from seeds washed down by rivers, so it could be considered a near-endemic. It was found at lower altitudes in the small patches of moist grassland in Maronga (*Darbyshire* 966), although not common, and a single plant was found on sandy soils under *Uapaca lissopyrena* forest along the Rio Murere at 280 m altitude, perhaps from seed washed down from the mountains above. This species is assessed as of Least Concern (Darbyshire *et al.* in prep.) as it is thriving and unthreatened in the upland Chimanimani, but these lowland populations are still worthy of protection. It has been assessed as Least Concern (Darbyshire *et al.*, in prep.).

Xyris sp. ?nov. – this species was fairly frequent in a small area of moist grassland near the Maronga campsite (*Darbyshire* 938) growing alongside *X. angularis* (see Section 5.6 below). It has not been matched with any known southern African species but more specimens are needed to confirm whether or not it is a new species. It was not seen in other moist grassland sites visited.

5.4 Swamps

Pandanus livingstonianus (Figure 9) – this species is assessed as possibly Vulnerable (Beentje in Flora Zambesiaca, 2009). It is comparatively widespread across the Mahate and Zomba areas, ranging in altitude from 150 to 900 m, but was scarce in Maronga. It would not seem to be particularly threatened here, although the stems are cut for construction wood in places.

5.5 Miombo Woodland

Pachycarpus chirindensis – this species is restricted to the Manica Highlands of the Zimbabwe–Mozambique border and is potentially threatened. It was recorded in Ndombene Forest, Mahate (*Banze* 333).

5.6 New Mozambique Records

During the 2015 survey work a number of species were recorded or confirmed for the first time in Mozambique. *Flora Zambesiaca* and the *Flora of Mozambique* website (www.mozambiqueflora.com) were consulted to confirm that these records were new.

Alchornea hirtella forma *hirtella* – this form, which is probably worthy of a higher taxonomic status, is otherwise known mainly from West Africa with the nearest records being from Zambia. It was common in the Maronga forests (*Darbyshire* 878, 879).

Cyanotis arachnoidea – recorded from rocky ground in forest at Thekeza, Zomba (*Massunde* 007), this is a widespread species in tropical Africa and tropical Asia.

Cyathula prostrata var. *prostrata* – a widespread tropical African species, but this variety is a new record for Mozambique; it was recorded from Mpunga (*Cheek* 17907) and was also frequent in Maronga (*Darbyshire*, sight record). Var. *pedicellata* also occurs.

Cyperus albostriatus – recorded from Mpunga (*Cheek* 17863), near Thekeza, Zomba (*Cheek* 18014) and common in the Maronga area (*Darbyshire* sight record). A southern African species.

Cyperus distans – recorded from swamp grassland at Mpunga (*Cheek* 17915), this is a pantropical species but new to Mozambique.

Cyrtorchis ringens – recorded from Mahate (*Banze* 348), this is a widespread tropical African epiphyte in forest and moist woodland from Senegal to Malawi.

Eriocaulon inyangense – recorded from mossy fissures in sandstone rocks in riverine forest in Maronga (*Darbyshire* 985); this is a fairly widespread but uncommon herb species of central and southern Africa.

Eriochrysis pallida – this striking grass was recorded from one small area of moist grassland in Maronga (*Darbyshire* 932). It is widespread but somewhat scattered across tropical Africa, and represents a new generic record for Mozambique.

Fimbristylis aphylla – recorded from Maronga (*Darbyshire* 926), where it was common in a small area of moist grassland. This species has a scattered distribution in tropical Africa and SE Asia.

Oldenlandia angolensis – this slender herb was recorded from a small area of moist grassland in Maronga (*Darbyshire* 920). It is fairly widespread in southern tropical Africa but not common.

Schoenoplectus corymbosus – this sedge was recorded from Chimanimani sandstone outcrops by a waterfall on the Rio Murere in Maronga (*Banze* 363). It is a widespread species in Africa and parts of Asia.

Solanum viarum – this aubergine (eggplant) relative is an invasive weed from South America; in Africa it has previously only been recorded from W Africa and from South Africa. It was well-naturalised in the margins of a swamp in Mpunga (*Cheek* 17838), and may also be more widespread in the region as spiny *Solanum* species were also seen at e.g. Maronga but not collected.

Xyris angularis – recorded from a small area of moist grassland at Maronga (*Darbyshire* 918); it was previously known from the Zimbabwe side of southern Chimanimani but is otherwise a West African species.

5.7 Invasive Plants

By far the most significant invasive plant species across the area is the shrub *Vernonanthura phosphorica* (previously known as *Vernonia polyanthes*), a member of the Compositae (daisy) family (Figure 20). This is a shrub or small tree up to 4 m tall (normally 2–3 m), sometimes with a woody trunk to 2–4 cm diameter or more. The leaves are oblong-lanceolate, to 12 cm long, dull green and mostly hairless above but greyish stellate-hairy below, whilst the inflorescence is a large terminal head and the flowers are white and without ray-florets (Flora of Zimbabwe website). It has become common, abundant or even dominant in disturbed sites, in secondary vegetation, along roadsides and on forest margins across the Chimanimani area. The species can be found even in shaded disturbed forest; unlike many invasives, it does not require much sunlight to establish. However, it does not seem to invade

miombo and similar woodlands, presumably because of the different soils. Growth is very rapid, and dispersal is by the copious number of small plumose seeds distributed by wind. Burning of vegetation, so widespread across the area, seems to actively encourage both its growth and dispersal. Mono-dominant stands covering many hectares are commonly seen on hill slopes.

Native to Brazil, this species appears to have been introduced as a nectar plant for bees around Sussundenga town, possibly in the early 1990s (Flora of Zimbabwe website) by an international NGO. It has since become a serious invader of even slightly disturbed areas at lower altitudes along the border mountains of Zimbabwe and Mozambique, such as the lower Vumba and areas around Chimanimani (Flora of Zimbabwe website). Over the last 15 years it has also started to appear at higher altitudes, e.g. in the Vumba and Chimanimani Mountains (in the latter up to at least 1350 m), although less abundantly.

Vernonanthura is valued by local communities as it is such a good bee-fodder plant, and most local people do not see it as a problem. Although it is highly invasive of fallows, especially recent fallows derived from semi-deciduous forest, there is little in the way of a rootstock and it can be cleared fairly quickly if new fields are planned. Normally, clearance seems to be by fire; once dry stands of *Vernonanthura* burn readily. However, from a conservation viewpoint this is a dangerous alien invasive plant as it inhibits or supresses regeneration of damaged or cleared forest. Also, because it ignites and burns readily fires become more widespread and common as there is a greater fuel load. With frequent burning, the humus in the forest soils is lost and the soils are subsequently less able to support forest species.

Surprisingly, the invasive nature of this species does not seem to have been noted elsewhere (e.g. in Cronk & Fuller 2001), even in South Africa (e.g. Henderson 2001). There appear to be no known methods of control, other than manual cutting and/or burning. Seeds are so readily dispersed, and probably so widespread now, that eradication would prove very difficult.

Fig. 20. *Vernonanthura phosphorica*, Maronga [ID].

Fig. 21. *Podocarpus elongatus* (right) & *Sclerochiton caeruleus* (centre), both Maronga [both ID]; *Otiophora lanceolata* (right), Zomba [MC].

Fig. 22. *Vepris drummondii*, Maronga (left) [ID] and *Funtumia africana*, Mpunga (right)[MC].

Fig. 23. *Crepidorhopalon whytei* (*flavum*) (left), *Sericanthe* sp.B, Maronga [ID] and *Gutenbergia westii* (right), Zomba [MC]

6. PLANTS WITH ECONOMIC POTENTIAL

One objective of the project is to find species of potential economic value in the community forest areas of the Chimanimani TFCA buffer zone with a view to the possibility of some being harvested sustainably, improving the livelihoods of the communities and providing communities with an economic incentive to protect the natural forest habitat. Discussion on this and some possibilities are given below.

6.1 High-value Paper-making Materials

At Mpunga large quantities of mature individuals of the understorey tree *Funtumia africana* were found (Figure 22b), a species that dominates the subcanopy of the semi-deciduous forest over many hundreds of hectares. High value paper for the stationery trade sometimes incorporates hair plumes from the seeds of members of the Apocynaceae family (which includes *Funtumia*) to give a particular texture and finish. We understand there has been a shortage of reliable supply of this exclusively wild-sourced raw material; most Apocynaceae species producing this material occur at low frequency. A sample specimen of the seed hairs was collected for market-testing with potential buyers. The Mpunga area shows possible commercial potential because it has a globally rare combination of (a) a high density of yielding plants and (b) extensive areas of the species, with c) relative ease of harvest (trees begin fruiting only 3–4 m from the ground). Local labour equipped with bamboo poles with cutting hooks will be able to harvest fruits at around March–April time.

At Zomba a second species of Apocynaceae providing a similar product was found (*Strophanthus petersianus*), but at a much lower frequency and in degraded forest around houses. At both Mpunga and Zomba, *Synaptolepis* of the paper-making family Thymelaeaceae was noted, but at low frequency.

6.2 Edible Forest Fruits for Preserving and Marketing

In both Mpunga and Zomba *Sclerocarya* (in woodland) and *Ximenia caffra* (on forest edge/thicket) occur in patches and have been considered to have commercial potential in earlier internal reports. In the extensive miombo woodlands of the Mahate area, large stands of the tree *Uapaca kirkiana* were seen, producing much fruit in early November. These fruits are readily eaten and at times are sold in markets such as Chimoio. There is a distinct possibility for harvesting and marketing of these fruits on a seasonal basis.

Another species in Mpunga that may yield edible fruit for preservation and marketing is *Dovyalis macrocalyx*. An alternative route to marketing might be in the form of jams rather than drying, while a unique selling point might be that it is otherwise not commercially available.

A search for existing data on edibility is required, while corroboration on edibility from the local community is also advisable. Harvesting and experimental food processing would be needed. If successful, quantification of the resource with local help would be needed to find areas where the target species is most plentiful.

6.3 High-value Finished Timber Products for Export

In principle, we understand that timber products are not a target of the project. Yet, if sustainability can be demonstrated and verified, they cannot be ruled out entirely. Two products seen lend themselves to scaled-up production and export.

Furniture: Adjustable folding chairs of all wood manufacture, produced to a very high

standard and with all-wooden joints including those that rotate (Figure 25), were commonly seen in Maronga and also in Zomba. It appears that most are made from mbawa (*Khaya anthotheca*). Whilst it is doubtful if this large tree – generally found along rivers – could be sustainably harvested, trees destroyed during the clearance of fields could be utilized for the manufacture of chairs for 'export', rather than just left and burnt as at present. Since whole companies have been created in the UK on the basis of marketing sustainable furniture produced by single communities elsewhere in the tropics, e.g. in India, this possibility warrants further evaluation.

Kitchen utensils: At Thekeza (Zomba) and in Maronga, kitchen utensils carved from two fast-growing, soft-wooded forest species were seen – *Funtumia*, common in the Mpunga area, and *Harungana madagascariensis,* an common pioneer forest species. More intensive harvesting of either would have no significant impact on the conservation value of these forests. The examples seen have the unique selling point of being evidently handmade, are aesthetically pleasing and of unusual design. If marketed, they would have the benefit of detailed and unusual provenance information. This combination of features may prove attractive to a number of people in developed countries.

6.4 Essential Oils

There is a vast market for essential oils from an increasing number of known species for the perfume, therapeutic and cosmetic industries, and 95% of commercial essential oils are thought to be produced from three main plant families – Myrtaceae, Rutaceae and Lamiaceae. Of the Myrtaceae only two species of *Syzygium* were seen in Mpunga, both low frequency along the swamp grassland. *Harrisonia abyssinica* (Rutaceae) is abundant in woodland in Zomba and contains essential oils or limonoids. More promising are Lamiaceae (Labiatae, mint and basil family), of which about 10 species were seen in secondary forest and woodland in the Zomba area. Most were fairly abundant, and even semi-weedy in fallow fields. However, it is not known if any of these would be of particular value in this regard.

6.5 Papyrus Products

The Zomba area has at least one large papyrus (*Cyperus papyrus*) swamp. The local community already manufactures sleeping mats from this species which are sought after and are exported locally within Manica Province (Figure 24). There is scope for expanding the marketing of this product nationally, and possibly for diversifying the products that are manufactured. However, the peculiar mechanical properties of the species so lend themselves to the cushioning and insulation desired in a sleeping mat that marketing the product within increasingly affluent Mozambique might well absorb most of the production. Papyrus is fast-growing and self-sustaining so long as it is managed sensibly. Experimentation is required to determine the best interval between cutting cycles.

In Maronga, reed mats made from *Phragmites* were seen. However, the only stands of *Phragmites* reeds noted were are associated with open rivers and were limited in extent.

