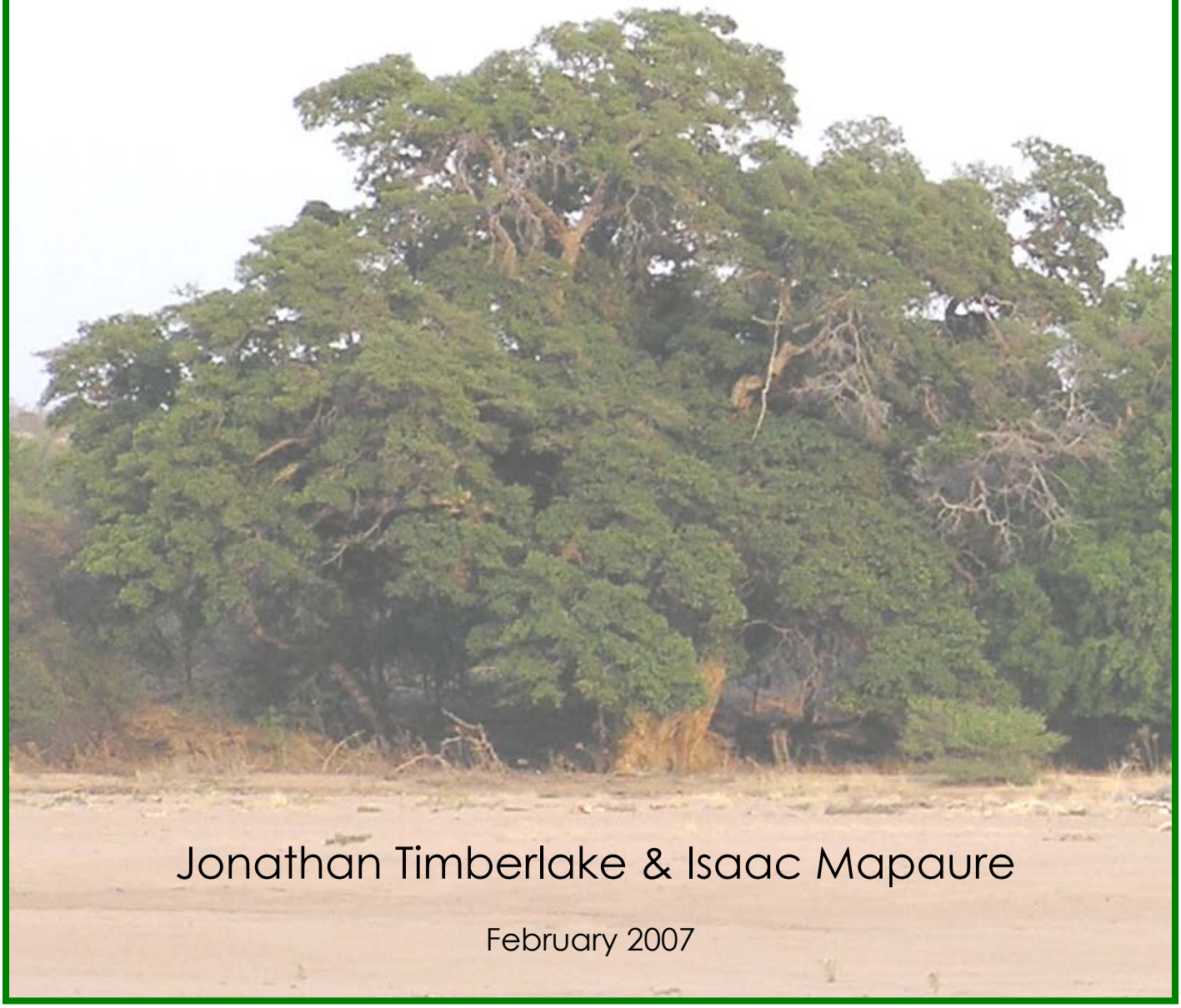
BUBIANA CONSERVANCY VEGETATION SURVEY



Jonathan Timberlake & Isaac Mapaure

February 2007

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SAND COUNTY FOUNDATION / WORLDWIDE FUND FOR NATURE (WWF)
LANDHOLDER MONITORING PROGRAMME: BUBIANA CONSERVANCY

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PREFACE

This publication was originally produced in October 2001 by the Biodiversity Foundation for Africa as a consultant's report for the Sand County Foundation and the WWF Landholder Monitoring Programme. It has since been slightly edited for publication in the BFA's Occasional Publications in Biodiversity series. The BFA is very grateful to Mike Jones and the Bradley Fund for the Environment of Sand County Foundation for permission to do this.

ACKNOWLEDGEMENTS

We particularly wish to thank Ken and Dianne Drummond for facilitating the whole survey and hosting us at Rocky Glen. Darrel and Heather Collett hosted us initially at Mjingwe Ranch, while Jonathan Collet and Natasha introduced us to the area. Basil Steyn and Driekus Stander provided accommodation at Sondalani Game Lodge for the latter part of the study. Poogie and Joan Darlow showed us around Tamba Ranch and gave useful background information. Kombvani Matatu assisted in the field on Mjingwe and Makugwe.

Mike Jones initiated the study, provided technical backup and arranged for the satellite imagery, while Ian Games and Kudakwashe Muhwandagara carried out the GIS mapping. Plant identification was by Bob Drummond; Heather Whitham put sample points on maps.

The study was funded by the Bradley Fund for the Environment of Sand County Foundation, USA, to whom we are most grateful..

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SUMMARY

A reconnaissance-scale vegetation survey of the enlarged Bubiana Conservancy near West Nicholson in south-western Zimbabwe was carried out in April/May 2001 on behalf of the Sand County Foundation/WWF Landholder Monitoring Programme. The survey was required to assist land managers in determining the range and types of wildlife habitat and to provide a firmer basis for management decisions.

The study area was stratified using satellite imagery, followed by extensive ground-based fieldwork. Data analysis was both by computer and manual, and adopted a phytosociological approach similar to that used in other recent surveys over large parts of Zimbabwe. The analysis also drew out vegetation-environment relationships.

A total of six vegetation groups were identified – Hill vegetation, Miombo woodland, Acacia woodland, Mopane woodland, Riparian woodland and Disturbed vegetation – some of which were subdivided to give a total of 11 vegetation types. These are fully described in terms of their species composition, structure, distribution, environmental determinants, conservation and economic value. A typical catenary sequence is illustrated.

It was not possible to map most of these types at the survey scales (1:250,000 – 1:100,000) so a series of nine mapping units, principally based on geology and geomorphology, were described. These form the basis of the map presented. Much of the vegetation is a mixture or mosaic of three woodland types – miombo, acacia and mopane. Miombo dominates on sandier soils, especially in the north and east, while acacia and mopane dominate on depositional loamy soils in the south and west. Large granite and gneiss dwalas (hills) support distinctive and diverse vegetation types. Riparian woodland is very poorly developed.

Vegetation types of particular conservation interest are the gully forest and *Myriathamnus* shrubland on granite/gneiss dwalas. It is recommended that two or so such areas in the south/south-eastern section of the conservancy be designated as specially protected. They should cover a range of the larger hills and include part of the surrounding miombo and mopane woodland. Particular attention needs to be given to the endemic cycad, *Encephalartos concinnus*. One of the two major global populations of this species is found in the conservancy.

A final recommendation is that if better maps of wildlife habitat are required, more detailed survey work of priority areas is required.

1. INTRODUCTION

The Bubiana Conservancy lies in south-western Zimbabwe some 30 km south-east of West Nicholson in Gwanda District. Comprising commercial ranching land, it falls under Natural Region V (Agritex 1984) in the Limpopo Intensive Conservation Area (ICA). The conservancy was formed in 1991, initially from eight cattle ranches, with a view to encouraging the consumptive use of wildlife as a land use option and for better protection of an introduced population of black rhino (du Toit & Price Waterhouse 1994, Goodwin *et al*. 1997). More recently, some adjacent properties have joined the conservancy, which now comprises 14 properties totalling approximately 1800 km^2.

The Sand County Foundation, a US-based NGO, in 2000 agreed to assist land managers with the monitoring of natural resources under its Monitoring by Landholder Program. Under this programme, administered in Zimbabwe by the WWF Regional Office in Harare, inventory work was planned in order to provide a baseline for future monitoring. A vegetation survey was considered essential to this process.

The Biodiversity Foundation for Africa (BFA) was asked to carry out a reconnaissance-scale vegetation survey of the 'new' (enlarged) conservancy in early 2001 using a method which is scientific, repeatable and nationally acceptable. This would contribute towards the goal of establishing an adaptive management system to assist the conservancy to achieve its economic and ecological objectives based on the use of the full range of natural resources, and in preparation for more detailed planning in land use. Fieldwork was carried out during April-May 2001 and the report presented in October 2001.

This report firstly describes briefly the study area and its physical attributes, then outlines the survey methodology. The individual vegetation types are described in terms of their species composition and ecological attributes. From the satellite imagery used mapping units are derived, as shown on the accompanying map. A brief account is given of species or communities of particular biological or conservation interest. Finally, the significance of the findings is discussed, and recommendations for further action are given.

2. PREVIOUS STUDIES

There appear to have been no previous specific studies of the vegetation or botany of the Bubiana area (Timberlake & Nobanda 1993). The regional vegetation map of Wild and Barbosa (1967) shows the area as being composed of three types: *Terminalia sericea* (mangwe) tree savanna in the north west, *Julbernardia globiflora* (mnondo) savanna woodland in the east, while the majority is *Colophospermum mopane* (mopane) tree savanna. Under the national description of vegetation by Rattray (1961), the area comprises mostly tree/bush savannas of *Combretum*, *Acacia* and *Colophospermum* types interspersed with areas of *Julbernardia globiflora* woodland.

The area was not covered by the communal lands vegetation survey (Timberlake, Nobanda & Mapaure 1993). However, the consultancy report on tourism potential of the SE Lowveld (du Toit & Price Waterhouse 1994, p.39) has a useful brief description of the vegetation.

A detailed study of the neighbouring Doddieburn and Manyoli ranches was carried out by Dasmann and Mossman (1962), further elaborated by Simpson and Cowie (1967) as part of a study on kudu. These ranches are on very similar substrates, although the riparian and alluvial plant communities are much better represented there and there are fewer dwalas. Both ranches, but not the Bubiana Conservancy, were also covered in a survey of the Gwanda I.C.A. (Cruttenden 1960), being classified as *Colophospermum mopane* veld. As part of one of the Rhodesian Schools Exploration Society expeditions, surveys were carried out on both Doddieburn and Manyoli ranches, but were not written up. An unpublished list of named plant specimens collected in 1972 by Gerald Pope as part of this expedition is available at the National Herbarium, Harare.

A discussion on the general vegetation of southern Matabeleland, with particular reference to its utilization for grazing and its degradation, is provided by West (1967). Interestingly, all these studies emphasise the dominance or importance of mopane, something we did not find so marked in our study of Bubiana.

