BIODIVERSITY AND CONSERVATION OF MCHESE MOUNTAIN, MALAWI

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Mchese Mountain main peak (JT)

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Acknowledgements

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SUMMARY

Mchese Mountain (15°49'S, 35°43'E) is a northern outlier of the Mt Mulanje massif in south-eastern Malawi, separated from the main massif by the lowland Fort Lister Gap. Unlike Mt Mulanje, it does not have an upland plateau and is heavily dissected with deep, almost inaccessible gorges, separated by narrow precipitous spurs. The main peak (15°49'05.8"S, 35°42'16.0"E) is at 2289 m, with the Mozambique border lying 12 km to the west. Most of the drainage is northward into Lake Chilwa. Mt Mchese lies within the Mulanje Forest Reserve and is managed by the Forest Department of the Government of Malawi and protected under forest legislation. Although adjacent to the well-studied Mt Mulanje, Mchese has rarely been visited by biologists and not much is known on its biodiversity or on its conservation values.

This report gives a detailed account of Mt Mchese, primarily on its vegetation and botany but also its physical features and history, based on the findings from an international scientific expedition in 2008 carried out under a UK Government Darwin Initiative grant. The detailed results from the establishment of a long disturbance transect are also presented, along with various recommendations concerning conservation and future work.

Within the Forest Reserve the Mchese area covers around 75 km^2, with about 5300 hectares of this above 1000 m. From satellite imagery, aerial photos and limited fieldwork, the extent of montane forest is estimated at around 1000 hectares, higher than had previously been believed. The great majority of this moist forest is on steep slopes on the east-facing and northern slopes, and is almost undisturbed, except locally by fire. This finding is of considerable conservation interest. There is no upland grassland owing to topography; the other major habitat is bare rock and rock slopes.

One of the most characteristic features of Mchese, apart from its deep, steep-sided gullies, is the 4000 hectares of miombo woodland on all the surrounding slopes, mainly comprising *Brachystegia manga*, *Brachystegia utilis*, *Julbernardia globiflora*, *Uapaca kirkiana* and *Uapaca nitida*, with *Brachystegia spiciformis* on ridges at slightly higher altitudes. The scattered trees of *Pericopsis angolensis* are apparently favoured for cutting for timber. Where there has been extensive disturbance, bamboo (*Oxytenanthera abyssinica*) thickets are found. However, the miombo woodland is still being encroached upon for timber, firewood and for charcoal. Both firewood and sawn timber are seen coming out of the Forest Reserve on a daily basis, most of which is unlikely to be under permit.

Of the 480 plant taxa recorded from Mchese above 700 m altitude (252 of them by this expedition), 156 had not previously been recorded from there and 31 were new records for the whole Mulanje massif. The habitat supporting most of the endemic plant species on Mt Mulanje is upland grassland, a habitat not really present on Mchese. Only 11 of the known Mulanje endemics/near-endemics have been found on Mt Mchese. *Buxus nyasica*, known from only two sites, one of which is a gorge on Mchese, was not rediscovered. Given that only some of the habitats present on Mt Mulanje are found on Mt Mchese, the flora and vegetation is rather similar.

No zoological studies were carried out by the expedition, or indeed previously. The bird fauna is believed to be similar to that found in the same habitats on Mt Mulanje. Both Mulanje and Mchese are considered to be an Important Bird Area.

The globally threatened tree *Widdringtonia whytei* (Mulanje Cedar), considered Endangered by IUCN in 2009, occurs on spurs and forest margins, although rarely in moist forest itself. It has been very heavily logged such that there are possibly no adult seed-bearing trees left. This sub-population of Mulanje Cedar, a species confined to the Mulanje massif, is now practically extinct. Although the legislation for its protection is in place, this is not being implemented adequately.

To assist in the management of Mt Mchese by the Forest Department and the Mulanje Mountain Conservation Trust, a 1 km-long transect was placed running upslope through miombo woodland on the southern side. Recording and monitoring of the transect should give some indication of the level of disturbance as well as the tree species and size classes exploited. Mean tree density was 912 trees/ha, with more stems closer to the Reserve boundary possibly owing both to coppicing and naturally denser vegetation. The most frequent species out of the 25 recorded were *Uapaca kirkiana*, *Brachystegia manga*, *Brachystegia utilis* and *Pterocarpus angolensis*, with the same four species comprising over 85% of the total basal area, equivalent to 18.03 m^2/ha. *Brachystegia manga* was found to be an important component in the lower third of the transect, but was replaced by *Brachystegia utilis* in the upper two-thirds. The majority of stems over 4 cm diameter recorded were in the 4–10 cm size class, with less than 5% over 30 cm diameter (the size of medium to large trees), and most of the basal area (53%) was in the 10–20 cm size class.

Basal area recorded as having been cut was equivalent to 3.94 m^2/ha, just over 22% of total basal area. The largest volume was of *Brachystegia manga* (45% of total cut) and *Uapaca kirkiana*

(29%); the equally common *Brachystegia utilis* was surprisingly cut very little. Over 70% of cut basal area was recorded from the lowest part of the transect, most of this was from 4 to 20 cm in size.

Ten recommendations for conservation action are given. These focus on: (a) the conservation importance of Mchese's moist montane forests and the threats to them from fire; (b) the importance of the extensive miombo woodlands surrounding the mountain in terms of erosion and flood control, as well as for biodiversity; (c) the need for strong action to control illegal woodcutting in the Forest Reserve; (d) the need for more detailed disturbance monitoring to ensure timely and appropriate action; and (e) the major threat of extinction to the endemic Mulanje Cedar (*Widdringtonia whytei*) on the mountain owing to extensive illegal exploitation.

1. INTRODUCTION

A scientific expedition to Mchese Mountain, part of the Mt Mulanje complex in southern Malawi, was carried out from 27 May to 10 June 2008. The expedition was funded under a Darwin Initiative grant to the Royal Botanic Gardens, Kew – "Monitoring and Managing Biodiversity Loss on South-East Africa's Montane Ecosystems". It was a collaborative effort between the Royal Botanic Gardens Kew in UK, the Instituto de Investigação Agrária de Moçambique (IIAM), the Mulanje Mountain Conservation Trust (MMCT), the Forest Research Institute of Malawi (FRIM) and BirdLife International, and the expedition comprised 15 botanists and foresters from the first four institutions (Bayliss 2008); there was no specific input from ornithologists or other zoologists. A full list of participants is given in Appendix 1.

The objectives of the expedition and study were:

1. To undertake botanical and vegetation field survey of Mchese Mountain,
2. To train a team of Mozambican and Malawian biologists in botanical and vegetation survey techniques,
3. To assess the extent, status and threats to moist forests on the mountain and to other biodiversity,

This report attempts to document what is known on the biodiversity and physical attributes of Mchese, to present the expedition's results, and to outline the threats to that biodiversity. It also outlines conservation management issues, with particular reference to moist forest above 1400 m altitude, and gives some conservation recommendations.

This was the fourth expedition under the Darwin project. It differed from the others in that it took place in Malawi on Mt Mchese, adjacent to and forming part of the Mt Mulanje massif, rather than in Mozambique. The emphasis of this expedition was principally on monitoring and helping MMCT gather information suitable for management of the mountain, rather than on broad biodiversity survey as was undertaken by previous expeditions under the Darwin project (Bayliss 2008). MMCT has been requested to look at possibly helping the Malawi Forest Department manage Mchese Mountain as well as Mulanje.

Mchese has also attracted recent attention owing to the high levels of unauthorized exploitation of the remaining individuals of Mulanje Cedar (*Widdringtonia whytei*), Malawi's National Tree, on its upper slopes, and to the expanded cutting of miombo woodland inside the Forest Reserve that forms an 'apron' around the mountain. The miombo timber is cut for construction wood, charcoal and wood for firing bricks, and this has resulted in potential damage to montane biodiversity, as well as increasing the risk of flash floods and disasters such as that in 1991 (see Section 3.3).

2. STUDY AREA

2.1 Location

Mt Mchese in south-eastern Malawi is an outlier of the Mt Mulanje massif, and is often regarded as part of that mountain. About 7500 ha in size, it is included within the Mulanje Forest Reserve. Unlike Mt Mulanje, which is a massif with a plateau at 1800–2000 m with rocky peaks rising out of it, Mt Mchese (centred on 15°45'S, 35°43'E) is heavily dissected with deep, almost inaccessible gorges separated by narrow precipitous spurs (Chapman & White 1970) and without any plateau or upland level ground. The main peak, at 2289 m (15°49'05.8"E, 35°42'16.0"E, Figs. 1, 2), is not as high as peaks on the Mulanje massif (e.g. Sapitwa at 3002 m) or on the Nyika plateau in northern Malawi (e.g. Nganda at 2606 m), but is higher than other montane areas in Malawi. The second highest peak on Mchese is at 2162 m. Another rocky hill, Machmeba (1298 m), lies 8 km north-west of Mchese (Fig. 4, 5). The Fort Lister Gap, which separates Mchese from the Mulanje massif immediately to the south, lies at between 1107 to 1053 m, while the Fort Lister Forestry office (which is actually on the slopes of Mt Mulanje) is at 1052 m (Figs. 4, 5).

Figure 1 (left). Mchese peak and Nthambi gorge from the air in 1988 (from White *et al.* 2001).

Figure 2 (below). Mt Mchese, looking across the Fort Lister Gap from Mt Mulanje (from White *et al.* 2001).

The Mozambique border lies less than 12 km west of Mchese at the Fort Lister gap, while the nearest major town is Blantyre–Limbe, some 70 km to the west. Lake Chilwa, into which all Mchese's rivers drain, lies 40 km to the north (Fig. 3). The nearest mountain also studied under the Darwin project is Mt Chiperone, 80 km due south of Mchese.

Road access to Mchese is not particularly good. The main tarred road from Blantyre goes to Mulanje Boma and the Mozambique border, with a turn-off at Chitakali just before Mulanje going to Phalombe, the main population centre for the Mchese area. A new all-weather road is now being constructed from Chitakali through Phalombe to Zomba. The road from Phalombe, on the western slopes of Mchese, through the Fort Lister Gap to townships such as Chiringa on the eastern side, is in poor condition (Fig. 6). Hence communications and access are not particularly good at present, although should soon improve significantly with the completion of the Zomba road.

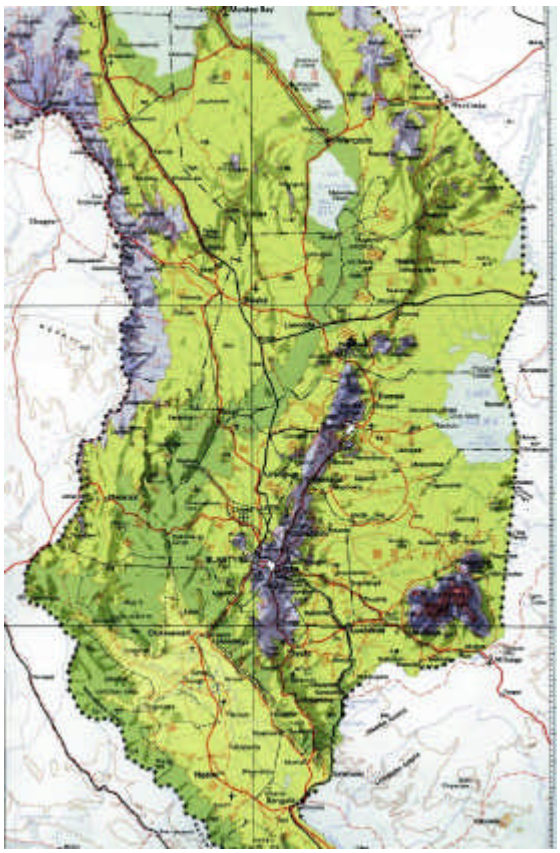
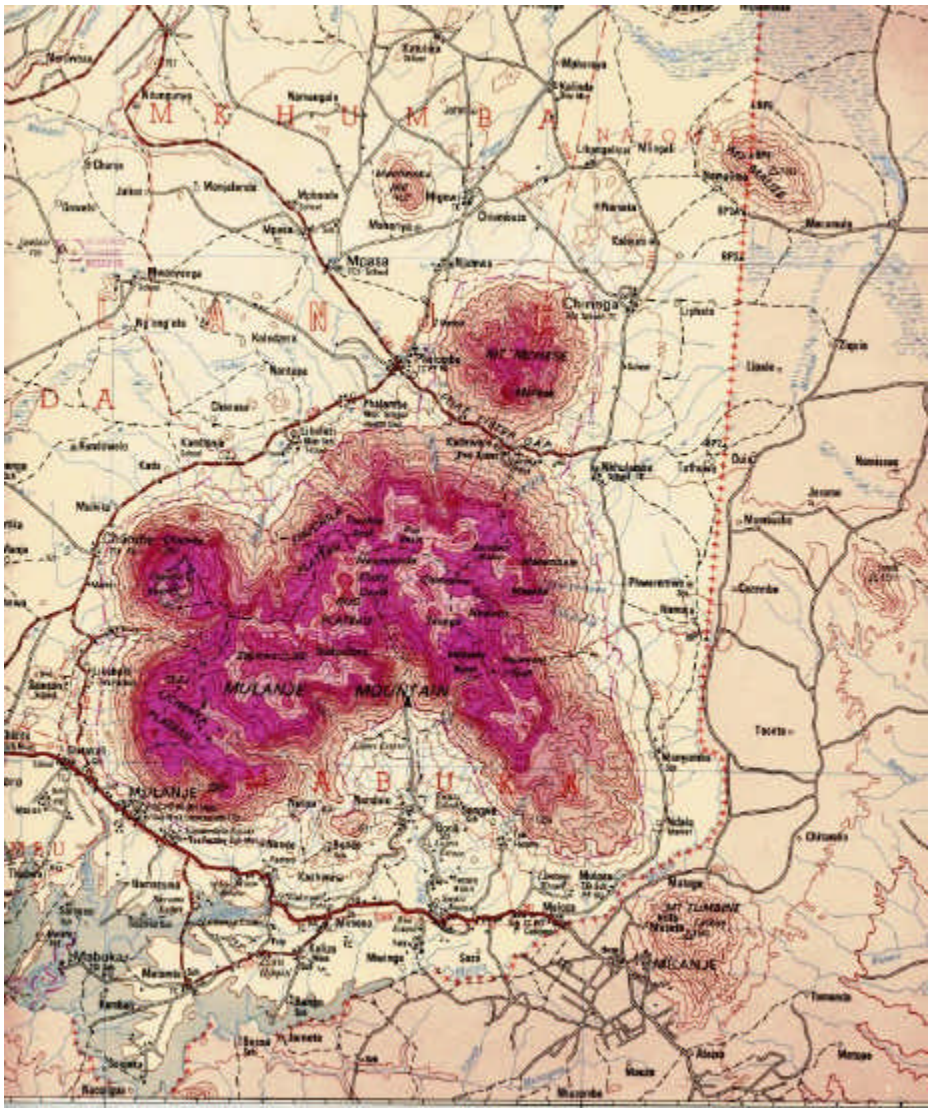


Figure 3 (left). Southern Malawi with Mulanje in bottom right corner (from National Atlas of Malawi 1983).

Figure 4 (below). Mulanje Mountain and surrounding area, showing Mt Mchese to the north-east (from National Atlas of Malawi 1983).



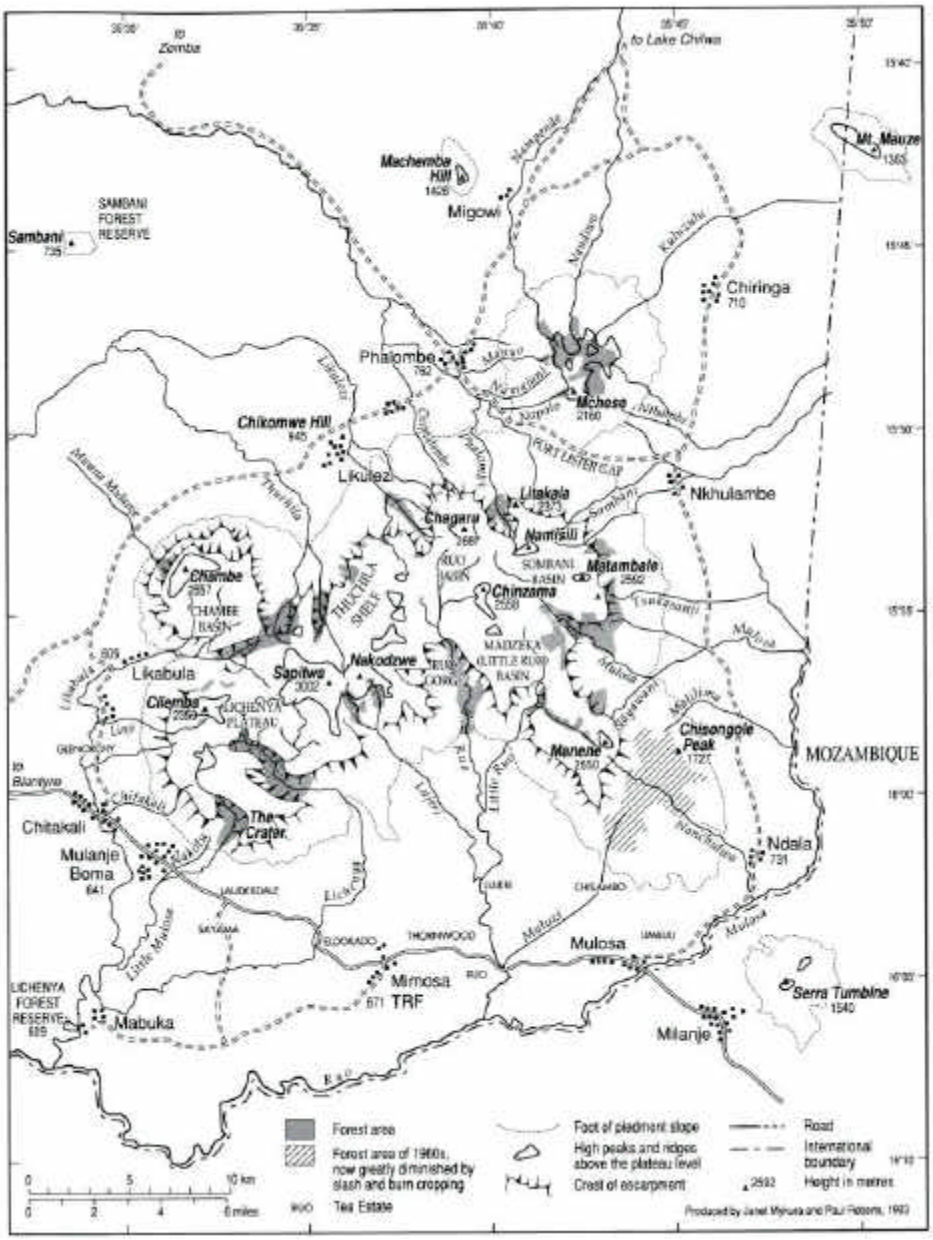


Figure 5. Sketch map of Mulanje and Mchese area, showing main peaks and rivers (from White *et al.* 2001).

The whole area forms part of a gazetted Forest Reserve – the Michese and Milanje Forest Reserve – of which the Mchese part covers around 7500 ha. About 5300 ha of this lies above 1000 m altitude, and 2120 ha above 1400 m, which is generally regarded as the lower limit of montane vegetation. However, encroachment upon the reserve and high levels of unauthorized exploitation of forest reserves, primarily for Mulanje Cedar (*Widdringtonia whytei*) for timber and various miombo trees for construction wood, charcoal or for firing bricks, has increased drastically over the last decade. This has severely impacted upon the integrity of both the Forest Reserve and montane biodiversity.

Access to the montane areas above 1400 m was difficult owing to steepness and the lack of tracks (Figs. 6, 7), but there was comparatively good road access around the mountain and to the miombo woodland areas (Bayliss 2008).

2.2 Geology, Geomorphology and Drainage

The main part of Mchese mountain is composed of quartz–syenite rock, related to granite, the same as that forming the Mulanje massif, while the main peak area is of harder quartz–syenite–porphyry (Dixey 1927, Eastwood 1988, 1:100,000 scale geological map, Fig. 8). There is a narrow band of true granite outcropping on the lower western and southern slopes (Fig. 9), with a wide 'apron' of gneiss forming the footslopes all around the mountain. The latter has numerous small dykes of syenite and dolerite running in it, most with a N–S orientation. The harder syenitic rocks, as on Mulanje, are what have formed the mountain as the less-hard gneiss erodes. The slopes are all very steep and there is much active natural erosion.

Figure 6 (above). Topographic map of Mchese mountain area (1:50,000 scale). Fort Lister Gap area is bottom centre, with Phalombe town on the extreme left.

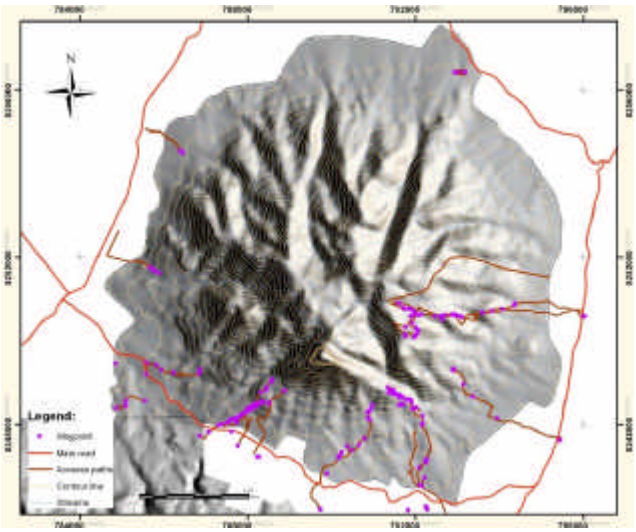


Figure 7 (left). Digital elevation model of Mchese Forest Reserve area with GPS recording points.

According to the Natural Regions and Areas map of Malawi (Min. Agriculture & Natural Resources 1971, drawn by A.R. Stobbs), the Mchese area consists of the same landforms found on Mt Mulanje. The peaks and gorges (unit 46a, S & G) consist of Basement Complex rocks (principally syenite) with lithosols and *Brachystegia* hill and escarpment woodland, and with montane evergreen forest in gully heads. This is surrounded by the Chilwa–Palombe Plain and Mlanje pediment (unit 45e) of colluvial outwash an undulating pedeplain mostly derived from syenite with residual hills. The soils are grey-brown and ferruginous-ferralitic, medium-textured and acidic, supporting *Brachystegia–Julbernardia* woodland. Rainfall on the plains is said to be around 840–1016 mm/year.

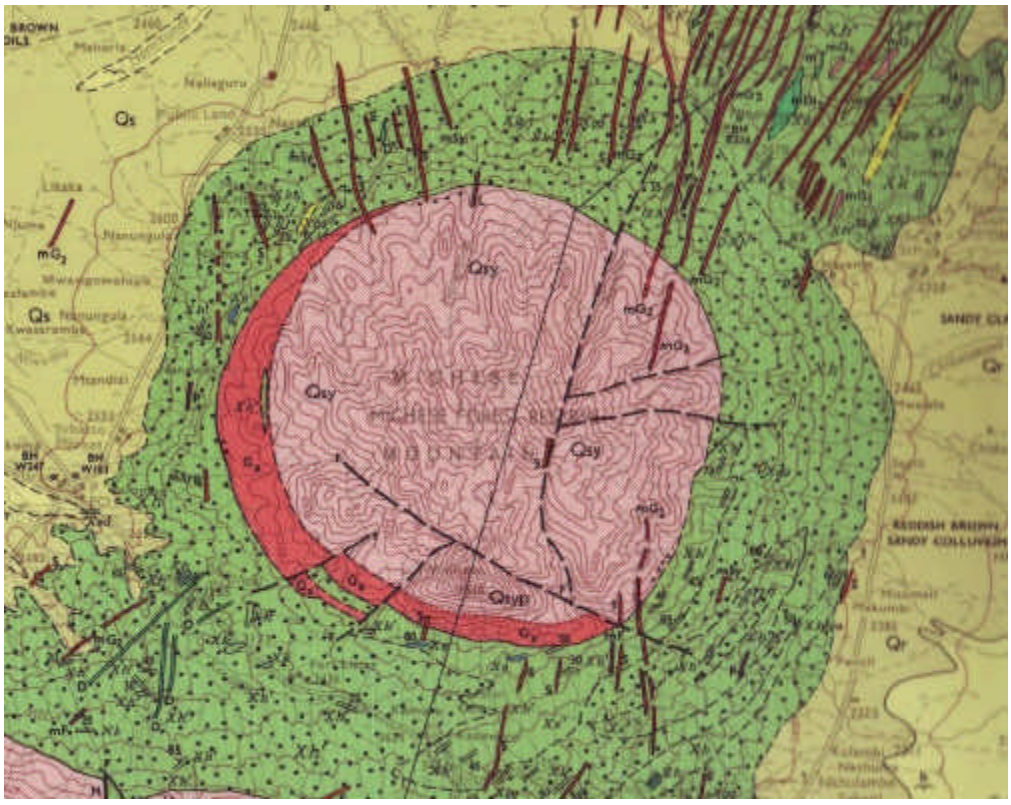


Figure 8. Portion of geology map covering Mt Mchese (1:100,000 sheet). Qsy = quartz-syenite; Qsyp = quartz-syenite-porphyry; Ga = granite; Xh' = gneiss; mSy, S, D = dykes (syenite, dolerite).