6.6 Coffee

Some plants of a species of wild coffee, *Coffea salvatrix*, were seen in the Zomba area. It is planned to obtain seeds from these and send them off to see if there would be any interest in it as a specialist coffee. *C. salvatrix* is only found in Chirinda Forest in SE Zimbabwe, in the lowland area in Mozambique around the Chimanimani Mountains and in S Malawi.

6.7 Medicines

In view of the sensitivity to intellectual property rights of local communities, especially

regarding traditional medicines, no specific attempt was made to look at commercial possibilities in this direction.

One potential medicinal species is *Craterispermum schweinfurthii* (mundotha), which is common in the forests of Maronga and which we were informed by two guides is used to stimulate male sexual activity (a natural 'viagra'). This claim would need to be investigated phytochemically, but may have some potential.

Fig. 24. Papyrus mat being made, Zomba [TT].

Fig. 25. Small folding chair made of *Khaya* wood, Zomba [MC].

7. MAIN BOTANICAL AND CONSERVATION FINDINGS

The main botanical and conservation findings from the study are outlined below. Following some general comments, particular species and areas thought to be significant for conservation are described. This is followed by comments on species with possible economic potential and conclusions of potential ecotourism interest.

7.1 Vegetation

From study of Google Earth imagery and time spent walking through the study areas, it is obvious that there has been extensive loss of forest and dense woodland vegetation from the less steep areas, particularly in Zomba, and over much of Maronga. This wide-scale clearance can be seen in the remnant patches of dense vegetation left, possibly for specific purposes, in sharp contrast to the surrounding scrub, fallows and low woodland, and the significant number of remnant large trees in fields; very few large trees now remain. The latter shows not only that forest was present earlier, as the trees are generally forest species, but also the height of the original canopy.

This loss of forest cover has been due to three factors. Firstly, by far the most significant factor is clearance for agriculture, which greatly accelerated after the end of the civil war in 1992 as people moved back into the area and asserted their rights (Schafer & Bell 2000). Secondly, fierce forest fires resulting from the drought of 1991/92 destroyed large areas of Mpunga/Moribane and Mahate when forest undergrowth and foliage presumably became very dry. Much evidence of this can be clearly seen still in the form of blackened stumps of large canopy trees, the relative lack of medium to large-sized trees, and the occasional emergent tree showing where the canopy height used to be. The presence of regenerating cohorts of such species as *Newtonia buchananii* in places may also have been a result of this damage. Thirdly, the construction of the Cabora Bassa powerlines through Moribane forest and the eastern parts of Zomba which necessitated clearance of a wide swathe of forest and woodland (Schafer & Bell 2000), which is still regularly cleared to stop regrowth. Schafer & Bell (2000) discuss deforestation and community management of forest resources in the Moribane area in the light of local and national politics, particularly during the 1990s following the civil war.

However, on the other hand, the presence of small numbers of elephant in Mahate and western Mpunga/Moribane has reduced the pressure to expand agricultural production in those areas. The losses of banana, maize, etc. to elephants, as well as risk to human life, are too great. As elephants are not present in the Zomba area, there has been no similar constraint to expansion of agriculture there.

7.2 Species of Conservation Interest

A total of 532 taxa (species, subspecies and varieties) were recorded during the study, including both specimens and sight records. These consisted of 20 Pteridophytes, 1 gymnosperm, 109 monocotyledons in 22 families and 402 dicotyledons in 79 families. Although the number of species found varied greatly between community areas (ranging from 157 to 287), figures can not be considered indicative of relative diversity as they probably more reflect collecting effort.

When selecting or managing conservation areas particular focus should be given to the range-restricted and endemic species highlighted in Section 5. Of particular concern are the following:

- Forest: *Vepris drummondii*, *Synsepalum* sp. cf. *kaessneri*, stands of *Maranthes goetzeniana*, *Coffea salvatrix*.

- Chimanimani sandstone outcrops along ridges: *Ficus muelleriana*, *Otiophora lanceolata*, *Gutenbergia westii* (along with any other narrow endemic species).
- Chimanimani sandstone outcrops along rivers: *Streptocarpus acicularis*, *Danthoniopsis chimanimaniensis*, *Vernonia muelleri* subsp. *muelleri.*
- Moist grassland: *Crepidorhopalon whytei* "*flavum*", *Xyris* sp. ?nov., *Mesanthemum africanum*.

It is clear from the discussion in Section 5 that, within the Chimanimani foothills, the highest priority sites for species conservation fall within the TFCA Core Zone and adjacent foothill areas of the Maronga community and the Thekeza area of the Zomba community. *Coffea salvatrix*, however, is recorded only from Maurami Forest.

None of these species require complex management plans but need protection of their habitat, including a halt to deforestation at Maronga and Thekeza and reduced (but not entirely suppressed) use of fire in the quartzite outcrops in both areas.

There are five endemic plant species or subspecies confined to the eastern or southern Chimanimani foothills area – *Ficus muelleriana*, *Otiophora lanceolata*, *Streptocarpus acicularis*, *Vepris drummondii* and *Vernonia muelleri* subsp. *muelleri*. In addition, there are possibly three new species known only from the study area – *Crepidorhopalon whytei* '*flavum*', *Synsepalum* sp. cf. *kaessneri* and *Xyris* sp. ?nov. Particular attention needs to be given to their conservation and they are, of course, of particular interest for ecotourism.

Although there are many species endemic to the Chimanimani Mountains, nearly all of these are only or primarily found above about 600 m altitude in the southern parts and 1000 m in the north. Some however, e.g. *Mesanthemum africanum* and *Syncolostemon flabellifolius*, have been found in the study area at lower altitudes, presumably arising from seed washed down by rivers flowing off the mountains.

One species of negative conservation significance is the invasive shrub to small tree, *Vernonanthura phosphorica* (see Section 5.7). This very aggressive species, introduced from Brazil perhaps two decades ago, is invading not only fallows and recently burnt areas, but also in some cases fairly intact forest and woodland (although apparently not miombo). It can be very abundant or even totally dominant on hillslopes at low altitudes, and is now even found up in the mountains. Once established, *Vernonanthura* appears to out-compete regenerating forest species, greatly inhibiting forest regeneration after clearance for small-scale agriculture. In addition, as it is very flammable and can regrow rapidly from seed after fire, once *Vernonanthura* stands are present fire also becomes more frequent in occurrence, also impacting upon forest regeneration.

7.3 Areas of Conservation Interest

This is discussed under three headings – the TFCA Core Zone, community conservation areas proposed by the various communities, and areas proposed by Kew based on known or assumed biodiversity values (see Figures 26 to 30).

The Chimanimani Trans-Frontier Conservation Area (TFCA), approximately 2500 km^2 in extent and covering areas in both Mozambique and Zimbabwe, was established in the 1990s. The TFCA comprises a Core Zone where no settlement or extractive use is allowed, and a Buffer Zone where natural resource management and some economic activity is allowed as long as it is not incompatible with conservation objectives. On the Mozambique side the Core Zone has recently been re-defined and gazetted, but in essence it covers the Chimanimani National Reserve – primarily land above 350 m altitude in the south and 600–800 m in the

north, with a total extent of around 645 km^2 (Anon. undated). The Buffer Zone covers a larger area of 1681 km^2 eastwards from the Chimanimani foothills to the Rio Lucitu in the south, the Rio Mussapa Pequena in the east, and northwards to Mt Tsetserra (Ghiurghi, Dondeyne & Bannermann 2010a). Three Forest Reserves, originally gazetted in 1953 for timber production – Maronga, Zomba and Moribane – lie in the Buffer Zone. The present study was focussed almost entirely on botany and conservation in the community areas of Mahate, Mpunga, Zomba and Maronga in the Buffer Zone.

However, at first it was not very clear where exactly the TFCA Core Zone boundary lay, nor how "hard" it would be as regards use by communities. A draft Directive from the Council of Ministers in 2013 giving 64 georeferenced points was later used and mapped which showed the Chimanimani TFCA Core Zone extending into some of the areas that communities had thought were part of the Buffer Zone. Given the higher biodiversity values of the foothills compared to the more-heavily cleared pediplain, this means that a significant extent of some of the community-proposed conservation areas actually lies within the TFCA Core Zone, presumably under the direct responsibility of the National Park authorities (Administração Nacional das Áreas de Conservação). Some areas of fieldwork conducted by Kew were later found to actually lie inside the Core Zone. This has been taken into account in the report, and all Kew-proposed areas lie outside (although often adjacent to and abutting) the Core Zone–Buffer Zone boundary. The issue of the actual area extent that communities can use for ecotourism, community conservation, etc., will obviously need to be determined before any developments or conservation initiatives occur.

In addition, a major point of concern is that a number of households lie at present within the TFCA Core Zone as presently drawn, including Regulo Mahate and in Maronga Saguta Comeni, although only by a few hundred metres. However, some fields currently being cultivated lie almost 2 km inside the Core Zone. In Maronga in particular, there are some households moving into what is obviously the Core Zone and being quite destructive in terms of forest clearance.

To a significant extent, and quite understandably, the community-proposed conservation areas in Mahate, Mpunga, Zomba and Maronga (Figure 26) generally represent areas with few if any settlements or fields. They are presumably areas the community feels are not highly desirable from an agricultural perspective (either poor soils, steep slopes and subject to the destructive impacts of elephants), but can form the nucleus of ecotourism initiatives. In selecting and drawing boundaries for areas with higher conservation values, the Kew team kept these points in mind. It is recognised that in the case of Mpunga and Zomba in particular, and to a lesser extent in Maronga, the areas proposed by the community do include what appear to be the most appropriate remaining areas for conservation from a biodiversity perspective.

Across the study area, the following places have been identified by the botanical team as being of particular interest. Table 1 shows the extent of each community, the area proposed by the community for conservation (which generally extends into the TFCA Core Zone), and seven areas totalling 127.5 km^2 proposed by Kew (which lie outside the Core Zone).

a) *Mahate* (Figure 27)
The extensive miombo woodland suggested as a community conservation area is in moderately good condition but is not particularly significant in terms of its plant biodiversity. It is similar in composition and structure to a number of other areas in Mozambique. A significant extent of it lies within the TFCA Core Zone.

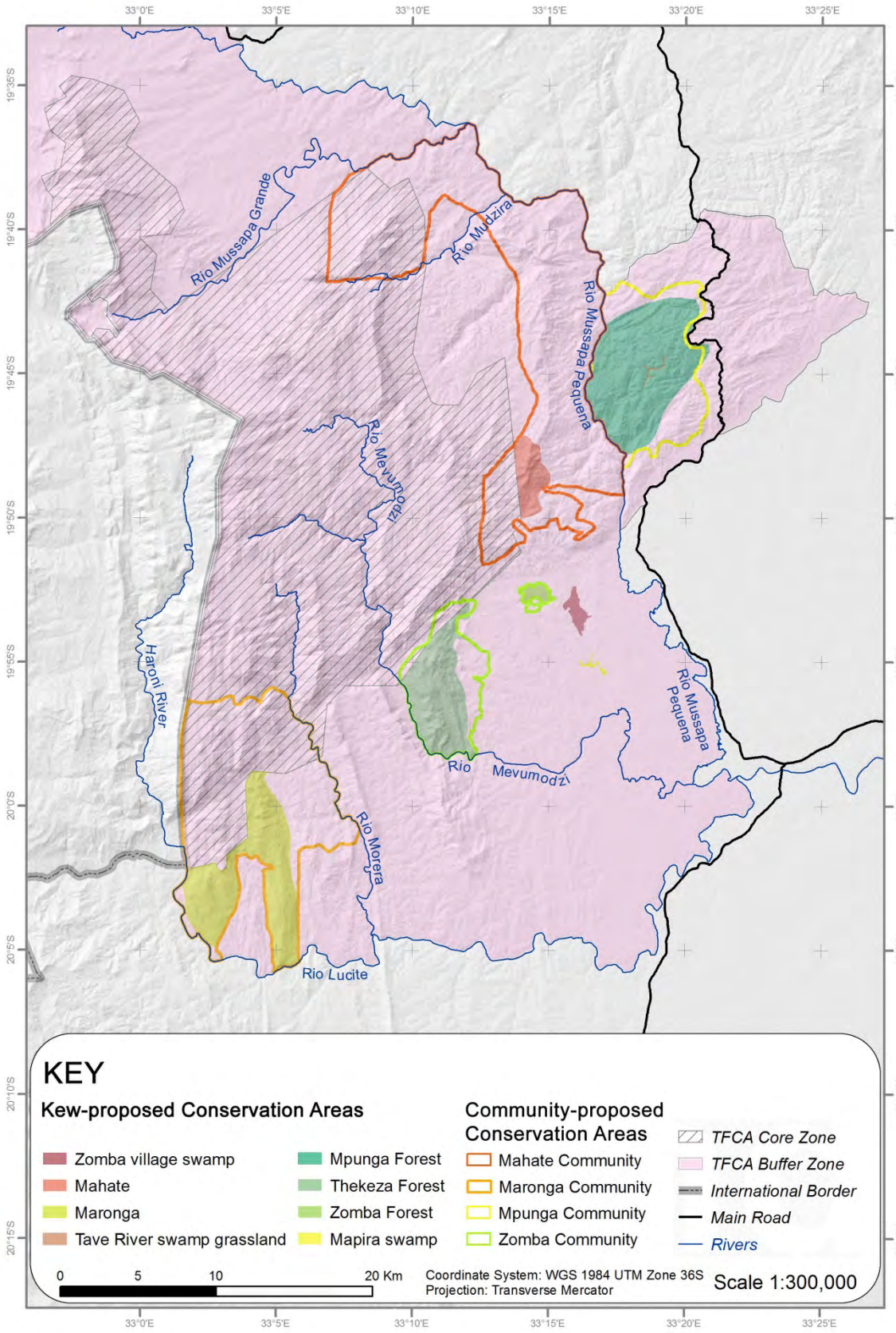

Fig. 26. Community- and Kew-proposed conservation areas within the Chimanimani TFCA.