3. STUDY AREA

The present, enlarged, Bubiana Conservancy consists of 14 properties totalling approximately 1800 km^2. These are shown in Figure 1 and comprise, from west to east and north to south:

Janee Ranch
Sondalani (including Inhlaba, Sipuma, Krenilworth, Observatory, Lucknow)
Tshabezi (including Inyoni, Inkutu, Pepeluza, Coltswood, Inhuna, Ziwe)
Tamba
Mashura Ranch
Dwala
Mkashe Ranch (including part of Mashura)
Ladi (including Ingogo, Pirie, Rooiberg)
Rocky Glen (including Boulder Creek Ranch, part of Wedza Block)
Peregwe (part of the former Wedza Block)
Barberton (part of the former Wedza Block)
Sovelele (part of the former Wedza Block)
Makugwe (part of the former Wedza Block)
Mjingwe (part of the former Wedza Block)

All these properties were formerly beef cattle ranches, and many still were in May 2001. There is now some limited cultivation under irrigation, notably at Rocky Glen, and previously there had been limited dryland cropping on suitable soils. A major form of land use in recent years has been trophy hunting of wildlife, often carried out alongside cattle ranching. Sport fishing and wildlife viewing from up-market lodges is an important source of income on some ranches, notably Sondalani, Tamba and Barberton.

3.1 Geomorphology and Hydrology

The conservancy is situated at the lower end of what is effectively the Limpopo middleveld, where the central watershed plateau falls away to the pediment of the Limpopo lowveld. It is mostly broken country, while the adjacent Bubye Conservancy (formerly Lemco Ranch) is much more level. A particular feature of the Bubiana is the large rounded hills or dwalas, particularly in the south and south east (Rocky Glen and Mjingwe). According to Lister (1987), the area forms part of the Pliocene erosion surface (5–1.6 million years ago) with a small portion in the north being the Post-African erosion surface (Miocene age, 23–5 million years ago).

Altitude is mostly from 800 to 900 m above sea level, but ranges from peaks of around 1000 m (the highest points are Gaha, an impressive granite dwala in Belingwe communal land close to Peregwe at 1208 m, and Filangwe on Rocky Glen at 1093 m) to a low point of 680 m along the Bubi River on Boulder Creek.

Drainage is mostly in a south-easterly direction and directed towards the Limpopo. The rivers are still relatively small with their headwaters in the granite areas not far to the north. Two larger rivers cross the study area – the Bubye (Bubi) and the Bubiana – joining just outside the conservancy to the south. The Bubiana has two major tributaries, the Umlali and Mahari. Other significant rivers are the Tshabezi/Tshaba and Fiungule, which drain into the Umzingwane River, the Soveli and Makugwe draining into the Mwenezi River and Manyuchi dam, and the Umtshungwe draining into the Bubi River. There is little significant underground water (du Toit & Price Waterhouse 1994).

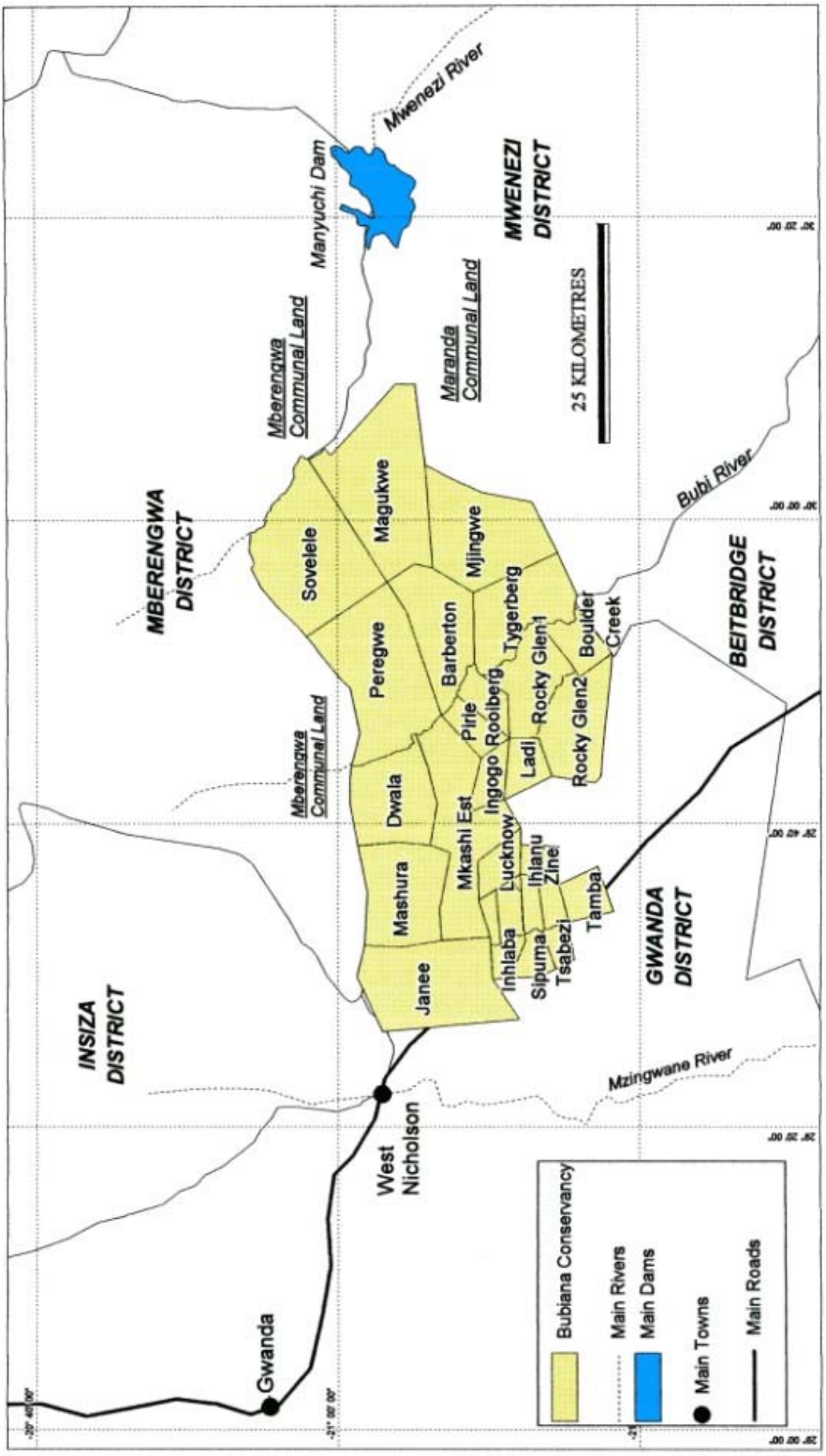

Figure 1. Location and properties comprising the Bubiana Conservancy, SW Zimbabwe.

3.2 Climate

Although in Natural Region V, the area is not as arid as, for example, Beitbridge. The hills on the northern boundary probably receive more moisture than records for West Nicholson, the nearest long-term meteorological station, would suggest.

Mean annual rainfall for the conservancy is given as 400–500 mm, but with high variability (du Toit & Price Waterhouse1994). Figures for West Nicholson for 1952-1988 show a mean rainfall of 506.1 mm/year, with the highest rainfall in 1977/78 of 982.7 mm, and the lowest of 168.9 mm in 1986/87 (Agritex 1989). During the 1991/92 drought, rainfall was under 150 mm. The mean daily maximum temperature for October to January is 30-31^{o}C (although daily maxima can exceed 40^{o}C at times), with a mean daily minimum of 5-8^{o}C in mid-year (Agritex 1989). There are occasional frosts in places.

3.3 Geology and Soils

Virtually all the conservancy is composed of rocks of the Archaean Basement complex, and fall into two zones (Robertson 1973). The Granulite Zone is a broad belt of metamorphosed granulites and granitic gneisses some 30 km wide stretching in a north-easterly direction, covering the southern and eastern parts of Bubiana. It is part of the Limpopo Mobile Belt and forms a southern boundary against the Rhodesian craton. To the north-west is a similarly orientated zone containing the highly deformed Msazi Schist Belt surrounded by tonalitic gneisses.

The Granulitic Zone consists of metamorphosed granites of Precambrian age comprising granitic gneiss, which becomes enderbitic (with higher levels of the mica mineral biotite) to the south west (Robertson 1973). A noticeable and attractive feature of the conservancy in the south and south east are the large rounded gneiss dwalas. There appears to be no specific geological reason for this, other than perhaps being a more resistant facies. However, Lister (1987) suggests that there is a greater likelihood of exfoliation of granites and gneisses and development of dwalas, with higher amounts of potassium-bearing feldspars. With lower quantities of feldspars the terrain is likely to be less rugged and distinctive. Within this broad matrix of granitic gneiss there are enclaves of mafic granulite containing minerals such as pyroxene, plagioclase, hornblende and biotite, particularly in the east Barberton/northwest Mjingwe area and northern parts of Rocky Glen. These mafic enclaves give rise to reddish, more fertile, sandy loam soils. Numerous Karoo age dolerite dykes run through the centre of the conservancy in a NNE-SSW direction. Soils derived from these are reddish, loamy and fertile.

The Msazi Schist Belt consists of metamorphosed igneous rocks, also of Precambrian age, comprising amphibolite and tremolite schist, along with banded ironstone sediments (Robertson 1973). Such rocks give rise to reddish, more fertile and loamy soils that are only moderately acid. The Mweza Range, lying just outside the northeastern border of the conservancy, is a tall range of hills consisting of schists with a serpentine cap (a metamorphosed basic igneous rock). There are numerous small mine workings on its slopes, and the large operational Sandawana Mine extracts emeralds. The tonalitic gneiss surrounding the Basement schists is rich in silica (quartz), hence soils are pale, acidic coarse sands of comparatively low fertility. Where geomorphology has favoured deposition, soils are deeper and generally medium textured sands.

In the north of the conservancy large granite dwalas are found, forming part of the Chibi granite batholith. These give rise to some spectacular scenery (e.g. Gaha mountain) and somewhat richer, coarse sandy soils. The granites are extensive in Mberengwa communal land to the north.

An interesting geological feature running from north to south through Dwala and Mkashi is a satellite of the Great Dyke. Consisting of norite, a basic nutrient-rich rock that gives rise to fine reddish soils, it is, however, hardly noticeable as a physical feature on the ground.

Most soils across the conservancy are shallow loamy sands derived from the underlying gneiss. However, there are pockets of deeper sandy soils especially in the north, and areas of deeper sandy loams in the south. There is very little development of alluvium along the rivers.

4. METHODS

The method used for the survey was that developed under the communal lands vegetation survey (Timberlake, Nobanda & Mapaure 1993), with minor modifications. This has been used for many of the communal lands and also for areas of the National Parks estate and the Tuli/Maramani area to the south (Timberlake, Mapaure & Chapano 1999).