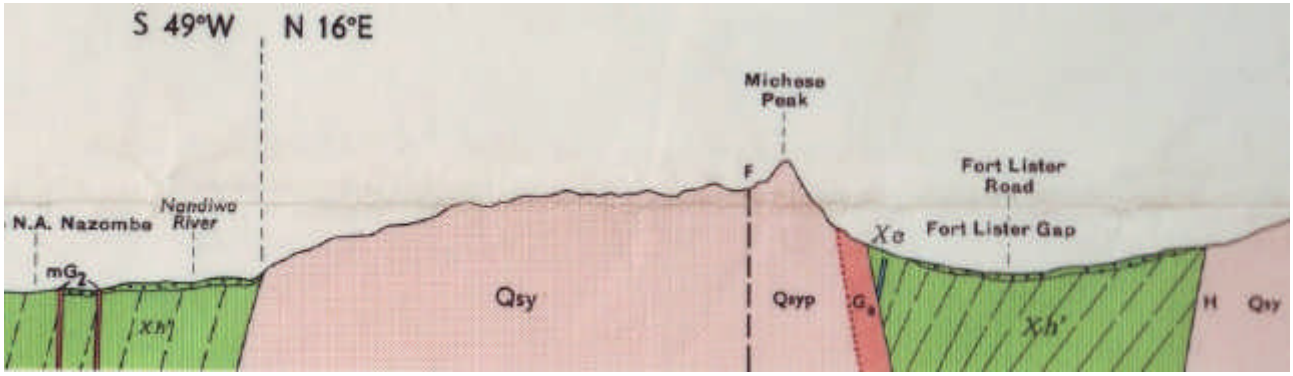


Figure 9. Geological profile across Mt Mchese area (from 1:100,000 geological map).

Most of the rivers draining the slopes of Mchese eventually flow northwards into Lake Chilwa. The Nanthali and Karama rivers flow off to the west to join the Phalombe (Fig. 3), while the Nandiwo and Namphende drain the northern slopes and later join the Sombani. Various smaller rivers drain

the eastern flanks, flowing into Mozambique before re-entering Malawi to join the Sombani before it enters Lake Chilwa. All these rivers are seasonal with only minimal flow during the drier months.

2.3 Climate

Mchese mountain is mostly in the rain shadow of Mulanje, so rainfall would be expected to be significantly lower than on Mulanje's wet southern slopes. However, some of the moist air and rain from the south-east trades reaches Mchese, as can be seen in the development of moist forest on the upper south-eastern slopes above an altitude of 1400 m.

Climatic data for Fort Lister or Phalombe were not available so unpublished rainfall data from Glenorchy Estates, a tea estate on the southern slope of Mt Mulanje, were used, although it is recognized that Fort Lister / Mchese would be significantly drier than this.

Figures for 1991–2006 show a 10-year mean annual rainfall of 1713 mm (ranging from 743 mm in 1992 to 2164 mm in 1999), with mean monthly figures over the same period ranging from 37 mm in June to 361 mm in January. The highest monthly figure over 16 years were 696 mm in March 2006 and 69 mm in January 1993, whilst the lowest were zero in August 2005 and 2 mm in June 1997. The very coarse-scale climate maps in the National Atlas of Malawi (c.1983) suggest an annual rainfall figure of between 1200–1600 mm, a mean minimum temperature (presumably on lower slopes) of 14–16^{o}C and a mean maximum of 26–28^{o}C. However, the legend from the National Regions map (Min. Agriculture & Natural Resources 1971) suggests rainfall on the Phalombe plain of 840–1016 mm/year.

3. HISTORY

3.1 Early History

It was thought that Mt Mulanje was never permanently occupied by early man (Hugh-Jones *et al.* 1957), although recent archaeological evidence in the Thuchila area suggests that settlements were present there during the Middle Stone Age 280,000 to 30,000 years ago, but no dates are available (Menno Welling, pers. comm. 2009). However, owing to the very rugged terrain it is most unlikely that any semi-permanent habitation was ever present on the mid- and upper-slopes of Mchese.

The Nyanga people apparently arrived in the general Mulanje area about 200 years ago (Hugh-Jones *et al.* 1957), but were preceded in the area by other groups such as the Yao. According to Jim Chapman, when he did the first comprehensive boundary survey of the two mountains in 1958, the local Nyanja still referred to the "abatwa" or "little yellow men" (perhaps San Bushmen?) as living or having lived on both Mulanje and Mchese mountains, legendary or real people of which they were rather afraid. "The abatwa were reported to inveigle people into the fastness of Mchese, from which they might not emerge for weeks, never quite the same people they were!" (Chapman, pers. comm. 2009). At that time Mchese forest was regarded as sacrosanct and only intrepid hunters would venture there.

Apparently the first European to see Mt Mulanje was David Livingstone, going up the Shire River in 1859. But the first scientific expedition up Mulanje (but not Mchese) was by Alexander Whyte in 1891, who reached the Lichenya plateau. He collected numerous plant specimens, and some Mulanje species are named after him. By 1893 some timber extraction had already started on Mt Mulanje.

According to Johnston (1897) in his account of the early days of British Central Africa, the British Central Africa Protectorate and the adjacent areas under the British South Africa Company were in the process of being divided into administrative divisions around 1893 as part of the consolidation of British control of this part of Africa. At this time a "troublesome" chief called Matipwiri was mounting raids in the Mulanje area, and it was decided to build a defensive fort – Fort Lister – between Mts Mulanje and Mchese. The idea of a fort at this locality had first been suggested by the then Consul, Mr Hawes, in 1886, and again later by Harry Johnston himself. Finally, Fort Lister, named after Sir Villiers Lister of the British Foreign Office, was constructed in 1893 (Fig. 10), along with Fort Anderson which was situated south of Mt Mulanje.

Construction of the fort, under Captain C.E. Johnson, was apparently welcomed by the local Nyanja people who were being raided by to Yao from the north and east as part of the slave trade, but, unsurprisingly, not by the Yao themselves under Chief Nyaserera. This resulted in an unsuccessful attempt to kill Capt. Johnson, apparently at a temporary house at the fort site. Subsequently there was also rebellion from another Yao chief, Chief Mkanda, who then burnt down a Scotch Mission station in the area before being chased into the "crags and precipices" of Mt Mulanje and defeated. It is interesting to note that at this time nearly all the soldiers used by the British were Sikhs from the Indian Army, brought over from India as an embryonic police force.

Before this period, the Fort Lister Gap was a favoured slave caravan route into Mozambique and the coast beyond, and siting a defensive fort at a vantage point here (presumably the area was then less well wooded than it is now) gave wide view over the Phalombe plains to the west and the plains in what is now Mozambique to the east. Fort Lister in its heyday served as the base for the local District Officer (Stuart-Mogg 2002) and had an armoury, a Post Office and some houses (Fig. 11). Two graves are still to be seen, one belonging to Gilbert Stevenson, cousin of the author Robert

Louis Stevenson, who was based there and shot himself in 1896. Much of the fort today is ruined, but it is still protected as a National Monument.

Although the Fort Lister Gap was obviously a significant route with much activity along it a hundred years ago, it is doubtful if any environmental impact spread further than the valley itself. It is also very likely that the Gap was significantly less wooded than it is now, and was presumably maintained in such a condition.

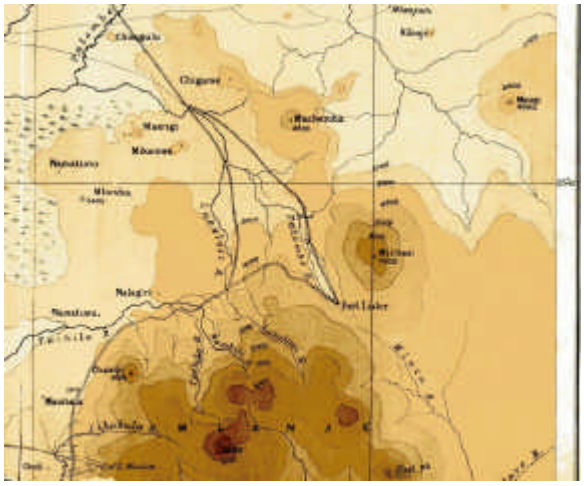


Figure 10. Map of Mchese area around 1897 (from Johnston 1897).

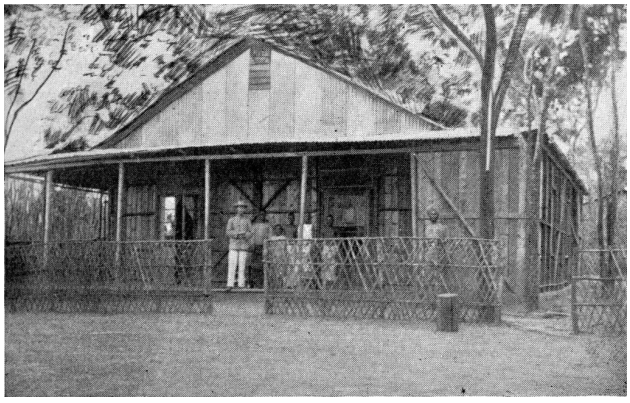


Figure 11. Tax collector's house in Fort Lister in 1890s (from Johnston 1897).

3.2 Forestry Reserve

Recognising the importance of forests on Mt Mulanje and Mt Mchese, both as a source of water for the populations living below as well as for its valuable timber, the colonial government in 1927 gazetted both mountains as a joint Forest Reserve – the Michese and Milanje Forest Reserve. This situation has continued since that time, although for many years Mchese has received far less attention than Mt Mulanje.

The first forest boundary survey was undertaken by Jim Chapman in 1958, and a Forest Department office was established near Fort Lister at the start of the Sombani Path up Mt Mulanje in the 1950s. Although the office still remains, in recent years the Forester-in-Charge has moved to Phalombe. The main role today of the Forest Department regarding Mchese is to stop encroachment into the gazetted Forest Reserve for cutting of miombo woodland for firewood and charcoal, and to stop illegal exploitation of the very few remaining Mulanje Cedars on the upper mountain slopes.

A house for the District Administrator was built in the middle of the Fort Lister Gap on the Mchese side of the road. This is now almost in ruins, and remaining bricks are being taken away for building huts nearby. More recent occupants in the late 1950s included John Killick, then an Agricultural Officer.

3.3 Phalombe Disaster – 1991

In early March 1991, very high rainfall was experienced in the Mchese area, with 414.1 mm recorded over just 4 days at Naminjiwa near Phalombe township on the south-western slopes. This exceptionally high rainfall, coming on top of a good rainy season, caused saturation of the soils and boulders on the slopes of the mountain resulting in a landslip and massive flooding around the mountain at 8.00 on 10 March 1991. Large boulders, broken trees, stones and soil channelled down

narrow river valleys, sweeping all before it (Fig. 12). This became known as the Phalombe disaster after the main population centre affected, in which 500 people were killed, many families made homeless and between 85,000 and 130,000 persons affected, depending on source (UN Assessment Mission, 23 March 1991 (Anon. 1991a) and memo from Regional Commissioner, 25 Sept. 1991 (Anon. 1991b), respectively). An international relief effort was mounted following a UN Mission (Anon. 1991a), and international assistance and reconstruction continued for more than a year after. This consisted not just of food relief, but also covered reconstruction of houses, resettlement and repairs to roads and water supplies. A monument was been erected in Phalombe township commemorating the event (Fig. 13).

Figure 12. Footslope of southern side of Mt Mchese immediately after flood, Phalombe disaster, March 1991 (R. Illingworth).

Figure 13. Phalombe disaster memorial, Phalombe Business Centre (JT).

Such flash floods have probably occurred before – locally they are known as 'napolo'. Jim Chapman saw evidence of ill-sorted boulders in the early 1960s in the Phalombe Gorge that probably came from a similar event. However, the greater density of population and increase in number of settlements around the foot of the mountain over the last 50 years made the 1991 event particularly destructive.

It is also not clear what role the extensive deforestation on the lower slopes of Mchese and cutting of riverine forests would have had in exacerbating the disaster. Certainly the buffering effects of natural vegetation cover have been substantially removed in recent years.

4. VEGETATION

4.1 Vegetation Description

Previous studies have described the vegetation of Mt Mulanje (Chapman 1962, Chapman & White 1970, Chapman 1994, Dowsett-Lemaire *et al.* 2001, Strugnell 2006), but there has been very little reference to the vegetation of Mt Mchese itself. Usually, the descriptions refer to the fact that Mchese is in Mt Mulanje's rainshadow so the vegetation is drier, to the surrounding area of miombo, and to the existence of some moist forest higher up the slopes.

Mt Mchese is a rugged peak, and access to the upper slopes is not easy. The paths up are generally small and very steep. Hence unfortunately only limited time was spent in the portion above 1400 m, which is where the moist forest and montane elements are found. From visual observation there is a reasonable extent of most forest on the upper slopes, particularly on the east-facing slopes and in the northern valleys/ravines, but no real montane grassland. This study has been the first to try and quantify and map the extent of forest.

4.2 Vegetation Survey

No specific ground-based vegetation survey was carried out on Mt Mchese, although vegetation was recorded at various places (see Fig. 14 for localities visited) to obtain an idea of community structure and composition. Using satellite imagery, an unsupervised classification of the vegetation of Mchese was carried out (J. Bayliss, pers. comm; see below), followed by a visual assessment of historic airphotos.

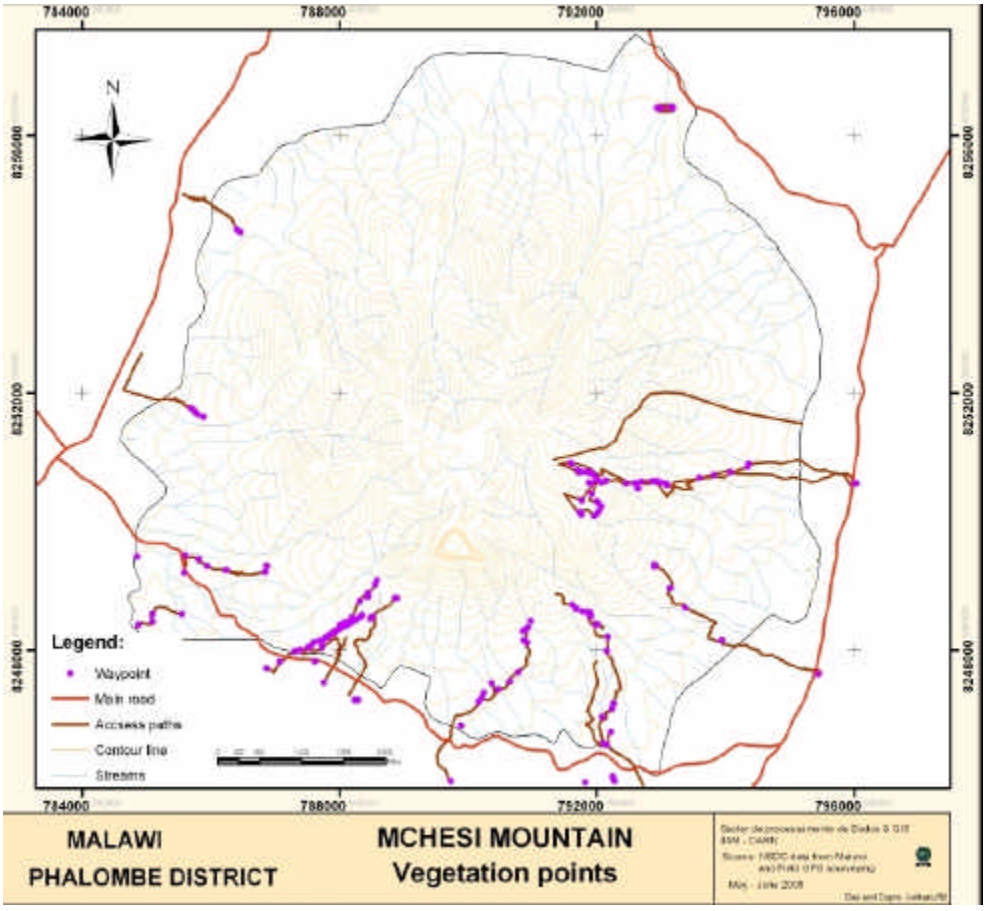


Figure 14. Vegetation and botanical recording points across Mt Mchese.

4.2.1 Digital Classification

Initially, using Erdas Imagine, a draft vegetation map was made based on an unsupervised classification (maximum likelihood algorithm applied to a 6-band stack image) of a Landsat ETM+ image with 30 m resolution from May 2002 (path 167, row 071, Fig. 15). Twelve classes in 8 broad habitat types were recognised, including an additional 'unclassified' class.

Following fieldwork and the recording of 282 ground control points (GPS readings in areas clearly either forest, woodland or cleared), a final vegetation map was developed using the same Landsat image with radiometric and geometric correction (Fig. 16). The following broad habitat types were separated: wet forest, miombo woodland, upland grassland, pine plantation, Mulanje cedar forest, agriculture, rock and shadow. Based on this initial interpretation, it was calculated that approximately 1000 hectares of moist forest is present, largely found above 1500 m.

It is recognised that this may be an overestimate as the difference between moist forest and dense woodland is not clear-cut and shadow effects may be significant. However, this is thought to be the best estimate possible at this stage without more extensive field survey, particularly of the northern slopes and valleys.

Figure 15. Landsat ETM image of Mt Mchese (May 2002). The Fort Lister Gap is clearly seen in the lower left.

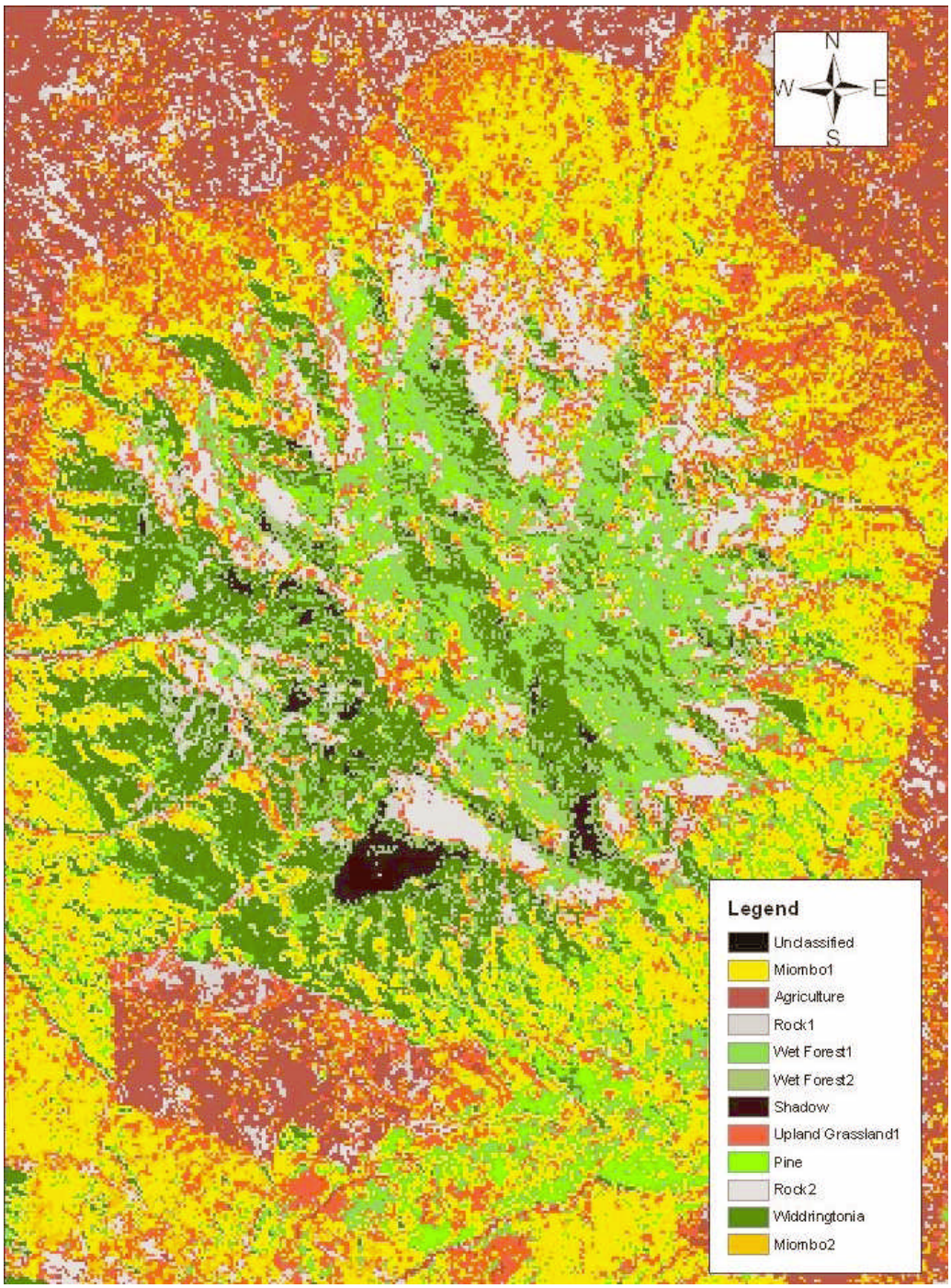


Figure 16. Digital analysis of Mt Mchese vegetation.

4.2.2 Airphoto Analysis

However, the level of resolution with Landsat imagery is poor given both the relatively small size of the study area and also the very uneven and steep topography. Of more value was a set of 1: 25,000 scale aerial photographs dating from August 1995, which were used in the field for orientation and in assisting interpretation of vegetation patterns.

Malawi Block 5, 95/3885 A, Strip 5, 6 Aug 1995, 0063–0066 (N–S)
Malawi Block 5, 95/3885 A, Strip 6, 6 Aug 1995, 0089–0093 (S–N)

From the aerial photographs a number of observations could be made:

1. The main drainage lines appear scoured and bare, possibly related to the Phalombe floods of 1991 or to the generally steep topography and active erosion.

2. The boundaries of the Forest Reserve are very "hard", showing the great pressure on land use in the surrounding area. But this also shows the maintenance of gazetted boundaries in 1995 as far as woodland clearance is concerned (individual trees inside may have been cut).
3. That the vegetation on soils derived from gneiss is denser and better-developed than that on syenite soils. Woody cover on the mid-slopes of Mchese is generally thin.
4. Forest is confined to the higher parts of the mountain, as would be expected, and seems better developed on west-facing sides of gorges and deeply-incised valleys. This may be an artefact of daylight angle at the time the photo was taken.
5. On the upper montane ridges there are linked areas of non-woody vegetation, extending over perhaps 40 ha in total. There does not appear to be any upland grassland on more-level ground.
6. The most heavily forested area appears to be in the steep Nathambi valley north-east of the main Mchese peak.
7. The main Mchese peak and associated ridges (composed of quartz–syenite–porphyry) are essentially bare of woody vegetation.

4.3 Vegetation Types

There are two main vegetation types on the mountain, although other minor ones also occur. The main ones are miombo woodland forming an apron around the mountain, and moist forest on the upper slopes. In addition there are patches of bracken land with smaller shrubs on high ridges, areas of bare rock and *Coleochloa* "grassland" on steep rock faces, and minor patches of other woodland or forest types in gullies or along rivers.

4.3.1 Moist Forest

Moist forest, surprisingly, appears to be best developed on the west-facing slopes and in the steeper valleys of the 'crater' immediately north of the main peak. Significant areas are seen along upper tributaries of the Nandiwo, Nampende and, especially, in the upper Nathambi valley and on the upper east-facing slopes of the massif (Figs. 17, 18). The best estimate of moist forest extent available at present is around 1000 ha, which is significantly larger than was previously thought. This figure makes Mt Mchese of equal significance in terms of montane forest extent to the main Mulanje massif. The remaining medium-altitude Chisongoli forest on the lower south-eastern slopes of Mt Mulanje is estimated at 2000 ha.