Table 1. Proposed areas for conservation, Chimanimani foothills communities.

	area (km^2)
Mpunga	
total community area	160
community-proposed conservation area	66.5
proposed forest area for conservation (Kew)	48.6
proposed Tave R area for conservation (Kew)	0.15
Mahate	
total community area	504
community-proposed conservation area (incl. TFCA Core)	187
proposed area for conservation (Kew)	8.16
Zomba	
total community area	230
community-proposed conservation area (incl. TFCA Core)	36.2 + 2.19
Thekeza forest area proposed for conservation (Kew)	25.1
Mapira swamp area proposed for conservation (Kew)	0.43
Zomba forest area proposed for conservation (Kew)	1.73
Zomba swamp area proposed for conservation (Kew)	2.18
Maronga	
total community area	179
community-proposed conservation area (incl. TFCA Core)	129
proposed area for conservation (Kew)	40.7
Total area TFCA Core Zone	682 km^2

More important for plant conservation is the narrow area along the footslopes of the Chimanimani massif, mostly on nutrient-deficient white sandstones and quartzites, but including are patches of moist forest and *Brachystegia tamarindoides* woodland. Much of this vegetation actually lies within the TFCA Core Zone, but there is a small area of 816 ha lying outside (Zona Mabhika). Of particular interest (although not visited) are two forest patches at 19°43'11"S, 33°09'06"E (1150 m) and 19°44'09"S, 33°09'13"E (1050 m) and the forest and grasslands in a valley at 19°41'37"S, 33°08'35"E (1000–1300 m). Both localities lie well within the TFCA Core Zone.

b) *Mpunga* (Figure 28)

Mpunga forest – this includes forest areas known as Mbiquiza and part of the western section of the former Moribane Forest Reserve. All of it now lies within the community wildlife or 'ecotourism' area where elephants roam, which is close to the Ndzou eco-lodge. A bee-fence attempts to keep elephant, which roam across the area and up into the Chimanimani foothills to the west, away from habitation and fields. The area exceeds 50 km^2 in extent from Chitowa along the Rio Mussapa Pequeno across to the bee-fence and Ndzou Lodge.

Tave River swamp grasslands – these grasslands are in the "wildlife" section of Mpunga community and extend along the Rio Tave and some of its tributaries from approx. 19°45'26"S, 33°18'29"E to 19°44'24"S, 33°19'13"E (alt. 500–520 m). Along with the associated forests it has now been designated as a conservation area by the community. Total extent is estimated at 15.5 ha, but with an ecotone between forest and grassland exceeding 8 km in length. This area should be conserved in conjunction with the surrounding forest/woodland areas. It is the diversity of habitats and the ecotones along their margins that makes it of particular interest.

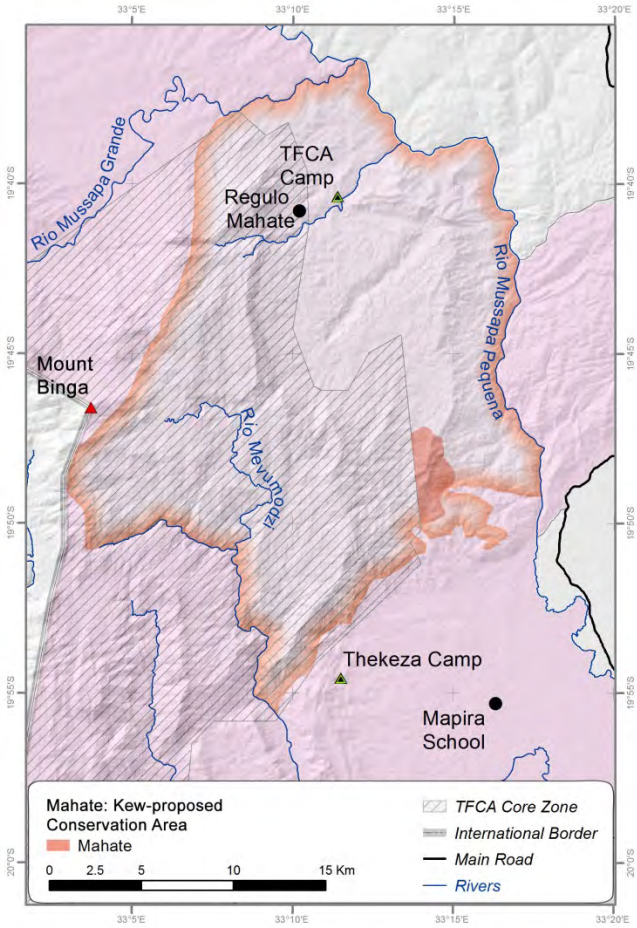

Fig. 27. Mahate community boundary and Kew-proposed conservation areas.

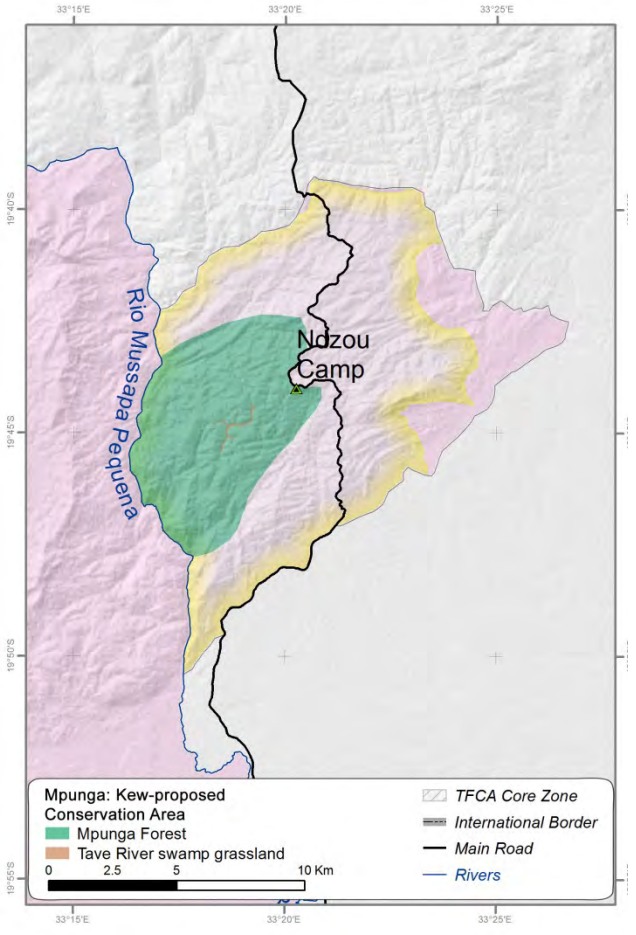

Fig. 28. Mpunga community boundary and Kew-proposed conservation areas.

c) *Zomba* (Figure 29)
Thekeza Forest – a relatively large area (2510 ha) of relatively little-disturbed woodland/forest on the heavily dissected foothills of the Chimanimani Mountains, extending from approx. 19°52'19"S, 33°11'26"E to 19°58'07"S, 33°11'19"E (alt. 200–1000 m). It lies north of the Rio Mufomodzi adjacent to the Core Zone. Although all this area has been set aside by the community for conservation, a few families and fields are situated inside near the margins. The area consists of various types of woodland, including miombo on the ridges, with much denser forest and streams in the deeper gullies.

Zomba or Maurani forest – an area of well-developed forest lying within the old Zomba Forest Reserve, with inclusions of *Pandanus* swamp, degraded grassland, secondary woodland and a very few small arable fields, centred on 19°52'36"S, 33°14'30"E (alt. 200 m) with *Pandanus* at 19°52'55"S, 33°15'26"E. Much of the forest area is still used as a traditional cemetery so has been protected from clearance for many years. The fringing *Pandanus* swamp forest occurring in a narrow fringing along the Rio Chindore is of particular interest as it is rather scarce regionally. Total extent is 170 ha, of which only perhaps 1 or 2 ha is *Pandanus* swamp.

Mapira swamp forest – another area of fringing forest with *Pandanus* is found at the confluence of the Rio Mucutucu and a smaller river at 19°55'08"S, 33°16'36"E (alt. 150 m). Although narrow, and with no accompanying dryland forest, the stands of *Pandanus* and riverine trees are significant.

Zomba papyrus swamp – an area of papyrus swamp with associated aquatics, flooded grassland and riverine fringing forest in the middle of the Zomba community area, centred on 19°53'30"S, 33°16'00"E (alt. 150 m). Only part of this area was visited. The most important parts are probably the open water permanent papyrus swamp and the fringing forest, especially if there are any stands of *Pandanus*. Total area is around 220 ha with a perimeter of 9 km.

Of particular concern in Zomba is that most of the remaining vegetated small rivers, some of which support fringing forest and populations of *Pandanus*, as well as large trees of *Khaya anthotheca*, do not seem to be under any type of proposed protection. From the point of view of human welfare, these are vitally important as they help ensure year-round supply of water for drinking and washing, and help reduce siltation. In addition, from a conservation perspective, these fringing forests and *Pandanus* swamp areas are among the most and restricted habitats in the area. The papyrus stands have economic potential.

d) *Maronga* (Figure 30)
There are three broad areas of conservation interest, which have been combined on the map. Much of the remaining forest in the area actually lies within the TFCA Core Zone. The total extent proposed for conservation by Kew is 4070 ha.

The footslopes at the base of the Chimanimani massif mostly support a tall and well-developed forest that has not yet been extensively damaged. This extends from the Makurupini area and the Zimbabwe border at the Haroni River in the south to the Zomba area in the north. Riverine forests along the larger rivers are also of interest. The area around the Makurupini Falls (20°00'13"S, 33°01'52", 650 m) in the south has been well-collected by Zimbabwean botanists with many interesting records.

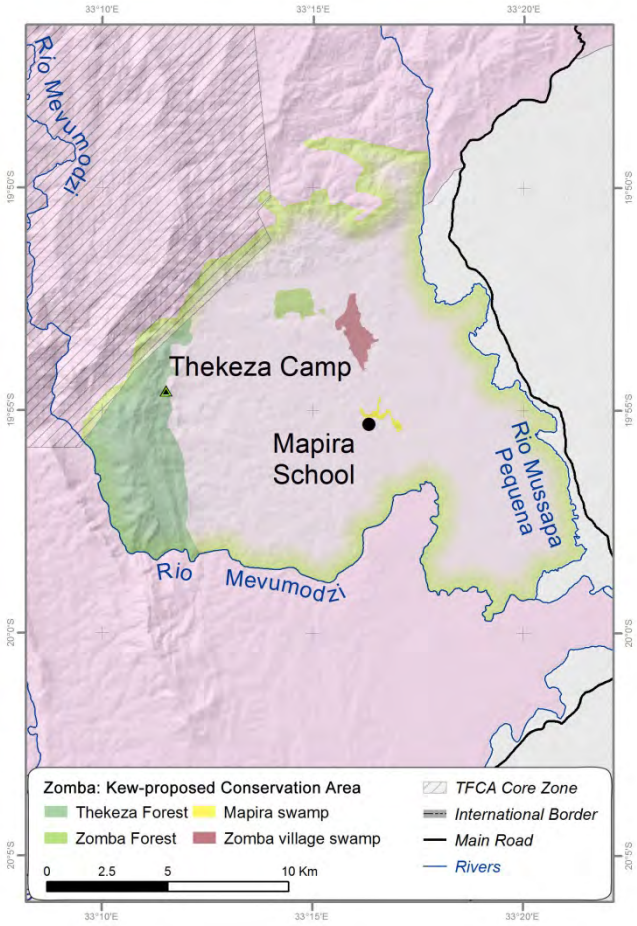

Fig. 29. Zomba community boundary and Kew-proposed conservation areas.