4.1 Image Interpretation

A preliminary interpretation of satellite imagery was carried out and drawn on a transparent overlay. The images used were false colour Landsat TM photographic prints at 1:250,000 scale (sheets SF 35-8/12, SF 36-5, SF 35-4 and SF 36-1, all dated 8 March 1992), using bands 2, 3, 4. These images were produced by the Zimbabwe Forestry Commission under the VegRIS project. The environmental/vegetation units drawn were delineated on the basis of their relative homogeneity of tone, texture and colour. Underlying geology and soil type appear to be the major separating criteria. Another, more recent, Landsat TM image at 1:100,000 scale was also used (28 April 2000, i/d L71170075-07520000423). However, despite enhancement this image did not have as clear differentiation of units as the earlier one, possibly as much of the vegetation was still in full leaf at that time.

4.2 Fieldwork

Fieldwork consisted of sampling of vegetation in representative areas within these delineated units over a period of 12 days in April/May 2001, usually in places readily accessible by vehicle. Only few of the very variable rocky hills were recorded. Most preliminary mapping units and geological types were sampled three or more times. A full list of coordinates of the sampling locations is given in Appendix A, and shown on a map in Appendix B. At each sample point the following were recorded:

a) GPS reading of locality;
b) a list of woody species seen within an area of 0.5 to 1 ha, avoiding roadside margins or obvious environmental features such as drainage lines. A cover-abundance value for each species in each of three height classes (<0.5 m, 0.5-3 m, >3 m) was noted;
c) environmental features such as geology, slope, soil type, evidence of grazing, burning, wood use, etc.;
d) a structural classification of the vegetation (canopy heights and cover).

Species of uncertain identity were collected for later identification at the National Herbarium, Harare. Detailed notes were made in the field on associations and environmental correlations.

4.3 Data Analyses

After confirmation of species identity, all data were entered onto computer using a similar format to that used under the communal lands vegetation survey.

Hierarchical Cluster Analysis (HCA) using an average linkage method (van Tongeren 1995) was performed on a matrix of 62 plots by 177 species using species abundance data. This produces a classification identifying similarities amongst plots based on species composition. Later, Detrended Correspondence Analysis (DCA) (ter Braak 1986, 1995), an indirect gradient analysis technique, was applied on the species cover-abundance data to elucidate relationships amongst the various plant associations and underlying environmental gradients.

Canonical Correspondence Analysis (CCA) (ter Braak 1987, 1988) was used to explore species-environment relationships. This direct gradient analysis technique seeks relationships between vegetation and explanatory variables and assumes a unimodal model of vegetation response. CCA was performed on the same species data set as for DCA and an explanatory variables data set to investigate relationships.

The explanatory data set consisted of the following variables: (a) vegetation condition scored as 0, 1 or 2 (undisturbed, disturbed, degraded, respectively); (b) soil texture scored as 1, 2 or 3 (predominantly sandy, predominantly loamy, and rocky soils, respectively); (c) woody cover scored as 1, 2 or 3 (for <10%, 10-50% and >50% cover, respectively); and (d) canopy height scored on a scale of 1 or 2 (for <10m and >10m, respectively). All environmental canonical axes were tested for significance using the Monte Carlo permutation test. The CANOCO package (ter Braak & Smilauer 1997, ter Braak 1991) was used for DCA and CCA analyses, while MINITAB (Minitab 1998) was used for HCA.

4.4 Vegetation Descriptions

Based on the data analyses and on field knowledge, descriptions of the vegetation types were drawn up. Types were described in terms of dominant and typical constituents of woody cover, soil type and distribution. It is important to note that the legend and descriptions are based primarily on field notes and observations, not on the results of the computer analysis, although the analysis does generally support the manually-derived descriptions.

The vegetation units described are ecological units based on species composition of the woody layer, not on density of woody cover. They represent, in general, what the vegetation would naturally be, not necessarily what it is at present after modification by human activities.

Conservation value was subjectively based, and placed within a national perspective. Types that are widespread, already well represented in conservation areas, and were not in particularly good condition in Bubiana, were considered as being of low conservation value. Types that are diverse, restricted in distribution nationally and still in good condition in Bubiana were considered as being of high conservation value.

4.5 Final Mapping

After analysing the data, and with a working idea as to vegetation types and patterns, a vegetation map was prepared. The 1:100,000 satellite imagery was re-interpreted (with the 1:250,000 image to aid with certain details) and used for the final map. Complexes of vegetation types were combined to form mapping units, thus what was mapped were not vegetation types as such, but complexes or mosaics.

The final interpretation on mylar sheeting was digitised and put onto a GIS. GPS Control points were added. From this area determinations were made.

5. RESULTS

5.1 Vegetation

Hierarchical Cluster Analysis separated the vegetation into six major divisions (Figure 2). These were modified slightly based on field experience, with two being amalgamated and one further division (disturbed areas) being created. Within the six broad divisions, 11 distinguishable vegetation types were recognised (Table 1), and are described below.

Table 1. Bubiana vegetation types and samples.

Vegetation group	**Vegetation type**	**Samples**
HILLS	A1. *Myriathamnus* shrubland	12, 13, 21, 42
	A2. Gully forest	22, 23
	A3. *Brachystegia glaucescens* woodland	03, 11
MIOMBO	B1. *Brachystegia spiciformis* woodland	41
	B2. *Julbernardia globiflora* woodland	10, 14, 27, 28, 29, 30, 49, 51
	B3. *Terminalia sericea* woodland	01, 38, 39, 44
ACACIA	C1. *Acacia nigrescens* woodland	08, 09, 15, 18, 20, 25, 26, 31, 34, 36, 37, 43, 47, 48, 50, 52, 53, 56,
MOPANE	D1. *Colophospermum* woodland	02, 07, 16, 17, 24, 33, 40, 45, 54, 55, 57, 58, 59, 62
RIPARIAN	E1. *Acacia galpinii* woodland	04, 05, 06, 35
DISTURBED	F1. *Acacia tortilis* woodland	32, 46, 61
	F2. *Dichrostachys* thicket	19

However, these types are not appropriate units for mapping owing to their tight mosaic nature across the conservancy. The units used for mapping are described later (section 5.3) and are different from the individual vegetation types. At a much more detailed scale (e.g. 1:25,000) it would be possible to map out the individual vegetation types described below. Table 1 shows the main vegetation types, their composition and samples.

The large rocky outcrops, whether of gneiss or granite, support very different vegetation from the footslopes or pediments. Outcrops of Basement schists and dolerite also have a different vegetation and composition from the surrounding pediments, but the differences are one of degree and the vegetation hardly justifies being regarded as a different type at this scale.

A full list of species recorded by sampling point is given as Appendix C, and a full list of all species recorded in the conservancy during the survey, arranged by family, is given as Appendix D.

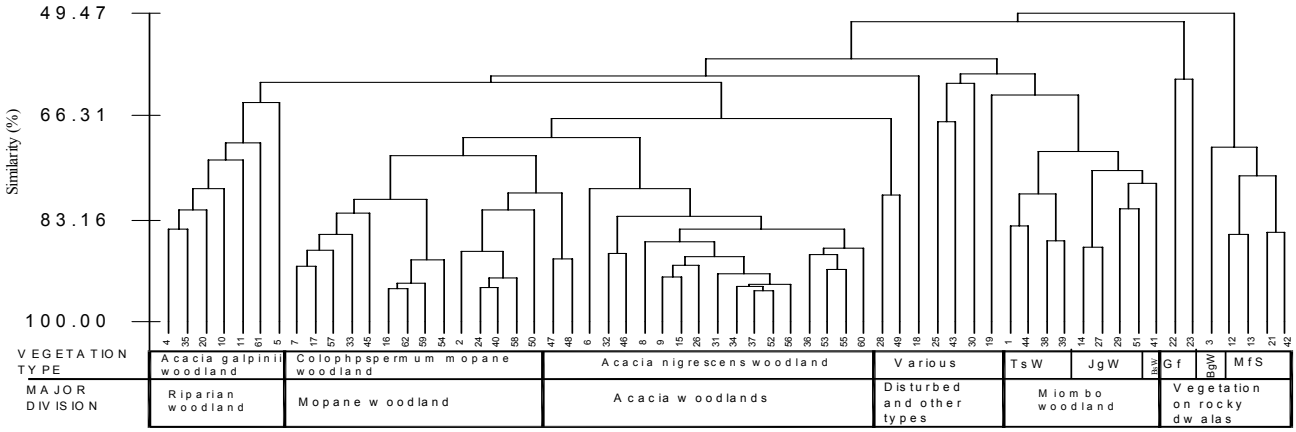

Figure 2. Hierarchical Cluster Analysis for Bubiana vegetation data.

5.2 Vegetation Catenas

Vegetation types and species composition very clearly followed soil type. However, the variation in soils and the soil catena across the landscape were at a scale not possible to map given the objectives and constraints of the present survey. A typical catenary sequence is shown in Figure 3, but the composition will vary according to underlying geology.

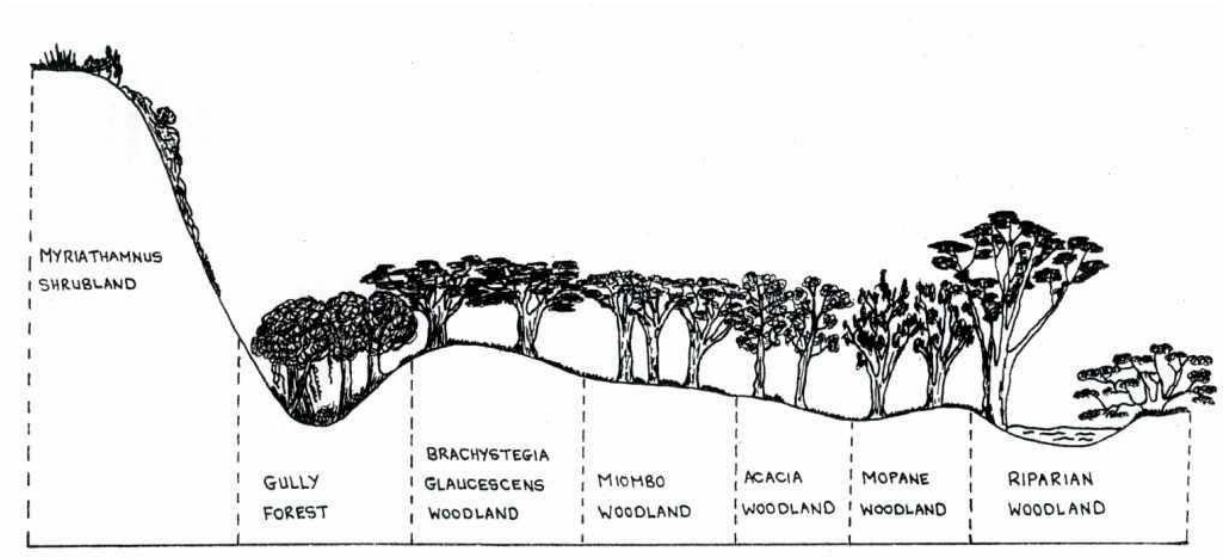

Figure 3. Typical vegetation catenary sequence in Bubiana.