The only moist forest area looked at in detail was on the ridges above Misomali village on the eastern flanks (camp at 15°48'20"S, 35°43'33"E, 1670 m). On ridges around 1300 m a stunted forest 4–8 m high of *Englerophytum magalismontanum* and *Strychnos henningsii* with occasional emergents of *Mystroxylon aethiopicum* is found. Around 1700 m and where soils are a bit deeper and moisture more available, *Chrysophyllum gorungosanum* tends to be dominant with emergents of *Mystroxylon aethiopicum* 30–50 m high and a sub-canopy of *Garcinia kingaensis*, *Rawsonia lucida*, *Myrianthus holstii* and *Macaranga capensis* 15–20 m high. Above 1700 m, *C. gorungosanum* disappears and the forest is dominated by *Mystroxylon aethiopicum* to 40 m high with an sub-canopy 8–15 m high of *Drypetes gerrardii*, *Xymalos monospora*, *Rawsonia lucida* and *Myrianthus holstii* with the occasional *Cassipourea malosana*. At the highest elevations of 1900–2000 m, *Rapanea melanophloeos* and *Macaranga capensis* and *Lasianthus kilimanscharicus* are seen.

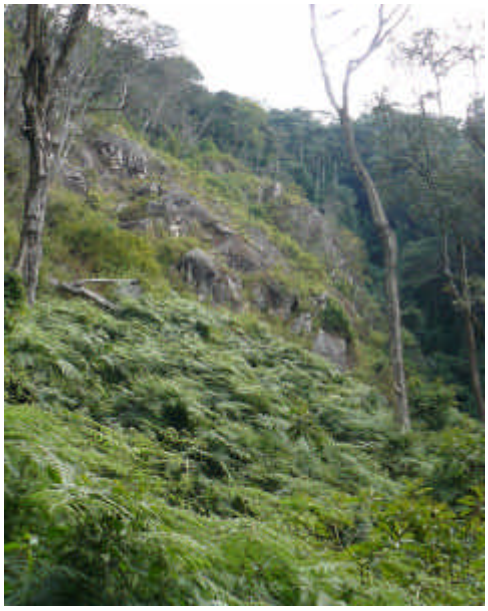
There are a few small open patches (5–10 ha) on and just below the main ridges (Fig. 19) with a 1–2 m high cover of bracken (*Pteridium aquilinum* subsp. *aquilinum*) along with herbs and small shrubs

of Lamiaceae, Amaranthaceae and Asteraceae (in particular the shrubs *Solanecio mannii* and *Vernonia colorata*). These patches appear to be fire-maintained and, owing to high fuel loads and their dry state for much of the dry season, support fierce fires probably set by itinerant hunters. Forest cover can only re-establish with great difficulty and in some cases the open patches seem to be expanding into the surrounding forest areas.

Figure 17. Moist forest on upper eastern slopes, Mt Mchese (JB).

Figure 18. Ridgetop moist forest on eastern slopes, Mt Mchese (JB).

Figure 19. Open grass / bracken patch in moist forest, eastern slopes of Mt Mchese (JT).



4.3.2 *Miombo Woodland*

Miombo woodland is characterised by a dominance of trees of the genera *Brachystegia* and/or *Julbernardia* with a canopy cover of 20–80% and a distinct and more-or-less continuous grass layer. The ecology of such woodlands is distinct from that of either forest or grassland, and often supports a distinctive biodiversity.

There is large expanse of miombo surrounding Mt Mchese from around 700 m at the Fort Lister Gap to over 1200 m, although it is now being seriously encroached upon. Analysis of satellite imagery suggests around 4000 ha of miombo woodland are found within the Mchese portion of the Forest Reserve. Almost all the lower parts of the Forest Reserve, including the "corridor" linking it to Mt Mulanje, comprise miombo woodland dominated by *Brachystegia* species (Figs. 20–22). Most of this, from around 700 to 1200 m, is on brown loamy soils derived from gneissic rock. In the lower areas, from 700–1000 m, the dominant tree is generally *Julbernardia globiflora* with *Uapaca nitida* and *U. kirkiana*, while above this the main species is *Brachystegia manga*, forming a more open woodland of 20–30% canopy cover with *Uapaca kirkiana* and *Pterocarpus angolensis*.

Brachystegia utilis is common above 1200 m on steeper slopes, often dominating, sometimes with *B. boehmii*. On the ridges from 1300–1400 m the dominant tree is *Brachystegia spiciformis* with its spreading canopy, possibly owing to cooler air temperatures and perhaps greater moisture from low clouds. At least on the southern slopes, the commonest trees appear to be *Uapaca kirkiana*, *Brachystegia manga* and *B. utilis*.

The dominant miombo species from 700–1200 m are *Brachystegia manga*, and/or *Julbernardia globiflora*, *Uapaca kirkiana* and *Uapaca nitida*. The latter two species are particularly widespread and common. Common and major associated trees include *Pterocarpus angolensis*, *Pericopsis angolensis*, *Cussonia arborea*, *Erythrina abyssinica* (more common at higher elevations), *Diplorhynchus condylocarpon* (on lower, drier slopes), *Pseudolachnostylis maprouneifolia*, *Dalbergia boehmii*, *Brachystegia boehmii* (local), *Brachystegia utilis* (local), *Lannea discolor*, *Psorospermum febrifugum*, *Combretum molle* (local), *Parinari curatellifolia*. *Bauhinia petersiana* is found in the shrub layer along with *Annona senegalensis*, and there are thickets of bamboo (*Oxytenanthera abyssinica*) along drainage lines and in gullies. *Brachystegia spiciformis* is found as large trees to 20 m along some permanent and semi-permanent watercourses, or more commonly as smaller trees to 6 m high on ridges above 1200–1300 m. The well-developed grass layer comprises *Hyparrhenia cymbaria*, other *Hyparrhenia* spp., *Setaria* sp. and *Themeda triandra*.

Figure 20. Mt Mchese from south showing miombo 'apron' and low woodland on slopes (JT).

Figure 21. Mt Mchese from south east showing gully vegetation, miombo woodland below and agriculture on pediment (JT).

Figure 22. Mt Mchese from south west showing 'apron' of miombo woodland and surrounding agricultural land (JT).

Figure 23. Miombo woodland, burnt and coppiced, southern slopes (JT).

There is plenty of evidence of moderate to high levels of wood utilization in the miombo woodlands up to an altitude of 1200 m (Fig. 23). This involves cutting of trees, in particular *Pericopsis angolensis* and *Cussonia arborea*. presumably for construction poles, but also some in situ cutting of large trunks for planks, effectively pit-sawing. Evidence was widespread, and exploitation in places appears unsustainable, i.e. extraction exceeds growth and regeneration.

Figure 24. Bamboo thicket, lower slopes of Mchese (JT).

4.3.3 Gully Vegetation

The vegetation in the steep-sided gullies and along the small sesaonal rivers is very significant, and also quite different from the surrounding miombo. It includes a number of forest or forest-margin species, as well as those more generally associated with river margins (Fig. 26). In the gullies, such species as *Trema orientalis*, *Bridelia micrantha* and *Solanecio mannii* are common, with *Nuxia oppositifolia* along the stream margins. Riverine gulleys with additional moisture contain large trees of *Brachystegia spiciformis*, *Syzygium cordatum* and, on river banks, *Breonadia salicina*. Forest species such as *Newtonia buchananii* can be locally common in moister sites above 1100–1200 m, the lower limit of forest outliers, along with *Englerophytum natalense* and *Tecomeria capensis*. At lower altitudes the naturalised *Toona ciliata* is not uncommon. Quite frequently, and particularly common on steep slopes leading down to larger drainage lines, extensive thickets of bamboo, *Oxytenanthera abyssinica*, are found, possibly indicating previous disturbance (Fig. 24).

One particular magnificent gulley was seen at 1280 m among large boulders at the base of a boulder slope (15°49'37"S, 35°42'56"E) with a 'forest' of *Phoenix reclinata* palms to 18 m high and an understorey of *Dracaena steudneri* to 16 m (Fig. 25). However the lush microclimate has also led to a large fuel-load, and fires had had a damaging effect. Others species seen here include forest margin trees such as *Ekebergia benguelensis* and *Trema orientalis*, along with *Smilax kraussiana* and *Toddalia asiatica*.

4.3.4 Grassland

No significant extent of grassland was seen on Mt Mchese, or noted on air photos. There were a few grassland patches (see Section 4.2.1), but these were considered to be secondary and not natural, unlike the case on Mt Mulanje which has extensive upland grassland or shrublands on plateaux, which also supports many of its endemic species.

Figure 25 (left). Grove of *Phoenix reclinata* and *Dracaena steudneri*, southern slopes Mt Mchese (JT).

Figure 26 (below). Gully vegetation, mid-slopes of Mt Mchese (JT).

5. BOTANY

5.1 Previous Collecting

Compared to Mt Mulanje there has been very little botanical collecting or recording from Mchese. There are no records from Mchese in the first botanical account of Mulanje (Whyte 1894). Prior to the present survey, almost the only records are from Jim and Betty Chapman. Chapman was Forest Officer in the area at various times and first went to Mchese as part of the forest boundary survey in 1958, when he made some plant collections. However, the main period he and his wife were on Mchese was from May 21–August 7 1988, during which 192 numbers were collected. They explored the Nthambi valley, but failed to get into the Kuluzulu valley or cross over into the Nandiwo valley (J. Chapman, pers. comm. 2009). In addition, there are four collections from David Goyder and Alan Paton in 1992, a few from Dick Brummitt & Elias Banda in 1970 and from M. Iwarsson and Olaf Ryding in June 1970 and June 1978.

5.2 Plant Checklist and Records

During the expedition fertile plant specimens were collected from miombo woodland in the Fort Lister Gap between the Mulanje massif and Mt Mchese, in *Newtonia* forest in the river valleys, from higher rocky ridges and from moist forest above 1400 m. Collecting was greatly restricted by topography as the mountain is particularly steep. In addition, numerous sterile specimens were also collected for vegetation classification purposes, particularly from the forest. Collecting localities are shown in Figure 14.

The total of numbered collections was 255, most having three duplicates. Complete sets are deposited in the National Herbarium in Maputo (LMA), the Malawi National Herbarium in Zomba (MAL) and at Kew, while the fourth (incomplete) set is deposited the Universidade Eduardo Mondlane in Maputo (LMU). The number is less than collected on other project expeditions as the focus of this trip was primarily on monitoring techniques.

Annex 2 lists all 480 taxa recorded from Mt Mchese above 700 m altitude (2 Pteridophytes, 3 gymnosperms, 44 monocots and 431 dicots). All expedition records are included (252 taxa from collections or sight records), along with sight records and citations from White *et al.* (2001) and Strugnell (2006). This total includes 156 taxa not previously recorded from Mt Mchese. More interestingly, 31 taxa were not previously cited in Strugnell's checklist of the broad Mt Mulanje massif (including Mchese) or for Mulanje in the book by White *et al*. These records are shown in Table 1.

Three taxa in this list are also new to Malawi: *Cuscuta cassytoides, Ximenia americana* (possibly) and *Chionanthus foveolatus* subsp. *major* have been recorded from surrounding countries, but not previously from Malawi. Two taxa – *Gnidia chapmanii* and *Widdringtonia whytei* – have a localised distribution and are listed as Endangered according to IUCN (2004) conservation assessment criteria. Evidence of limited regeneration of *Widdringtonia* and lack of local seed sources suggests its conservation assessment will need to be upgraded, at least for the Mchese population.

It was expected that Mt Mchese would be floristically very similar to the main Mulanje peak, with the exception of the extensive grassland habitats. These are essentially absent on Mt Mchese. This expected degree of similarity was confirmed.

Table 1. New plant records for the Mulanje–Mchese massif.

Family	**Species**
Acanthaceae	Dyschoriste trichocalyx *(Oliv.) Lindau*
Aloaceae	Aloe chabaudii *Schönland* var. chabaudii
Anacardiaceae	Trichoscypha lucens *Oliv.*
Annonaceae	Anonna senegalensis *Pers.*
Araliaceae	Cussonia arborea *A.Rich.*
Asteraceae	Helichrysum stenopterum *DC.*
Asteraceae	Vernonia jelfiae *S.Moore* var. jelfiae
Capparaceae	Boscia salicifolia *Oliv.*
Convolvulaceae	Cuscuta cassytoides *Engelm.* – new record for Malawi
Crassulaceae	Crassula swaziensis *Schönl.*
Crassulaceae	Kalanchoe humilis *Britten*
Cyperaceae	Cyperus diffusus *L.* subsp. sylvestris *(Ridl.) Kük.*
Leg.: Caesalpinioideae	Piliostigma thonningii *(Schumach.) Milne-Redh.*
Leg.: Caesalpinioideae	Swartzia madagscariensis *Desv.*
Leg.: Papilionoideae	Crotalaria natalitia *Meisn.*
Leg.: Papilionoideae	Mucuna pruriens *(L.) DC.* var. pruriens
Lamiaceae	Plectranthus autranii *(Briq.) A.J.Paton*
Melastomataceae	Warneckea sansibarica *(Taub.) Jacq.-Felix*
Moraceae	Ficus cyathistipula *Warb.*
Moraceae	Ficus glumosa *Delile*
Moraceae	Ficus stuhlmannii *Warb.*
Olacaceae	Ximenia americana *L.* – possible new record for Malawi
Oleaceae	Chionanthus foveolatus *(E.Mey.) Stearn* subsp. major *(I.Verd.) Stearn* – new record for Malawi
Poaceae	Andropogon chinensis *(Nees) Merr.*
Poaceae	Hyparrhenia rufa *(Nees) Stapf*
Poaceae	Melinis ambigua *Hack.*
Poaceae	Oplismenus compositus *(L.) P.Beauv.*
Poaceae	Pennisteum unisetum *(Nees) Benth.*
Proteaceae	Protea angolensis *Welw.*
Rubiaceae	Pauridiantha paucinervis *(Hiern) Bremek.* subsp. holstii *(K Schum.) Verdc.*
Rubiaceae	Pavetta schumanniana *K.Schum.*

5.3 Plant Endemics

There are 71 plant taxa listed in Strugnell (2002, 2006) as being endemic to Mt Mulanje, representing about 5.3% of the spermatophyte flora recorded by her from the mountain. Only four of these are trees. It is likely that this number will decrease once further botanical exploration is carried out on mountains in adjacent parts of Mozambique, something that the present Darwin project is attempting to do. Already five species previously thought to be endemic to Mulanje have been found on Mt Namuli (Timberlake *et al.* 2009).

The great majority of the Mulanje endemics are taxa restricted to upland grassland on the plateau or peaks, habitats which are hardly present on Mt Mchese. Therefore it is not surprising that only 11 Malawi or Mulanje endemics, or near-endemics known only from Mt Mulanje and Mt Namuli in Mozambique, have been found on Mt Mchese. These are shown in Table 2.

In 1988 Jim Chapman, collecting plants in the Nthambi gorge above Misomali village in Nkhulambe area on the south-east slopes of Mchese, found a specimen of the shrub *Buxus nyasica* (Chapman 8828), the only known occurrence of this Malawi endemic apart from on Soche Mountain in the Shire Highlands. Unfortunately he never got an opportunity to explore the Nandiwo Gorge, across the watershed and running north, which was then well-forested. As far as we are aware, this shrub has not been collected since. During the expedition, extensive searches were made to locate it, even in the Nthambi gorge where it had been recorded previously. However, it was not found, suggesting that the its conservation assessment should be upgraded.

Table 2. Malawi and Mulanje endemics / near-endemics recorded from Mt Mchese.

Family	**Species**	**Lf.**	**Notes**
Acanthaceae	Isoglossa grandiflora *C.B.Clarke*	S	Mulanje endemic
Apocynaceae	Cynanchum viminale *(L.) L.* subsp. mulanjense *(Liede & Meve) Goyder*	c	S & C Malawi, Namuli
Balsamaceae	Impatiens zombensis *Baker f.*	h	only from S Malawi & Mt Tumbine
Buxaceae	Buxus nyasica *Hutch.*	S	S Malawi endemic; rare
Cupressaceae	Widdringtonia whytei *Rendle*	T	Mulanje endemic
Cyperaceae	Tetraria mlanjensis *J.Raynal*	h	Mulanje endemic
Flacourtiaceae	Rawsonia burtt-davyi *(Edlin) F.White*	T	Mulanje endemic
Melastomataceae	Dissotis johnstoniana *Baker f.* var. johnstoniana	S	endemic to Mulanje & Namuli
Moraceae	Ficus modesta *F.White*	T	only in S Malawi
Proteaceae	Faurea racemosa *Farmar*	T	endemic to S Malawi & Namuli
Proteaceae	Protea caffra *Meisn.* subsp. nyasae *(Rendle) Chisumpa & Brummitt*	S	Mulanje endemic
Rubiaceae	Pyrostria chapmanii *Bridson* subsp. chapmanii	T	Mulanje endemic
Thymeleaeaceae	Gnidia chapmanii *B. Peterson*	S	only from Mulanje & Namuli

Figure 27. *Aloe chabaudii* var. *chabaudii* on rock outcrop above miombo woodland (JT).

6. ZOOLOGY

6.1 Introduction

The animals, vertebrates and invertebrates, of Mt Mchese were not studied in any great detail during the expedition as the focus was primarily on the assessment of habitat condition, monitoring and anthropogenic disturbance.

The main Mulanje massif has normally been the area of biological study and, as a result, Mt Mchese has generally been overlooked and has few historical records. As Mchese is only separated from the main Mulanje massif by about 1 km (the Fort Lister Gap), it is believed that any historical records from Mchese may have been incorporated into lists covering the Mt. Mulanje Forest Reserve as a whole.

When asked, most authorities (e.g. Francoise Dowsett-Lemaire for birds, pers. comm. 2008) say they assume that the species present would be a subset of those found on Mt. Mulanje, recognising that some specialised habitats are not found on Mchese and others are of much smaller extent (e.g. upland grassland). It is not thought there are species present on Mt Mchese that are not present on Mulanje.

Mt Mulanje is an Important Bird Area (Dowsett-Lemaire, Dowsett & Dyer (2001) and a discussion of the birds on Mt Mulanje is given in Dowsett-Lemaire (1989). Dowsett-Lemaire (pers, comm. 2008) says that the Thyolo Alethe, an endangered bird, is found in forests there at around 1400 m altitude, as is a Mulanje–Zomba endemic bird, the yellow-bellied race of the Bar-throated Apalis.

This section presents an overview of known historical zoological records and activities occurring on Mt Mchese, and also any incidental observations made during the current expedition.

6.2 Historical records

One early and interesting anecdote was recorded by Harry Johnston in his book on British Central Africa (Johnston 1897). He says "...the natives of Mlanje assert that there is a small mountain zebra dwelling on Michese Mountain which is an outlying spur of the Mlanje range. Up to the present, however, we have been unable to secure a specimen." Nothing further has been heard of this, and it is most unlikely that a different taxon of zebra existed on Mchese, although historically zebra did exist in the surrounding area.

As a result of a marked increase in human population (2 million in 1930, 9 million in 1995, and 15 million in 2008) there has been a dramatic decline in the numbers of large mammals all over Malawi. According to Dudley (1979), the Phalombe Plain which surrounds Mt Mchese has lost zebra, oribi and blue wildebeest over the last 50 years.

In his paper on ‘Wildlife Depredation in Malawi: The Historical Dimension’, Brian Morris (1995) writes of the menace of large mammals such as carnivores (lions, leopard, hyena) and mammals that raided crops (such as elephant, baboon, bush pig and some antelope species). Morris mentions that the Phalombe Plain just north of Mt Mchese was the region best known in Malawi for attacks on humans by hyenas. In 1955 Fred Balestra, a local planter and keen hunter who had lived near Fort Lister for over 30 years, was called to a local village in which a man had been eaten by a hyena. This was followed by another two deaths shortly after. The following year, in 1956, there were a further five deaths, another five in 1957, and six deaths in 1958. Such a pattern continued until 1961 when eight people were killed by hyenas (Balestra 1962). Interestingly, the killings always seemed

to start around September. He concluded that this coincided with the start of the bush fires which burn off all cover, reducing the availability of game to hyenas. Balestra estimated the hyena population to be in the order of 100, roaming in packs of 4 to 12, and the only available cover for them to lie up during the day was on Mulanje and Mchese mountains.

Attacks by hyenas are very rare these days but, according to local porters, hyenas still reside in the foothills of Mchese. They also tell of leopards living on the mountain although it has been about 10 years since the last one was last seen by local hunters. The current expedition did not find any evidence of leopard, although it is likely that they are still found on Mt Mchese as the forest cover is substantial and in a relatively undisturbed condition.

Jim Chapman, ex-District Forestry Officer for Mulanje, noted the occurrence of many snares as he climbed up to the main peak in 1988 and observed Crowned Eagle (*Stephanoaetus coroaetus*) and many White-necked Ravens (*Corvus albicollis*, Fig. 28). At the same time he came across a hunting party carrying out a dead civet cat (J. Chapman, pers. comm.).

In 2005 Julian Bayliss, Carl Bruessow and Lynn Hughes climbed to the summit of Mt. Mchese where they disturbed several klipspringers. While during the present expedition, an elephant shrew was observed in montane forest above 1500 m altitude, although it was not determined whether it was the Four-toed (*Petrodromus tetradactylus*) or the Checkered Elephant Shrew (*Rhynchocyon cirnei*). Both are recorded from the main Mulanje massif.

During the present expedition and previously, Crowned Eagles (*Stephanoaetus coroaetus*) and many Whiten-necked Ravens (*Corvus albicollis*) were observed flying over the summit. Based on the extent of montane forest covering the high ridges, which appears less disturbed than that on the neighbouring Mulanje massif, it is likely Crowned Eagles are also nesting on Mchese.

Also during the present expedition, several butterfly traps were erected that trapped good female specimens of the southern Malawi form of *Charaxes xiphares woodi* (Fig. 29).

Figure 28. White-necked Raven (*Corvus albicollis*) on Mt. Mchese (JB).

Figure 29. *Charaxes xiphares woodi* – females trapped on Mt. Mchese (JB).

7. DISTURBANCE TRANSECTS

The Darwin expedition linked up for three days with one of a series of Earthwatch expeditions which are assisting MMCT monitor changes in utilization of the woodlands around Mts Mulanje and Mchese. This particular Earthwatch group comprised African participants from Kenya, Tanzania, Madagascar and Malawi, all of them professionally involved in conservation in one form or another. Detailed discussions were held on approaches to biodiversity monitoring, with particular emphasis on vegetation and woodland. Criteria for monitoring sites, spatial and temporal resolution of recording and what and how to record were discussed, resulting in the selection of an additional set of disturbance transects on the northern slopes of Mchese adjacent to Chiringa township.

7.1 MMCT–Earthwatch Transects

The methods used to establish the additional set of disturbance transects on Mchese's northern slopes follow those outlined in Nangoma *et al.* (in prep.). Full transect data will be published later through MMCT. The data collected show not only levels of utilization, but also the species concerned. Compared around the two mountains, Mchese and Mulanje, results to date indicate differing levels of utilization, and where conservation measures need to take place.

Three 250 m transects were laid parallel to each other, 50 m apart. The ends of the transects were recorded with a GPS, and small pile of stones laid every 20–30 m to allow for more accurate relocation of the tape at a later date. Within a distance of 2.5 m from each side of the laid-down tape (i.e. effectively a belt transect 5 m wide), all woody plants greater than 1 cm diameter at breast height were assessed for utilization or damage. The position of each stem and the species was noted using the distance along the 250 m transect along with its distance (and side) from the transect tape. Transects will be recorded annually.

At the same time, permanent plots are been put in nearby to provide a better assessment of species diversity/frequency and growth rates. The plots are 50 × 20 m, within which all stems with a dbh of 10 cm or more are tagged with numbered aluminium markers. The species and position of each stem are also recorded as distance along both plot axes thus enabling relocation. However, a permanent plot was not put in at this Mchese site as it was realised that the site may well have had most trees removed within 2–3 years, and the growth and density/frequency data could not be considered reliable owing to disturbance.

The group concluded that one or two additional permanent plots on Mt Mchese would be most useful, but that these should be placed in a relatively undisturbed area of miombo woodland, especially if growth data from different species was to be obtained for setting of sustainable management levels and options. The choice of such an area would depend on a broad vegetation survey of Mchese to identify a representative area. Such a site was chosen later, but a plot was not established at this time.

7.2 New Disturbance Transect

The disturbance transects put in earlier by MMCT, following the methods outlined in Bayliss (2005) and Nangoma *et al.* (in prep.) and based on earlier forest monitoring studies in Tanzania, give an indication of levels of woody plant utilization and change at a given site, but do not show how utilization changes with distance away from settlements or roads. In an attempt to determine utilization within the Forest Reserve in relation to distance from the reserve boundary up the lower slopes of the mountain, a 1 km long transect was put in by the Darwin Initiative team on the

southern slopes of Mchese in the Fort Lister Gap. The methods and main findings are given below. It may be considered useful to establish other such long transects on the other side of Mchese to give an indication of speed of wood utilization encroachment within the miombo woodland.

The data arising from this 1 km long transect are analysed and presented here. They can be analysed in various ways: (a) by species composition, (b) by basal area, (c) by stem size class, (d) by proportion cut, and (e) overall, by changes in any of these parameters along the transect. The main focus here is on species composition along the transect, preference of each species for cutting, and differences in size classes being cut.