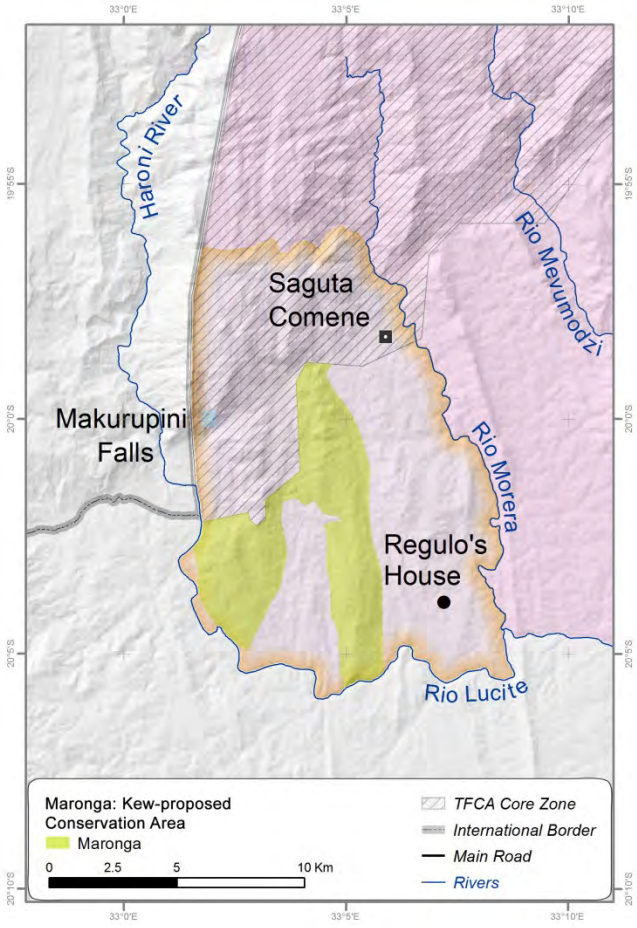

Fig. 30. Maronga community boundary and Kew-proposed conservation areas.

One locality of particular concern that was visited is a set of fields at 19°57'13"S, 33°05'47"E (380 m) belonging to one family and extending over perhaps 10 ha. This appears to have been cleared over the last few years – an example of forest destruction that can be seen elsewhere. Destruction has been particularly severe here, with large trees of *Newtonia*, *Khaya* and *Maranthes* exceeding 100 cm dbh being felled, burnt and left lying. The timber value alone of these trees is significant, although of course there is no market nearby. However, looking at 1982 air photos from Zimbabwe, just extending to this area, it can be seen that this particular field was visible even then. It is possible that this relatively steep slope was being cultivated in the early 1980s, was abandoned during the war, and has only recently been reopened as people move back into the area. The size of some of the trees being felled in 2015 showed that they were much older than the 40 years suggested by that interpretation, so some expansion must have taken place.

A separate vegetation type, although within the same mapping unit, occurs on the long rocky outcrops or spurs composed of white sandstone and similar resistant rocks from the Chimanimani massif, running up to 13 km south from the base of the mountains. These generally support miombo woodland, with some Chimanimani endemics in the more open areas under *Brachystegia tamarindoides*. Pressures on such areas are not as high as with forests as soils are rocky and poor; it is soils under forest that are most sought after for agriculture.

Also worthy of conservation effort are the areas of natural moist grassland that punctuate the Maronga forests in the Chimanimani foothills. These are of particular interest for their assemblage of herbaceous species, some of which are highly range-restricted.

Finally, the larger rivers flowing through the area from the Chimanimani Mountains support some interesting species in their fringing forests or woodland, and also occasional specimens of Chimanimani endemics that have grown from seed presumably washed down from higher up. Riverine vegetation also acts as a corridor for species movement, both plant and animal, across the area, and thus is important in helping maintain populations and allowing both gene-flow and recolonization after local extinction.

7.4 Species of Possible Economic Interest

There were only a limited number of plant species noted that could have economic value if exploited by the local communities. In addition, there is an issue of quantity and availability, although for some species some form of cultivation might be possible. Another significant factor for remote communities such as Maronga and Mahate is distance to a road-head from where they could be distributed or sold.

In the past, commercial interest has been expressed regarding the plume-like seeds of some Apocynaceae fruits for incorporation into high-value paper. This is still being followed up. At Mpunga and Zomba in particular, many individuals of the understorey tree *Funtumia africana* (Apocynaceae) were found, enough to provide a reasonable although seasonal supply. Harvesting could be readily done by local communities.

In the extensive miombo woodlands of the Mahate area, large stands of the tree *Uapaca kirkiana* were seen, producing much fruit in early November. These fruits are readily eaten and sold in markets such as Chimoio. Harvesting and marketing of these fruits on a seasonal basis would be relatively straightforward.

Although the project was not looking at non-sustainable uses, such as timber extraction, there may be possibilities for small-scale artisanal use of timbers for higher-value products. One

such product is the small folding chair, commonly seen in villages, mostly made from the wood of the large tree *Khaya anthotheca*. Use of the timber in this way might enable at least some value to be gained after felling of this species during field clearance, trunks which are otherwise often burnt in situ. Numerous kitchen utensils made from small stems of the trees *Funtumia africana* and *Harungana madagascariensis*, both common pioneer forest species, were noted in the area.

The fast-growing papyrus (*Cyperus papyrus*) and reeds (*Phragmites* sp.) can be fairly easily managed for a sustained harvest. Reed and papyrus mats were seen in some places, especially in Zomba. Their manufacture locally for income-generation would be possible.

Other possible species of interest include a species of wild coffee, *Coffea salvatrix*, in the Zomba area, the seeds of which might be of interest as a specialist coffee.

Elephants in the Mpunga area are of particular importance from an ecological perspective in controlling woody encroachment and keeping the grassland areas open; they are also important from a tourism viewpoint in both the Mpunga and Mahate areas. Owing to dangers to people and destruction of crops, their presence also reduces the desirability of human settlement and cropping over large areas of woodland and semi-deciduous forest.

7.4 Ecotourism and Ecotrails

Ecotourism potential is dependent not just on the biodiversity and scenery found in an area, but also accessibility and the ability to see a range of things of interest within a limited time. The proximity of accommodation and water will also play a role. Here we restrict the findings and discussion to areas with botanical interest and some possible trails.

The Mpunga forest area is close to the main road and within walking distance of Ndzou Lodge. Although the habitat diversity of the semi-deciduous forest area is limited, the mix of swamp grassland, forest margin and forest itself is not only species-rich but also attractive to wildlife such as elephant. The area seems most suited to ecotourism activity, especially if visitors could be taken into and across the attractive swamp grasslands of the Rio Tave during much of the year. Crossing from the main tourist track into Mbiquza Forest near 19°44'55"S, 33°18'39"E would be a good route.

During the World Bank-funded TFCA initiative, a track was cleared around 2010 in the Mpunga area (the initial stretch possibly using a bulldozer) from the main road near 19°43'52"S, 33°20'07"E southwest to around 19°45'07"S, 33°19'03"E. Although now (June 2015) mostly overgrown, the track is still readily passable on foot. This track, running primarily along the ridge, can certainly act as a 'spine' for future tourism developments.

In Zomba the forests of the upper Chimanimani foothills at Thekeza appear to be better-developed, more diverse and interesting botanically than those of Mpunga. However, there are no elephant and perhaps less wildlife interest. The biggest limitation is that it is a 15 km walk, mostly through settlements and fields, in order to get there. It is unlikely to be a good place to develop ecotourism. Walkers would prefer to hike into the Chimanimani mountains themselves.

The papyrus swamp and wetlands near to the *Pandanus* and forest area in Zomba may have some particular scarce or range-restricted bird species in them which would be of particular interest to birders, but this needs to be investigated further.

Mahate is quite difficult to access, particularly during the wetter part of the year, owing to flooded rivers. The only significant areas of botanical interest are where the Chimanimani massif rises from the surrounding miombo woodland. The somewhat-separate block of Mt Huco / Mt Mbhanha (name seems to depend on source), especially the middle slopes, is considered sacred, but would be a good place for a walking trail, perhaps starting or ending at the Rio Mussapa crossing or the main National Parks camp. There are apparently some spectacular waterfalls, such as at 19°41'48"S, 33°08'52"E (1200 m).

The Maronga area is actually much easier to access for visitors from neighbouring Zimbabwe, crossing near the Haroni–Rusitu river junction where there is reasonable road access. Close by are the spectacular Makurupini Falls where the Makurupini River falls off the Chimanimani massif and flows into the Haroni. Given that the areas of botanical interest lie mostly along the Chimanimani footslopes and in the middle reaches of the larger rivers, any trail would probably run here, perhaps a 5-day trail with a mixture of mountain and forest walks. Access to a road in Mozambique involves a long trek of lesser tourism interest and could be quite dispiriting in view of the extent of forest loss in the old Maronga Forest Reserve. An alternative route could be a week-long south–north trail along the footslopes from the Makurupini to the Rio Mussapa in Mahate.

8. CONSERVATION RECOMMENDATIONS

1. Now that possible conservation areas have been identified by local communities and by Kew on the basis of their biodiversity, consideration needs to be given to how these areas and the species within them can best be effectively conserved. All species of conservation interest can be conserved within the appropriate habitat and none need additional measures – the threats to them mostly result from habitat clearance and modification.

2. The uncertainty regarding the actual location of the TFCA Core Zone–Buffer Zone boundary needs to be sorted out on the ground, as well as what activities, such as community-based ecotourism, might be permissible in these areas. At present some people are living inside the Core Zone and are continuing to clear forest.

3. Monitoring of fire extent and field clearance needs to be initiated, particularly within the proposed conservation areas and close to the Core Zone. Part of this could be an education programme pointing out the detrimental effects of and economic losses resulting from frequent burning.

4. The invasiveness of the weed *Vernonanthura* is a major concern; further investigation is required into both the impact it is having on native vegetation and any possible methods for control. A careful eye needs to be kept on this species.

5. The economic potential and markets for those species identified as being of possible economic interest should be investigated further. This includes the plumed seeds of the understorey tree *Funtumia africana* used for specialist papers, particularly common in Mpunga; the edible fruits of the miombo woodland tree *Uapaca kirkiana*; the extensive stands of *Cyperus papyrus* in swamps in Zomba that could be used for mats; and timber from trees such as *Khaya anthotheca* that can be used to make small folding chairs. In addition, the species distribution and quantification of production levels across each community needs to be carried out.

6. Ecotourism options are limited due to access, with the obvious exception of forest areas in Mpunga inhabited by elephant and within walking distance of Ndzou Lodge close to the main road. Additional areas that could be looked at for ecotourism potential are:

   a) A spectacular waterfall coming off the Chimanimani massif at 19°41'48"S, 33°08'52"E, (1200 m, not visited) in Mahate, near a gap in the mountains. The section of the Chimanimani Mountains to the north is considered sacred, and visitors are not welcome, although it looks very suited to trekking from a fairly accessible road.

   b) In Mpunga the mix of swamp grassland, forest margin and forest itself is not only species-rich but also attractive to wildlife. Of particular scenic interest are the swamp grasslands of the Rio Tave. It would be useful to have tourist all-season crossing points here.

   c) In Zomba the forests of the upper Chimanimani foothills at Thekeza are better-developed, more diverse and botanically interesting than those of Mpunga. However, there are no elephant and less wildlife interest. The biggest limitation is the 15 km walk mostly through settlements and fields to get there.

   d) The *Pandanus* fringing swamp areas in Zomba, sometimes associated with fairly intact forest patches, although the 10–12 km walk rather reduces its tourism potential. Similar

Pandanus stands can be found along some of the larger rivers in the north of Mahate. These swamps and wetlands may have some particular scarce or range-restricted bird species in them which would be of particular interest to birders.

e) The Makurupini waterfalls and associated forests in the far south of Maronga are an attraction, but are far more easily accessed from Zimbabwe. The walk from the nearest road head in Mozambique is over 25 km. This, and forests in Maronga to the north, could form part of a multi-day Chimanimani camping trail, going north into Zomba.

7. Future biodiversity investigations should focus on establishing the distribution, population status and any specific threats to the more important species of conservation interest, e.g. *Maranthes goetzeniana*, *Vepris drummondii*, *Ficus muelleriana*, *Streptocarpus acicularis*, *Pandanus livingstonianus*. The present study was not able to adequately quantify species occurrence and population sizes.

8. Given the importance of international ornithologists/birders to ecotourism, a detailed bird survey of the whole Chimanimani foothills area would be very useful. Checklists could be made, and community members trained in bird identification.

9. ACKNOWLEDGEMENTS

Firstly we would like to thank members of the communities of Mahate, Mpunga, Zomba and Maronga for their support and cooperation during the fieldwork, especially the Chiefs, Headmen, guides and porters. Particular thanks go to Simon Chimelela (Mahate) who provided very useful background information on the area. At the Micaia Foundation, great support and assistance was provided by Milagre Nuvunga, Andrew Kingman and Alberto Albazino.