On the bare upper slopes of granite or gneiss dwalas *Myriathamnus* shrubland is found. Where the slopes are more gentle, and some soil build-up can occur, *Brachystegia glaucescens* woodland dominates. At the foot of the dwala where moisture runoff is good and nutrient levels high, a thin band of gully forest is seen.

Coming out onto the pediment or plain, the dominant vegetation is generally *Julbernardia* woodland on gneiss, or *Brachystegia spiciformis* woodland on granite soils in the moister northern section. Where topography or geology allows a build up of more loamy soil, the vegetation is mostly *Acacia nigrescens* woodland, its height often reflecting the soil depth and fertility. Patches of clay-rich soil support mopane woodland, mostly confined to areas of soil deposition.

Fringing the larger drainage lines is a taller woodland of *Acacia galpinii* or, if heavily disturbed, *Acacia tortilis*.

5.3 Vegetation Types

A. VEGETATION ON HILLS

The vegetation found on the slopes and at the base of granite and gneiss hills is quite distinctive. Although very varied, there is a pattern with *Myriathamnus* shrubland and/or bare rock on the steeper upper slopes, *Brachystegia glaucescens* woodland on gentler slopes where there is some soil formation, and gully forest or dense thicket along the base where moisture and nutrient levels are highest. The three types are described below. Vegetation on schist and similar rocks is different.

A1. *Myriathamnus* shrubland
A very varied vegetation type comprising species adapted to long dry periods. Most species are confined to small patches of skeletal soils or crevices, often with large expanses of bare rock in between giving a patchwork appearance. The most characteristic species is the short (50 cm high), shrubby Resurrection plant, *Myriathamnus flabellifolius*, found in mats associated with the tufted sedge *Coleochloa setifera* and the grass *Danthoniopsis pruinosa*. Scattered, stunted tree species, mostly 6-10 m high giving 5-20% cover, include *Albizia versicolor*, *Albizia tanganyicensis*, *Ficus* species, *Commiphora mollis*, *Kirkia acuminata*, *Lannea schweinfurthii*, *Sclerocarya birrea* and *Euphorbia cooperi*. The shrub layer often includes *Rhoicissus revoilii*, *Ozoroa insignis*, *Grewia flavescens*, *Pouzolzia mixta*, *Elephantorrhiza goetzei*, *Croton gratissimus* and *Vitex petersiana*. *Aloe* species and *Xerophyta* are common. Small trees of *Ficus abutifolia* are found rooted in crevices.

The major areas of this type are in the south east of the conservancy, associated with the large dwalas on Rocky Glen and Mjingwe, and in the far north on the border with Belingwe communal land. Species composition in the latter is richer owing to higher rainfall. Otherwise the type is found scattered throughout, especially in the eastern half.

There is little wildlife potential (except for baboons and some reptiles), but such areas are of great scenic value. Few useful plant species are present. Their biodiversity conservation value, however, is very high. It is on these hills that a number of unusual or localised species are found, for example the endemic cycad *Encephalartos concinnus*. Good examples of gneiss and granite gills should be considered as conservation areas.

A2. Gully forest
Gully forest is another very varied vegetation type containing a wide diversity of species, but rarely all together in one locality. The most typical species are probably the low evergreen tree *Englerophytum magalismontanum*, and the shrubs *Hexalobus monopetalus*, *Tabernaemontana elegans* and *Bauhinia galpinii*. Grass cover is poor to absent. The composition, structure and appearance of these narrow belts of forest/thicket vary greatly from hill to hill.

The type is usually only a few metres wide and is confined to the base of hills where moisture levels (from runoff) and nutrient levels (from weathering rock) are much higher than elsewhere. It can also be found in larger gullies between dwalas, but is absent from hills of schist or other rock types. The soils contain many large stones and comprise a high proportion of dark brown to blackish humus.

This vegetation type is associated with the bases of large hills, mostly those with extensive bare areas. It is principally found in the south east of the conservancy (Rocky Glen and Mjingwe) and in the far north where such hills are most common.

These forests are a valuable habitat for some species of wildlife (baboon, certain antelope, birds and reptiles) and as many of the constituent species produce fleshy fruits (e.g. figs, *Hexalobus*, *Englerophytum*) they are an important feeding ground for baboons and many birds. Good examples of gully forest are becoming rare in Zimbabwe, and those found in the Bubiana should be considered as some of the highest priorities for biodiversity conservation. The forests have little economic value except as a "sponge" helping to maintain spring/seepage flows for a longer period of the year.

A3. *Brachystegia glaucescens* woodland
Found on the lower, more gentle slopes of granite and gneiss hills and outcrops, this woodland type is characterised and dominated by tall (10-14 m high) spreading, open-canopied trees of *Brachystegia glaucescens*. Total woody cover is around 20-40%. Other common trees include *Commiphora* species and *Xeroderris stuhlmannii*, while common shrubs are *Mundulea sericea*, *Grewia* species and *Psydrax livida*. It grades into both gully woodland and *Myriathamnus* shrubland, and also into *Julbernardia* woodland on the pediments. Grass cover is poor. Soils are thin, but often fairly humus-rich.

The type is found in patches on many of the gneissic hills in the conservancy, particularly in the eastern part. It is widespread, but not particularly common or extensive. Apart from the value of *B. glaucescens* timber, often used for hut construction, this woodland has little economic value. It is not prime wildlife habitat, but does have scenic value. Its biodiversity conservation value is moderate, especially when relatively undisturbed. This type is widespread across the highveld and middleveld of Zimbabwe, but is rarely extensive.

Although strictly-speaking a type of miombo woodland, *B. glaucescens* woodland is here treated separately with hill vegetation types. It was felt it sits better here from a management perspective.

B. MIOMBO WOODLAND

Miombo woodland is a widespread vegetation formation across south central Africa, including much of the Zimbabwe highveld and middleveld. Defined as woodland dominated by trees of the genera *Brachystegia*, *Julbernardia* and *Isoberlinia* (the latter is not present in

Zimbabwe), it has a characteristic tall deciduous canopy with a well developed grass layer, and is fire-adapted. The Bubiana Conservancy is on the southern margins of miombo woodland in Zimbabwe, where such woodland gives way to *Acacia* and mopane woodland so characteristic of the lowveld. There are three miombo woodland types present. Being at the dry margins of miombo, *Brachystegia*-dominated woodland (apart from the drought-tolerant *B. glaucescens*) is only found where rainfall or 'guti' levels effectively reduce the length of the dry season, that is where the land rises on the northern boundary. Otherwise the more tolerant *Julbernardia globiflora* dominates along with other typical dry miombo species. *Terminalia* woodland, the third type, appears to be a product of land degradation and disturbance.

B1. *Brachystegia spiciformis* woodland

This typical miombo woodland type is characterised by trees up to 10 m high of *Brachystegia spiciformis* (msasa), co-dominant with *Julbernardia globiflora*. Total woody cover is around 40-60%. Other common trees include *Terminalia sericea*, *Pterocarpus angolensis*, *Lannea discolor*, *Combretum molle*, *Strychnos madagascariensis*, *Bridelia mollis*, *Pseudolachnostylis maprouneifolia*, *Albizia amara* and *Ozoroa insignis*. The main shrubs are *Flacourtia indica*, *Dichrostachys cinerea* and *Margaritaria discoidea*. The grass layer is often well developed with *Eragrostis* species, *Pogonarthria squarrosa*, *Urochloa mosambicensis* and *Panicum maximum*. Soils are sandy to loamy, brown in colour, and moderately deep.

This type is very localised within the conservancy, being confined to the slopes of large granite hills on the boundary with Belingwe communal land and the slopes of the Mweza Range on Basement schists near Sandawana Mine. Much of the type has been partially cut for wood or cleared for fields, and nearly all appears to be burnt frequently. Although possibly good wildlife habitat, there is little wildlife remaining in these areas owing to levels of human settlement. Timber from both *B. spiciformis* and *Julbernardia* is suitable for construction and firewood. In its present state its biodiversity conservation value is low, but when relatively undisturbed it would have a moderate to high value.

B2. *Julbernardia globiflora* woodland

A widespread woodland type characterised by the dominance of 8-10 m high trees of *Julbernardia globiflora* (mnondo). Canopy cover is mostly around 40-60%. Other typical trees include *Combretum molle*, *Combretum collinum*, *Albizia amara*, *Bridelia mollis*, *Lannea schweinfurthii*, *Xeroderris stuhlmannii*, *Commiphora mollis*, *Strychnos madagascariensis* and *Gardenia volkensii*. On slightly heavier soils *Acacia nigrescens* comes in, while *Crossopteryx febrifuga* appears in higher rainfall areas. In some areas of deeper sands on tonalitic gneiss, the miombo woodland is 'purer' and contains species such as *Pseudolachnostylis maprouneifolia*, *Burkea africana*, *Terminalia sericea* and *Acacia goetzei* subsp. *goetzei*, without any *Acacia nigrescens*. Common shrubs are *Grewia flavescens*, *Grewia monticola*, *Dichrostachys cinerea*, *Psydrax livida*, *Flueggea virosa* and *Flacourtia indica*. The grass layer is relatively well developed comprising *Eragrostis rigidior*, *Eragrostis superba*, *Pogonarthria squarrosa*, *Heteropogon contortus* and *Panicum maximum*, with annuals such as *Perotis patens*, *Melinis repens* and *Urochloa mosambicensis* in disturbed areas.

The type is widespread on undulating or hilly terrain on granitic and tonalitic gneiss in the eastern and northern parts of the conservancy. It is principally found on slightly elevated ground where soils are coarse-textured or eroding; *Acacia* woodland occupies the lower ground on depositional soils. However, generally miombo woodland is intermingled with *Acacia* woodland forming a mosaic with many areas of mixed vegetation.

The economic value of miombo woodland is moderate. It provides valuable grazing, although not of high quality owing to soil nutrient limitations and the short growing season. A number of species have value as timber or for construction and firewood. Its biodiversity conservation value is moderate.

B3. *Terminalia sericea* woodland

This woodland type, characterised by dominance of medium-sized trees of *Terminalia sericea* (mangwe), 6-8 m high with 40-80% woody cover, is probably a result of previous clearance of *Julbernardia* woodland; the *Terminalia* is secondary. Other common species include *Combretum apiculatum*, *Combretum collinum*, *Peltophorum africanum*, *Rhus leptodictya* and shrubs of *Grewia flavescens*, *Dichrostachys cinerea*, *Psydrax livida* and *Lippia javanica*. The grass layer is generally well developed but dominated by annuals or weak perennials such as *Pogonarthria squarrosa*, *Melinis repens*, *Perotis patens* and *Aristida* species. Better grasses include *Panicum maximum*, *Brachiaria nigropedata* and *Eragrostis rigidior*. Soils are coarse sand to loamy sand, and moderately deep.

This type is found in isolated patches of coarse sandy soils on pediments derived from tonalitic gneiss in the eastern and northern parts of the conservancy. It is believed to be derived from the surrounding *Julbernardia* woodland by recolonisation after woodland clearance for lands or settlement, and here is not related to vlei margins. It has minimal economic value, except for the *Terminalia* and *Combretum* wood, as the grazing vale of most grasses is not high and the soils are not suited to cultivation. Its biodiversity conservation value is low.