7.3 Methods

A starting point was chosen just inside the Forest Reserve boundary in the Fort Lister Gap, close to the ruined ex-District Commissioners house by the Napolo river (see Fig. 30 and Annex 3).

Using GPS coordinates and sighting with ranging rods, a series of contiguous 100 m tape transects were laid in a straight line perpendicular to the reserve boundary running up the slope towards Mchese peak. The transect was marked with small piles of stones at c.100 m intervals. The starting altitude was 1115 m and the finishing altitude 1000 m uphill was 1313 m. All woody stems with a diameter of 4 cm or more in a belt 2.5 m each side of the laid tape were measured. Data recorded were: (a) species, (b) whether stem is dead or alive, (c) whether stem is cut or not (and if so, at what height), (d) stem diameter at breast height (1.3 m) of all stems (sometimes 2 or more per individual plant), (e) where stem has been cut below 1.3 m, the diameter at that point, and (f) distance along transect (metres from start). The transect took a group of 6 persons 1.5 days to set up and record (Figs. 31, 32). Full measurements are given in Annex 4.

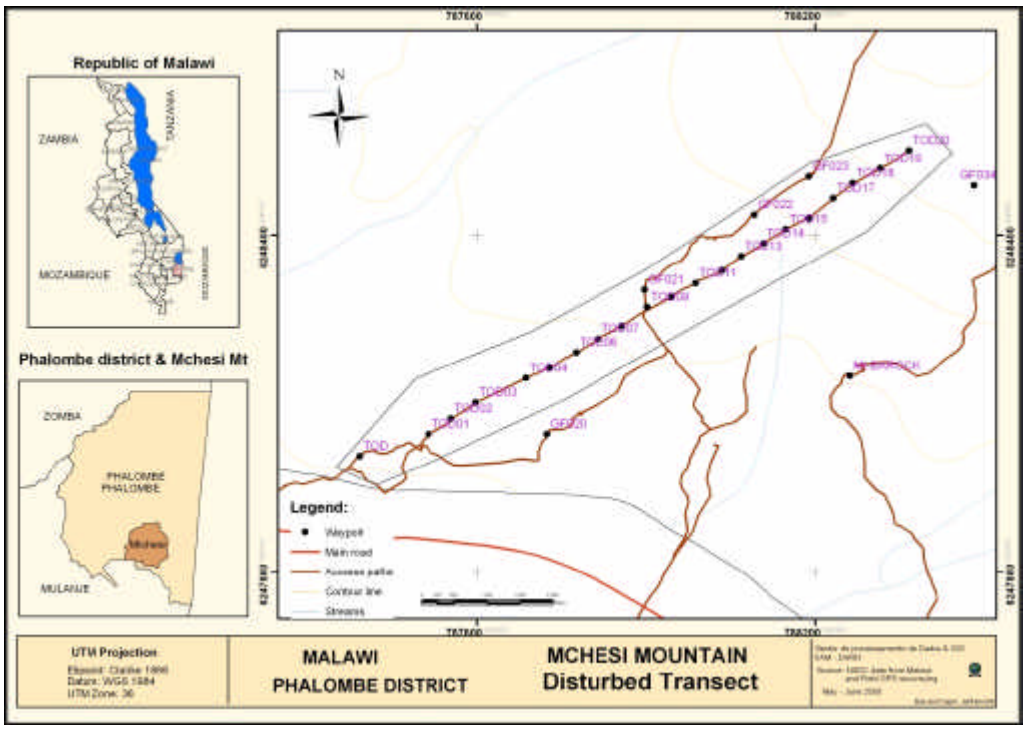


Figure 30. Location of disturbance transect by Fort Lister Gap.

In many of the later analyses, transect data were broken down into 10 × 100 m or 3 × 330 m sections to give an indication of change up the slope. On the lower part of the transect it was apparent that there were more but smaller stems than higher up, and utilization levels were moderately high, even though all removal or cutting of live wood is prohibited within the Reserve.

Figures 31 & 32. Recording disturbance transects, Mt Mchese (photos CS & TH).

7.3.1. Tree Density and Species Composition

The total number of trees exceeding 4 cm dbh recorded over the 1000 × 5 m belt transect (= 0.5 ha) was 456, giving an overall density of 912 trees/ha, ranging from 320 trees/ha equivalent at 800–900 m along the transect to 1620 trees/ha at 0–100 m (Table 3). The figures refer to individual trees, many of which may have more than one stem greater than 4 cm at 1.3 m height. Tree density was significantly higher in the lower half of the transect, probably owing to coppicing from earlier cutting. In addition, the woodland appears to naturally thin out at around 1230 m altitude as slopes get steeper and soils thinner, with an associated change in species composition (see section 7.3.2).

Along the transect 25 species of tree or shrub were recorded, all of them typical of miombo woodland. Over 37% were *Uapaca kirkiana* which, together with *Brachystegia manga*, *Brachystegia utilis* and *Pterocarpus angolensis*, contributed almost 70% of the total number of stems (Table 4).

Table 3. Numbers of trees and basal area along the disturbance transect**.**

transect section (m)	**no. trees**	**total BA (cm^2)**	**amount BA cut (cm^2)**	**% BA cut**
0–100	81	16,224.8	6,511.8	40.1
101–200	72	11,898.7	2,731.3	23.0
201–300	55	11,114.6	4,075.7	36.7
301–400	78	10,355.1	2,894.9	28.0
401–500	40	8,580.5	546.3	6.4
501–600	31	10,135.0	1,917.4	18.9
601–700	37	4,993.0	164.4	3.3
701–800	20	6,244.7	491.1	7.9
801–900	16	4,746.0	429.3	9.0
901–1000	26	5,864.6	361.8	6.2
	456	90,157.0	20,124.0	22.3

7.3.2 Basal Area

Stem density gives one measure of relative species importance, but a more useful one is often basal area, that is the stem area at breast height derived from the diameter measurements. It is also a better measure of wood availability.

Table 3 and Fig. 33 show basal area in each 100 m section along the transect, as well as the amount of basal area that had been cut. It would be expected that total basal area of woody stems would be lower closer to the Forest Reserve boundary and habitation, the source of utilisation, and become greater moving up the slope. But in fact the reverse is true, with distinctly lower basal area in the upper parts. As mentioned above, this appears to be due in part to the woodland naturally thining out higher up on more shallow soils, but may also represent a stimulation of growth resulting from coppicing lower down. This is examined below in terms of size class distribution.

Table 4. Numbers of trees and basal area by species along the disturbance transect, arranged in order of species importance by basal area.

Species	**no. trees**	**total BA (cm^2)**	**amount BA cut (cm^2)**	**% BA cut**
Uapaca kirkiana	171	28,069.0	3,631.1	12.9
Brachystegia manga	71	23,869.4	5,606.5	23.5
Brachystegia utilis	42	18,507.9	451.7	2.4
Pterocarpus angolensis	31	6,269.1	3,001.8	47.9
unknown (dead)	17	4,456.8	3,832.0	86.0
Pericopsis angolensis	17	1,837.5	873.7	47.5
Annona senegalensis	18	1,148.4	691.2	60.2
Julbernardia globiflora	9	1,053.8	254.1	24.1
Combretum adenogonium	7	865.5	63.6	7.4
Cussonia arborea	13	605.9	103.2	17.0
Steganotaenia araliacea	4	499.4	275.9	55.2
Lannea discolor	10	447.3	253.5	56.7
Burkea africana	2	349.2	323.7	92.7
Dalbergia nitidula	2	341.8	254.5	74.5
Albizia antunesiana	1	339.8	0.0	0.0
Vitex doniana	6	296.7	107.4	36.2
Parinari curatellifolia	6	247.9	106.2	42.9
Ximenia caffra	7	229.8	32.2	14.0
Bridelia micrantha	1	204.2	63.6	31.2
Vangueria infausta	3	123.7	51.3	41.4
Protea angolensis	8	119.1	38.3	32.2
Rothmannia sp.	4	94.6	0.0	0.0
Psorospermum febrifugum	3	84.1	28.3	33.6
Margaritaria discoidea	1	60.5	60.5	100.0
Faurea saligna	1	19.6	19.6	100.0
Faurea speciosa	1	15.9	0.0	0.0

Total basal area was 90,157 cm^2, equivalent to 18.03 m^2/ha, with the four main species (*U. kirkiana*, *B. manga*, *B. utilis*, *Pterocarpus angolensis*) comprising over 85% of this figure (Table 4, Fig. 34). The changes in basal area of the four main species along the transect are shown in Fig. 35. From this it can be seen that *Brachystegia manga* is an important component in the lowest third of the transect, but is replaced in importance by *Brachystegia utilis* in the upper two-thirds. *Uapaca*

kirkiana has a significantly greater basal area in the lower third, as does *Pterocarpus angolensis*. Basal area in the lowest third of the transect is more than double that in the uppermost third.

7.3.3 Size Class Distribution

All individual stems above 4 cm diameter were separated into five size classes: 4–10.0 cm, 10.1–20.0 cm, 20.1–30.0 cm, 30.1–40.0 cm and >40 cm (hence 528 stems but only 456 trees, and a slight difference in total basal area owing to rounding down). The total number of stems and basal area for each size class along the entire transect are shown in Table 5 and graphically in Fig. 36.

From Table 5 it can be seen that the majority of stems recorded (59%) were in the 4–10 cm size classes, and less than 5% were above 30 cm in size. However, Figure E shows that 59% of stems in the smallest size class only accounted for around 12% of basal area while the 5% of stems greater than 30 cm accounted for 36% of basal area. Most basal area (53%) is found in the 10–20 and 20–30 cm size classes.

Table 5. Numbers of stems and basal area by size class along entire transect.

species	**no. stems**	**BA (cm^2)**	**% BA cut**
size class 1 (4-10 cm)	313	10,532	48.3
size class 2 (10-20 cm)	137	21,813	34.9
size class 3 (20-30 cm)	53	25,685	15.8
size class 4 (30-40 cm)	17	15,288	6.7
size class 5 (>40 cm)	8	16,827	26.8
TOTAL	528	90,146	

7.3.3 Proportion of Stems Cut

The total basal area recorded as being cut was 20,124 cm^2, equivalent to 3.94 m^2/ha, and represents just over 22% of total basal area. This can be viewed by species, by size class, or by distance along the transect.

It was previously thought that *Pericopsis angolensis* and *Pterocarpus angolensis* were the most important cut species. However, Table 4 shows that the largest volume cut in terms of basal area was actually *Brachystegia manga* (11,213 cm^2/ha or 45% of total wood cut), followed by *Uapaca kirkiana* (7,262 cm^2/ha or 29% of total wood cut). Cut stems of unknown species (dead with no obvious identifying features) comprised 19% of total cut. It is particularly interesting to note that although *B. manga* was heavily cut, *B. utilis* was cut very little but it is almost as common. It is assumed that *B. utilis* wood is not desired for construction.

Both *Pericopsis angolensis* and *Pterocarpus angolensis* were heavily cut (almost half of all trees had been cut), although owing to availablity a greater quantity of *Pterocarpus* wood was cut (6,004 cm^2/ha) than of *Pericopsis* (1,747 cm^2/ha). This could, of course, be due to previous removal of *Pericopsis* over the years.

Fig. 36 also shows the amount of total basal area cut according to size class, showing a higher amount being cut in the smaller size classes. Although the greater proportion of cut basal area was in the smallest size class, the greatest quantity cut was from the 10–20 cm size class, followed by the largest size class (>40 cm).

Over 70% of cut basal area occurred in the lowest third of the transect (Fig. 37), with more than half of this in size classes from 4–20 cm. This is to be expected as trees larger than 30 cm dbh are not easy to cut with an axe, or to transport. The main demand in this area is probably for hut poles, which would normally only be 10–15 cm in diameter.

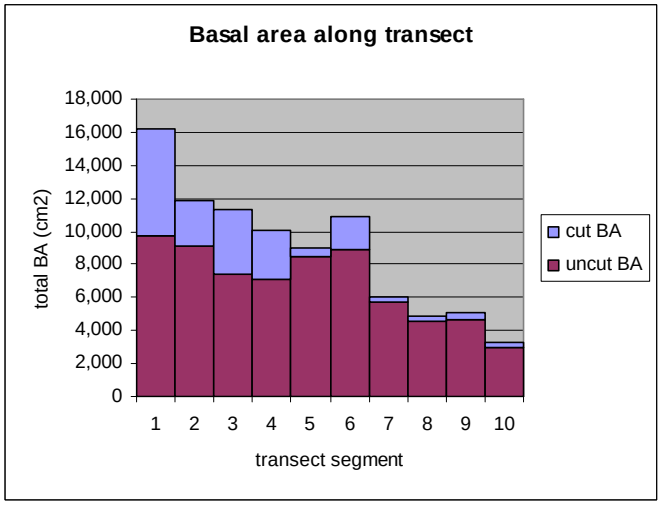


Figure 33. Basal area of woody stems along disturbance transect, shown in 100 m segments.

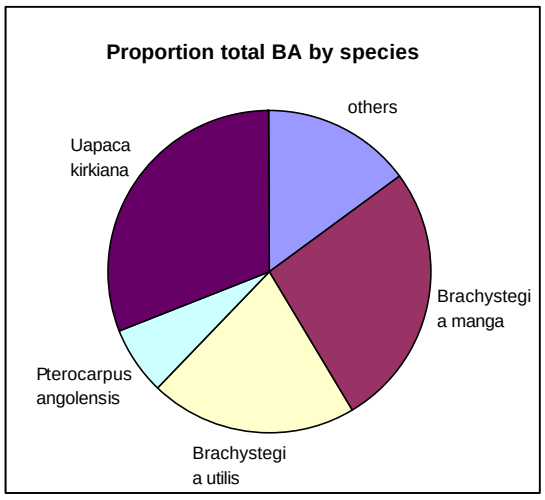


Figure 34. Proportion of total basal area by species for entire disturbance transect data.

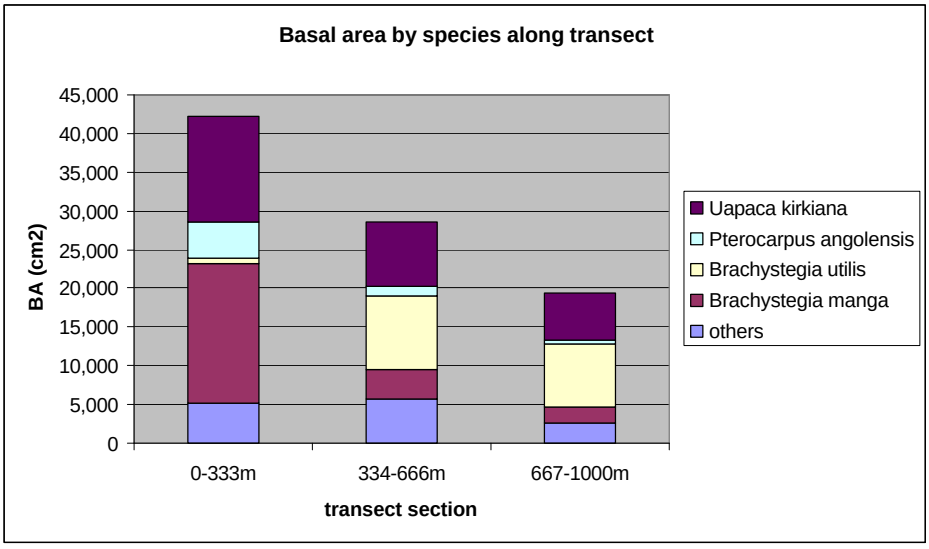


Figure 35. Basal area of main woody species in lower, mid and upper parts of disturbance transect.

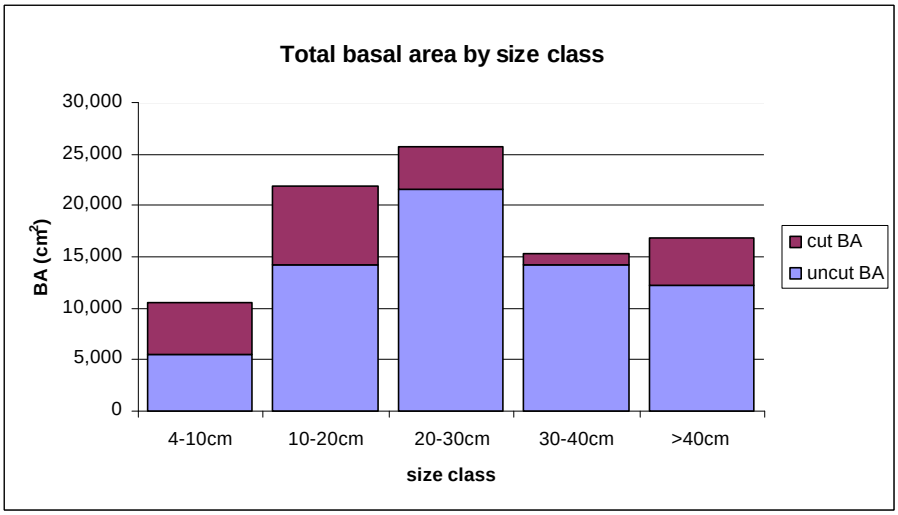


Figure 36. Total basal area by size class for entire transect, showing proportion cut.

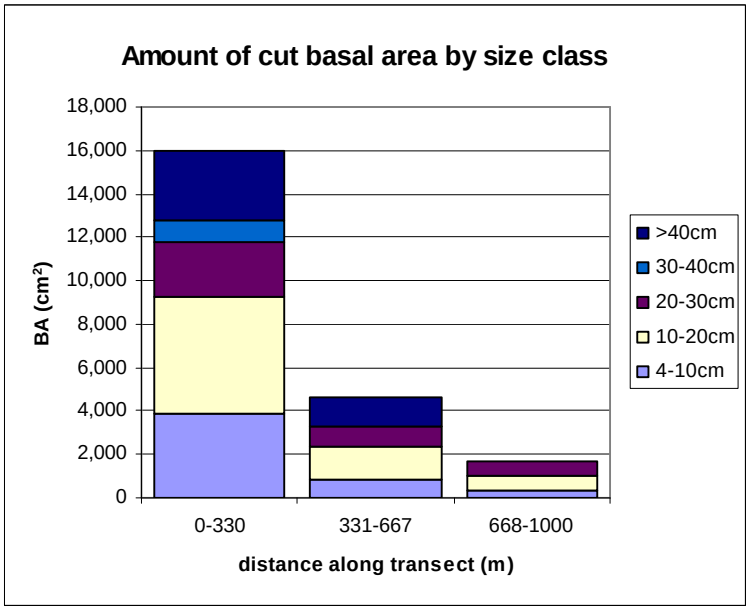


Figure 37. Amount of cut basal area in various parts of disturbance transect.

8. CONSERVATION

8.1 Threats

As mentioned before, Mt Mchese, its forests and much of the immediately surrounding woodland, is protected as part of the Michese and Mulanje Forest Reserve. There is a functioning Forest Station in the Fort Lister Gap at the foot the Sombani path up Mt Mulanje, although the Forest Officer is now based in Phalombe town. Recent discussions have raised the possibility of management for the area being delegated from the Forest Department to the Mulanje Mountain Conservation Trust (MMCT), although this has not yet happened.

The principal threats to biodiversity of Mchese relate to the forests on the upper ridges and peaks (including *Widdringtonia*), to the surrounding miombo woodland, and to the wildlife. These are discussed below.

The montane moist forest on the upper slopes generally remains in a good state, probably owing to the steepness of the terrain. There is no evidence of significant change in extent over the last 40 years. However, the main threat is selective felling of trees, in particular *Widdringtonia whytei*, a topic covered in more detail in Section 8.3. Very few adult trees above 40 cm dbh appear to remain, and there is much evidence of cutting of stems down to 20 cm diameter. There is significant concern in that no seed trees are seen to remain on Mchese and hence no seed will be available for natural regeneration.

On the lower slopes, there is significant cutting of forest and woodland trees. Streams of people were seen at various times carrying cut planks or poles up to 10 cm in diameter along paths where they exit the Forest Reserve (Fig. 38). Species noted included *Khaya anthotheca*, *Macaranga capensis*, *Chrysophyllum gorungosanum*, *Newtonia buchananii* and *Rothmannia* sp. Pit-sawing sites are also not uncommon – the main cut species noted was *Uapaca kirkiana* (Fig. 39). Throughout the miombo woodland the favoured tree for cutting, to the extent that very few medium or larger trees remain, is *Pericopsis angolensis*. Other species are taken out for hut construction, firewood and, especially, charcoal, particularly *Brachystegia* spp., *Julbernardia globiflora* and *Uapaca* spp.

Figure 38 (left). Transporting firewood from western part of Mchese Forest Reserve (JT).

Figure 39 (right). Wooden frame for cutting of planks, Mchese Forest Reserve (JT).

The other threat is from wild fires. Most of these start on the footslopes in miombo areas with tall grass where fire can readily get hold. The more the woodland is cleared, the greater the biomass of grass, except in areas where it is grazed, which is not common here. Miombo woodland is generally adapted to fires, although species diversity is reduced and regeneration restricted when fires are particularly fierce or frequent. The main conservation threat is when fire gets into steep-side gullies, destroying the thick vegetation, or where it occurs at the forest edge or in grassy areas within the upland forest. Gully vegetation is a mix of woodland and forest elements, but in the dry season can become very dry and fire-prone. Fire here destroys both the plants and the moister microclimate, hence inhibiting regeneration of moisture-requiring species.

Figure 40. Gullying and soil erosion on western margins of Mchese Forest Reserve (JT).

At present there are two MMCT–Earthwatch disturbance transects and plots established in Mchese, one on the northern slopes and one inside the Forest Reserve corridor in the Fort Lister area (Section 7.1). In addition, the present Darwin expedition team established a longer disturbance transect up the southern slopes from the Fort Lister Gap (Section 7.2). These transects/plots are monitored annually, usually with Earthwatch programme support. However, the key point now is to ensure that the findings from this monitoring are incorporated into management decision-making. The mechanism for this does not yet seem to have been established. Encroachment of tree cutting or clearance has been going on for a number of years, to the extent that the Reserve is now significantly smaller than it originally was. In particular, forest timbers in the upper moist forest are now being targeted. Such felling is not as sustainable as cutting of miombo trees, which generally coppice readily. It also leads to gaps being created in the forest that support fire, thus opening up the forest further.

8.2 Miombo Woodland

The boundary of the Forest Reserve runs through the 'apron' of miombo woodland around the base of Mchese. The boundary is "hard" and can readily be seen on satellite imagery, air photos or on the ground. Cultivation and near-total tree clearance takes place up to the Reserve boundary. In some instances the current boundary is inside the gazetted boundary as shown on the map, where presumably re-gazetting has occurred, even if only at a local level. The Reserve boundary is generally not respected in term of utilization, except as regards clear-felling and cultivation.

Although this belt of miombo is not of particular intrinsic value in terms of biodiversity, at least below 1200 m altitude, it is very important in helping control erosion and rapid run-off from the mountain (Fig. 40). Loss of the miombo woodland would greatly increase the damage to houses and crops owing to flooding, such as occurred in Phalombe in 1991.

The legislation necessary for conservation or wise use of the Forest Reserve is present, especially regarding controls on the extraction of timber, as are Forestry Department staff and authority to implement it. However, these powers are generally not being exercised. The legislation, mandate and powers are adequate, but the will to implement them often seems to be lacking. Consequently the forest and woodland, in particular the few remaining *Widdringtonia*, Malawi's National Tree, are being badly affected. There is a loss of natural capital to the system, with only individual, not public, gain.

8.3 *Widdringtonia* Conservation

Widdringtonia in the family Cupressaceae is a southern African genus of gymnosperm trees with only four species, closely related to *Cupressus* and *Juniperus*. Two of these species are confined to the Cape Fold mountains in SW South Africa, one (*W. nodiflora*) is fairly widespread across the mountains of southern Africa, including Eastern Zimbabwe and Mt Gorongosa in Mozambique, and one (*W. whytei*) is endemic to Mt Mulanje and Mchese (Chapman 1995, Bayliss *et al.* 2007). The taxonomy has been confused in the past, and it is not always easy to separate *W. whytei* and *W. nodiflora* when they are found together, especially if not fully mature. Commonly termed the Mulanje Cedar, it is Malawi's national tree and an icon for conservation. The Mulanje Cedar is a large tree with highly-prized timber for construction (door and window frames, roof joists), making boxes and roofing shingles. It is insect resistant owing to a high content of aromatic resins, which give it a distinctive and pleasant smell. More details are given in a useful small book, The Mulanje Cedar by Jim Chapman (Chapman 1995), and in Bayliss *et al.* (2007).