At Kew Kate Gold was the initial Project Leader, followed by Tiziana Ulian assisted by Alex Hudson. Our thanks for their organisational efforts and support. We also wish to thank other participants in the trip who helped in data gathering including Livhu Nkuna from South Africa and Thomas Timberlake from UK. A number of people in the Kew Herbarium were involved in plant identification; in addition to some of the report authors these were Gill Challen, Phil Cribb, Nina Davies, George Gosline, David Goyder, Aurelie Grall, Isabel Larridon, Mike Lock, Jo Osborne, Sylvia Phillips, Brian Schrire and Martin Xanthos. Others who helped with identifications were Bart Wursten from the Meise Herbarium and Ines Chelene, Eva Vaz and A. Zombamele from IIAM Maputo. Thanks also to Tim Wilkinson of Kew's GIS Unit who prepared all the maps.

10. REFERENCES & BIBLIOGRAPHY

Anon. (n.d.). Chimanimani Transfrontier Conservation Area. SADC/ German Cooperation/ giz. 2 pp brochure. https://www.giz.de/en/downloads/giz2015-en-tfca-chimanimani.pdf, accessed March 2016.

Bell, R.H.V. (1999). Management Plan. Volume 1, Recommendations for the Future. Report prepared for Transfrontier Conservation Area Project by the National Directorate of Forests and Wildlife with support from the GEF, Maputo, Mozambique.

Broadley, D.G. (1974). The Lusitu Forest – a new protected area. *Wild Rhodesia* **3**: 17.

Cronk, Q.C.B. & Fuller, J.L. (2001). *Plant Invaders: The Threat to Natural Ecosystems*. People & Plants Series. Earthscan, Oxford.

Dondeyne, S., Ndunguru, E., Rafael, P. & Bannerman, J. (2009). Artisanal mining in central Mozambique: Policy and environmental issues of concern. *Resources Policy* **34**: 45–50.

Dutton, T.P. & Dutton, E.A.R. (1975). Reconhecimento preliminar das montanhas de Chimanimani e zonas adjacentes com vista à criação duma área de conservação. *Anais do Serviços do Veterinária de Moçambique* **20/21**: 123–203.

Ghiurghi, A., Dondeyne, S. & Bannerman, J.H. (2010a). Chimanimani National Reserve. Management Plan, volume 1. Report prepared by AgriConsulting for the Ministry of Tourism, Maputo, Mozambique.

Ghiurghi, A., Dondeyne, S. & Bannerman, J.H. (2010b). Appendix 6, List of rare and endangered plants of Chimanimani Conservation Area. In: Chimanimani National Reserve. Management Plan, volume 3. Report prepared by AgriConsulting for the Ministry of Tourism, Maputo, Mozambique.

Gomes e Sousa, A. (1967). *Dendrologia de Moçambique: Estudo Geral*. 2 vols. Série Memórias No. 1. Instituto de Investigação Agronómica de Moçambique, Maputo.

Gomes e Sousa, A. (1968). Reservas florestais de Moçambique. Comunicações 10. Instituto de Investigação Agronómica de Moçambique, Maputo.

Guedes, B. (2004). Caracterização silvicultural e comparação das reserves florestais de Maronga, Moribane e Zomba, Província de Manica. Unpublished thesis, Licenciatura em Engenharia Florestal. Faculty of Forestry, Universidade Eduardo Mondlane, Maputo. 51 pp.

Hadj-Hammou, J. (2014). Field guide to the endemic plants of the Chimanimani area. Unpublished manuscript. RBG Kew, London.

Hall, J.B. & Swaine, M.D. (1981). *Distribution and Ecology of Vascular Plants in a Tropical Rainforest: Forest vegetation in Ghana*. W. Junk, The Hague, Netherlands.

Henderson, L. (2001). *Alien Weeds and Invasive Plants*. Plant Protection Research Institute Handbook No. 12. Agricultural Research Council, Pretoria, South Africa.

Hughes, D.M. (2001). Rezoned for business: How eco-tourism unlocked Black farmland in Eastern Zimbabwe. *Journal of Agrarian Change* **1**: 575–599.

Hughes, D.M. (2007). *From Enslavement to Environmentalism: Politics on a Southern African Frontier*. University of Washington Press, Seattle / Weaver Press, Harare.

Hyde, M.A., Wursten, B.T., Ballings, P., Dondeyne, S. & Coates Palgrave, M. (2015a). Flora of Mozambique: Outing no. 18: Visit by Bart Wursten and Stefaan Dondeyne to Mozambique. http://www.mozambiqueflora.com/speciesdata/outing-display.php?outing_id=18, retrieved 2 September 2015.

Hyde, M.A., Wursten, B.T., Ballings, P., Dondeyne, S. & Coates Palgrave, M. (2015b). Flora of Mozambique: Outing no. 31: Field trip to Zomba and Mount Magorogodo, Chimanimani Transfrontier Conservation Area, 20 Oct 2013-01 Nov 2013. Accessed at: http://www.mozambiqueflora.com/speciesdata/outing-display.php?outing_id=31, retrieved 2 September 2015.

Lock, J.M. (2006). The seasonally dry vegetation of Africa: parallels and comparisons with the Neotropics. In: *Neotropical Savannas and Seasonally Dry Forests: Plant Diversity, Biogeography and Conservation* (edited by R.T. Pennington, G.P. Lewis & J.A. Ratter), pp. 449–467. Taylor & Francis, Florida, USA.

Magness, T.A. [editor] (1973). Vakwashi (the hunters of knowledge): Expedition to the Hode People. Report from the Vakwashi Branch, Rhodesian Schools Exploration Society. Salisbury, Zimbabwe.

Monteiro, J., Dondeyne, S., Wursten, B., Bannerman, J., Melby, H. & Sitoe, A. (2011). Vegetation composition of natural gaps in Moribane forest (Mozambique). *African Journal of Ecology* **49**: 510–514.

Muhate, A. (2004). Estudo da composição e estrutura arbórea ao longo de um gradiente altitudinal na Reserva Florestal de Moribane. Unpublished thesis, Licenciatura em Engenharia Florestal. Faculty of Forestry, Universidade Eduardo Mondlane, Maputo. 43 pp.

Müller, T., Sitoe, A. & Mabunda, R. (2005). Assessment of Forest Reserve Network in Mozambique. Unpublished report, 47 pp. WWF Mozambique, Maputo. Accessed at www.coastalforests.tfcg.org/pubs/RAPPAM_MZQ.pdf

Parker, V. (2001). Mozambique. In: *Important Bird Areas in Africa and Associated Islands* (edited by L.D.C. Fishpool & M.I. Evans), pp. 627–638. Pisces Publications/BirdLife International, Newbury & Cambridge, UK.

Phipps, J.B. & Goodier, R. (1962). A preliminary account of the plant ecology of the Chimanimani mountains. *Journal of Ecology* **50**: 291–319.

Ryan, P.G., Cassidy, R. & Salinger, T. (1984). The Haroni–Lusitu Junction revisited. *Honeyguide* **30**: 90–91.

Schafer, J. & Bell, R. (2002). The State and community-based natural resource management: The case of the Moribane Forest Reserve, Mozambique. *Journal of Southern African Studies* **28**: 401–420.

Sim, T.R. (1909). *Forest Flora and Forest Resources of Portuguese East Africa*. Taylor & Henderson, Aberdeen.

de Sousa, C. (2009). Levantamento de utilização de espécies silvestres pela comunidade de M'punga. Unpublished report for Micaia, IIAM, Maputo. 20 pp.

Timberlake, J.R. (1992). Chimanimani centre of plant diversity. Manuscript. National Herbarium, Harare.

Timberlake, J.R. & Müller, T. (1994). Identifying and describing areas for vegetation conservation in Zimbabwe. *Strelitzia* **1**: 125–139.

Van Wyk, A.E. & Smith, G.F. (2001). Chimanimani–Nyanga Centre. Chapter 10, *Regions of Floristic Endemism in Southern Africa: A review with emphasis on succulents*, pp. 140–145. Umdaus Press, Hatfield, South Africa.

White, F. (1978). The Afromontane region. In: *Biogeography and Ecology of Southern Africa* (edited by M.J.A. Werger), pp. 463–513. W. Junk, The Hague.

ANNEX 1. LIST OF PARTICIPANTS

Trip 1, June-July 2015
Aurelio Banze, Herbarium, IIAM, Maputo.
Martin Cheek, Herbarium, Royal Botanic Gardens, Kew, UK.
Hercília Chipanga, Micaia Foundation, Chimoio.
Armindo Carlos Dapaz, Chimoio.
Valdemar Rodriques Fijamo, Estação Florestal de Sussundenga, IIAM, Sussundenga.
Carlos Joaquim Jeque, Estação Florestal de Sussundenga, IIAM, Sussundenga.
João Massunde, Micaia Foundation, Nzhou Camp, Sussundenga.
Daglasse Muassinar, Micaia Foundation, Chimoio.
Livhuwane Nkuna, Millennium Seed Bank project, SANBI, Pretoria, South Africa.
José Ranguana, Mpunga community, Sussundenga.
José Seda, Mpunga community, Sussundenga.
Jonathan Timberlake (team leader), Royal Botanic Gardens, Kew, UK.
Thomas Timberlake, student, University of Oxford, UK.

Trip 2, November 2015
Aurelio Banze, Herbarium, IIAM, Maputo.
Simon Chimelela, Mahate community, Sussundenga.
Iain Darbyshire, Royal Botanic Gardens, Kew, UK.
Valdemar Rodriques Fijamo, Estação Florestal de Sussundenga, IIAM, Sussundenga.
João Massunde, Micaia Foundation, Nzhou Camp, Sussundenga.
Daglasse Muassinar, Micaia Foundation, Chimoio.
Jonathan Timberlake (team leader), Royal Botanic Gardens, Kew, UK.
Kenneth Vhanda, Chimoio.

ANNEX 2. LIST OF PLANT SPECIES FOUND

This list cover all species collected and identified or with sight records from the Mpunga, Zomba, Mahate and Maronga communities.

Nomenclature follows that in use at RBG Kew; family nomenclature follows APG III.
s/r = sight record; * = species of particular conservation interest (see text).
f = fern; t = tree; s = shrub; li = liana; h = herb; cl = climber; ep = epiphyte

Species	l/f	Mpunga	Zomba	Mahate	Maronga	
PTERIDOPHYTA						
Aspleniaceae						
Asplenium buettneri *Brause*	f		X			
Asplenium inaequilaterale *Willd.*	f	X	X			
Dennstaedtiaceae						
Microlepia speluncae *(L.) T.Moore*	f	X	X			
Pteridium aquilinum *(L.) Kuhn*	f				X	s/r
Dryopteridaceae						
Bolbitis heudelotii *(Fée) Alston*	f		X			
Elaphoglossum macropodium *(Fée) T.Moore*	f		X			
Lycopodiaceae						
Lycopodiella caroliniana *(L.) Pic.Serm.*	f				X	
Lycopodiella cernua *(L.) Pic.Serm.*	f				X	
Lygodiaceae						
Lygodium kerstenii *Kuhn*	f	X	X			
Marratiaceae						
Marattia fraxinea *Sm.*	f		X		X	
Nephrolepidaceae						
Nephrolepis biserrata *(Sw.) Schott.*	f				X	
Osmundaceae						
Osmunda regalis *L.*	f				X	
Polypodiaceae						
Microsorum punctatum *(L.) Copel.*	f	X				
Microsorum scolopendria *(Burm.f.) Copel.*	f		X	X		
Platycerium cf. alcicorne *Desv.*	f	X				s/r
Sinopteridaceae						
Pellaea calomelanos *(Sw.) Link* var. swynnertoniana *(Sim) Schelpe*	f		X		X	
Tectariaceae						
Tectaria gemmifera (Fée) Alston	f		X		X	
Thelypteridaceae						
Christella buchananii *(Schelpe) Roux*	f		X			
Christella gueinziana *(Mett.) Holttum*	f	X			X	
Cyclosorus interruptus *(Willd.) H.Itô*	f	X			X	
GYMNOSPERMS						
Podocarpaceae						
Podocarpus elongatus *(Aiton) Pers.*	s				X	*
DICOTYLEDONS						
Acanthaceae						
Asystasia gangetica *(L.) T.Anderson* subsp. micrantha *(Nees) Ensermu*	h	X				
Barleria spinulosa *Klotzsch* subsp. spinulosa	h	X		X		s/r
Brillantaisia cicatricosa Lindau	h		X		X	s/r