C. ACACIA WOODLAND

The majority of the Bubiana Conservancy comprises woodlands characterised by *Acacia nigrescens*. As could be expected, these woodlands vary in composition, primarily depending on soil texture and soil depth. However, it has not been possible to consistently or usefully subdivide them, hence they are treated here as one variable type.

Sandier soils (sand and loamy sand) tend to support miombo woodland types (types B2 to B3), while heavier, clay-rich depositional soils support mopane woodland (type D1). *Acacia* woodlands fall in between, but show much intergradation with both the others. The Bubiana Conservancy is best considered a mosaic of these three woodland 'groups', with miombo predominating in the north, east and south east, and *Acacia*/mopane dominating in the west and south west.

C1. *Acacia nigrescens* woodland

A very varied but generally moderately dense (60-80% total woody cover) woodland vegetation type dominated by trees 10-14 m high of *Acacia nigrescens*. Trees of *Combretum apiculatum* and *Colophospermum mopane* are also common, along with *Sclerocarya birrea*, *Commiphora glandulosa*, *Commiphora mollis*, *Kirkia acuminata* and *Ziziphus mucronata*. Less frequent trees include *Acacia gerrardii*, *Acacia nilotica*, *Acacia tortilis*, *Combretum hereroense*, *Lonchocarpus capassa* and *Lannea schweinfurthii*, with *Combretum collinum* on slightly sandier soils. The shrub layer is dominated by *Grewia flavescens*, *Grewia monticola* and *Dichrostachys cinerea*, with lower amounts of *Ehretia obtusifolia*, *Euclea divinorum* and *Flueggea virosa*. Grasses comprise *Eragrostis* species, *Panicum maximum* and *Urochloa mosambicensis*.

The type is mostly found on brown or red-brown sandy loam or sandy clay loam soils. Although it is perhaps the most widespread vegetation type, and hence very varied, it is most common in the south and west of the conservancy. Rocky outcrops of dolerite, norite and schists are often covered by this vegetation type. The ridge of Basement schists running across the conservancy is covered by it, but with a higher proportion of *A. nigrescens* trees, *Commiphora* spp. and *Combretum apiculatum* (see mapping unit IIb).

The small part of the conservancy on the Great Dyke outliers (norite) has vegetation of this type. No clear difference in either vegetation structure or species composition was noted here, except at one site (plot 43) which had a high cover-abundance of *Bolusanthus speciosus* and scattered *Ozoroa paniculosa*.

Acacia woodland is good for ranching; grass cover is good and nutritious with high levels of *Panicum maximum*. *Acacia* wood is good for fencing and firewood, but appears to be less desirable for this than mopane. The type does not have a particularly high conservation value, but patches on red brown soils derived from metavolcanics are said to provide good rhino habitat (K. Drummond, pers. comm.). It also provides an important browse both for cattle and wildlife. R. du Toit (pers. comm.) mentions a high utilization of the Basement schist ridge mentioned above by giraffe and other browsers.

D. MOPANE WOODLAND

Woodland dominated by trees of *Colophospermum mopane* (mopane) is widespread and typical of the Zimbabwe lowveld. It is generally found on heavier-textured (clay-rich) depositional soils. Although variable in composition, it is usually difficult to clearly separate out different types of mopane woodland, and this has not been attempted here. Mopane woodland is much more extensive in the Bubye Conservancy to the south, and its distribution across the Bubiana illustrates the transitional nature of the conservancy, from middleveld to lowveld. Hence it is much more extensive in the south and west, away from gneiss hills and skeletal soils.

D1. *Colophospermum mopane* woodland

A distinctive woodland type, dominated by trees 8-12 m high of *Colophospermum mopane*. Canopy cover is from 60-80%. The woodland is lower on shallow or eroding soils, but can be taller and thicker on deep sandy clay loams. Typical associated species are *Acacia nigrescens*, *Acacia nilotica*, *Albizia harveyii*, *Combretum apiculatum*, *Commiphora glandulosa* and *Ziziphus mucronata*, with *Spirostachys africana* on deeper and moister soils. There is a diverse shrub layer dominated by *Dichrostachys cinerea*, *Grewia flavescens* and *Grewia monticola*, along with *Euclea divinorum*, *Flueggea virosa*, *Ehretia obtusifolia*, *Dalbergia melanoxylon*, *Ormocarpum trichocarpum*, *Ximenia americana* and *Ximnia caffra*. The grass layer consists of *Heteropogon contortus*, *Eragrostis* species, *Panicum maximum* and *Urochloa mosambicensis*.

This type is found on depositional soils, mostly sandy loams to sandy clay loams, but is sometimes seen on loamy sands. Although widespread across the conservancy, mopane woodland is most extensive on the pediments to the south and west. In the east it is confined to small pockets within *Acacia nigrescens* woodland where clay particles have accumulated. Small patches of sodic soils with characteristic shrubby mopane are found within the type, but are not discussed here.

Mopane woodland provides good dry season browse for livestock and wildlife and, where it is not dense, it also provides good grazing. Mopane wood is valued for construction, fencing and firewood. Most areas of this woodland type are not suited to cultivation owing to periodic flooding and difficulties in working the soil. It does not have great conservation value in itself, only as a habitat for wildlife.

E. RIPARIAN WOODLAND

Woodlands flanking larger seasonal water courses are very poorly developed in the conservancy. The main reason for this is probably the limited extent of alluvium as rivers are generally small in their upper reaches and have not developed any floodplain. Only one vegetation type is present, but its extent is too small to map at the survey scale.

E1. *Acacia galpinii* woodland

A tall woodland with trees 12-16 m high of *Acacia galpinii*, flanking seasonal sand rivers such as the Bubye and Bubiana. Although tall, there is little development of fringing shrub vegetation, and woody cover is from 40-60%. Other characteristic species include *Acacia nigrescens*, *Acacia tortilis* subsp. *heteracantha*, *Lonchocarpus capassa*, *Ziziphus mucronata*, *Diospyros mespiliformis* and, occasionally, *Ficus sycomorus*. Common shrubs include *Flueggea virosa*, *Grewia flavescens*, *Grewia monticola*, and the climbers *Combretum microphyllum* and *Combretum mosambicense*. On the banks of larger rivers the shrub/small tree *Nuxia oppositifolia* is seen. The grass layer consists of *Panicum maximum*, *Cynodon dactylon*, *Chloris* sp. and *Urochloa mosambicensis*. In the river bed itself, on sandbanks, dense beds of the reed *Phragmites mauritianus* are commonly found. Soils are loamy sand, with coarse sand closer to the river.

This type is found flanking the Bubye, Bubiana, Tchabezi, Umtshungwe, Sovoleli, Makugwe and similar rivers right across the conservancy. The larger the river, the better developed the riparian woodland, although rarely is it wider than 20 m on each bank.

The economic value of riparian woodland is in protecting river banks from further erosion, as wildlife habitat, and for large timber trees. Grazing is good in these areas owing to moderate nutrient levels in the soil, moisture being available for a slightly longer period of the year, and to the light shade. Biodiversity conservation value of this type within the conservancy is moderate to low, but better developed riparian woodland supports a number of unusual or localised species.

F. DISTURBED AREAS

The Bubiana Conservancy has been used for settlement and agriculture for many years. Although not suited for cropping, smaller areas have been cleared in the past for homesteads and subsistence or semi-commercial crops. When abandoned these revert to woodland, but usually with a somewhat different species composition. The conservancy has, for much of the last 50 years, been used for cattle ranching. Kraal sites and the zones around drinking points were partially cleared or degraded. With the reduction in cattle numbers, such areas are reverting, again with a slightly different species composition. Bush encroachment is often encountered.

The vegetation described under this heading is varied but is broadly classed as *Acacia tortilis* woodland or *Dichrostachys* thicket, mostly on sandier soils. *Terminalia sericea* woodland, believed also to result from disturbance long back, was described earlier (Type B3). Degraded

land on heavier-textured soils differs less from *Acacia nigrescens* or mopane woodland from which it originated, and is not described here as a separate type.

F1. *Acacia tortilis* woodland
A very varied but generally low, open woodland dominated by trees 6-8 m high of *Acacia tortilis* subsp. *heteracantha* with 20-40% canopy cover. Sometimes the vegetation is more thicket-like with a well developed shrub layer. Other typical species include *Acacia nigrescens*, *Acacia nilotica*, *Combretum apiculatum* and *Ziziphus mucronata*, with shrubs of *Grewia monticola*, *Diospyros lycioides* and *Rhus leptodictya*. Composition is very varied as the broad type is found on a range of soil types ranging from coarse sand to sandy loam. The grass cover is moderate, being dominated by annuals or weak perennials such as *Urochloa mosambicensis* and *Pogonarthria squarrosa*. *Panicum maximum* is found in the shelter of bushes. There is also a wide range of annual and perennial herbs.

The type, much of which was associated with heavy disturbance in the past, is scattered across the conservancy in small pockets. It is more common closer to major drainage lines where, presumably, soils were more suited to cultivation. Areas presently cultivated under irrigation can be expected to become this type 10-20 years after being abandoned. In many instances such areas provide useful grazing and browse for both livestock and wildlife. Its biodiversity conservation value is low, except as occasional habitat for wildlife.

F2. *Dichrostachys* thicket
A very localised type of dense thicket 3-4 m high comprising *Dichrostachys cinerea* with scattered emergent trees to 10 m of *Acacia nigrescens*, *Acacia tortilis*, *Terminalia sericea, Lonchocarpus capassa* and *Albizia amara*. The grass cover, where the thicket has been partially cleared, consists of *Digitaria* and *Eragrostis rigidior*. The type is found on broad ridges in the Sovelele dam area in the northeastern part of the conservancy, and smaller patches can be seen elsewhere. It appears to be on coarse sand overlying heavier soils, and is thought to result from widespread clearing and cultivation some 20 years ago. The smaller patches, however, appear to be related to overgrazing around old cattle handling facilities.

The type would appear to have little economic value, and its conservation value is linked solely to being a suitable habitat (or forage resource?) for rhino (R. du Toit, pers. comm.).

5.4 Mapping Units

As mentioned previously, the described vegetation types in many instances are not clearly mappable at the survey scale. For example, riparian woodland is so narrow that it would just be a line at 1:100,000 scale, and vegetation types on rocky hills are so intermingled that any map would be a mass of lines of little interpretive value. The major limitation, perhaps, is that over much of the conservancy, especially in areas of gneiss rock outcrops in the eastern half, many of the described vegetation types form a tight mosaic. No one vegetation type is dominant; the mosaic can comprise eight different vegetation types, five of them widespread.

This problem has been overcome by producing a map consisting of mapping units, <u>not</u> vegetation types. The units are shown in Table 2 and described below, while the vegetation map is presented as Figure 4. Areas within the conservancy under each unit are given in Table 3.