The Mulanje Cedar occurs in groves and its regeneration requirements are still not clear. It is a pioneer species that needs open (including burnt) areas to establish, yet saplings are also fire-sensitive. Infrequent fire is thought to be necessary for regeneration. Cedar is often associated with thickets of *Phillipia* (= *Erica benguellensis*) (Chapman & White 1970) and is mostly found between 1500 and 2150 m (White et al. 2001). It is generally confined to ravines and hollows and the upper parts of deeply incised gorges (Chapman & White 1970), sites where there is good drainage and less competition from other woody vegetation (Fig. 40). Mulanje Cedar is most common on drier side of the mountain in rain-shadow areas (Chapman 1995) and is obviously susceptible to fire at some stages, but also able to resist light burns at other stages. The species can tolerate some level of fire once established.

Most accessible cedar stands on Mt Mulanje had been worked through for timber by 1956, but at that time there had been no exploitation of cedar on Mt Mchese (Chapman & White 1970, Chapman 1995). Marked cutting on Mchese seems to date from around the time of the Phalombe disaster, and was hardly noticeable before (Jim Chapman, pers. comm. 2008). Today there are very few individuals left on the mountain, while the stands on Mt Mulanje have been greatly reduced in number and extent (Bayliss *et al.* 2007). *Widdringtonia whytei* is considered Endangered A1 B1B2 on the Sabonet Plant Red Data List (Golding 2002) and as Endangered A1abcd, B1+2abcde on the IUCN 2009 Red Data List (version 2.3, accessed August 2009).

During the the present expedition, efforts were made to try and document any cutting of Mulanje Cedar that was seen, as well as trying to determine how much was left on Mchese. The limited observations made and data collected are given below.

Widdringtonia trees (stumps or live plants) were found on three rocky ridges on Mt Mchese. The first ridge was at an altitude of 1610 m between areas of moist forest (Fig. 42). Six live *Widdringtonia* trees were seen alongside 18 cut stumps; the diameter distribution is shown in a box plot (Fig. 41). This shows that most cut trees were 40 cm diameter or over, although some were only

20 cm diameter. One large live tree was 12 m high and 65 cm in diameter, but all other live trees had a trunk diameter of less than 20 cm (estimated to be 15 years old; Julian Bayliss, pers. comm.), suggesting that trees are selectively felled by the time they reach that size. It is highly likely that these remaining juvenile trees will be cut before reaching their fertile stage and producing seed, thus making natural regeneration highly unlikely.

On the second ridge examined, no live *Widdringtonia* trees were seen but only a cluster of stumps. From the condition of the stumps it is estimated that they were cut 30–50 years ago. Over 100 cut stumps were found on the third ridge visited, with cutting assessed as recent. Significant regeneration was observed at this site with 17 live juvenile cedars 30–50 cm high, presumed to be parented by the same seed tree (Fig. 43).

Figure 40. Mature tree of *Widdringtonia whytei* on slopes of Mt Mchese (TH).

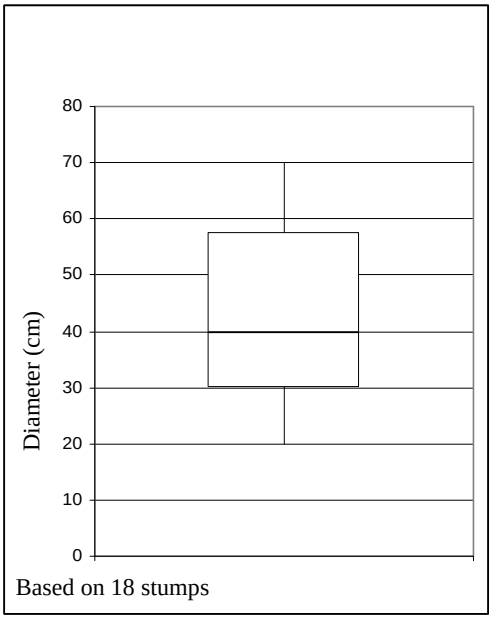


Figure 41. Size distribution of cut *Widdringtonia* stumps, Mt Mchese. Most trees cut before maturity.

Figure 42. Fire and *Widdringtonia* cutting, Mchese ridgetop (JB).

Figure 43. Regeneration of *Widdringtonia*, Mt Mchese (JB).

This preliminary survey suggests a different situation on Mchese to that on the main peak where most cut stumps exceed 55 cm diameter (Makungwa 2008), with exception of the Sombani region where the distribution of stump sizes was similar.

Historically, there were large stands of *Widdringtonia* on Mchese, as was documented by Chapman after his visit in 1958 (Chapman 1995). Across these three ridges on Mchese in 2008, no *Widdringtonia* trees were seen at a reproductive stage. There is thus considerable concern for the regeneration of this isolated population, the only other natural population of the species apart from those on Mt Mulanje itself.

8.4 Tea Research Plots, Mulanje

The Tea Research Foundation, a regional industry-funded research organisation based just outside Mulanje town, has on its site a 73 ha area of lowland moist forest. Small patches were cleared within this forest for the planting of clusters of tea bushes, genetically isolating them from other tea plants nearby. Other exotic timber trees were also introduced. This area is apparently one of the few remaining patches of lowland rainforest remaining in southern Malawi (White *et al.* 2001), although no work has been done on it except an unpublished list and forest profile by Jim Chapman 1988.

During the Darwin expedition a day was spent recording species composition and evaluating the forest for its potential for management and conservation by MMCT, resulting in a report and recommendations (Alves & de Sousa 2008). The main findings were (a) that exotic species should be removed, although this is not easy as they will generally regenerate in the gaps created, (b) to protect the forest against wild fires, (c) to implement some silvicultural treatments to enhance production of desired species, (d) possibly use enrichment planting of desired species, and (e) to involve local communities in its management such they receive some benefits.

9. RECOMMENDATIONS

1. Mt Mchese supports around 1000 hectares of good quality montane moist forest, particularly above 1400 m on its northern and eastern slopes. The stands are relatively large, and less disturbed than those on the main Mulanje massif, and hence are of significant conservation value. Further survey is required to confirm their actual extent, composition and condition, particularly on the northern slopes and gullies. All necessary measures should be taken to ensure their conservation, and to maintain the ecological services the forest provides.

2. The few remaining scattered individuals of Mulanje Cedar, *Widdringtonia whytei*, are being relentlessly and heavily exploited, despite being legally protected in a Forest Reserve. Hardly any mature trees larger than 30 cm diameter were seen, even at a distance. It is possible that there are now no viable seed trees left from which regeneration could take place. Strong measures need to be taken to control this exploitation, which emanates mostly from settlements on the northern and eastern sides.

3. The extensive band of miombo woodland surrounding the mid- and upper-slopes of Mt Mchese at 700 to 1000 m altitude forms not only an important buffer for the forests above but has an invaluable role in helping reduce erosion and runoff from the peaks above. Owing to the high rainfall, steepness and poor moisture storage capacity, runoff from Mchese can be disastrous for settlements and fields at the base and on lower slopes, as was seen during the 1991 Phalombe disaster. This band of miombo woodland must be afforded full protection in terms of retaining its cover and erosion-control attributes. Encroachment into the existing Forest Reserve should not be allowed, and efforts should be made to encourage people not to settle on the erosion-prone lower slopes, especially in the Fort Lister Gap.

4. The miombo woodland "corridor" in the Fort Lister Gap, linking Mt Mchese to the main Mulanje massif, is very important in ensuring movement of species, particularly terrestrial vertebrates, between the two areas. It helps retain the viability of the areas for biodiversity conservation. Strong efforts need to be continued to ensure this area is not cut, cleared, frequently burnt or removed from the protected Forest Reserve.

5. The disturbance transect put in under this project in the Fort Lister Gap should be recorded on an annual or biennial basis. This also applies to plots and disturbance transects installed previously by MMCT/Earthwatch. Any evidence of encroachment and tree cutting should be turned into management action and acted upon, rather than being regarded as just of academic interest.

6. Further long disturbance transects need to be established on the northern, eastern and, especially western sides of Mt Mchese, placed at right angles to the "disturbance front" not parallel to it, i.e. generally the transect would be placed going up the slope from the Forest Reserve boundary. This would be a good opportunity for MMCT and Earthwatch to monitor the whole Forest Reserve as access is good on all sides.

7. Fires pose a significant danger to some of the vegetation types on the mountain, particularly open woodland, forest margins and vegetation in gullies. Strong measures need to be taken to reduce fire incidence, perhaps primarily through education and awareness. The construction and maintenance of firebreaks across Mchese mountain is probably not a practical option owing to the steep terrain, although it may be useful to create a boundary firebreak around the lower slopes. Of particular concern is the potential expansion of forest gaps, comprising flammable bracken and shrubs, at the expense of moist forest.

8. The present actual, agreed Forest Reserve boundary in places appears to be some distance up the slopes of Mt Mchese from the gazetted boundary shown on older maps. Population pressures are high, particularly on the western and eastern slopes. It may be possible to demarcate the Forest Reserve using either firebreaks or plantings of *Eucalyptus* or similar species, thus clearly showing where the accepted boundaries now are. Continual shifting of the boundaries in view of "new realities on the ground" is not a viable or sustainable option, and must be resisted.

9. At present there are very inadequate forest patrols around Mchese, resulting in a significant degree of illegal exploitation of forest products. A strong and active presence of Forestry Department management staff needs to be put in place as a matter of urgency.

10. Conservation efforts on Mchese and around Mt Mulanje are often rendered ineffective because of public figures who encourage people living around the mountain to earn a living from exploiting the resources available. Such people do not condemn, and sometimes passively support, the illegal exploitation of Mulanje cedar and miombo timber. This is a very big challenge and needs to be addressed in a determined fashion, and by politicians at a senior level.

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ANNEX 1. Participants on Mchese expedition, May–June 2008.

Tereza Alves, Forestry Research Section, IIAM, Marracuene, Mozambique.

Rogério Mauro da Costa Jamice, Station Manager, Madonge Forest Research Station, IIAM, Chimoio, Mozambique.

Aurélio Constantino Banze, Plant Collector, National Herbarium, IIAM, Maputo, Mozambique.

Julian Bayliss, Darwin Project Regional Coordinator, Mt Mulanje Conservation Trust, Mulanje, Malawi.

Feliciano Baptista João, Technician, Madonge Forest Research Station, IIAM, Sussundenga, Mozambique.

Carl Bruessow, Executive Director, Mulanje Mountain Conservation Trust, Mulanje, Malawi.

Jorge Francisco, GIS Unit, Land & Water Department, IIAM, Maputo, Mozambique.

Tim Harris, Herbarium, RBG Kew, London, UK.

Steven Mphamba, Herbarium Assistant, Forestry Research Institute of Malawi, Zomba, Malawi.

Abobacar Mussagy, Driver, IIAM, Forestry Research Unit, Marracuene, Mozambique.

David Nangoma, Ecologist, Mulanje Mountain Conservation Trust, Mulanje, Malawi.

Hassam Patel, Botanist, Mulanje Mountain Conservation Trust, Mulanje, Malawi.

Alinafe Carolyne Litta, Assistant Forestry Research Officer, Research Institute of Malawi, Zomba, Malawi.

Monica Nyasosela, Assistant Forestry Research Officer, Research Institute of Malawi, Zomba, Malawi.

Mateus Sitole, Driver, Mandonge Forestry Station, IIAM, Sussundenga, Mozambique.

Camila de Sousa, Forestry Research Section, IIAM, Marracuene, Mozambique.

Jonathan Timberlake, Project Coordinator, Herbarium, RBG Kew, London, UK.

ANNEX 2. Plant checklist from Mchese Mountain above 700 m.

T - tree; S - shrub; t - small tree; c - liana; h - herb
1 = specimen; 2 = sight record; 3 = Strugnell 2006; 4 = EFFM, White et al. 2001
Nomenclature follows current usage at RBG Kew.

Family	**species + authority**	**l/f**	**ref.**	**notes**
PTERIDOPHYTES				
Oleandraceae	Oleandra distenta *Kunze*	h	1	
Dennstaedtiaceae	Pteridium aquilinum *(L.) Kuhn* subsp. aquilinum	h	2	
GYMNOSPERMS				
Cupressaceae	Widdringtonia whytei *Rendle*	T	2	Mulanje endemic
Podocarpaceae	Podocarpus henkelii *Dallim.& A.B.Jacks*	T	3,4	may be mis-id
Podocarpaceae	Podocarpus latifolius *(Thunb.) Mirb.*	T	3	
MONOCOTYLEDONS				
Aloaceae	Aloe chabaudii *Schönland* var. chabaudii	h	2	
Amaryllidaceae	Crinum macowanii *Baker*	h	3	
Arecaceae	Borassus aethiopum *Mart.*	T	2	
Arecaceae	Phoenix reclinata *Jacq.*	T	1	
Arecaceae	Raphia farinifera *(Gaertn.) Hyl.*	T	2,3	
Asparagaceae	Asparagus krebsianus *Kunth*	h	3	
Behniaceae	Behnia reticulata *(Thunb.) Didr.*	c	3	
Commelinaceae	Commelina bracteosa *Hassk.*	h	1	
Commelinaceae	Commelina subulata *Roth*	h	3	
Cyperaceae	Bulbostylis macra *(Ridl.) C.B.Clarke*	h	3	
Cyperaceae	Cyperus diffusus *L.* subsp. sylvestris *(Ridl.) Kük.*	h	1	
Cyperaceae	Tetraria mlanjensis *J.Raynal*	h	3	Mulanje endemic
Dracaenaceae	Dracaena fragrans *(L.) Ker-Gawl.*	S	1	
Dracaenaceae	Dracaena laxissima *Engl.*	S	1	
Dracaenaceae	Dracaena steudneri *Engl.*	S	2,3	
Dracaenaceae	Sansevieria sp. A	h	1	
Dracaenaceae	Sansevieria sp. B	h	1	
Iridaceae	Crocosmia aurea *(Hook.) Planch.*	h	1	
Iridaceae	Dietes iridioides *(L.) Klatt*	h	3	
Orchidaceae	Bulbophyllum sandersonii *(Hook.f.) Rchb.f.* subsp. sandersonii	h	3	
Orchidaceae	Eulophia longisepala *Rendle*	h	3	
Orchidaceae	Eulophia venulosa *Rchb.f.*	h	3	
Orchidaceae	Polystachya dendrobiiflora *Rchb.f.*	h	3	
Orchidaceae	Tridactyle cf. tridentata *(Harv.) Schltr.*	h	1	
Poaceae	Andropogon chinensis *(Nees) Merr.*	h	1	
Poaceae	Hyparrhenia cymbaria *(L.) Stapf*	h	1	
Poaceae	Hyparrhenia finitima *(Hochst.) Stapf*	h	3	
Poaceae	Hyparrhenia rufa *(Nees) Stapf*	h	1	
Poaceae	Melinis ambigua *Hack.*	h	1	
Poaceae	Loudetia phragmitoides *Hochst.*	h	1,3	
Poaceae	Loudetia simplex *(Nees) C.E.Hubb.*	h	2	
Poaceae	Oplismenus compositus *(L.) P.Beauv.*	h	1	
Poaceae	Oreobambos buchwaldii *K.Schum.*	S	4	
Poaceae	Oxytenanthera abyssinica *(A.Rich.) Munro*	S	1,3	
Poaceae	Panicum aequinerve *Nees*	h	3	in FZ area only from Mulanje
Poaceae	Panicum wiehei *Renvoize*	h	1	
Poaceae	Pennisetum polystachion *(L.) Schult.*	h	1	

Poaceae	Pennisteum unisetum *(Nees) Benth.*	h	1	
Poaceae	Phragmites mauritianus *Kunth*	h	3	
Poaceae	Themeda triandra *Forssk.*	h	1	
Smilacaceae	Smilax anceps *Willd.*	c	2	
Velloziaceae	Xerophyta sp.	h	2	
Xyridaceae	Xyris straminea *L.A.Nilsson*	h	3	
Zingiberaceae	Afromomum zambesiacum *(Baker) K.Schum.* subsp. zambesiacum	h	3	
DICOTYLEDONS				
Acanthaceae	Barleria spinulosa *Klotzsch*	h	1	
Acanthaceae	Dicliptera leonotis *C.B.Clarke*	h	3	
Acanthaceae	Dicliptera maculata *Nees* subsp. maculata	h	3	
Acanthaceae	Dyschoriste trichocalyx *(Oliv.) Lindau*	h	1	
Acanthaceae	Hypoestes forskaolii *(Vahl) R.Br.*	h	1	
Acanthaceae	Hypoestes triflora *(Forssk.) Roem.& Schult.*	h	1,3	
Acanthaceae	Isoglossa grandiflora *C.B.Clarke*	S	3	Mulanje endemic
Acanthaceae	Justicia mollugo *C.B.Clarke*	h	3	
Acanthaceae	Justicia striolata *Mildbr.*	h	3	
Acanthaceae	Mellera lobulata *S.Moore*	S	3,4	
Acanthaceae	Mellera submutica *C.B.Clarke*	h	3	
Acanthaceae	Mimulopsis solmsii *Schweinf.*	S	3	
Acanthaceae	Pseuderanthemum subviscosum *(C.B.Clarke) Stapf*	h	3	
Amaranthaceae	Achyranthes aspera *L.* var. pubescens *(Moq.) C.C.Towns.*	h	3	
Amaranthaceae	Cyathula cylindrica *Moq.*	h	1,3	
Anacardiaceae	Lannea discolor *(Sond.) Engl.*	T	2,3	
Anacardiaceae	Lannea schimperi *(A.Rich.) Engl.*	T	3	
Anacardiaceae	Mangifera indica *L.*	T	2	naturalised
Anacardiaceae	Ozoroa insignis *Delile* subsp. reticulata *(Baker f.) R.& A.Fern.*	T	1,3	
Anacardiaceae	Rhus longipes *Engl.* var. longipes	S	1	
Anacardiaceae	Rhus natalensis *Krauss*	S	1,3	
Anacardiaceae	Rhus teuninervis *Engl.*	S	1	
Anacardiaceae	Trichoscypha lucens *Oliv.*	T	1	
Annonaceae	Anonna senegalensis *Pers.*	S	2	
Annonaceae	Artabotrys brachypetalus *Benth.*	c	3	
Annonaceae	Cleistochlamys kirkii *(Benth.) Oliv.*	S	3	
Annonaceae	Hexalobus monopetalus *(A.Rich.) Engl.& Diels* var. obovatus *Brenan*	S	3	
Annonaceae	Uvaria lucida *Benth.* subsp. virens *(N.E.Br.) Verdc.*	c	1	
Apiaceae	Alepidea peduncularis *A.Rich.*	h	1	
Apiaceae	Heteromorpha arborescens *(Spreng.) Cham.& Schltdl.*	T	2	
Apiaceae	Lefebvrea longipedicellata *Engl.*	h	3	
Apiaceae	Steganotaenia araliacea *Hochst.*	T	2	
Apocynaceae	Ancylobothrys tayloris *(Stapf) Pichon*	c	3,4	
Apocynaceae	Carissa bispinosa *(L.) Brenan*	S	1,3	
Apocynaceae	Ceropegia speciosa *H.Huber*	c	3	
Apocynaceae	Cynanchum viminale *(L.) L.* subsp. mulanjense *(Liede & Meve) Goyder*	c	1	S & C Malawi, Namuli
Apocynaceae	Cynanchum viminale *(L.) L.* subsp. suberosum *(Meve & Liede) Goyder*	c	1,3	
Apocynaceae	Diplorhynchus condylocarpon *(Müll.Arg.) Pichon*	T	2	
Apocynaceae	Holarrhena pubescens *(Buch.-Ham.) G.Don.*	T	3	
Apocynaceae	Rauvolfia caffra *Sond.*	T	3	
Apocynaceae	Mondia whitei *(Hook.f.) Skeels*	c	3	
Apocynaceae	Secamone alpinii *Schult.*	c	3	

Apocynaceae	Strophanthus courmontii *Franch.*	c	3	
Apocynaceae	Strophanthus nicholsonii *Holmes*	S	3	
Aquifoliaceae	Ilex mitis *(L.) Radlk.*	T	3	
Araliaceae	Cussonia arborea *A.Rich.*	T	1	
Araliaceae	Polyscias fulva *(Hiern) Harms*	T	1	
Araliaceae	Schefflera umbellifera *(Sond.) Baill.* var. buchananii *(Harms) Tennant*	T	1	
Aristolochiaceae	Aristolochia albida *Duch.*	c	3,4	
Asteraceae	Anisopappus kirkii *(Oliv.) Brenan*	S	3	
Asteraceae	Dicoma elliptica *G.V.Pope*	h	1,3	
Asteraceae	Gutenbergia cordifolia *Oliv.* var. marginata *(O.Hoffm.) C.Jeffrey*	h	3	
Asteraceae	Helichrysum herbaceum *(Andr.) Sw.*	h	3	
Asteraceae	Helichrysum kirkii *Oliv.& Hiern*	h	1	
Asteraceae	Helichrysum odoratissimum *(L.) Less.*	S	3	
Asteraceae	Helichrysum stenopterum *DC.*	h	1	
Asteraceae	Inula glomerata *Oliv.& Hiern*	h	3	
Asteraceae	Mikania cordata *(Burm.f.) B.L.Robb.*	c	3	
Asteraceae	Senecio syringifolius *O.Hoffm.*	c	3	
Asteraceae	Solanecio mannii *(Hook.f.) C.Jeffrey*	S	1	
Asteraceae	Vernonia colorata *(Wild) W.F.M.Drake* subsp. oxyura *(O.Hoffm.) C.Jeffrey*	S	1	
Asteraceae	Vernonia holstii *O.Hoffm.*	S	3	
Asteraceae	Vernonia jelfiae *S.Moore* var. jelfiae	h	1	
Asteraceae	Vernonia karaguensis *Oliv.& Hiern*	h	3	
Asteraceae	Vernonia melleri *Oliv.& Hiern* var. melleri	h	3	
Asteraceae	Vernonia pteropoda *Oliv.& Hiern*	S	3	
Asteraceae	Vernonia thomsoniana *Oliv.*	S	3	
Balsamaceae	Impatiens sylvicola *Burtt Davy & Greenway*	h	1,3	
Balsamaceae	Impatiens zombensis *Baker f.*	h	1	only S Malawi & Mt Tumbine
Bignoniaceae	Stereospermum kunthianum *Cham.*	T	2,3	
Bignoniaceae	Tecomaria capensis *(Thunb.) Spach* subsp. nyassae *(Oliv.) Brummitt*	S	1	
Boraginaceae	Trichodesma ambacense *Welw.*	h	3	
Burseraceae	Commiphora eminii *Engl.* subsp. zimmermannii *(Engl.) J.B.Gillett*	T	3,4	
Burseraceae	Commiphora mollis *(Oliv.) Engl.*	T	3	
Buxaceae	Buxus nyasica *Hutch.*	S	3,4	rare; S Malawi endemic
Campanulaceae	Lobelia trullifolia *Hemsl.* subsp. trullifolia	h	1	
Cannellaceae	Warburgia salutaris *(G.Bertol.) Chiov.*	T	3,4	threatened sp.
Capparaceae	Boscia salicifolia *Oliv.*	T	2	
Capparaceae	Maerua angolensis *DC.*	S	3	
Capparaceae	Maerua pubescens *(Klotzsch) Gilg*	S	3	
Cecropiaceae	Myrianthus holstii *Engl.*	T	1,2	
Celastraceae	Maytenus acuminata *(L.f.) Loes.* var. acuminata	T	1	
Celastraceae	Maytenus heterophylla *(Eckl.& Zeyh.) N.Robson*	S	3	
Celastraceae	Maytenus undata *(Thunb.) Blakelock*	S	3	
Celastraceae	Mystroxylon aethiopicum *(Thunb.) Loes.*	T	1,3	
Celastraceae	Pterocelastrus echinatus *N.E.Br.*	T	1	
Chrysobalanaceae	Parinari curatellifolia *Benth.*	T	2	
Chrysobalanaceae	Parinari excelsa *Sabine*	T	4	
Clusiaceae	Garcinia huillensis *Oliv.*	T	2	
Clusiaceae	Garcinia kingaënsis *Engl.*	T	2,4	