Dicliptera heterostegia *Nees*	h	X			X	s/r
Hypoestes forskaolii *(Vahl) R.Br.* var. forskaolii	h		X			
Justicia betonica *L.*	s	X			X	
Justicia nyassana *Lindau*	h	X				
Justicia scandens *Vahl*	h		X			
Justicia striata *(Klotzsch) Bullock*	h	X	X			
Justicia tenella *(Nees) T.Anderson*	h				X	
Mellera lobulata *S.Moore*	h		X			
Phaulopsis imbricata *(Forssk.) Sweet* subsp. imbricata	h	X			X	
Pseuderanthemum subviscosum *(C.B.Clarke) Stapf*	h	X	X		X	
Sclerochiton coeruleus *(Lindau) S.Moore*	h		X		X	*
Thunbergia alata *Sims*	h	X			X	s/r
Thunbergia usambarica *Lindau*	h	X				
Amaranthaceae						
Achyranthes aspera *L.* var. pubescens *(Moq.) C.C.Towns.*	h	X				
Alternanthera brasiliana *(L.) Kuntze*	h		X			
Celosia trigyna *L.*	h		X		X	
Centemposis gracilenta *(Hiern) Schinz*	h		X			
Cyathula prostrata *(L.) Blume* var. pedicellata *(C.B.Clarke) Cavaco*	h	X			X	s/r
Cyathula prostrata *(L.) Blume* var. prostrata	h	X			X	s/r
Psilotrichum scleranthum *Thwaites*	h	X			X	
Pupalia lappacea *(L.) A.Juss.* var. velutina *(Moq.) Hook.f.*	h		X			
Anacardiaceae						
Anacardium occidentale *L.*	t		X			s/r
Lannea discolor *(Sond.) Engl.*	t			X		s/r
Lannea edulis *(Sond.) Engl.*	s			X		s/r
Lannea schimperi *(A.Rich.) Engl.*	t			X		
Persea americana *Mill.*	t				X	s/r
Rhus chirindensis *Baker f.*	s		X	X	X	
Sclerocarya birrea *(A.Rich.) Hochst.*	t		X			s/r
Trichoscypha lucens *Oliv.*	t		X		X	
Annonaceae						
Annona senegalensis *Pers.*	s	X	X	X	X	
Artabotrys brachypetalus *Benth.*	c		X			
Cleistochlamys kirkii *(Benth.) Oliv.*	s		X			
Monanthotaxis trichocarpa *(Engl. & Diels) Verdc.*	s		X		X	s/r
Uvaria lucida *Benth.* subsp. virens *(N.E.Br.) Verdc.*	s	X	X			
Xylopia aethiopica *(Dunal) A.Rich.*	t		X	X	X	
Xylopia parviflora *(A.Rich.) Benth.*	t	X	X	X		
Aphloiaceae						
Aphloia theiformis *(Vahl) Benn.*	t				X	
Apiaceae						
Centella asiatica *(L.) Urb.*	h				X	s/r
Steganotaenia araliacea *Hochst.*	t		X			
Apocynaceae						
Carissa bispinosa *(L.) Merxm.*	s			X	X	
Cryptolepis oblongifolia *(Meisn.) Schltr.*	cl				X	
Dictyophleba lucida *(K.Schum.) Pierre*	h	X		X	X	
Diplorhynchus condylocarpon *(Müll.Arg.) Pichon*	t	X	X	X	X	
Funtumia africana *(Benth.) Stapf*	t	X	X	X	X	
Holarrhena pubescens *(Buch.-Ham.) G.Don.*	t			X		s/r
Landolphia buchananii *(Hallier f.) Stapf*	l	X	X	X	X	
Margaretta rosea *Oliv.* subsp. whytei *(K.Schum.) Mwanyambo*	h			X		

Marsdenia sylvestris *(Retz.) P.I.Forst.*	h	X				
Mascarenhasia arborescens *A.DC.*	s			X	X	
Mondia whitei *(Hook.f.) Skeels*			X			
Oncinotis tenuiloba *Stapf*	li	X			X	
Pachycarpus chirindensis *(S.Moore) Goyder*	h			X		*
Rauvolfia caffra *Sond.*	t	X	X			s/r
Saba comorensis *(A.DC.) Pichon*	li		X		X	s/r
Strophanthus petersianus *Klotzsch*	li		X			
Tabernaemontana elegans *Stapf*	s	X				
Tabernaemontana stapfiana *Britten*	s	X				
Tabernaemontana ventricosa *A.DC.*	t	X	X		X	
Voacanga africana Stapf	s	X	X			
Voacanga thouarsii *Roem.& Schult.*	t		X		X	
Araliaceae						
Cussonia arborea *A.Rich.*	t			X		s/r
Cussonia spicata *Thunb.*	t			X	X	s/r
Hydrocotyle mannii *Hook.f.*	h	X				
Hydrocotyle sibthorpioides *Lam.*	h				X	
Asteraceae						
Acanthospermum cf. hispidum *DC.*	h				X	s/r
Acmella caulirhiza *Delile*	h	X				
Adenostemma viscosum *J.R.& G.Forst.*	h				X	
Ageratum conyzoides *L.*	h				X	s/r
Ageratum intermediate between houstonianum & conyzoides	h	X				
Ananthura pteropoda *(Oliv.& Hiern) H.Rob.& Skvarla*	h		X			
Anisopappus chinensis *Hook.& Arn.* subsp. buchwaldii *(O.Hoffm.) S.Ortiz, Paiva & Rodr.-Oubiña*	h		X		X	
Aspilia pluriseta *Schweinf.*	h		X	X	X	
Bidens pilosa *L.*	h		X		X	s/r
Crassocephalum rubens *(Jacq.) S.Moore* var. sarcobasis *(DC.) C.Jeffrey & Beentje*	h	X				
Crassocephalum × picridifolium *(DC.) S.Moore*	h				X	
Emilia discifolia *(Oliv.) C.Jeffrey*	h		X			
Gutenbergia westii *(Wild) Wild & G.V.Pope*	h		X		X	*
Helichrysum nudifolium *(L.) Less.* var. nudifolium	h			X	X	
Launaea cornuta *(Oliv.& Hiern) C.Jeffrey*	h		X			
Mikania chenopodiifolia *Willd.*	h	X			X	
Nidorella auriculata *DC.*	h		X			
Vernonanthura phosphorica *(Vell.) H.Rob.*	t/s	X	X	X	X	
Vernonia acuminatissima *S.Moore*	h	X				
Vernonia amygdalina *Delile*	s		X			
Vernonia cinerea *(L.) Less*	h	X				
Vernonia holstii *O.Hoffm.*	h	X				
Vernonia muelleri *Wild* subsp. muelleri	s		X		X	*
Vernonia wollastonii *S.Moore*	h				X	
Balsaminaceae						
Impatiens walleriana *Hook.f.*	h				X	
Impatiens sp.	h				X	s/r
Bignoniaceae						
Markhamia obtusifolia *(Baker) Sprague*	t	X	X	X	X	s/r
Markhamia zanzibarica *(DC.) K.Schum.*	t	X				
Boraginaceae						
Heliotropium sp.	h				X	s/r

Cactaceae						
Rhipsalis baccifera *(J.S.Muell.) Stearn*	ep				X	
Campanulaceae						
Lobelia fervens *Thunb.*	h				X	s/r
Wahlenbergia abyssinica *(A.Rich.) Thulin*	h				X	
Cannabaceae						
Celtis africana *Burm.f.*	t	X	X			
Celtis gomphophylla *Baker*	t	X	X		X	
Trema orientalis *(L.) Blume*	t	X	X	X	X	s/r
Caryophyllaceae						
Drymaria cordata *(L.) Roem.& Schult.*	h	X				
Celastraceae						
Apodostigma pallens *(Oliv.) R.Wilczek*	s		X			
Gymnosporia mossambicensis *(Klotzsch) Loes.*	s	X		X		
Pristimera longipetiolata *(Oliv.) N.Hallé*	cl				X	
Salacia elegans *Oliv.*	s		X			
Salacia leptoclada *Tul.*	li/s	X				
Chrysobalanaceae						
Maranthes goetzeniana *(Engl.) Prance*	t	X	X	X	X	*
Parinari curatellifolia *Benth.*	t	X		X	X	
Clusiaceae						
Garcinia huillensis *Oliv.*	t		X	X		
Garcinia kingaensis *Engl.*	t				X	
Garcinia livingstonei *T.Anderson*	t			X		s/r
Harungana madagascariensis *Poir.*	t/s	X	X	X	X	s/r
Combretaceae						
Combretum molle *G.Don.*	t	X	X	X	X	
Combretum paniculatum *Vent.*	li		X		X	
Combretum zeyheri *Sond.*	t	X				s/r
Pteleopsis myrtifolia *(M.A.Lawson) Engl.& Diels*	t	X	X	X	X	
Connaraceae						
Agelaea pentagyna *(Lam.) Baill.*	li	X	X		X	
Rourea orientalis *Baill.*	s	X			X	
Convolvulaceae						
Astripomoea malvacea *(Klotzsch) A.Meeuse* var. malvacea	h		X			
Ipomoea tenuirostris *Choisy* subsp. tenuirostris	h	X				
Ipomoea wightii *(Wall.) Choisy*	h					
Jacqemontia tamnifolia *(L.) Griseb.*	c		X			
Merremia pterygocaulos *(Choisy) Hallier f.*	h	X				
Crassulaceae						
Kalanchoe sexangularis *N.E.Br.* var. sexangularis	h		X			
Kalanchoe sp. (K. sexangularis *N.E.Br.*?)	h				X	s/r
Raphidiocystis chrysocoma *(Schumach.) C.Jeffrey*	h	X			X	*
Zehneria scabra *(L.f.) Sond.*	cl				X	s/r
Dipterocarpaceae						
Monotes engleri *Gilg*	t			X		
Ebenaceae						
Diospyros mespiliformis *A.DC.*	t		X			
Diospyros natalensis *(Harv.) Brenan* subsp. natalensis	s			X	X	
Euclea natalensis *A.DC.* subsp. acutifolia *F.White*	s			X		
Ericaceae						
Erica cf. hexandra *(S.Moore) E.G.H.Oliv.*	s				X	
Erythroxylaceae						
Erythroxylum emarginatum *Thonn.*	s	X	X	X	X	

Euphorbiaceae						
Euphorbia hirta *L.*					X	s/r
Acalypha ornata *A.Rich.*	s	X	X		X	
Alchornea hirtella *Benth.*	s/t		X		X	
Alchornea laxiflora *(Benth.) Pax & K.Hoffm.*	s	X				
Clutia abyssinica *Jaub.& Spach.*	s	X				
Croton sylvaticus *Hochst.*	t	X	X			
Macaranga capensis *(Baill.) Sim*	t	X	X	X	X	
Manihot glaziovii *Müll.Arg.*	h		X			
Neoboutonia melleri *(Müll.Arg.) Prain*	t	X				
Pseudolachnostylis maprouneifolia *Pax*	t			X	X	s/r
Tragia kirkiana *Müll.Arg.*	h	X				
Gentianaceae						
Anthocleista grandiflora *Gilg*	t	X			X	s/r
Halagoraceae						
Laurembergia repens *(L.) P.J.Bergius* subsp. brachypoda *(Hiern) Oberm.*	h				X	
Hydrostachyaceae						
Hydrostachys polymorpha *Klotzsch*	h			X		
Hypericaceae						
Psorospermum febrifugum *Spach.*	s		X	X	X	
Icacinaceae						
Pyrenacantha kirkii *Baill.*	cl		X			
Rhaphiostylis beninensis *(Planch.) Benth.*	cl		X		X	
Lamiaceae						
Achyrospermum carvalhi *Gürke* var. carvalhi	h	X	X			
Aeollanthus rehmannii *Gürke*	h		X			
Clerodendrum cephalanthum *Oliv.* subsp. swynnertonii *(S.Moore) Verdc.*	li	X				
Haumaniastrum venosum *(Baker) Agnew*	h				X	
Hoslundia opposita *Vahl*	h		X		X	s/r
Leonotis ocymifolia *(Burm.f.) Iwarsson* var. raineriana *(Vis.) Iwarsson*	h	X			X	s/r
Leucas milanjiana *Gürke*	h		X		X	
Mesophaerum suaveolens *(L.) Kuntze*	h		X		X	s/r
Ocimum africanum *Lour.*	h		X		X	s/r
Plectranthus sanguineus *Britten*	h				X	
Plectranthus swynnertonii *S.Moore*	h		X		X	
Pycnostachys urticifolia *Hook.*	h	X	X	X	X	s/r
Rotheca incisa *(Klotzsch) Steane & Mabb.*	s	X				
Rotheca myricoides *(Hochst.) Steane & Mabb.* var. discolor *(Klotzsch) Verdc.*	s				X	
Syncolostemon flabellifolius *(S.Moore) A.J.Paton*	s				X	*
Tetradenia bainesii *(N.E.Br.) Phillipson*	h			X		
Vitex buchananii *Gürke*	s	X				
Vitex doniana *Sweet*	t	X	X	X	X	
Vitex payos *(Lour.) Merr.*	t	X	X	X		s/r
Lauraceae						
Cassytha filiformis *L.*	c		X		X	s/r
Leg.: Caesalpinioideae						
Bauhinia galpinii *N.E.Br.*	s	X	X	X	X	s/r
Brachystegia boehmii *Taub.*	t			X		
Brachystegia spiciformis *Benth.*	t		X	X	X	
Brachystegia tamarindoides *Benth.* subsp. microphylla *(Harms) Chikuni*	t		X	X	X	