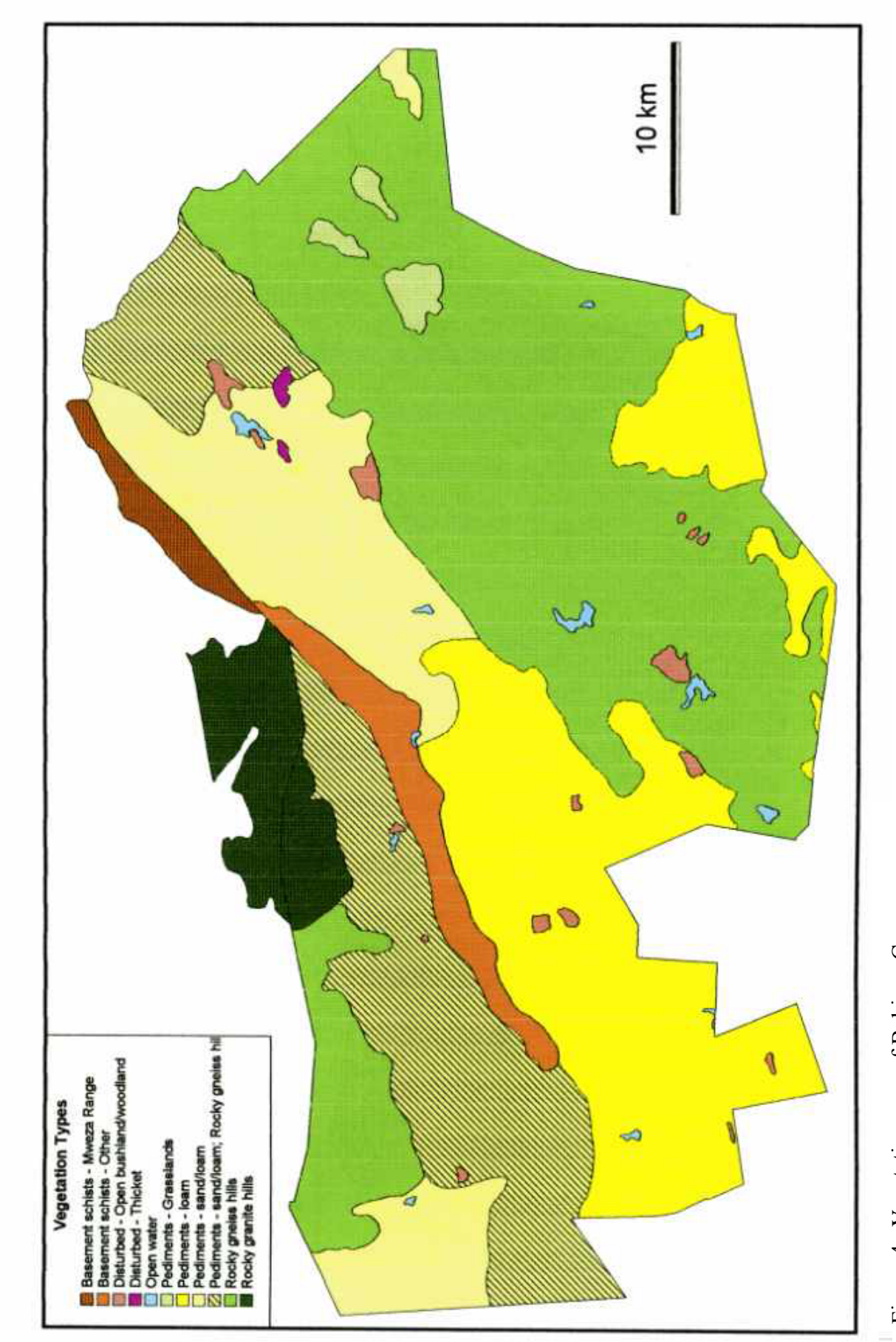

Figure 4. Vegetation map of Bubiana Conservancy.

Table 2. Mapping units for Bubiana Conservancy vegetation survey.

Map unit	**Map subunit**	**Vegetation types**
I. ROCKY HILLS	(a) Granite hills	A1 *Myriathamnus* shrubland A2 Gully forest A3 *Brachystegia glaucescens* woodland B1 *Brachystegia spiciformis* woodland B2 *Brachystegia glaucescens* woodland
	(b) Gneiss hills	A1 *Myriathamnus* shrubland A2 Gully forest A3 *Brachystegia glaucescens* woodland B2 *Brachystegia glaucescens* woodland
II. BASEMENT SCHISTS	(a) Mweza Range	B1 *Brachystegia spiciformis* woodland
	(b) Other	C1 *Acacia nigrescens* woodland
III. PEDIMENTS	(a) Sand / loam	B2 *Brachystegia glaucescens* woodland B3 *Terminalia sericea* woodland C1 *Acacia nigrescens* woodland D1 *Colophospermum* woodland E1 *Acacia galpinii* woodland F1 *Acacia tortilis* woodland
	(b) Loam	C1 *Acacia nigrescens* woodland D1 *Colophospermum* woodland E1 *Acacia galpinii* woodland
	(c) Grassland	C1 *Acacia nigrescens* woodland
IV. DISTURBED / FALLOW	(a) Open woodland	F1 *Acacia tortilis* woodland
	(b) Thicket	F2 *Dichrostachys* thicket

I. Rocky Hills

This mapping unit consists of land with a high incidence of rock outcrop, either of gneiss or granite. It covers a large part of the conservancy, except for the south west and centre. The land surface is mostly eroding, but there are patches of deposition.

The unit consists of the hills themselves (vegetation types A1 to A3), miombo woodland on the lighter-textured soils (types B1 to B3, *B. spiciformis*, *Julbernardia* and *T. sericea* woodlands), with *Acacia* woodland (type C1) and mopane woodland (type D1) on the heavier-textured and depositional soils. Along larger drainage lines *Acacia galpinii* woodland (type E1) is found. Areas of disturbance or cultivation have mostly been mapped separately. The unit consists of two subtypes, mapped separately.

Ia *Rocky Granite Hills*
This subunit is only found in the central northern part on the boundary with Mberengwa communal land. It is confined to granite hills, which are often not easy to distinguish from the metamorphosed gneiss. A geological map was used to separate them (Tyndale-Biscoe 1972). The area is generally more moist with higher rainfall, and also has higher elevation.

Vegetation consists primarily of the three hill types (A1 to A3, *Myriathamnus* shrubland, gully forest, *B. glaucescens* woodland), although gully forest (A2) is not well represented, and miombo woodland on the pediments (types B1 and B2, *B. spiciformis* and *Julbernardia* woodland). A characteristic species is *Brachystegia spiciformis*.

Ib *Rocky Gneiss Hills*
The second subunit is far more widespread, being found across most of the conservancy.

Vegetation consists of the three hill types (A1 to A3, *Myriathamnus* shrubland, gully forest, *B. glaucescens* woodland), miombo woodland on the sandier pediments (B2 and B3, *Julbernardia* and *T. sericea* woodland), and *Acacia* and mopane woodlands (C1 and D1) on heavier-textured and depositional soils. *Acacia galpinii* woodland (E1)is found along larger drainage lines.

It would only be possible to separate out the various vegetation types in this map unit by using airphotos and a more detailed survey scale (e.g. 1:25,000).

II Basement Schists
This mapping unit consists of the outcropping ridge of schists (ironstone, schist, amphibolite) running across the conservancy from north east to south west. Such rocks give rise to fertile reddish soils supporting a slightly different vegetation, and are very apparent on satellite imagery. The unit is subdivided into two subtypes based on size of hills, constituent rock types and vegetation.

IIa *Basement Schists – Mweza Range*
This subunit is limited in extent and confined to the tall hills of the Mweza Range near Sandawana Mine on the north-eastern boundary. The hills are capped with serpentine rock. Soils are deep near the base, red-brown and fertile. The better moisture status here allows development of what is almost highveld vegetation.

The vegetation is miombo woodland with *Brachystegia spiciformis* (type B1), although much of this has now been cleared and an open woodland or bushland results, frequently burnt through by fire.

IIb *Basement Schists – Other*
The second subunit is more extensive and runs from the northern boundary to the Tshabezi River. The ridge is readily visible but is not as tall as Mweza, rising only 20-50 m above the surrounding pediment. Soils are fertile and red-brown, but often shallow and rocky.

Vegetation is mostly *Acacia nigrescens* woodland (type C1) with a high proportion of *Commiphora* species and *Combretum apiculatum*. It is generally denser than surrounding *Acacia* woodland with many *Grewia* and other shrubs.

Table 3. Areas under each mapping unit within the Bubiana Conservancy.

Map unit		**area (km^2)**
I. Rocky hills	(a) granite	26.9
	(b) gneiss	756.6
[Rocky hills (gneiss) + Pediments (sand/loam)		319.4]
II Basement Schists	(a) Mweza	-
	(b) other	60.1
III Pediments	(a) sand/loam	260.8
	(b) loam	429.0
	(c) grassland	17.1
IV Disturbed / Fallow	(a) open woodland	14.8
	(b) thicket	2.2
V Open Water (dams)		7.8
TOTAL		**1894.7**

III Pediments
This map unit is the most widely distributed, being found right across the conservancy. It is divided into three subunits depending on soil type, the majority of which are derived from gneiss. There are, in addition, inclusions of soil derived from mafic granulite and amphibolite.

IIIa *Pediments – Sand / loam*
This subunit contains a mixture of vegetation types on a wide range of soils. In most cases it comprises both miombo (types B2 and B3, *Julbernardia* and *T. sericea* woodland) and *Acacia* (C1) woodlands, with small patches of mopane (D1) and riparian woodland (E1).

This subunit and subunit Ib form a mosaic, and for much of their extent they are mapped as a complex. This complex is found across the central part of the conservancy. The only area of subunit IIIa with minimal inclusion of rocky outcrops is in the north west by the main Bulawayo road.

IIIb *Pediments – Loam*
The second subunit is confined to loamy soils (mostly sandy loam to sandy clay loam) in the central and south-western parts. Soils are often moderately deep, fertile and red-brown in colour.

The main vegetation types are *Acacia* woodland (C1) and mopane woodland (D1), but with small inclusions of *Julbernardia* woodland (type B2), riparian woodland (E1) and disturbed areas (F1). This unit extends into the Bubye Conservancy to the south and into Doddieburn to the south west.

IIIc *Pediment – Grasslands*
The third subunit is confined to relatively small patches of sandy clay loam in the east. probably derived from amphibolite. Vegetation is an open variant of *Acacia* woodland (type C1) with scattered trees of both *A. nigrescens* and *A. galpinii*. Although soils are fertile, these areas do not seem to be favoured for cultivation, perhaps owing to seasonal waterlogging.

IV Disturbed / Fallow Areas
Scattered across the conservancy, particularly close to larger rivers or water sources, are areas that have been cleared for crops or livestock. They are mostly on sandier soils. The map unit comprises vegetation types F1 and F2 and is divided into two subunits on this basis.

IVa *Disturbed – Open woodland / bushland*
This subunit is found mostly on lighter-textured soils and results from both abandoned fields and areas around homesteads and cattle water sources. Vegetation is *Acacia tortilis* woodland (type F1) and is varied in both density and presence of other species.