Clusiaceae	Garcinia livingstonei *T.Anderson*	T	3,4	
Clusiaceae	Harungana madagascariensis *Poir.*	T	2	
Clusiaceae	Hypericum revolutum *Vahl*	S	1	
Clusiaceae	Psorospermum febrifugum *Spach*	S	1,3	
Combretaceae	Combretum adenogonium *A.Rich.*	T	2,3	
Combretaceae	Combretum molle *G.Don.*	T	2,3	
Combretaceae	Combretum zeyheri *Sond.*	T	3	
Combretaceae	Pteleopsis myrtifolia *(Laws.) Engl.& Diels*	T	3	
Combretaceae	Terminalia stenostachya *Engl.& Diels*	T	2,3	
Connaraceae	Rourea orientalis *Baill.*	S	2,3	
Convolvulaceae	Cuscuta cassytoides *Engelm.*	c	1	new Malawi record
Convolvulaceae	Cuscuta kilimanjari *Oliv.* var. kilimanjari	c	3	
Convolvulaceae	Ipomoea fulvicaulis *(Choisy) Hallier f.* var. heterocalyx *(Schulze-Menz) Verdc.*	c	3	
Convolvulaceae	Ipomoea involucrata *P.Beauv.* var. operosa *(C.H.Wright) Verdc.*	c	3	
Convolvulaceae	Turbina stenosiphon *(Hallier f.) Meeuse*	c	3,4	
Cornaceae	Cornus volkensii *Harms*	T	3,4	
Crassulaceae	Crassula swaziensis *Schönl.*	h	1	
Crassulaceae	Kalanchoe elizae *Berger*	h	3	
Crassulaceae	Kalanchoe humilis *Britten*	h	1	
Cucurbitaceae	Coccinea grandiflora *Cogn.*	c	3	
Cucurbitaceae	Diplocyclos decipiens *(Hook.f.) C.Jeffrey*	h	3	
Dipterocarpaceae	Monotes africanus *A.DC.*	T	2	
Ebenaceae	Diospyros abyssinica *(Hiern) F.White* subsp. abyssinica	T	3,4	
Ebenaceae	Diospyros kirkii *Hiern*	T	1,3	
Ebenaceae	Diospyros lycioides *Desf.* subsp. sericea *(Bernh.) de Winter*	S	3	
Ebenaceae	Diospyros natalensis *(Harv.) Brenan*	T	1,3	
Ebenaceae	Diospyros whyteana *(Hiern) F.White*	T	1,3	
Ebenaceae	Diospyros zombensis *(B.L.Burtt) F.White*	S	1,3	
Ebenaceae	Euclea crispa *(Thunb.) Gürke* subsp. crispa	S	3,4	
Ebenaceae	Euclea natalensis *A.DC.* subsp. obovata *F.White*	S	3,4	
Ebenaceae	Euclea racemosa *Murr.* subsp. schimperi *(A.DC.) F.White*	S	1,3	
Ericaceae	Agarista salicifolia *(Lam.) G.Don*	T	1	
Ericaceae	Erica benguelensis *(Engl.) E.G.H.Oliv.*	S	1,3	
Ericaceae	Erica johnstoniana *Britten*	S	1	
Ericaceae	Erica microdonta *(C.H.Wright) E.G.H.Oliv.*	S	3	
Erythroxylaceae	Erythroxylum emarginatum *Thonn.*	T	1,3	
Escalloniaceae	Choristylis rhamnoides *Harv.*	S	3	
Euphorbiaceae	Alchornea laxiflora *(Benth.) Pax & K.Hoffm.*	S	3	
Euphorbiaceae	Antidesma membranaceum *Müll.Arg.*	S	3	
Euphorbiaceae	Antidesma vogelianum *Müll.Arg.*	S	3	
Euphorbiaceae	Bridelia cathartica *G.Bertol.* subsp. melanthesoides *(Baill.) J.Léon.*	S	2,3	
Euphorbiaceae	Bridelia micrantha *(Hochst.) Baill.*	T	2	
Euphorbiaceae	Clutia abyssinica *Jaub.& Spach.*	S	3	
Euphorbiaceae	Croton sylvaticus *Krauss*	T	3	
Euphorbiaceae	Drypetes gerrardii *Hutch.* var. gerrardii	T	1,3	
Euphorbiaceae	Drypetes reticulata *Pax*	T	3	
Euphorbiaceae	Euphorbia ingens *Boiss.*	T	3	
Euphorbiaceae	Hymenocardia acida *Tul.*	S	2	
Euphorbiaceae	Macaranga capensis *(Baill.) Benth.*	T	2,3	
Euphorbiaceae	Margaritaria discoidea *(Baill.) Webster* var. nitida *(Pax) Radcl.-Sm.*	S	3,4	
Euphorbiaceae	Phyllanthus beillei *Hutch.*	S	1,3	

Euphorbiaceae	Phyllanthus inflatus *Hutch.*	T	4	
Euphorbiaceae	Phyllanthus polyanthus *Pax*	S	3	
Euphorbiaceae	Phyllanthus reticulatus *Poir.* var. glaber *(Baill.) Müll.Arg.*	S	3	
Euphorbiaceae	Pseudolachnostylis maprouneifolia *Pax* var. glabra *(Pax) Brenan*	T	2,3	
Euphorbiaceae	Sapium ellipticum *(C.Krauss) Pax*	T	2	
Euphorbiaceae	Uapaca kirkiana *Müll.Arg.*	T	1,2,3	
Euphorbiaceae	Uapaca nitida *Müll.Arg.*	T	1,2	
Euphorbiaceae	Uapaca sansibarica *Pax*	T	2,3	
Flacourtiaceae	Aphloia theiformis *(Vahl) Benn.*	T	1,3	
Flacourtiaceae	Dovyalis macrocalyx *(Oliv.) Warb.*	S	1,3	
Flacourtiaceae	Flacourtia indica *Merr.*	S	2	
Flacourtiaceae	Gerrardina eylesiana *Milne-Redh.*	S	3	
Flacourtiaceae	Homalium dentatum *(Harv.) Warb.*	T	3	
Flacourtiaceae	Rawsonia burtt-davyi *(Edlin) F.White* ??	T	1	sterile, but good match; Mulanje endemic
Flacourtiaceae	Rawsonia lucida *Harv.& Sond.*	T	1,3	
Flacourtiaceae	Scolopia stolzii *Gilg*	T	3	
Gentianaceae	Exacum zombense *N.E.Br.*	h	3	only S Malawi & N Mozambique
Gesneriaceae	Streptocarpus goetzei *Engl.*	h	1	
Heteropyxidaceae	Heteropyxis natalensis *Harv.*	T	2,3	
Icacinaceae	Apodytes dimidiata *Arn.*	T	3	
Lamiaceae	Achyrospermum laterale *Baker*	S	3	
Lamiaceae	Aeollanthus buchnerianus *Briq.*	h	1,3	
Lamiaceae	Aeollanthus ukamensis *Gürke*	h	3	
Lamiaceae	Haumaniastrum villosum *Oliv.*	h	3	
Lamiaceae	Leonotis decadonta *Gürke* var. decadonta	S	3	
Lamiaceae	Leonotis ocymifolia *(Burm.f.) Iwarsson* var. raineriana *(Vis.) Iwarsson*	S	3	
Lamiaceae	Leucas milanjiana *Gürke*	h	1,3	
Lamiaceae	Plectranthus alboviolaceus *Gürke*	S	3	
Lamiaceae	Plectranthus autranii *(Briq.) A.J.Paton*	h	1	
Lamiaceae	Plectranthus esculentus *(N.E.Br.) G.Taylor*	h	3	
Lamiaceae	Plectranthus pubescens *Baker*	h	3	
Lamiaceae	Plectranthus stenosiphon *Baker*	h	1	only S Malawi & C Mozambique
Lamiaceae	Plectranthus swynnertonii *S.Moore*	h	1,3	
Lamiaceae	Rotheca myricoides *(Hochst.) Steane & Mabb.*	S	3	
Lamiaceae	Scutellaria schweinfurthii *Briq.* subsp. paucifolia *(Baker) A.J.Paton*	h	3	
Lamiaceae	Tetradenia riparia *(Hochst.) Codd*	S	2	
Lamiaceae	Vitex buchananii *Gürke*	S	3	
Lamiaceae	Vitex doniana *Sweet*	T	2	
Lauraceae	Cassytha filiformis *L.*	c	3	
Lauraceae	Ocotea kenyensis *(Chiov.) Robyns & Wilczek*	T	3,4	Nampende valley, 1700m
Leg: Caesalpinioideae	Afzelia quanzensis *Welw.*	T	2	
Leg: Caesalpinioideae	Bauhinia petersiana *Bolle*	S	2	
Leg: Caesalpinioideae	Brachystegia boehmii *Taub.*	T	1	
Leg: Caesalpinioideae	Brachystegia floribunda *Benth.*	T	1	Fort Lister; uncertain id
Leg: Caesalpinioideae	Brachystegia manga *De Wild.*	T	1,3	
Leg: Caesalpinioideae	Brachystegia spiciformis *Benth.*	T	1	

Leg: Caesalpinioideae	Brachystegia tamarindoides *Benth.* var. microphylla (*Harms) Chikuni*	T	3	
Leg: Caesalpinioideae	Brachystegia utilis *Hutch.& Burtt Davy*	T	1	
Leg: Caesalpinioideae	Burkea africana *Hook.*	T	2	
Leg: Caesalpinioideae	Julbernardia globiflora *(Benth.) Troupin*	T	2	
Leg: Caesalpinioideae	Piliostigma thonningii *(Schumach.) Milne-Redh.*	T	2	
Leg: Caesalpinioideae	Pterolobium stellatum *(Forssk.) Brenan*	c	2,3,4	
Leg: Caesalpinioideae	Senna singueana *(Delile) Lock*	S	2,3	
Leg: Caesalpinioideae	Swartzia madagscariensis *Desv.*	T	1	
Leg: Mimosoideae	Acacia abyssinica *Hochst.*	T	3	
Leg: Mimosoideae	Acacia goetzei *Harms* subsp. goetzei	T	1,3	
Leg: Mimosoideae	Acacia karroo *Hayne*	T	3	Fort Lister gap
Leg: Mimosoideae	Acacia polyacantha *Willd.* subsp. campylacantha *(A.Rich.) Brenan*	T	3	
Leg: Mimosoideae	Acacia sieberiana *DC.* var. woodii *(Burtt Davy) Keay & Brenan*	T	1,3	
Leg: Mimosoideae	Albizia amara *(Roxb.) Boiv.* subsp. sericocephala *(Benth.) Brenan*	T	2,3	
Leg: Mimosoideae	Albizia antunesiana *Harms*	T	1	
Leg: Mimosoideae	Albizia gummifera *(J.F.Gmel.) C.A.Sm.*	T	1,3	
Leg: Mimosoideae	Albizia lebbeck *(L.) Benth.*	T	3	naturalised
Leg: Mimosoideae	Albizia tanganyicensis *Baker f.*	T	3	
Leg: Mimosoideae	Albizia versicolor *Oliv.*	T	2	
Leg: Mimosoideae	Dichrostachys cinerea *(L.) Wight & Arn.*	S	2,3	
Leg: Mimosoideae	Entada abyssinica *A.Rich.*	S	1	
Leg: Mimosoideae	Newtonia buchananii *(Baker) G.C.C.Gilbert & Boutique*	T	2	
Leg: Papilionoideae	Abrus precatorius *L.* subsp. africanus *Verdc.*	c	3	
Leg: Papilionoideae	Aeschynomene glauca *R.E.Fr.*	h	3	
Leg: Papilionoideae	Aeschynomene megalophylla *Harms*	S	1	
Leg: Papilionoideae	Aeschynomene nodulosa *(Baker) Baker f.*	S	1	
Leg: Papilionoideae	Craibia brevicaudata *(Vatke) Dunn* subsp. baptistarum *(Buttner) J.B.Gillett*	T	3	
Leg: Papilionoideae	Crotalaria argyroboides *Baker*	h	1	
Leg: Papilionoideae	Crotalaria natalitia *Meisn.*	h	1	
Leg: Papilionoideae	Dalbergia boehmii *Taub.*	T	1,3	
Leg: Papilionoideae	Dalbergia fischeri *Taub.*	c	3	
Leg: Papilionoideae	Dalbergia lactea *Vatke*	S	1,3,4	
Leg: Papilionoideae	Dalbergia melanoxylon *Guill.& Perr.*	S	2,3	
Leg: Papilionoideae	Dalbergia nitidula *Baker*	S	1	
Leg: Papilionoideae	Dalbergiella nyasae *Baker f.*	T	3	
Leg: Papilionoideae	Desmodium barbatum *(L.) Benth.* var. dimorphum *(Baker) B.G.Schub.*	h	3	
Leg: Papilionoideae	Desmodium repandum *(Vahl) DC.*	h	3	
Leg: Papilionoideae	Desmodium setigerum *(E.Mey.) Benth.*	h	3	
Leg: Papilionoideae	Dolichos sericeus *E.Mey.* subsp. sericeus	h	3	
Leg: Papilionoideae	Eriosema nutans *Schinz*	h	3	
Leg: Papilionoideae	Erythrina abyssinica *DC.*	T	2	
Leg: Papilionoideae	Indigofera atriceps *Hook.f.*	h	3	
Leg: Papilionoideae	Indigofera emarginella *A.Rich.* var. emarginella	h	1,3	
Leg: Papilionoideae	Indigofera fulvopilosa *Brenan*	h	3	
Leg: Papilionoideae	Kotschya scaberrima *(Taub.) Wild*	S	2,3	FZ montane endemic
Leg: Papilionoideae	Lablab purpureus *(L.) Sweet* subsp. uncinatus *Verdc.*	c	3	
Leg: Papilionoideae	Millettia lasiantha *Dunn.*	c	1,3	
Leg: Papilionoideae	Mucuna coriacea *Baker* subsp. irritans *(Burtt Davy) Verdc.*	c	2	

Leg: Papilionoideae	Mucuna poggei *Taub.* var. pesa *(De Wild.) Verdc.*	c	4	
Leg: Papilionoideae	Mucuna pruriens *(L.) DC.* var. pruriens	c	2	
Leg: Papilionoideae	Mundulea sericea *(Willd.) A.Chev.*	T	3	
Leg: Papilionoideae	Pericopsis angolensis *(Baker) van Meeuwen*	T	1	
Leg: Papilionoideae	Philenoptera bussei *(Harms) Schrire*	T	3	
Leg: Papilionoideae	Philenoptera violacea *(Klotzsch) Schrire*	T	3	
Leg: Papilionoideae	Pterocarpus angolensis *DC.*	T	2	
Leg: Papilionoideae	Sesbania macrantha *Phill.& Hutch.* var. macrantha	S	3	
Leg: Papilionoideae	Tephrosia aequilata *Baker*	S	3	
Leg: Papilionoideae	Tephrosia decora *Baker*	h	3	
Leg: Papilionoideae	Tephrosia elata *Deflers* subsp. heckmanniana *(Harms) Brummitt*	h	1	
Loganiaceae	Anthocleista grandiflora *Gilg*	T	2	
Loganiaceae	Nuxia congesta *Fresen.*	S	3	
Loganiaceae	Nuxia oppositifolia *(Hochst.) Benth.*	S	1	
Loganiaceae	Strychnos cocculoides *Baker*	T	1,3	
Loganiaceae	Strychnos henningsii *Gilg*	T	1,3	
Loganiaceae	Strychnos innocua *Delile*	S	3	
Loganiaceae	Strychnos lucens *Baker*	c	1	
Loganiaceae	Strychnos madagascariensis *Poir.*	T	2	
Loganiaceae	Strychnos mitis *S.Moore*	T	3,4	Nandiwo gorge, 1000-1300m
Loganiaceae	Strychnos potatorum *L.f.*	T	3	
Loganiaceae	Strychnos spinosa *Lam.*	T	2	
Loranthaceae	Globimetula mweroensis *(Baker) Danser*	s	3	
Loranthaceae	Phragmanthera usuiensis *(Oliv.) M.Gilbert* subsp. sigensis *(Engl.) Polhill & Wiens*	s	3	
Loranthaceae	Plicosepalus kalachariensis *(Schinz) Danser*	s	3	
Loranthaceae	Tapinanthus erianthus *(Sprague) Danser*	s	3	
Loranthaceae	Tapinanthus forbesii *(Sprague) Wiens*	s	1,3	
Malvaceae	Hibiscus burtt-davyi *Dunkley*	S	3	
Malvaceae	Hibiscus fuscus *Garcke*	h	3	
Malvaceae	Pavonia columella *Cav.*	h	3,4	
Melastomataceae	Dissotis canescens *(Graham) Hook.f.*	h	3	
Melastomataceae	Dissotis johnstoniana *Baker f.* var. johnstoniana	S	3	Mulanje & Namuli endemic
Melastomataceae	Memecylon sansibaricum *Taub.*	T	3	
Melastomataceae	Warneckea sansibarica *(Taub.) Jacq.-Felix*	T	1	
Meliaceae	Ekebergia benguelensis *C.DC.*	T	1	
Meliaceae	Ekebergia capensis *Sparrm.*	T	3	
Meliaceae	Khaya anthotheca *(Welw.) C.DC.*	T	2	
Meliaceae	Leptotrichilia volkensii *(Gürke) Leroy*	T	1	
Meliaceae	Toona cf. ciliata *M.Roem.*	T	2	naturalised
Meliaceae	Trichilia dregeana *Sond.*	T	1	
Meliaceae	Turraea holstii *Gürke*	T	3	
Meliaceae	Turraea nilotica *Kotschy & Peyr.*	S	3	
Melianthaceae	Bersama abyssinica *Fresen.* subsp. abyssinica	T	3	
Melianthaceae	Bersama abyssinica *Fresen.* subsp. engleriana *(Gürke) F.White*	T	1	
Menispermaceae	Tiliacora funifera *(Miers) Oliv.*	c	4	
Monimiaceae	Xymalos monospora *(Harv.) Baill.*	T	2	
Moraceae	Ficus cyathistipula *Warb.*	T	1	
Moraceae	Ficus exasperata *Vahl*	T	2	
Moraceae	Ficus glumosa *Delile*	T	1	
Moraceae	Ficus ingens *(Miq.) Miq.*	T	3	

Moraceae	Ficus modesta *F.White*	T	3,4	sensu EFFM; only in S Malawi
Moraceae	Ficus natalensis *Hochst.* subsp. natalensis	T	2,3	
Moraceae	Ficus scassellatii *Pamp.*	T	3	
Moraceae	Ficus stuhlmannii *Warb.*	T	1	
Moraceae	Ficus thonningii *Blume*	T	1	
Moraceae	Ficus vallis-choudae *Delile*	T	1	
Moraceae	Trilepisium madagascariense *DC.*	T	1,3	
Myricaceae	Morella pilulifera *(Rendle) Killick*	S	3	
Myricaceae	Morella serrata *(Lam.) Killick*	S	1	
Myrsinaceae	Embelia schimperi *Vatke*	c	3	
Myrsinaceae	Maesa lanceolata *Forssk.*	T	2	
Myrsinaceae	Myrsine africana *L.*	S	2	
Myrsinaceae	Rapanea melanophloeos *(L.) Mez*	T	2	
Myrtaceae	Eugenia capensis *(Eckl.& Zeh.) Sond.* subsp. nyassensis *(Engl.) F.White*	T	1,3	
Myrtaceae	Syzygium cordatum *Krauss*	T	1,3	
Myrtaceae	Syzygium guineense *(Willd.) DC.* subsp. afromontanum *F.White*	T	1,3	
Myrtaceae	Syzygium guineense *(Willd.) DC.* subsp. guineense	T	3	
Ochnaceae	Brackenridgea zanguebarica *Oliv.*	S	3	
Ochnaceae	Ochna gambleoides *N.Robson*	S	1,3	
Ochnaceae	Ochna holstii *Engl.*	T	1,3	
Ochnaceae	Ochna schweinfurthiana *F.Hoffm.*	T	2,3	
Olacaceae	Olax dissitiflora *Oliv.*	T	1,3	
Olacaceae	Olax obtusifolia *De Wild.*	T	1,3	
Olacaceae	Strombosia scheffleri *Engl.*	T	2	
Olacaceae	Ximenia americana *L.*	S	2	
Olacaceae	Ximenia caffra *Sond.*	S	2	
Oleaceae	Chionanthus foveolatus *(E.Mey.) Stearn* subsp. major *(I.Verd.) Stearn*	T	1	
Oleaceae	Olea capensis *L.*	T	1,3	
Oleaceae	Schrebera alata *(Hochst.) Welw.*	T	4	
Oleaceae	Schrebera trichoclada *Welw.*	T	3	
Oliniaceae	Olinia rochetiana *A.Juss.*	S	3	
Opiliaceae	Opilia amentacea *Roxb.*	S	3	
Piperaceae	Peperomia abyssinica *Miq.* var. abyssinica	h	3	
Piperaceae	Peperomia tetraphylla *(Forst.) Hook.& Arn.*	h	3	
Pittosporaceae	Pittosporum viridiflorum *Sims*	T	2,3,4	
Polygalaceae	Securidaca longipedunculata *Fresen.*	T	2	
Proteaceae	Faurea racemosa *Farmar*	T	3,4	endemic to S Malawi & Namuli
Proteaceae	Faurea rochetiana *(A.Rich.) Pic.Serm.*	T	2	
Proteaceae	Faurea saligna *Harv.*	T	2	
Proteaceae	Protea angolensis *Welw.*	S	1	
Proteaceae	Protea caffra *Meisn.* subsp. nyasae *(Rendle) Chisumpa & Brummitt*	S	3,4	Mulanje endemic
Proteaceae	Protea madiensis *Oliv.* subsp. madiensis	S	3,4	Fort Lister gap
Ranunculaceae	Clematis brachiata *Thunb.*	c	3	
Ranunculaceae	Clematis simensis *Fresen.*	c	1	
Ranunculaceae	Thalictrum rhychocarpum *Dill. & A.Rich.*	h	1	
Rhamnaceae	Gouania longispicata *Engl.*	c	3	
Rhamnaceae	Helinus integrifolius *(Lam.) Kuntze*	c	3	
Rhizophoraceae	Cassipourea malosana *(Baker) Alston*	T	1,3	
Rosaceae	Prunus africana *(Hook.f.) Kalkman*	T	1,3,4	

Rubiaceae	Aida micrantha *(K.Schum.) F.White* var. msonju *(K.Krause) Petit*	T	1	
Rubiaceae	Anthospermum welwitschii *Hiern*	S	3	
Rubiaceae	Breonadia salicina *(Vahl) Hepper & J.R.I.Wood*	T	2,4	
Rubiaceae	Catunaregum spinosa *(Thunb.) Tirveng.* subsp. taylori *(S.Moore) Verdc.*	S	2,3	
Rubiaceae	Coffea mufindiensis *Bridson* subsp. australis *Bridson*	S	1,3	
Rubiaceae	Coptospermum neurophyllum *(S.Moore) Degreef*	S	3	
Rubiaceae	Cremospora triflora *(Thonn.) K.Schum.* subsp. triflora	S	1,3,4	
Rubiaceae	Crossopteryx febrifuga *(G.Don) Benth.*	T	2,3	
Rubiaceae	Fadogia ancylantha *Hiern*	S	3	
Rubiaceae	Gardenia ternifolia *Schumach.& Thonn.* subsp. jovis-tonantis *(Welw.) Verdc.*	S	3	
Rubiaceae	Geophila repens *(L.) I.M.Johnst.*	h	3	
Rubiaceae	Hymenodictyon floribundum *(Hochst.& Steud.) B.L.Rob.*	T	1,4	Fort Lister gap
Rubiaceae	Hymenodictyon parvifolium *Oliv.*	T	3	
Rubiaceae	Ixora scheffleri *K.Schum.& K.Krause* subsp. scheffleri	T	1,3	
Rubiaceae	Keetia gueinzii *(Sond.) Bridson*	c	3	
Rubiaceae	Keetia venosa *(Oliv.) Bridson*	c	3	
Rubiaceae	Lasianthus kilimandscharicus *K.Schum.*	S	1	
Rubiaceae	Mussaenda arcuata Poir.	S	1	
Rubiaceae	Oxyanthus speciosus *DC.* subsp. stenocarpus *(K.Schum.) Bridson*	S	1,3	
Rubiaceae	Pauridiantha paucinervis *(Hiern) Bremek.* subsp. holstii *(K.Schum.) Verdc.*	S	1	
Rubiaceae	Pauridiantha symplocoides *(S.Moore) Bremek.*	T	3,4	
Rubiaceae	Pavetta chapmanii *Bridson*	T	3	
Rubiaceae	Pavetta crassipes *K.Schum.*	S	3	
Rubiaceae	Pavetta gardeniifolia *A.Rich.*	S	3	
Rubiaceae	Pavetta schumanniana *K.Schum.*	S	2	
Rubiaceae	Psychotria kirkii *Hiern*	S	3	
Rubiaceae	Psychotria zombamontana *(Kuntze) E.M.A.Petit*	S	1,3	
Rubiaceae	Psydrax parviflora *(Afzel.) Bridson* subsp. chapmanii *Bridson*	T	3	
Rubiaceae	Pyrostria chapmanii *Bridson* subsp. chapmanii	T	1	Mulanje endemic
Rubiaceae	Rothmannia engeleriana *(K.Schum.) Keay*	T	1,3	
Rubiaceae	Rothmannia fischeri *(K.Schum.) Bullock*	T	3	
Rubiaceae	Rothmannia manganjae *(Hiern) Keay*	S	3	
Rubiaceae	Rytigynia uhligii *(K.Schum.& K.Krause) Verdc.*	S	1,3	
Rubiaceae	Sericanthe andongensis *(Hiern) Robbr.* var. andongensis	S	3	
Rubiaceae	Sericanthe andongensis *(Hiern) Robbr.* var. mollis *Robbr.*	S	3	
Rubiaceae	Tapiphyllum velutinum *(Hiern) Robyns*	S	1,3	
Rubiaceae	Tarenna pavettoides *(Harv.) Sim* subsp. affinis *(K.Schum.) Bridson*	T	3	
Rubiaceae	Tricalysia acocantheroides *K.Schum.*	S	3	
Rubiaceae	Tricalysia coriacea *(Benth.) Hiern*	S	3	
Rubiaceae	Vangueria apiculata *K.Schum.*	S	3,4	
Rubiaceae	Vangueria infausta *Burch.*	S	1	
Rutaceae	Toddalia asiatica *(L.) Lam.*	c	2,3	
Rutaceae	Vepris bachmannii *(Engl.) Mziray*	T	1,3	
Rutaceae	Vepris nobilis *(Delile) Mziray*	T	3	
Rutaceae	Vepris trichocarpa *(Engl.) Mziray*	T	3,4	
Santalaceae	Osyris lanceolata *Hochst.& Steud.*	S	3	
Sapindaceae	Allophylus africanus *Beauv.*	S	1,3	
Sapindaceae	Allophylus chaunostachys *Gilg*	S	1,3	
Sapindaceae	Dodonaea viscosa *Jacq.*	S	2	