Brachystegia utilis *Burtt Davy & Hutch.*	t			X		
Burkea africana *Hook.*	t			X	X	
Chamaecrista mimosoides *(L.) Greene*	h		X		X	
Erythrophleum suaveolens *(Guill.& Perr.) Brenan*	t	X	X	X	X	
Julbernardia globiflora (Benth.) Troupin	t			X		
Piliostigma thonningii *(Schumach.) Milne-Redh.*	t		X			s/r
Senna singueana *Delile*	s			X		s/r
Senna × floribunda *(Cav.) H.S.Irwin & Barneby*	h			X		
Leg.: Mimosoideae						
Acacia nilotica (L.) *Delile* subsp. kraussiana *(Benth.) Brenan*	t			X		
Acacia pentagona *(Schumach.& Thonn.) Hook.f.*	li	X	X		X	s/r
Albizia adianthifolia *(Schumach.) W.Wight*	t	X	X	X	X	
Albizia glaberrima *(Schumach.& Thonn.) Benth.*	t		X			s/r
Albizia versicolor *Oliv.*	t			X		
Dichrostachys cinerea *(L.) Wight & Arn.*	s			X		s/r
Elephantorrhiza goetzei *(Harms) Harms*	s			X		
Entada abyssinica *A.Rich.*	t		X	X	X	
Entada rheedei *Spreng.*	li				X	
Newtonia buchananii *(Baker) G.C.G.Gilb.& Boutique*	t	X	X	X	X	s/r
Leg.: Papilionoideae						
Aeschynomene nodulosa *(Baker) Baker f.* aff. var. glabrescens *J.B.Gillett*	s				X	
Aeschynomene nodulosa (Baker) *Baker f.* var. nodulosa	s		X			
Crotalaria capensis *Jacq.*	h	X				
Crotalaria lachnophora *A.Rich.*	h		X			
Dalbergia boehmii *Taub.*	t			X	X	
Dalbergia melanoxylon *Guill.& Perr.*	s/t		X			s/r
Dalbergia nitidula *Baker*	s	X	X	X		
Desmodium repandum *(Vahl) DC.*	h				X	s/r
Desmodium salicifolium *(Poir.) DC.*	h	X				
Eriosema angolense *Baker f.*	h	X				
Eriosema parviflorum *E.Mey.*	h				X	
Eriosema psoraleoides *(Lam.) G.Don*	h		X	X	X	
Erythrina sp.	t		X			s/r
Indigofera fulgens *Baker*	h		X			
Indigofera fulvopilosa *Brenan*	h	X				
Indigofera hirsuta *L.*	h		X			
Indigofera lyallii *Baker* subsp. nyassica *J.B.Gillett*	s				X	
Macrotyloma axillare *(E.Mey.) Verdc.* var. glabrum *(E.Mey.) Verdc.*	cl		X			
Millettia stuhlmannii *Taub.*	t	X	X	X	X	s/r
Mucuna pruriens *(L.) DC.* subsp. pruriens	cl		X	X	X	s/r
Ormocarpum sp.	s			X		s/r
Pericopsis angolensis *(Baker) Meeuwen*	t	X		X	X	
Philenoptera bussei *(Harms) Schrire*	t			X		
Psophocarpus scandens *(Endl.) Verdc.*	cl		X			
Pterocarpus angolensis *DC.*	t	X	X	X	X	
Pterocarpus rotundifolius *(Sond.) Druce*	t			X		s/r
Tephrosia linearis *(Willd.) Pers.* var. discolor *(E.Mey.) Brummitt*	h				X	
Xeroderris stuhlmannii *(Taub.) Mendonça & E.C.Sousa*	t		X			s/r
Linaceae						
Hugonia orientalis *Engl.*	t		X			

Linderniaceae						
Crepidorhopalon whytei *(Skan) Eb.Fisch.* s.l.	h				X	*
Torenia thouarsii *(Cam.& Schltdl.) Kuntze*	h				X	
Loganiaceae						
Strychnos angolensis *Gilg*	li		X	X	X	
Strychnos lucens *Baker*	li				X	
Strychnos madagascariensis *Poir.*	t		X			
Strychnos spinosa *Lam.*	t			X	X	
Malvaceae						
Dombeya burgessiae *Harv.*	s	X				
Hibiscus diversifolius *Jacq.* subsp. rivularis *(Bremek.& Oberm.) Exell*	h	X				
Hibiscus surattensis *L.*	h	X			X	
Sida cf. acuta *Burm.f.*	h				X	s/r
Triumfetta pilosa *Roth* var. nyasana *Sprague & Hutch.*	h	X				
Triumfetta rhomboidea *Jacq.*	h	X			X	s/r
Urena lobata *L.*	h				X	s/r
Wissadula amplissima *(L.) R.E.Fr.*	h	X				
Melastomataceae						
Dissotis princeps *(Kunth) Triana* var. candolleana *(Cogn.) A.& R.Fern.*	h				X	
Dissotis princeps *(Kunth) Triana* var. princeps	s	X				
Heterotis prostrata *(Thonn.) Benth.*	h				X	
Tristemma mauritianum *J.F.Gmel.*	h				X	
Meliaceae						
Ekebergia capensis *Sparm.*	t	X	X			
Khaya anthotheca *(Welw.) C.DC.*	t	X	X	X	X	s/r
Trichilia emetica *Vahl*	t	X	X			
Melianthaceae						
Bersama abyssinica *Fresen.*	t	X	X	X	X	s/r
Menispermaceae						
Cissampelos mucronata *A.Rich.*	cl		X		X	s/r
Cissampelos torulosa *Harv.*	cl	X			X	
Tinospora caffra *(Miers) Troupin*	cl		X	X		
Moraceae						
Dorstenia psilurus *Welw.* var. psilurus	h		X			
Ficus bubu *Warb.*	t		X		X	s/r
Ficus vallis-choudae *Delile*	t				X	s/r
Ficus capreifolia *Delile*	s		X			
Ficus exasperata *Vahl*	t		X			
Ficus lutea *Vahl*	t	X	X	X	X	
Ficus mucuso *Ficalho*	t		X			*
Ficus muelleriana *C.C.Berg*	s				X	*
Ficus natalensis *Hochst.* subsp. natalensis	s		X		X	
Ficus sur *Forssk.*	t		X	X	X	
Ficus thonningii *Blume*	ep	X				
Milicia excelsa *(Welw.) C.C.Berg*	t	X	X		X	s/r
Morus mesozygia *Stapf*	t	X			X	
Trilepisium madagascariensis *DC.*	t	X	X		X	
Myrsinaceae						
Maesa lanceolata *Forssk.*	s	X				
Myrtaceae						
Eucalyptus sp.	t				X	s/r
Eugenia capensis *(Eckl.& Zeyh.) Harv.* subsp. gracilipes *F.White*	s				X	

Psidium guajava *L.*	t		X			s/r
Syzygium cordatum *C.Krauss*	t	X		X	X	
Syzygium guineense *(Willd.) DC.* subsp. guineense	t				X	
Ochnaceae						
Brackenridgea zanguebarica *Oliv.*	t	X		X	X	
Ochna arborea *DC.* var. oconnorii *(E.Phillips) Du Toit*	s				X	
Ochna macrocalyx *Oliv.*	s			X		
Ochna natalitia *(Meisn.) Walp.*	s		X			
Ochna schweinfurthiana *F.Hoffm.*	t			X		
Sauvagesia erecta *L.*	h				X	
Olacaceae						
Olax dissitiflora *Oliv.*	t			X	X	
Ximenia caffra *Sond.* var. caffra	s	X		X		
Oleaceae						
Schrebera alata *(Hochst.) Welw.*	t	X		X		
Schrebera trichoclada *Welw.*	t	X				
Onagraceae						
Ludwigia abyssinica *A.Rich.*	h				X	
Ludwigia cf. octovalvis *(Jacq.) P.H.Raven*	h				X	s/r
Opiliaceae						
Opilia amentacea *Roxb.*	s			X		
Orobanchaceae						
Buchnera hispida *D.Don*	h				X	
Cycnium adonense *Benth.*				X		
Sopubia ramosa *(Hochst.) Hochst.*	h		X			
Oxalidaceae						
Biophytum helenae *Buscal.& Muschl.*	h				X	
Passifloraceae						
Adenia lobata *(Jacq.) Engl.* subsp. rumicifolia *(Engl.& Harms) Lye*	cl		X			
Basananthe triloba *(Bolus) W.J.de Wilde*	h	X	X			
Phyllanthaceae						
Antidesma membranaceum *Müll.Arg.*	s				X	
Antidesma venosum *Tul.*	s		X	X	X	s/r
Antidesma voegelianum *Müll.Arg.*	t	X				
Bridelia atroviridis *Müll.Arg.*	t	X	X		X	s/r
Bridelia micrantha *(Hochst.) Baill.*	t	X	X	X	X	
Cleistanthus polystachyus *Planch.* subsp. milleri *(Dunkley) Radcl.Sm.*	s/t		X		X	
Cleistanthus schlechteri *(Pax) Hutch.* var. pubescens *(Hutch.) J.Léonard*	s			X		
Hymenocardia acida *Tul.* var. mollis *(Pax) Radcl.-Sm.*	s			X	X	
Hymenocardia ulmoides *Oliv.*	s				X	
Maprounea africana *Müll.Arg.*	t		X		X	
Margaritaria discoidea *(Baill.) G.L.Webster* var. nitida *(Pax) Radcl.-Sm.*	s		X	X		
Phyllanthus myrtaceus *Sond.*	s				X	*
Phyllanthus nummulariifolius *Poir.* var. nummulariifolius	h	X	X		X	
Uapaca kirkiana *Müll.Arg*	t			X	X	s/r
Uapaca lissopyrena *Radcl.-Sm.*	t			X	X	
Uapaca nitida *Müll.Arg.*	t			X	X	s/r
Uapaca sansibarica *Pax*	t		X			
Piperaceae						
Peperomia bangroana *C.DC.*	h				X	
Piper umbellatum *L.*	cl	X			X	s/r

Pittosporaceae						
Pittosporum viridiflorum *Sims*	s			X		
Polygalaceae						
Polygala gazensis *Baker f.*	h			X	X	
Polygala producta *N.E.Br.*	h				X	
Securidaca longepedunculata *Fresen.*	t			X		
Polygonaceae						
Persicaria decipiens *(R.Br.) K.L.Wilson*	h	X			X	s/r
Potomogetonaceae						
Potamogeton octandrus *Poir.*	h		X			
Proteaceae						
Faurea saligna *Harv.*	t		X	X		
Putranjivaceae						
Drypetes arguta *(Müll.Arg.) Hutch.*	s/t		X		X	
Drypetes natalensis *(Harv.) Hutch.* var. natalensis	t				X	
Ranunculaceae						
Clematis viridiflora *Bertol.*	cl		X			
Rhamnaceae						
Helinus integifolius *(Lam.) Kuntze*	h		X			
Lasiodiscus pervillei *Baill.* subsp. pervillei	s				X	
Rosaceae						
Rubus pinnatus *Willd.*	cl	X			X	s/r
Ranunculaceae						
Aidia micrantha *(K.Schum.) F.White*	t	X	X	X	X	
Anthospermum ternatum *Hiern* subsp. randii *(S.Moore) Puff*	h				X	
Breonadia salicina *(Vahl) Hepper & J.R.I.Wood*	t	X		X	X	
Calycosiphonia spathicalyx *(K.Schum.) Robbr.*	s			X	X	
Catunaregum obovata *(Hochst.) A.E.Gonç.*	s			X		s/r
Coffea salvatrix *Swynn.& Phillipson*	s		X			*
Craterispermum schweinfurthii *Hiern*	s/t		X	X	X	
Cremaspora triflora *(Thonn.) K.Schum.* subsp. triflora	s			X		
Crossopteryx febrifuga *(G.Don) Benth.*	t			X		s/r
Diodea sarmentosa *Sw.*	h	X			X	s/r
Empogona kirkii *Hook.f.*	s				X	
Fadogia homblei *De Wild.*	h			X		
Gardenia imperialis *K.Schum.*	t				X	
Geophila repens *(L.) I.M.Johnston*	h	X			X	s/r
Ixora narcissodora *K.Schum.*	s		X			
Keetia venosa *(Oliv.) Bridson*	t	X	X		X	
Leptactina platyphylla (Hiern) Wernham	t	X				
Mussaenda arcuata *Poir.*	cl		X		X	
Oldenlandia affinis *(Roem.& Schult.) DC.* subsp. fugax *(Vatke) Verdc.*	h	X			X	s/r
Oldenlandia angolensis *K.Schum.*	h				X	
Oldenlandia goreensis *(DC.) Summerh.*	h				X	
Otiophora lanceolata *Verdc.*	h		X		X	*
Otomeria elatior *(DC.) Verdc.*	h				X	
Oxyanthus pyriformis *(Hochst.) Skeels*	s	X				
Oxyanthus speciosus *DC.*	s		X	X	X	
Paederia bojeriana *(A.Rich.) Drake* subsp. foetens *(Hiern) Verdc.*	h		X			
Pentas purpurea *Oliv.*	h		X		X	
Pentodon pentandrus *(Schumach.& Thonn.) Vatke* var. minor *Bremek.*	h				X	