IVb *Disturbed – Thicket*
The second subunit is confined to sandy soils around Sovelele dam in the north east which appear to be long-abandoned fields. A thicket vegetation dominated by *Dichrostachys* (type F2) is found. It is very localised.

5.5 Environment

Indirect gradient analysis using DCA showed two major gradients associated with the first two axes, which respectively accounted for 64.2% and 48.4% of the variation in species data. DCA axis 1 is associated with a soil texture gradient, with increasing loam fraction from left to right (Figure 5). DCA axis 2 is associated with a vegetation condition gradient, where degraded sites were separated from less disturbed sites. The bulk of the plots occur in the intermediate range of the two gradients, indicating similarities in soil texture and disturbance levels over a wide area of the conservancy.

Canonical Correspondence Analysis with Monte Carlo permutations indicated a significant influence of the measured variables on species data. The test showed significance along the first CCA axis ($F = 2.11$, $p<0.01$) and the overall test was also significant ($F = 1.54$, $p<0.01$). The first two CCA axes accounted for a cumulative 64.3% of the species-environment relationships. Soil texture and disturbance were associated with CCA axis 1, while canopy cover was associated with CCA axis 2. The association between canopy height and the two axes was balanced, indicating that it was not a strong explanatory variable in determining observed vegetation patterns.

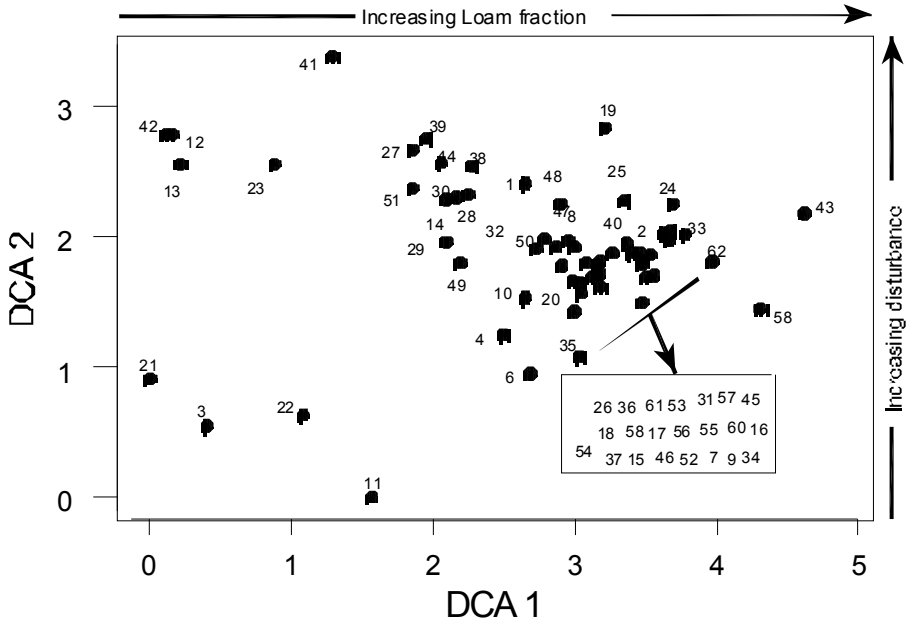

Figure 5. Detrended Correspondence Analysis ordination diagram of Bubiana vegetation and environment data, indicating major determinants of vegetation structure and composition. Numbers represent vegetation samples.

6. SPECIES AND HABITATS OF INTEREST

The only species of particular interest known from the area is the Zimbabwe endemic cycad *Encephalartos concinnus*. This plant is known from only three populations – Nyedzi dwala on Rocky Glen; Dyenhoro Natural Resources Defined Area on the granite Chingwarara Hill in Mberengwa communal land flanking the Mwenezi River 12 km northwest of Sandawana Mine; and from a granite hill just north of the Runde River (possibly Bangaugwe Hill) in Chivi communal land. It is regarded as Endangered under the IUCN Red Data Listing classification.

It is not known what practical sort of protection the Mberengwa population has, apart from formal designation under the Natural Resources Act. A visit in 1991 (Osborne 1991) showed a slightly smaller (although healthy) population than that on Rocky Glen on one side of the Defined Area, with "many" reported from the opposite hillside. It is believed access to the area is controlled by local residents. First noted in 1966, the Bubiana Conservancy population consisted of 58 individuals in 1991 (Osborne 1991). A visit during the present survey showed a similar number now. The status of the Runde population is unknown, but in 1967 was said to consist of only a few individuals.

The conservancy has particular responsibility for the continued existence of this very interesting species. Although two of the populations appear healthy and stable, reproduction is naturally very slow (John Donaldson, NBI Cape Town, pers. comm. to Diane Drummond, July 1997), and a desire to utilize them (at present the leaves are used occasionally for basket-making) or sudden change in land use could cause the species to become globally extinct in the wild.

Various species found are interesting in that they are near the limits of their range and do not extend much further west or south. They are indicative of higher rainfall and extend from the Matobo Hills, as with *Ochna glauca* and *Cyphostemma melleri*, or along the Limpopo escarpment as with most of the others listed below:

Allophylus rubifolius subsp. *alnifolius*
Brachystegia glaucescens
Cordia grandicalyx
Cyphostemma kilimandscharicum
Cyphostemma melleri
Encephalartos concinnus
Ficus stuhlmannii
Gymnosporia buxifolia
Gymnosporia putterlickioides
Homalium dentatum
Indigofera swaziensis var. *perplexa*
Maytenus undata
Ptaeroxylon obliquum
Rhynchosia divaricata
Teclea reflexa
Terminalia gazensis
Tetradenia brevispicata
Turraea floribunda

A vegetation type that is particularly rich and interesting is the gully forest or thicket found along the base of the larger hills or in gullies between them. The plant communities here are diverse, very varied between localities, and include species of restricted distribution. In most cases the species are more commonly associated with moister areas in the highveld. Strong efforts should be made to conserve a selection of such communities, especially in the south east, perhaps as part of a complex of large rocky hills/outcrops with lichens and drought-adapted plants, thus giving representation of the full vegetation catena.

Conservation measures that could be considered are protection from fire, no cutting of either undergrowth or trees, and to ensure that drainage is not made more rapid by the construction of drains or roads.

The upper reaches of Mount Towla, outside of the present conservancy, support a moisture-demanding vegetation unusual in the lowveld and would be worthy of further botanical investigation.

7. DISCUSSION

7.1 Vegetation

The vegetation of Bubiana is fairly diverse and typical of much of the Limpopo middleveld, that area where the land starts to fall away from the main plateau towards the Limpopo lowveld. Much of the area is on shallow gneissic soils that are naturally eroding, with only pockets of deposition. This diversity covers miombo, *Acacia* and mopane woodlands in a complex mosaic, not mappable at a reconnaissance scale. Miombo predominates on sandy soils in the moister and higher northern parts and in the dwala landscape of the south east, while *Acacia* and mopane woodlands predominate on the deeper more loamy soils at lower altitudes to the west and south west.

Riparian woodland is very poorly developed, and has also been heavily impacted upon, perhaps more than for other vegetation types in terms of proportion of its total extent.

Of greatest biological interest is the dwala complex in the south east portion of the conservancy. Here a wide range of habitats are found in close proximity, including some containing species of normally restricted distribution. Of particular note is the rare and endangered endemic cycad, *Encephalartos concinnus*.

The results agree broadly with the regional vegetation map (Wild & Barbosa 1967), and also with the more detailed survey of Dasmann and Mossman (1962) on the nearby Doddieburn and Manyoli ranches. They state that the variation in vegetation there – principally mopane woodland – is one of degree rather than a distinct ecological separation. They found extensive areas of *Acacia tortilis* woodland along the Umzingwane River, but such areas are very much more limited in Bubiana, probably as the extent of alluvium is much less developed as rivers are smaller.

The adjacent Bubye Conservancy to the south is not only at a lower altitude than most of the Bubiana but is also mostly on depositional loamy soils. Hence miombo is almost entirely absent, and most of the vegetation is mopane and *Acacia* woodland. As the rivers there are larger and less incised, there is also broader and better developed riparian woodland, again illustrating the transitional nature of Bubiana vegetation, intermediate between plateau miombo and lowveld mopane/*Acacia*.

The woody cover map of Zimbabwe (Forestry Commission 1998) shows almost all of the conservancy as 'woodland' (20-80% woody cover) with extensive areas of 'cultivation' in the adjacent communal lands. The hills in the north east are classified as 'bushland' (20-80% cover of bushes under 5 m high).

7.2 Plant Species

Appendix D lists all the species recorded from the conservancy, 145 of which are woody. With more detailed survey work, covering gully woodland, hills and riparian woodland in particular, the number of species would probably reach 180. Such a figure is not particularly high compared to, for example, around 230 species in the (moister) Matobo Hills further north, which are also part of the broad Limpopo escarpment.

Ecological notes on some of the main woody species are given in Appendix E. Appendix F lists woody species recorded from the area since flooded by the Manyuchi Dam, located not far from Sovelele in Maranda communal land, north-east of the Bubiana Conservancy.

7.3 Trends in Vegetation Change

The vegetation of Bubiana Conservancy shows much evidence of modification, principally from livestock grazing but also from selective clearance of trees for small-scale cultivation and timber. Clearance is mainly found around long-established homesteads and on alluvium or relatively close to rivers. Cultivation appears to be mostly subsistence in nature, and most dates from 20-50 years ago. Trends in vegetation composition are difficult to determine owing to lack of baseline data. In addition, there are likely to be some radical changes soon due to resettlement (see Anon. 2000).

It is likely that the conservancy is generally more wooded over most of its extent now than it was 50 years ago. There has been an increasing awareness among commercial ranchers of the desirability of encouraging growth of indigenous woodland, and also – in recent years – a move away from livestock management to wildlife, with the attendant reduction in range management practices such as selective clearance and burning.

The northern and north-western parts show evidence of overgrazing in the past, particularly areas on red loam soils, with a higher proportion of secondary vegetation and rangeland weeds. Soils are often partially eroded. Soil erosion was particularly noted in parts of Tamba, probably related to grazing and cultivation many years previously. Another factor is that the south-eastern portion of the conservancy is mostly covered in rocky hills and was less suited to livestock production. Although signs of degradation are still present, such as areas of *Acacia tortilis* woodland or *Dichrostachys* thicket, much of this appears to have occurred many years ago. There is less evidence of current land degradation.

Very little damage from wildlife was noted, although occasional trees were badly damaged by elephant. Moderately high levels of wildlife grazing and browsing were seen on Sondalani.

Bush encroachment is scattered in occurrence and mostly confined to ranches on red loam soils with moderate to high cattle populations. *Dichrostachys cinerea* – a common encroachment species – is widespread. The major *Dichrostachys* thickets seem to be associated with old fields, but smaller thickets have resulted from overgrazing around cattle handling and watering facilities. It has been noted (R. du Toit, pers. comm.) that some of these stands appear to be senescing, perhaps reflecting better range management practices over the last decade.