Sapindaceae	Filicium decipiens *(Wight & Arn.) Thwaites*	T	4	
Sapindaceae	Haplocoelum foliolosum *(Hiern) Bullock*	T	1,3	
Sapindaceae	Lecaniodiscus fraxinifolius *Baker*	T	3,4	
Sapindaceae	Pappea capensis *(Spreng.) Eckl.& Zeyh.*	T	3	
Sapindaceae	Zanha africana *(Radlk.) Exell*	T	2,3	
Sapindaceae	Zanha golungensis *Hiern*	T	3,4	
Sapotaceae	Chrysophyllum gorungosanum *Engl.*	T	1,3	
Sapotaceae	Englerophytum magalismontanum *(Sond.) T.D.Penn.*	T	1,4	
Sapotaceae	Englerophytum natalense *(Sond.) T.D.Penn.*	T	1,4	
Sapotaceae	Manilkara discolor *(Sond.) J.H.Hemsl.*	T	3	
Sapotaceae	Mimusops zeyheri *Sond.*	T	1	
Sapotaceae	Synsepalum brevipes *(Baker) T.D.Penn.*	T	1,4	
Scrophulariaceae	Buchnera hispida *D.Don*	h	3	
Scrophulariaceae	Diclis tenella *Hemsl.*	h	3	
Scrophulariaceae	Halleria elliptica *Thunb.*	S	1,3	
Scrophulariaceae	Orobanche minor *Smith*	h	1	
Scrophulariaceae	Sopubia ramosa *(Hochst.) Hochst.*	h	1	
Simaroubaceae	Harrisonia abyssinica *Oliv.*	S	3,4	
Simaroubaceae	Kirkia acuminata *Oliv.*	T	2,3	
Solanaceae	Solanum anguivi *Lam.*	h	3	
Solanaceae	Solanum terminale *Forssk.*	c	1	
Sterculiaceae	Cola greenwayi *Brenan*	T	1,3	
Sterculiaceae	Dombeya burgessiae *Harv.*	S	1,4	
Sterculiaceae	Dombeya rotundifolia *(Hochst.) Planch.*	S	2,3	
Sterculiaceae	Dombeya torrida *(J.F Gmel.) Bamps* subsp. erythroleuca *(K.Schum.) Seyani*	T	3	
Thymeleaeaceae	Gnidia chapmanii *B. Peterson*	S	1,3,4	only Mulanje & Namuli
Thymeleaeaceae	Synaptolepis alternifolia *Oliv.*	S	3	
Tiliaceae	Grewia flavescens *Juss.*	S	1	
Tiliaceae	Grewia micrantha *Bojer*	S	3	
Tiliaceae	Sparmannia ricinocarpa *(Eckl.& Zeyh) Kuntze*	S	1,3,4	
Tiliaceae	Triumfetta pilosa *Roth* var. effusa *(Harv.) Wild*	h	3	
Tiliaceae	Triumfetta rhomboidea *Jacq.*	h	2,3	
Ulmaceae	Celtis africana *Burm.f.*	T	3	
Ulmaceae	Celtis gomphophylla *Baker*	T	3	
Ulmaceae	Trema orientalis *(L.) Blume*	T	2	
Urticaceae	Girardinia diversifolia *(Link) Friis*	h	4	
Urticaceae	Urera cameroonensis *Wedd.*	c	1	
Verbenaceae	Lippia javanica *(Burm.f.) Spreng.*	h	4	
Viscaceae	Viscum combreticola *Engl.*	s	3	
Viscaceae	Viscum cylindricum *Polhill & Wiens*	s	3,4	
Viscaceae	Viscum shirense *Sprague*	s	3	
Viscaceae	Viscum triflorum *DC.*	s	3,4	
Vitaceae	Cissus aff. cucumerifolia *Planch.*	c	3	
Vitaceae	Cissus cornifolia *(Baker) Planch.*	s	3	
Vitaceae	Cissus petiolata *Hook.f.*	c	3	
Vitaceae	Cyphostemma kilimandscharicum *(Gilg) Wild & R.B.Drumm.* var. kilimandscharicum	c	3	
Vitaceae	Cyphostemma masukense *(Baker) Wild & R.B.Drumm.* subsp. masukense	c	3	

ANNEX 3. Mt Mchese disturbance transect – position.

Transect starts next to a large *Brachystegia manga* tree (waypoint TOD 01) just inside the Forest Reserve boundary, a few hundred metres from the old District Commissioner's house. This ruined house is situated close to the road from Phalombe to the Forest Department offices, on the left soon after crossing the Nampolo River. The transect is 1000 m long, heading in a straight line NNE (60^{o}) towards the main Mchese peak.

waypoint	distance (m)	south	east	altitude (m)*
TOD 00		15^{o}49'48.7"	35^{o}40'58.9"	1102
TOD 01	0	15^{o}49'47.5"	35^{o}41'03.0"	1115
TOD 02	50	15^{o}49'46.8"	35^{o}41'04.5"	1124
TOD 03	100	15^{o}49'45.0"	35^{o}41'05.8"	1131
TOD 04	150	15^{o}49'44.2"	35^{o}41'08.7"	1143
TOD 05	200	15^{o}49'44.3"	35^{o}41'10.1"	1149
TOD 06	300	15^{o}49'42.7"	35^{o}41'11.6"	1167
TOD 07	350	15^{o}49'42.2"	35^{o}41'13.1"	1178
TOD 08	400	15^{o}49'41.1"	35^{o}41'14.4"	1169
TOD 09	450	15^{o}49'40.0"	35^{o}41'15.9"	1182
TOD 10	500	15^{o}49'39.4"	35^{o}41'17.3"	1196
TOD 11	550	15^{o}49'38.4"	35^{o}41'18.9"	1203
TOD 12	600	15^{o}49'37.9"	35^{o}41'19.5"	1220
TOD 13	650	15^{o}49'37.0"	35^{o}41'21.4"	1227
TOD 14	700	15^{o}49'36.0"	35^{o}41'23.0"	1232
TOD 15	750	15^{o}49'35.3"	35^{o}41'24.1"	1225
TOD 16	800	15^{o}49'34.4"	35^{o}41'25.4"	1263
TOD 17	850	15^{o}49'34.1"	35^{o}41'26.7"	1286
TOD 18	900	15^{o}49'32.9"	35^{o}41'28.4"	1298
TOD 19	950	15^{o}49'32.1"	35^{o}41'29.8"	1277
TOD 20	1000	15^{o}49'30.7"	35^{o}41'31.0"	1313

* altitude from GPS; not accurate

ANNEX 4. Mt Mchese disturbance transect – Combined data, June 2008.

DISTURBANCE TRANSECT – Combined data, by distance													
species	**cut (Y/N)**	**live/dead**	**diam. 1**	**diam. 2**	**BA (cm²)**	**cut diam.1**	**cut diam.2**	**BA (cm²)**	**total BA (cm²)**	**dist. (m)**	**notes**		
BRAC MANG	N	L	74.0		4301.40			0.00	4301.40	2.65	fork @1.5m		
CUSS ARBO	N	L	4.5		15.91			0.00	15.91	3.75			
XIME CAFF	Y	L			0.00	6.4		32.17	32.17	4.60			
BRAC MANG	Y	L			0.00	7.0		38.49	38.49	5.20			
BRAC MANG	Y	L			0.00	9.4		69.41	69.41	6.25			
BRAC MANG	Y	L			0.00	16.1	7.3	245.47	245.47	7.45			
BRAC MANG	N	L	5.7	4.0	38.09			0.00	38.09	7.75			
UAPA KIRK	Y	L			0.00	8.2		52.82	52.82	8.30			
BRAC MANG	Y	L			0.00	8.7		59.45	59.45	8.45			
BRAC MANG	Y	L			0.00	7.7		46.57	46.57	11.40			
COMB ADEN	N	L	4.0	4.0	25.14			0.00	25.14	12.25			
COMB ADEN	N	L	7.5		44.18			0.00	44.18	12.25			
CUSS ARBO	N	L	7.0		38.49			0.00	38.49	12.75			
UAPA KIRK	N	L	10.0		78.55			0.00	78.55	12.90			
PTER ANGO	N	L	4.8		18.10			0.00	18.10	14.65			
BRAC MANG	N	D	15.8		196.09			0.00	196.09	15.15	dead		
UAPA KIRK	Y	L			0.00	5.0		19.64	19.64	15.75	cut @ under 1.3m		
ANNO SENE	Y	L			0.00	5.8		26.42	26.42	20.40	cut @ under 1.3m		
CUSS ARBO	N	L	6.7	5.5	59.02			0.00	59.02	20.50	2 stems from base		
COMB ADEN	N	L	5.5		23.76			0.00	23.76	21.45			
COMB ADEN	Y	L			0.00	9.0		63.63	63.63	21.45			
VITE DONI	Y	L			0.00	6.0		28.28	28.28	21.46			
BRAC MANG	Y	L			0.00	7.2		40.72	40.72	24.00	cut @ under 1.3m		
BRAC MANG	Y	L			0.00	20.0	11.8	423.57	423.57	25.25	same tree		
BRAC MANG	Y	L			0.00	5.0	4.0	32.21	32.21	25.25	same tree		
BRAC MANG	Y	L			0.00	6.4	4.4	47.38	47.38	25.25	same tree		
CUSS ARBO	N	L	4.2		13.86			0.00	13.86	27.00	2 stems from base		
UAPA KIRK	Y	L			0.00	18.0		254.50	254.50	28.30	cut @ under 1.3m		
UAPA KIRK	Y	L			0.00	24.0		452.45	452.45	29.30			
VITE DONI	Y	L			0.00	5.0		19.64	19.64	29.30	cut @ under 1.3m		
UAPA KIRK	N	L	9.8		75.44			0.00	75.44	30.65			

VITE DONI	Y	L			0.00	8.7		59.45	59.45	32.15	shoots from base		
VITE DONI	N	L	8.6		58.10			0.00	58.10	35.25			
UAPA KIRK	N	L	19.1		286.56			0.00	286.56	36.85			
BRAC MANG	Y	L			0.00	9.5		70.89	70.89	38.00			
BRAC MANG	N	L	7.8		47.79			0.00	47.79	39.00			
JULB GLOB	N	L	5.0		19.64			0.00	19.64	39.10			
BRAC MANG	Y	L			0.00	11.0		95.05	95.05	42.10			
PTER ANGO	Y	L			0.00	46.5		1698.45	1698.45	42.50	cut at base		
BRAC MANG	Y	L			0.00	6.7		35.26	35.26	42.65			
CUSS ARBO	Y	L			0.00	7.8		47.79	47.79	43.00			
BRAC UTIL	Y	L			0.00	5.5	4.8	41.86	41.86	43.95			
JULB GLOB	N	L	6.8	5.5	60.08			0.00	60.08	44.30			
PARI CURA	N	L	4.4		15.21			0.00	15.21	44.35			
PARI CURA	N	L	4.0		12.57			0.00	12.57	44.40			
PARI CURA	N	L	4.9		18.86			0.00	18.86	44.40			
???	Y	D			0.00	13.0		132.75	132.75	46.30			
JULB GLOB	Y	L			0.00	7.2	5.2	61.96	61.96	46.80			
BRAC MANG	Y	L			0.00	6.2		30.19	30.19	49.65			
BRAC MANG	Y	L			0.00	7.5		44.18	44.18	50.00			
PROT ANGO	Y	L			0.00	4.0		12.57	12.57	50.33			
ANNO SENE	N	L	7.4		43.01			0.00	43.01	50.45			
UAPA KIRK	Y	L	25.9	23.8	971.86	14.0	14.3	314.58	1286.44	52.20	2 stems		
ANNO SENE	Y	L			0.00	7.0		38.49	38.49	54.00			
ANNO SENE	N	L	7.4		43.01			0.00	43.01	56.10			
JULB GLOB	Y	L			0.00	11.5		103.88	103.88	56.50			
PARI CURA		L			0.00	10.5		86.60	86.60	57.00	??		
ROTH SPP	N	L	5.4		22.91			0.00	22.91	57.20			
PSOR FEBR	N	L	4.8	4.9	36.96			0.00	36.96	57.40			
BRAC MANG	Y	L			0.00	7.0		38.49	38.49	58.40			
BRAC MANG	Y	L			0.00	5.6		24.63	24.63	60.50			
BRAC MANG	Y	L			0.00	8.9	7.0	100.71	100.71	60.85	same tree		
BRAC MANG	Y	L			0.00	6.3		31.18	31.18	60.85	same tree		
BRAC MANG	Y	L			0.00	6.0		28.28	28.28	61.00			
BRAC MANG	Y	L			0.00	4.1		13.20	13.20	61.20			
PTER ANGO	N	L	32.0	8.0	854.62			0.00	854.62	62.20	fork above 1.5m		
BRAC MANG	Y	L			0.00	6.9		37.40	37.40	63.00			
PSOR FEBR	Y	L			0.00	6.0		28.28	28.28	63.30			

LANN DISC	N	L	4.4		15.21			0.00	15.21	63.50			
LANN DISC	N	L	4.0		12.57			0.00	12.57	65.00			
BRAC MANG	Y	L			0.00	8.8		60.83	60.83	66.65			
ANNO SENE	Y	L			0.00	13.0	11.0	227.80	227.80	79.00	same tree		
ANNO SENE	Y	L			0.00	4.0		12.57	12.57	79.00	same tree		
COMB ADEN	N	L	6.5		33.19			0.00	33.19	80.00	same tree		
COMB ADEN	N	L	27.0	10.2	654.35			0.00	654.35	80.00	same tree		
PTER ANGO	N	L	32.7		839.93			0.00	839.93	84.80			
BRID MICR	Y	L	7.0	11.4	140.57	9.0		63.63	204.20	86.20	only 1 stem cut	**no. trees**	**81**
COMB ADEN	N	L	5.2		21.24			0.00	21.24	94.00		BA uncut	9,713.00
LANN DISC	N	Y	4.0		12.57			0.00	12.57	98.40		BA cut	6,511.77
BRAC MANG	Y	L			0.00	36.0		1018.01	1018.01	99.00		**Total BA**	**16,224.77**
BRAC MANG	N	L	26.8		564.18			0.00	564.18	99.30		**% BA cut**	**40.1**
CUSS ARBO	N	L	6.2		30.19			0.00	30.19	104.00			
LANN DISC	N	L	4.0		12.57			0.00	12.57	104.50			
BRAC MANG	N	L	28.8		651.53			0.00	651.53	107.20			
???	Y	D			0.00	4.0		12.57	12.57	108.00			
BRAC MANG	N	L	60.0		2827.80			0.00	2827.80	112.00			
PSOR FEBR	N	L	4.9		18.86			0.00	18.86	114.40			
BRAC MANG	N	L	24.4		467.66			0.00	467.66	117.20			
BRAC MANG	N	L	27.2		581.14			0.00	581.14	117.20			
ANON SENE	N	L	5.2	7.1	60.84			0.00	60.84	123.85			
ANON SENE	Y	L			0.00	6.0	5.5	52.04	52.04	124.55			
VITE DONI	N	L	5.9		27.34			0.00	27.34	125.80			
UAPA KIRK	N	L	7.5		44.18			0.00	44.18	128.75			
BRAC MANG	Y	L			0.00	5.8		26.42	26.42	130.25			
UAPA KIRK	N	L	9.7		73.91			0.00	73.91	131.20			
UAPA KIRK	Y	L			0.00	8.3		54.11	54.11	132.80	cut below 1.3m		
UAPA KIRK	N	L	16.5		213.85			0.00	213.85	135.50			
UAPA KIRK	N	L	14.0		153.96			0.00	153.96	138.40			
UAPA KIRK	Y	D			0.00	16.0		201.09	201.09	139.70	dead		
UAPA KIRK	N	L	18.6		271.75			0.00	271.75	140.65			
BRAC MANG	Y	L			0.00	6.0		28.28	28.28	141.65			
UAPA KIRK	Y	L			0.00	9.0		63.63	63.63	141.65	cut above 1.3m		
UAPA KIRK	Y	L			0.00	11.2		98.53	98.53	143.70			
UAPA KIRK	Y	L			0.00	9.4		69.41	69.41	145.00			

UAPA KIRK	Y	L			0.00	4.7		17.35	17.35	145.30			
BRAC MANG	Y	L			0.00	5.6		24.63	24.63	147.00			
BRAC MANG	Y	L			0.00	5.2		21.24	21.24	147.00			
UAPA KIRK	N	L	18.3		263.06			0.00	263.06	147.00			
UAPA KIRK	N	L	18.2		260.19			0.00	260.19	148.00			
UAPA KIRK	N	L	26.0		531.00			0.00	531.00	149.00			
BRAC MANG	Y	L			0.00	6.0		28.28	28.28	150.00			
UAPA KIRK	N	L	12.0		113.11			0.00	113.11	151.50			
BRAC UTIL	Y	L			0.00	7.0		38.49	38.49	152.20			
BRAC UTIL	Y	L			0.00	4.7		17.35	17.35	153.00	cut @ base		
???	Y	D			0.00	7.2		40.72	40.72	153.70	cut below 1.3m		
BRAC UTIL	Y	L			0.00	12.0		113.11	113.11	153.80			
BRAC UTIL	Y	L			0.00	7.4		43.01	43.01	154.60	cut below 1.3m		
BRAC MANG	Y	L			0.00	5.5		23.76	23.76	155.80	cut below 1.3m		
VITE DONI	N	L	11.5		103.88			0.00	103.88	156.70			
UAPA KIRK	N	L	21.5		363.10			0.00	363.10	157.50			
BRAC MANG	N	L	5.8		26.42			0.00	26.42	159.00			
PTER ANGO	Y	L			0.00	9.4		69.41	69.41	160.30			
PTER ANGO	Y	L			0.00	5.5		23.76	23.76	161.15	cut below 1.3m		
PTER ANGO	Y	L			0.00	5.4		22.91	22.91	162.30	cut below 1.3m		
BRAC MANG	Y	L			0.00	7.8		47.79	47.79	162.55			
BURK AFRI	Y	L			0.00	20.3		323.70	323.70	163.00			
BRAC UTIL	Y	L			0.00	11.0		95.05	95.05	165.00	cut below 1.3m		
BRAC MANG	Y	L			0.00	4.5		15.91	15.91	166.50	cut above 1.3m		
BRAC MANG	Y	L			0.00	5.8		26.42	26.42	167.00	cut above 1.3m		
UAPA KIRK	N	L	16.7		219.07			0.00	219.07	167.00			
UAPA KIRK	Y	L			0.00	5.3		22.06	22.06	167.00	cut below 1.3m		
UAPA KIRK	N	L	18.3		263.06			0.00	263.06	167.30	forked		
BRAC MANG	Y	L			0.00	8.0		50.27	50.27	168.00			
JULB GLOB	N	L	18.5		268.84			0.00	268.84	168.80			
???	Y	D			0.00	5.5		23.76	23.76	169.60	dead		
BRAC MANG	N	L	7.2		40.72			0.00	40.72	170.45			
UAPA KIRK	N	L	16.3	6.7	243.96			0.00	243.96	171.15			
BRAC MANG	Y	L			0.00	5.2		21.24	21.24	175.00	cut above 1.3m		
BRAC MANG	Y	L			0.00	8.0		50.27	50.27	175.20	cut below 1.3m		
BRAC MANG	Y	L			0.00	10.9		93.33	93.33	176.00	stump		
UAPA KIRK	N	L	13.0	12.3	251.59			0.00	251.59	178.30			

UAPA KIRK	N	L	14.6		167.44			0.00	167.44	179.00			
BRAC MANG	Y	L			0.00	6.9		37.40	37.40	179.50	cut below 1.3m		
BRAC MANG	Y	L			0.00	5.9		27.34	27.34	180.40	cut below 1.3m		
UAPA KIRK	N	L	13.3		138.95			0.00	138.95	181.50			
BRAC MANG	Y	L			0.00	5.5		23.76	23.76	183.00	cut above 1.3m		
PTER ANGO	Y	L			0.00	10.2		81.72	81.72	185.75	cut @ base		
UAPA KIRK	Y	L			0.00	9.3		67.94	67.94	189.50	cut below 1.3m		
???	N	D	16.6		216.45			0.00	216.45	193.25		**no. trees**	**72**
UAPA KIRK	Y	L	16.7		219.07			0.00	219.07	194.20		BA uncut	9,167.33
BRAC MANG	Y	L			0.00	19.0		283.57	283.57	196.30	cut above 1.3m	BA cut	2,731.34
UAPA KIRK	Y	L			0.00	21.1		349.71	349.71	196.80		**Total BA**	**11,898.68**
STEG ARAL	N	L	7.3		41.86			0.00	41.86	197.00		**% BA cut**	**23.0**
LANN DISC	Y	L			0.00	12.4		120.78	120.78	200.00			
FLUE VIRO	Y	L			0.00	6.5	5.9	60.53	60.53	201.70	cut below 1.3m		
BRAC MANG	Y	L			0.00	43.7		1500.06	1500.06	201.85			
PTER ANGO	N	L	7.3		41.86			0.00	41.86	202.00			
BRAC MANG	N	L	38.1		1140.24			0.00	1140.24	205.00			
LANN DISC	Y	L			0.00	13.0		132.75	132.75	205.14			
ROTH SPP	N	L	5.0		19.64			0.00	19.64	211.20			
PTER ANGO	N	L	6.7		35.26			0.00	35.26	214.75			
BRAC UTIL	N	L	18.6		271.75			0.00	271.75	215.75			
UAPA KIRK	N	L	7.2		40.72			0.00	40.72	216.70			
UAPA KIRK	N	L	6.5		33.19			0.00	33.19	217.20			
UAPA KIRK	N	L	17.6		243.32			0.00	243.32	217.70			
UAPA KIRK	Y	L			0.00	8.0		50.27	50.27	219.25			
UAPA KIRK	Y	L			0.00	12.5		122.73	122.73	219.25			
UAPA KIRK	N	L	16.7		219.07			0.00	219.07	220.50			
PARI CURA	Y	L			0.00	5.0		19.64	19.64	226.40	cut below 1.3m		
UAPA KIRK	Y	L			0.00	9.0		63.63	63.63	227.30			
UAPA KIRK	Y	L			0.00	12.5		122.73	122.73	229.00	cut below 1.3m		
UAPA KIRK	Y	L			0.00	8.5		56.75	56.75	229.25			
UAPA KIRK	N	L	12.6		124.71			0.00	124.71	233.00			
BRAC MANG	N	L	47.5		1772.28			0.00	1772.28	234.50			
UAPA KIRK	N	L	5.0	4.2	33.49			0.00	33.49	237.00	forked below 1.3m		
DALB NITI	N	L	8.3	6.5	87.30			0.00	87.30	239.40			
CUSS ARBO	N	L	4.9	4.0	31.43			0.00	31.43	241.75			