Polysphaeria lanceolata *Hiern*	h		X	X		
Psychotria capensis (Eckl.) Vatke subsp. capensis	s	X			X	
Psychotria mahonii *C.H.Wright*	s	X				
Psychotria peduncularis *(Salisb.) Steyerm.* var. nyassana (K.Krause) Verdc.	s	X	X	X	X	
Psychotria pumila *Hiern* var. buzica *(S.Moore) E.M.A.Petit*	h				X	
Psydrax kraussioides *(Hiern) Bridson*	cl		X		X	
Psydrax parviflora *(Afzel.) Bridson* subsp. chapmanii *Bridson*	t	X				
Rothmannia manganjae *(Hiern) Keay*	s	X	X	X		
Rutidea fuscescens *Hiern*	s				X	
Rytigynia sp.	s		X			
Sericanthe sp. B (Chimanimani taxon)	s		X			*
Tarenna pavettoides *(Harv.) Sim* subsp. affinis *(K.Schum.) Bridson*	s/t	X	X		X	
Tricalysia coriacea *(Benth.) Hiern* subsp. angustifolia *(J.G.Garcia) Robbr.*	s		X	X	X	
Tricalysia delagoensis *Schinz*	s		X		X	
Tricalysia jasminiflora *(Klotzsch) Hiern* var. jasminiflora	s		X			
Tricalysia pallens *Hiern*	s	X			X	
Vangueria infausta *Burch.*	t		X		X	
Rutaceae						
Citrus limon (L.) *Burm.f.*	t		X		X	
Harrisonia abyssinica *Oliv.*	s	X				
Vepris drummondii *Mendonça*	s				X	*
Vepris nobilis *(Delile) Mziray*	s			X		
Zanthoxylum leprieurii *Guill.& Perr.*	t		X			
Salicaceae						
Dovyalis macrocalyx *(Oliv.) Warb.*	s	X				
Flacourtia indica *(Burm.f.) Merr.*	s			X	X	
Rawsonia lucida *Harv.& Sond.*	s/t	X	X		X	
Sapindaceae						
Allophylus chaunostachys *Gilg*	s	X				
Aporrhiza paniculata *Radlk.*	t	X	X		X	
Blighia unijugata *Baker*	t	X	X	X	X	
Glenniea africana *(Radlk.) Leenh.*	t		X			s/r
Paullinia pinnata *L.*	s	X	X		X	s/r
Zanha golungensis *Hiern*	t			X		
Sapotaceae						
Englerophytum magalismontanum *(Sond.) T.D.Penn.*	t		X	X	X	
Mimusops cf. zeyheri *Sond.*	t				X	
Synsepalum brevipes *(Baker) T.D.Penn.*	t	X	X	X	X	
Synsepalum sp. cf. kaessneri *(Engl.) T.D.Penn.*	s		X		X	*
Solanaceae						
Solanum americanum *Mill.*	h		X			
Solanum viarum *Dunal*	h	X				
Stilbaceae						
Nuxia oppositifolia *(Hochst.) Benth.*	s			X	X	
Thymelaeaceae						
Peddiea africana *Harv.*	s			X	X	
Synaptolepis alternifolia *Oliv.*	cl	X		X		
Urticaceae						
Boehmeria macrophylla *Hornem.*	s		X		X	s/r
Myrianthus holstii *Engl.*	t				X	

Thymelaeaceae						
Lantana camara *L.*	s	X	X	X	X	
Lantana trifolia *L.*	s		X			
Lippia javanica (Burm.f.) Spreng.	h		X			
Priva flabelliformis *(Moldenke) R.Fern.*	h				X	s/r
Violaceae						
Rinorea convallarioides *(Baker f.) Eyles* subsp. convallarioides	s				X	
Rinorea ferruginea *Engl.*	s	X	X		X	s/r
Rinorea ilicifolia *(Oliv.) Kuntze* var. ilicifolia	s				X	
Vitaceae						
Ampelocissus obtusata *(Baker) Planch.*	cl			X		
Cissus petiolata *Hook.f.*	cl					
Cissus producta *Afzel.*	cl					
Cyphostemma cf. buchananii *(Planch.) Desc.*	cl		X			
Rhoicissus revoilii *Planch.*	h			X		
Rhoicissus tomentosa *(Lam.) Wild & R.B.Drumm.*	h	X			X	s/r
MONCOTYLEDONS						
Amaryllidaceae						
Crinum sp.	h		X			s/r
Scadoxus multiflorus *(Martyn) Raf.*	h		X	X	X	s/r
Araceae						
Colocasia esculenta *(L.) Schott*	h		X			
Culcasia falcifolia *Engl.*	cl				X	
Gonatopus boivinii *(Decne.) Engl.*	h	X		X		
Stylochaeton natalense *Schott* subsp. natalense	h			X		
Zamioculcas zamiifolia *(Lodd.) Engl.*	h	X		X	X	s/r
Arecaceae						
Borassus aethiopum *Mart.*	t					s/r
Elaeis guineensis *Jacq.*	t		X			s/r
Phoenix reclinata *Jacq.*	t			X	X	s/r
Asparagaceae						
Albuca abyssinica Jacq.	h			X		
Aloe sp. 1	h				X	s/r
Aloe sp. 2	h				X	s/r
Asparagus falcatus *L.*	cl				X	
Asparagus setaceus *(Kunth) Jessop*	h	X				
Chlorophytum blepharophyllum *Baker*	h			X	X	
Chlorophytum comosum *(Thunb.) Jacq.*	h	X				
Dracaena mannii *Baker*	s	X	X	X	X	
Drimia intricata *(Baker) J.C.Manning & Goldblatt*	h			X	X	
Ledebouria revoluta *(L.f.) Jessop*	h			X	X	
Asphodelaceae						
Dianella ensifolia *(L.) DC.*	h		X	X	X	
Burmanniaceae						
Burmannia madagascariensis *Baker*	h				X	
Colchicaceae						
Gloriosa superba *L.*	h				X	s/r
Commelinaceae						
Aneilema nyasense *C.B.Clarke* var. nyasense	h	X				
Commelina africana *L.*	h				X	s/r
Commelina benghalensis *L.*	h				X	s/r
Cyanotis arachnoidea *C.B.Clarke*	h		X		X	
Floscopa glomerata *(Schult.& Schult.f.) Hassk.*	h	X				

Murdannia simplex *(Vahl) Brenan*	h			X	X	
Costaceae						
Costus afer *Ker Gawl.*	h	X	X		X	
Costus macranthus *K.Schum.*	h			X		
Cyperaceae						
Carex spicato-paniculata *C.B.Clarke*	h	X				
Coleochloa setifera *(Ridl.) Gilly*	h		X		X	
Cyperus albostriatus *Schrad.*	h	X	X		X	s/r
Cyperus cf. nitidus *Lam.*	h				X	
Cyperus distans *L.f.*	h	X				
Cyperus papyrus *L.*	h		X			s/r
Cyperus prolifer *Lam.*	h				X	
Cyperus rotundus *L.*	h		X			
Fimbristylis aphylla *Steud.*	h				X	
Fuirena umbellata *Rottb.*	h	X				
Isolepis fluitans *(L.) R.Br.*	h				X	
Miscanthium sp.	h		X			s/r
Rhynchospora rugosa *(Vahl) Gale* subsp. brownii *(Roem. & Schult.) T.Koyama*	h				X	
Schoenoplectus corymbosus *(Roem.& Schult.) J.Raynal*	h				X	
Scleria distans *Poir.*	h				X	
Scleria racemosa *Poir.*	h	X				
Dioscoreaceae						
Dioscorea dumetorum *(Kunth) Pax*	cl	X				
Dioscorea praehensilis *Benth.*	cl	X	X			
Dracaenaceae						
Sansevieria sp.	h				X	s/r
Eriocaulaceae						
Eriocaulon inyangense *Arw.*	h				X	
Mesanthemum africanum *Moldenke*	h				X	*
Flagellariaceae						
Flagellaria guineensis *Schumach.*	cl		X			
Hypoxidaceae						
Hypoxis angustifolia *Lam.*	h				X	
Hypoxis nyasica *Baker*	h				X	
Iridaceae						
Crocosmia aurea *(Hook.) Planch.* subsp. aurea	h	X				
Dietes iridoides *(L.) Klatt*	h				X	*
Gladiolus atropurpureus *Baker*	h			X		
Orchidaceae						
Bulbophyllum elliotii *Rolfe*	h	X				
Bulbophyllum fuscum *Lindl.* var. melinostachyum *(Schltr.) J.J.Verm.*	h	X				
Bulbophyllum sandersonii *(Hook.f.) Rchb.f.*	ep		X			
Bulbophyllum scaberulum *(Rolfe) Bolus*	ep		X			
Cyrtorchis ringens *(Rchb.f.) Summerh.*	h			X		
Eulophia cucullata *(Sw.) Steud.*	h			X	X	
Eulophia pulchra *(Thouars) Lindl.*	h			X		
Jumellea walleri *(Rolfe) la Croix*	ep	X				
Microcoelia exilis *Lindl.*	h			X		
Polystachya concreta *(Jacq.) Garay & H.R.Sweet*	ep	X	X			
Polystachya modesta *Rchb.f.*	ep		X			
Rangaeris muscicola *(Rchb.f.) Summerh.*	ep		X			
Satyrium trinerve *Lindl.*	h				X	
Solenangis aphylla *(Thouars) Summerh.*	h			X		

Tridactyle bicaudata *(Lindl.) Schltr.*	ep		X			
Tridactyle tridactylites *(Rolfe) Schltr.*	ep			X		
Ypsilopus erectus *(P.J.Cribb) P.J.Cribb & J.Stewart*	ep		X			
Pandanaceae						
Pandanus livingstonianus *Rendle*	t		X	X	X	s/r
Poaceae						
Acroceras zizanioides *(Kunth) Dandy*	h				X	
Bothriocline cf. inyangana *N.E.Br.*	h	X				
Brachiaria brizantha *(A.Rich.) Stapf*	h	X				
Danthoniopsis chimanimaniensis *(J.B.Phipps) Clayton*	h			X	X	*
Digitaria sp.	h			X		s/r
Eriochrysis pallida *Munro*	h				X	
Heteropogon melanocarpus *(Elliot) Benth.*	h			X		s/r
Hyparrhenia cymbaria *(L.) Stapf*	h	X				
Hyparrhenia sp.	h			X	X	
Imperata cylindrica *(L.) Raeusch.*	h				X	
Ischaemum sp.	h	X			X	
Leptaspis zeylanica *Steud.*	h		X			
Megastachya mucronata *(Poir.) P.Beauv.*	h	X	X			
Melinis nerviglumis *(Franch.) Zizka*	h		X			
Melinis repens *(Willd.) Zizka*	h				X	
Olyra latifolia *L.*	h	X		X	X	
Oplismenus compositus *(L.) P.Beauv.*	h	X				
Oxytenanthera abyssinica *(A.Rich.) Munro*	s	X	X	X		s/r
Panicum brevifolium *L.*	h	X			X	
Panicum cf. hymeniochilum *Nees*	h	X				
Panicum dregeanum *Nees*	h				X	
Panicum hymeniochilum *Nees*	h	X				
Panicum maximum *Jacq.*	h	X	X			
Phragmites mauritianus Kunth	h		X			s/r
Sacciolepis curvata *(L.) Chase*	h	X				
Setaria megaphylla *(Steud.) T.Durand & Schinz*	h	X		X		
Themeda triandra *Forssk.*	h			X		s/r
Smilaceae						
Smilax anceps *Willd.*	cl	X	X		X	s/r
Xyridaceae						
Xyris angularis *N.E.Br.*	h				X	
Xyris sp. nov?	h				X	*
Zingiberaceae						
Aframomum cf. albiflorum *Lock*	h	X	X	X	X	s/r
Aframomum alboviolaceum *(Ridl.) K.Schum.*	h			X	X	
Siphonochilus aethiopicus *(Schweinf.) B.L.Burtt*	h			X		