LANN DISC	N	L	6.0		28.28			0.00	28.28	242.00			
BRAC MANG	Y	D			0.00	21.3		356.37	356.37	244.00	dead		
STEG ARAL	N	L	10.5	11.0	181.65			0.00	181.65	247.00			
LANN DISC	N	L	7.0		38.49			0.00	38.49	249.75			
LANN DISC	N	L	8.2		52.82			0.00	52.82	256.70			
STEG ARAL	Y	L			0.00	16.4	6.0	239.55	239.55	256.70			
UAPA KIRK	N	L	10.0		78.55			0.00	78.55	262.10			
BRAC MANG	Y	L			0.00	7.4		43.01	43.01	263.75			
PTER ANGO	Y	L			0.00	9.7		73.91	73.91	265.00			
BRAC MANG	Y	L			0.00	6.4		32.17	32.17	266.00			
UAPA KIRK	N	L	24.3		463.83			0.00	463.83	267.50			
PTER ANGO	Y	L			0.00	8.4	4.1	68.63	68.63	268.45	same tree		
PTER ANGO	Y	L			0.00	8.0	5.0	69.91	69.91	268.45	same tree		
UAPA KIRK	N	L	13.0		132.75			0.00	132.75	272.90			
UAPA KIRK	N	L	19.0		283.57			0.00	283.57	272.90			
PTER ANGO	Y	L			0.00	10.5	10.3	169.94	169.94	273.20			
UAPA KIRK	N	L	14.1		156.17			0.00	156.17	274.80			
UAPA KIRK	N	L	17.0		227.01			0.00	227.01	276.00			
UAPA KIRK	Y	L			0.00	10.8		91.62	91.62	276.50	cut below 1.3m		
UAPA KIRK	N	L	12.1	12.0	228.12			0.00	228.12	276.80	forked below 1.3m		
UAPA KIRK	N	L	13.6		145.29			0.00	145.29	277.80			
UAPA KIRK	N	L	7.8		47.79			0.00	47.79	279.00			
UAPA KIRK	Y	L	10.3	17.0	310.34	13.6		145.29	455.63	279.50	forked @ base, 1 cut		
PTER ANGO	Y	L			0.00	18.9	6.5	313.78	313.78	282.00			
PTER ANGO	Y	L			0.00	12.7	4.5	142.60	142.60	282.50	same tree. cut below 1.3m		
PTER ANGO	Y	L			0.00	4.0		12.57	12.57	282.50	same tree. cut below 1.3m		
UAPA KIRK	N	L	9.1		65.05			0.00	65.05	282.70	same tree	**no. trees**	**55**
UAPA KIRK	N	L	13.2	20.8	476.70			0.00	476.70	282.70	same tree	BA uncut	7,038.92
PTER ANGO	Y	L			0.00	4.4		15.21	15.21	285.40	cut below 1.3m	BA cut	4,075.68
ROTH SPP	N	L	6.0		28.28			0.00	28.28	289.30		Total BA	**11,114.60**
VANG INFA	Y	L			0.00	6.9	4.2	51.25	51.25	294.60		**% BA cut**	**36.7**
PTER ANGO	N	L	10.6	10.3	171.59			0.00	171.59	300.00	forked		
UAPA KIRK	N	L	10.4	11.8	194.33			0.00	194.33	304.00			
BRAC MANG	Y	L			0.00	7.2		40.72	40.72	307.80			
UAPA KIRK	N	L	17.3	14.5	400.24			0.00	400.24	311.50			
ANON SENE	Y	L			0.00	12.0	6.5	146.30	146.30	312.45	same tree		

ANON SENE	Y	L			0.00	8.5	10.5	143.35	143.35	312.45	same tree		
UAPA KIRK	N	L	13.9		151.77			0.00	151.77	313.35			
UAPA KIRK	N	L	9.0		63.63			0.00	63.63	313.70			
UAPA KIRK	Y	L			0.00	8.5		56.75	56.75	315.00	cut below 1.3m		
UAPA KIRK	Y	L			0.00	6.5		33.19	33.19	315.40	cut below 1.3m		
UAPA KIRK	N	L	13.2	7.0	175.36			0.00	175.36	315.70			
UAPA KIRK	Y	L			0.00	6.0		28.28	28.28	316.00	cut @ base		
UAPA KIRK	Y	L			0.00	10.0		78.55	78.55	316.20	cut below 1.3m		
UAPA KIRK	N	L	3.7	5.8	37.18			0.00	37.18	316.50			
UAPA KIRK	Y	L			0.00	8.0		50.27	50.27	317.00	cut below 1.3m		
UAPA KIRK	N	L	6.0		28.28			0.00	28.28	318.15			
UAPA KIRK	Y	L			0.00	13.6		145.29	145.29	318.45	cut below 1.3m		
UAPA KIRK	N	L	10.5		86.60			0.00	86.60	319.10			
UAPA KIRK	Y	L			0.00	12.8		128.70	128.70	319.80	cut below 1.3m		
UAPA KIRK	Y	L			0.00	8.0	9.0	113.90	113.90	320.00			
UAPA KIRK	N	L	5.5	14.8	195.82			0.00	195.82	321.50			
UAPA KIRK	N	L	11.5	9.0	167.51			0.00	167.51	321.80			
BRAC MANG	Y	L			0.00	5.8		26.42	26.42	324.80	cut below 1.3m		
XIME CAFF	N	L	4.8		18.10			0.00	18.10	325.00			
UAPA KIRK	Y	D			0.00	11.1		96.78	96.78	325.50	dead		
UAPA KIRK	N	L	10.9		93.33			0.00	93.33	326.00			
UAPA KIRK	N	L	14.6		167.44			0.00	167.44	331.40			
UAPA KIRK	N	L	5.5		23.76			0.00	23.76	332.40			
UAPA KIRK	N	L	13.4		141.04			0.00	141.04	333.50			
DALB NITI	Y	L			0.00	18.0		254.50	254.50	340.00			
BRAC MANG	N	L	37.0		1075.35			0.00	1075.35	341.40			
JULB GLOB	N	L	19.7		304.84			0.00	304.84	343.30			
BRAC UTIL	N	L	31.7		789.34			0.00	789.34	346.80			
JULB GLOB	Y	L	11.4		102.08	5.6		24.63	126.72	349.40	cut above 1.3m		
JULB GLOB	Y	L			0.00	9.0		63.63	63.63	350.00	cut below 1.3m		
???	Y	D			0.00	27.0		572.63	572.63	354.40	dead		
PTER ANGO	N	L	4.5		15.91			0.00	15.91	354.40			
PERI ANGO	Y	L			0.00	4.5		15.91	15.91	356.00	cut below 1.3m		
UAPA KIRK	N	L	29.5		683.58			0.00	683.58	358.00			
PERI ANGO	Y	L			0.00	10.6		88.26	88.26	358.40	cut below 1.3m		
UAPA KIRK	N	L	23.0		415.53			0.00	415.53	359.40			
UAPA KIRK	N	L	12.0		113.11			0.00	113.11	360.55			

BRAC MANG	Y	L			0.00	9.5		70.89	70.89	362.00			
UAPA KIRK	N	L	5.6		24.63			0.00	24.63	362.70			
BRAC UTIL	N	L	4.5		15.91			0.00	15.91	362.90			
BRAC UTIL	N	L	8.8		60.83			0.00	60.83	363.45			
UAPA KIRK	N	L	14.4		162.88			0.00	162.88	366.20			
???	Y	D			0.00	12.0		113.11	113.11	367.40	dead		
UAPA KIRK	N	L	6.5		33.19			0.00	33.19	369.00			
UAPA KIRK	N	L	6.6		34.22			0.00	34.22	369.40			
UAPA KIRK	N	L	12.4		120.78			0.00	120.78	369.60			
UAPA KIRK	N	L	4.4		15.21			0.00	15.21	370.10			
UAPA KIRK	N	L	11.2		98.53			0.00	98.53	370.65			
UAPA KIRK	N	L	7.6		45.37			0.00	45.37	371.00			
UAPA KIRK	N	L	4.1		13.20			0.00	13.20	371.50			
UAPA KIRK	N	L	13.2		136.87			0.00	136.87	372.50			
UAPA KIRK	N	L	14.5		165.15			0.00	165.15	372.50			
UAPA KIRK	Y	L			0.00	6.0		28.28	28.28	373.80			
UAPA KIRK	Y	L			0.00	7.0		38.49	38.49	373.90			
UAPA KIRK	N	L	5.0		19.64			0.00	19.64	375.50			
UAPA KIRK	N	L	5.0		19.64			0.00	19.64	375.55			
UAPA KIRK	N	L	9.9		76.99			0.00	76.99	375.55			
PTER ANGO	N	L	9.8		75.44			0.00	75.44	375.95			
???	Y	D			0.00	15.0		176.74	176.74	377.10	dead		
???	Y	D			0.00	14.5		165.15	165.15	381.30	dead		
UAPA KIRK	Y	L			0.00	4.7		17.35	17.35	382.40			
BRAC UTIL	Y	L			0.00	6.5	5.0	52.82	52.82	382.60			
BRAC MANG	Y	L			0.00	6.3		31.18	31.18	382.85			
CUSS ARBO	Y	L			0.00	8.4		55.42	55.42	385.00	unsure position		
BRAC UTIL	Y	L			0.00	6.9		37.40	37.40	385.00	cut below 1.3m		
BRAC UTIL	N	L	11.6		105.70			0.00	105.70	387.50			
PTER ANGO	N	L	13.4		141.04			0.00	141.04	387.85			
ROTH SPP	N	L	5.5		23.76			0.00	23.76	388.20			
BRAC MANG	N	L	12.0		113.11			0.00	113.11	390.40		**no. trees**	**78**
BRAC UTIL	N	L	11.0		95.05			0.00	95.05	394.10		BA uncut	7,460.24
PTER ANGO	N	L	11.2		99.24			0.00	99.24	397.10		BA cut	2,894.89
UAPA KIRK	N	L	5.0		19.64			0.00	19.64	397.85	same tree	**Total BA**	**10,355.13**
UAPA KIRK	N	L	9.9	8.1	128.52			0.00	128.52	397.85	same tree	**% BA cut**	**28.0**

BRAC MANG	Y	L			0.00	6.0		28.28	28.28	400.45			
LANN DISC	N	L	5.2		21.24			0.00	21.24	403.30			
ANON SENE	N	L	5.3		22.06			0.00	22.06	408.60			
XIME CAFF	N	L	4.5		15.91			0.00	15.91	410.00			
PTER ANGO	N	L	13.6		145.29			0.00	145.29	410.40			
BRAC UTIL	N	L	5.0		19.64			0.00	19.64	410.60			
UAPA KIRK	N	L	5.9		27.34			0.00	27.34	411.45			
JULB GLOB	N	L	7.5		44.18			0.00	44.18	414.00			
BRAC UTIL	N	L	12.8	18.3	391.75			0.00	391.75	415.00			
PTER ANGO	N	L	4.0		12.57			0.00	12.57	416.60			
PTER ANGO	N	L	11.6		105.70			0.00	105.70	417.60			
PARI CURA	N	L	11.0		95.05			0.00	95.05	420.70			
ANNO SENE	N	L	4.4		15.21			0.00	15.21	421.70			
ANON SENE	N	L	4.0		12.57			0.00	12.57	432.00			
UAPA KIRK	N	L	13.7		147.43			0.00	147.43	435.20			
PERI ANGO	Y	L			0.00	5.2		21.24	21.24	437.30			
ANNO SENE	N	L	5.6		24.63			0.00	24.63	445.20			
UAPA KIRK	Y	L	9.9		76.99	5.4		22.91	99.89	448.10	cut below 1.3m		
ANON SENE	N	L	6.6	5.9	61.56			0.00	61.56	448.40	same tree		
ANON SENE	N	L	6.7	7.9	84.28			0.00	84.28	448.40	same tree		
BURK AFRI	N	L	5.7		25.52			0.00	25.52	449.60			
ANON SENE	N	L	8.5		56.75			0.00	56.75	450.05			
UAPA KIRK	N	L	9.9		76.99			0.00	76.99	450.35			
CUSS ARBO	N	L	7.7		46.57			0.00	46.57	452.85			
BRAC UTIL	N	L	23.0	22.6	816.73			0.00	816.73	454.60			
STEG ARAL	Y	L			0.00	6.8		36.32	36.32	454.80			
UAPA KIRK	N	L	4.4		15.21			0.00	15.21	455.80			
UAPA KIRK	N	L	4.0		12.57			0.00	12.57	458.00			
BRAC UTIL	N	L	5.0		19.64			0.00	19.64	459.50			
BRAC UTIL	N	L	46.0		1662.12			0.00	1662.12	459.50			
BRAC MANG	N	L	35.0		962.24			0.00	962.24	460.80			
UAPA KIRK	Y	L			0.00	4.1		13.20	13.20	466.30	cut below 1.3m		
CUSS ARBO	N	L	5.0		19.64			0.00	19.64	471.10		**no. trees**	**40**
???	Y	D			0.00	22.0		380.18	380.18	471.60	dead	BA uncut	8,034.16
ANNO SENE	Y	L	4.5	4.7	33.26	7.5		44.18	77.44	474.50	cut below 1.3m	BA cut	546.32
PROT ANGO	N	L	4.1		13.20			0.00	13.20	483.60		**Total BA**	**8,580.47**
BRAC UTIL	N	L	34.0	24.5	1379.53			0.00	1379.53	490.60		**% BA cut**	**6.4**

BRAC UTIL	N	L	27.0	18.5	841.47			0.00	841.47	492.20			
CUSS ARBO	N	L	6.8		36.32			0.00	36.32	495.45			
BRAC UTIL	N	L	24.0	17.5	693.01			0.00	693.01	495.70			
UAPA KIRK	N	L	8.9		62.22			0.00	62.22	501.40			
UAPA KIRK	N	L	4.5		15.91			0.00	15.91	502.90			
BRAC UTIL	N	L	22.5		397.66			0.00	397.66	505.90			
UAPA KIRK	N	L	5.0		19.64			0.00	19.64	508.00			
UAPA KIRK	N	L	5.5		23.76			0.00	23.76	508.10			
???	Y	D			0.00	5.5		23.76	23.76	510.50	dead		
UAPA KIRK	N	L	5.3		22.06			0.00	22.06	511.40			
UAPA KIRK	N	L	4.0		12.57			0.00	12.57	511.70			
XIME CAFF	N	L	6.8	4.5	52.48			0.00	52.48	513.00			
UAPA KIRK	N	L	4.5		15.91			0.00	15.91	513.55			
BRAC MANG	N	L	32.3		819.50			0.00	819.50	516.35			
???	Y	D			0.00	12.0		113.11	113.11	517.00	dead		
XIME CAFF	N	L	5.6		24.63			0.00	24.63	518.70			
PERI ANGO	Y	L			0.00	14.6		167.44	167.44	519.60	cut above1.3m		
XIME CAFF	N	L	9.7		73.91			0.00	73.91	524.00			
UAPA KIRK	N	L	30.7		740.33			0.00	740.33	524.50			
UAPA KIRK	N	L	20.9		343.11			0.00	343.11	533.30			
PTER ANGO	N	L	25.6		514.79			0.00	514.79	543.95			
???	Y	D			0.00	15.8		196.09	196.09	551.25	dead		
BRAC UTIL	N	L	38.7		1176.44			0.00	1176.44	557.15	cut below 1.3m		
PERI ANGO	Y	L			0.00	11.8		109.37	109.37	564.20	cut below 1.3m		
PERI ANGO	N	L	8.6		58.10			0.00	58.10	564.40			
???	Y	D			0.00	40.8		1307.57	1307.57	567.20	cut below 1.3m		
PERI ANGO	N	L	14.4		162.88			0.00	162.88	570.00			
BRAC MANG	N	L	30.5		730.71			0.00	730.71	582.00			
BRAC UTIL	N	L	20.9		343.11			0.00	343.11	582.00			
BRAC UTIL	N	L	30.0		706.95			0.00	706.95	586.80		**no. trees**	**31**
UAPA KIRK	N	L	33.5		881.53			0.00	881.53	587.35		BA uncut	8,217.61
PERI ANGO	N	L	13.4		141.04			0.00	141.04	588.20	forked under 1.3m	BA cut	1,917.35
UAPA KIRK	N	L	33.2		865.81			0.00	865.81	595.40		**Total BA**	**10,134.96**
XIME CAFF	N	L	4.0		12.57			0.00	12.57	596.00		**% BA cut**	**18.9**
PTER ANGO	Y	L			0.00	8.0		50.27	50.27	601.25			

UAPA KIRK	N	L	24.8		483.11			0.00	483.11	603.18			
UAPA KIRK	N	L	4.5		15.91			0.00	15.91	607.50			
UAPA KIRK	N	L	18.5	23.0	684.37			0.00	684.37	608.60			
PROT ANGO	N	L	4.6	4.0	29.19			0.00	29.19	610.30			
UAPA KIRK	N	L	5.7		25.52			0.00	25.52	611.30			
PROT ANGO	N	L	4.0		12.57			0.00	12.57	611.60	forked under 1.3m		
UAPA KIRK	N	L	10.0		78.55			0.00	78.55	612.50			
UAPA KIRK	Y	L			0.00	9.6		72.39	72.39	613.15			
UAPA KIRK	N	L	9.0		63.63			0.00	63.63	613.90			
BRAC UTIL	N	L	4.7		17.35			0.00	17.35	617.10			
UAPA KIRK	N	L	4.7		17.35			0.00	17.35	617.10			
UAPA KIRK	N	L	7.3		41.86			0.00	41.86	617.10			
UAPA KIRK	N	L	6.9		37.40			0.00	37.40	618.00			
UAPA KIRK	N	L	7.0		38.49			0.00	38.49	619.00			
UAPA KIRK	N	L	7.4		43.01			0.00	43.01	620.00			
UAPA KIRK	N	L	7.6		45.37			0.00	45.37	620.10			
UAPA KIRK	N	L	6.1		29.23			0.00	29.23	621.50			
UAPA KIRK	N	L	8.3		54.11			0.00	54.11	623.50			
UAPA KIRK	N	L	4.7		17.35			0.00	17.35	624.40			
UAPA KIRK	N	L	4.2		13.86			0.00	13.86	625.15			
UAPA KIRK	N	L	24.2		460.02			0.00	460.02	626.05			
UAPA KIRK	N	L	4.1		13.20			0.00	13.20	627.30			
UAPA KIRK	N	L	8.7		59.45			0.00	59.45	627.35			
UAPA KIRK	N	L	6.7		35.26			0.00	35.26	630.00			
VANG INFA	N	L	7.6		45.37			0.00	45.37	631.50			
VANG INFA	N	L	4.0	4.3	27.09			0.00	27.09	632.40			
FAUR SALI	Y	L			0.00	5.0		19.64	19.64	645.40	cut below 1.3m		
UAPA KIRK	N	L	6.7		35.26			0.00	35.26	668.20			
UAPA KIRK	N	L	5.0		19.64			0.00	19.64	670.10			
PTER ANGO	N	L	5.7		25.52			0.00	25.52	672.80			
UAPA KIRK	N	D	20.8		339.84			0.00	339.84	682.60	dead		
BRAC MANG	N	L	31.7		789.34			0.00	789.34	683.95		**no. trees**	**37**
UAPA KIRK	N	L	24.3		463.83			0.00	463.83	687.15		BA uncut	4,828.59
PERI ANGO	Y	L			0.00	5.3		22.06	22.06	687.85		BA cut	164.37
BRAC UTIL	N	L	26.4		547.46			0.00	547.46	691.40		**Total BA**	**4,992.95**
BRAC UTIL	N	L	16.7		219.07			0.00	219.07	697.70		**% BA cut**	**3.3**

BRAC UTIL	N	L	30.7	29.4	1419.28			0.00	1419.28	711.60			
PERI ANGO	N	L	4.0		12.57			0.00	12.57	717.40			
UAPA KIRK	N	L	12.3		118.84			0.00	118.84	728.35			
UAPA KIRK	N	L	19.8		307.95			0.00	307.95	728.35			
PERI ANGO	Y	L	5.0		19.64	7.7	14.2	204.96	224.60	734.00	cut below 1.3m		
BRAC UTIL	N	L	15.8		196.09			0.00	196.09	742.30			
UAPA KIRK	N	L	27.5		594.03			0.00	594.03	745.15			
BRAC UTIL	N	L	25.3		502.79			0.00	502.79	749.50			
PERI ANGO	N	L	15.6		191.16			0.00	191.16	752.15			
UAPA KIRK	N	L	29.5		683.58			0.00	683.58	752.90			
UAPA KIRK	N	L	6.3		31.18			0.00	31.18	753.80			
PROT ANGO	Y	D			0.00	4.1		13.20	13.20	759.80	cut below 1.3m		
UAPA KIRK	Y	D			0.00	4.5		15.91	15.91	761.70	cut below 1.3m		
PROT ANGO	Y	L			0.00	4.0		12.57	12.57	762.65	cut below 1.3m		
PROT ANGO	N	L	4.0		12.57			0.00	12.57	763.55			
PERI ANGO	Y	L			0.00	8.9		62.22	62.22	767.90	cut below 1.3m	**no. trees**	**20**
BRAC MANG	N	L	28.5		638.02			0.00	638.02	772.65		BA uncut	5,753.64
PERI ANGO	Y	L	20.3		323.70	10.3	9.0	146.96	470.66	794.30	same tree	BA cut	491.08
PERI ANGO	Y	L			0.00	6.7		35.26	35.26	794.30	same tree	**Total BA**	**6,244.72**
BRAC UTIL	N	L	29.9		702.24			0.00	702.24	798.90		**% BA cut**	**7.9**
UAPA KIRK	N	L	26.1		535.09			0.00	535.09	804.00			
PERI ANGO	N	L	6.9		37.40			0.00	37.40	817.70			
PERI ANGO	N	L	4.7		17.35			0.00	17.35	818.50			
UAPA KIRK	N	L	5.7		25.52			0.00	25.52	819.45			
BRAC UTIL	N	L	28.0		615.83			0.00	615.83	821.40			
UAPA KIRK	N	L	15.7		193.62			0.00	193.62	824.10			
UAPA KIRK	N	L	7.8		47.79			0.00	47.79	825.35			
CUSS ARBO	N	L	13.0		132.75			0.00	132.75	828.30			
PROT ANGO	N	L	4.1		13.20			0.00	13.20	870.00			
UAPA KIRK	N	L	35.8		1006.73			0.00	1006.73	873.50			
BRAC UTIL	N	L	17.7		246.09			0.00	246.09	875.20			
UAPA KIRK	N	L	25.3		502.79			0.00	502.79	877.10		**no. trees**	**16**
BRAC UTIL	N	L	23.0		415.53			0.00	415.53	882.55		BA uncut	4,316.71
BRAC MANG	N	L	24.7		479.23			0.00	479.23	893.35		BA cut	429.28
PTER ANGO	Y	L	7.8		47.79	15.5		188.72	236.51	896.90		**Total BA**	**4,745.98**
???	Y	D			0.00	17.5		240.56	240.56	898.40	dead	**% BA cut**	**9.0**

PTER ANGO	N	L	12.5		122.73			0.00	122.73	901.75			
BRAC UTIL	N	L	26.5		551.62			0.00	551.62	909.05			
BRAC UTIL	N	L	14.2		158.39			0.00	158.39	910.75			
BRAC UTIL	N	L	17.7		246.09			0.00	246.09	913.10			
UAPA KIRK	N	L	16.4		211.27			0.00	211.27	937.90			
UAPA KIRK	N	L	16.3		208.70			0.00	208.70	938.00			
UAPA KIRK	N	L	10.0		78.55			0.00	78.55	938.65			
UAPA KIRK	N	L	20.7		336.58			0.00	336.58	941.75			
BRAC UTIL	N	L	29.3		674.34			0.00	674.34	944.20			
ALBI ANTU	N	L	20.8		339.84			0.00	339.84	945.90			
???	Y	D			0.00	20.6		333.33	333.33	946.30			
???	N	D	22.8		408.33			0.00	408.33	955.00	dead		
UAPA KIRK	N	L	9.4		69.41			0.00	69.41	967.00			
UAPA KIRK	N	L	5.0		19.64			0.00	19.64	967.20			
BRAC UTIL	N	L	47.3		1757.39			0.00	1757.39	970.40			
UAPA KIRK	N	L	6.9		37.40			0.00	37.40	976.10			
CUSS ARBO	N	L	10.0		78.55			0.00	78.55	979.15			
UAPA KIRK	N	L	4.6		16.62			0.00	16.62	980.00			
UAPA KIRK	N	L	4.9		18.86			0.00	18.86	981.10			
FAUR SPEC	N	L	4.5		15.91			0.00	15.91	982.50	forked above		
UAPA KIRK	N	D	4.1		13.20			0.00	13.20	987.55	dead		
UAPA KIRK	N	L	5.5		23.76			0.00	23.76	988.90		**no. trees**	**26**
UAPA KIRK	N	L	11.1		96.78			0.00	96.78	988.90		BA uncut	5,502.82
BRAC UTIL	Y	L			0.00	4.0		12.57	12.57	990.95		BA cut	361.81
BRAC MANG	Y	L			0.00	4.5		15.91	15.91	992.30	cut below 1.3m	**Total BA**	**5,864.63**
UAPA KIRK	N	L	4.9		18.86			0.00	18.86	999.90		**% BA cut**	**6.2**
Totals (cm^2)					**70,033.01**			**20,123.87**	**90,156.88**				
Total/ha (m^2/ha)					14.01			4.02	18.03				