Fast-track resettlement is taking place on a number of Bubiana properties. In the east, on Mjingwe and Makugwe, it was interesting to note that new fields were almost entirely cleared on red loam soils (*Acacia* woodland), and were rarely present on sandy soils (miombo woodland). This resettlement is likely to have a major effect on vegetation in parts of the conservancy – not only from clearance for cultivation but also from cutting of selected trees for construction and firewood. Vegetation in dwalas is less likely to be affected, at least initially, but there are concerns over impacts on forests at their bases and riparian woodland.

7.4 Fire

Fire is a natural part of woodland ecology in these areas, but was probably nowhere near as frequent as it has been over the last 50 or more years. Most species are adapted to fire, but frequent fire inhibits them from reaching their full size or dominance while allowing fire-resistant or highly fire-adapted species, such as *Terminalia sericea* and *Dichrostachys*, to become dominant. With fire protection, a dense shrub layer arising from suppressed multi-stemmed rootstocks often results.

Frequent fire, even if 'cool', can greatly modify vegetation structure over the years and give rise to a parkland with large tall trees and abundant grass. This often provides good rangeland, but if fire frequency or grazing pressures are reduced a dense shrubland can result. Shrubland has a much lower biodiversity interest than mature woodland, but may provide better habitat for some animal species such as kudu. In the northern sections, vegetation appears more open than it should be under the present climatic conditions, with large trees and shrubs but few medium-sized trees.

In summary, land management practices depend on the objectives of management. For livestock production, management towards more open woodland may be most appropriate, while for rhino a denser woodland may be required. From the viewpoint of general biodiversity (= species richness) conservation, a mosaic of habitats should be aimed at, with particular care being given to rocky hills and footslopes, and riparian fringes. These are key habitats for a wide range of both animal (including invertebrates) and plant species.

8. RECOMMENDATIONS

1. More detailed vegetation/habitat survey work should be carried out of selected areas of the conservancy using 1:25,000 airphotos. Mapping at this scale can detect differences in vegetation type that cannot be depicted at a scale of 1:100,000. Such areas should be selected on the basis of how important they are for wildlife species, particularly black rhino. Details of important management focal points such as bare sodic patches in mopane woodland could be mapped. Relationships between vegetation and soil types could be more carefully determined, giving rise to suggestions on rehabilitation of degraded areas.

2. Logically, the Bubiana and Bubye conservancies should be combined, incorporating any intervening properties. Management practices should be harmonised across the area and impediments to wildlife movement should be removed. As part of this combination, the present reconnaissance vegetation survey should be extended to cover the Bubye Conservancy. In addition, Mount Towla in the northern Bubye Conservancy should be investigated from a biodiversity conservation perspective.

3. Given that the Bubiana Conservancy is a transition zone between the highveld and lowveld, with changes in relief reflected in marked changes in vegetation, a digital elevation model would be useful in determining relief-related ecological patterns. Digital versions of the Surveyor-General's 1:50,000 map sheets are required with 20 m contour intervals; 100 m contour intervals would be too coarse.

4. The conservancy and adjacent area contain the major two global populations of an endemic and endangered cycad. It is recommended to search the area for other populations or relict individuals. In addition, these populations should be more formally conserved. At present the two populations appear stable and secure, but their status should be regularly monitored and observed for regeneration.

5. Two or more "biodiversity reserves" should be designated within the conservancy covering the full range of hill and gully vegetation; probably in the southeastern sector. These must encompass a small number of large gneiss dwalas, gully forests on their slopes, vegetation on the footslopes, and run out to cover part of the surrounding miombo and/or mopane woodland. They should be chosen to cover as wide a range as possible of habitats, scenic values and any unusual populations of plants.

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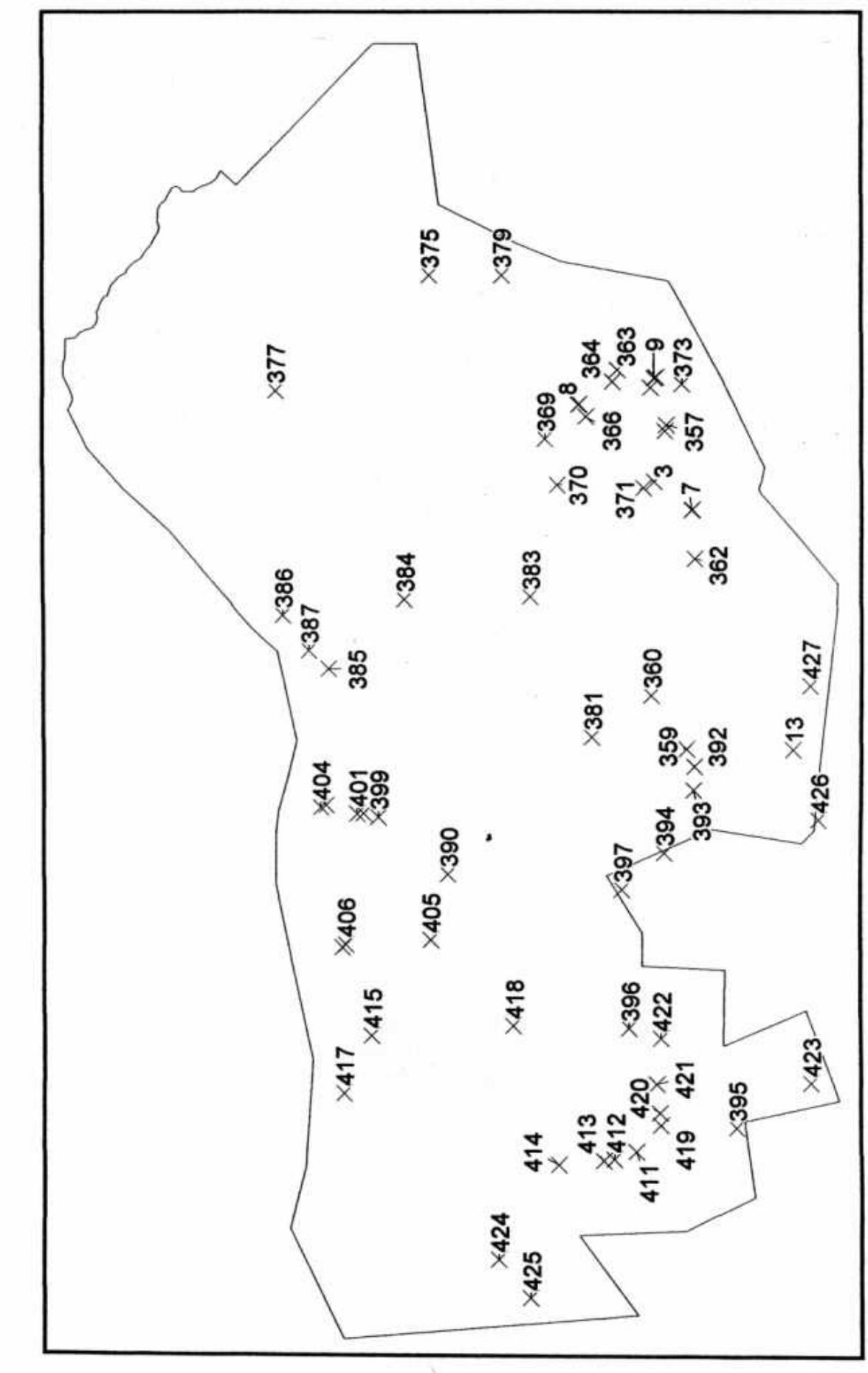
APPENDIX A. Bubiana vegetation survey waypoints, April/May 2001 (datum WGS 84, decimal minutes)

sample	waypoint	date	latitude (S)	longitude (E)	altitude (m)
B001	357	24 April	21o 12.90624	29o 56.41785	734
B002	358	24 April	21o 12.86504	29o 56.22119	736
B003	003	24 April	21o 12.547	29o 54.579	802
B004	007	24 April	21o 13.695	29o 53.632	
B005	006	24 April	21o 13.709	29o 53.651	720
B006	359	24 April	21o 13.52904	29o 45.77764	750
B007	360	24 April	21o 12.44886	29o 47.53920	790
B008	362	24 April	21o 13.77559	29o 52.03598	
B009	363	25 April	21o 11.42083	29o 58.23671	765
B010	364	25 April	21o 11.26504	29o 57.85466	
B011	365	25 April	21o 10.21705	29o 57.08508	
B012	008	25 April	21o 10.241	29o 57.100	788
B013	366	25 April	21o 10.45266	29o 56.69337	786
B014	369	25 April	21o 09.19803	29o 55.95050	775
B015	370	25 April	21o 09.57107	29o 54.45866	801
B016	371	25 April	21o 12.22034	29o 54.36178	779
B017	373	25 April	21o 13.39193	29o 57.76808	749
B018	375	26 April	21o 05.60537	30o 01.32951	766
B019	377	26 April	21o 00.86076	29o 57.52475	
B020	379	26 April	21o 07.86261	30o 01.33853	819
B021	009	26 April	21o 12.542	29o 57.967	790
B022	010	26 April	21o 12.607	29o 57.993	776
B023	011	27 April	21o 12.434	29o 57.659	772
B024	381	28 April	21o 10.64739	29o 46.15454	840
B025	383	28 April	21o 08.73776	29o 50.76333	806
B026	384	28 April	21o 04.84866	29o 50.66677	830
B027	385	28 April	21o 02.52158	29o 48.37638	867
B028	386	28 April	21o 01.09733	29o 50.13666	861
B029	386	28 April	21o 01.09733	29o 50.13666	861
B030	387	28 April	21o 01.91229	29o 48.97858	860
B031	390	28 April	21o 06.19857	29o 41.63362	877
B032	392	29 April	21o 13.76336	29o 45.21630	820
B033	393	29 April	21o 13.73182	29o 44.42515	820

B034	394	29 April	21o 12.83671	29o 42.36136	827
B035	395	29 April	21o 15.12807	29o 33.31599	783
B036	396	29 April	21o 11.80385	29o 36.58807	814
B037	397	29 April	21o 11.55505	29o 41.15308	839
B038	399	30 April	21o 04.06879	29o 43.51589	869
B039	400	30 April	21o 03.61657	29o 43.63111	867
B040	401	30 April	21o 03.41894	29o 43.61470	864
B041	403	30 April	21o 02.45946	29o 43.89151	850
B042	404	30 April	21o 02.27889	29o 43.82134	846
B043	405	30 April	21o 05.65912	29o 39.46779	876
B044	406	30 April	21o 03.06585	29o 39.30879	912
B045	407	30 April	21o 02.96382	29o 39.21449	920
B046	411	2 May	21o 12.04074	29o 32.52484	810
B047	412	2 May	21o 11.37255	29o 32.25608	813
B048	413	2 May	21o 11.03749	29o 32.22840	823
B049	414	2 May	21o 09.66441	29o 32.08550	843
B050	415	2 May	21o 03.87148	29o 36.31319	900
B051	417	2 May	21o 03.01081	29o 34.40389	958
B052	418	2 May	21o 08.22696	29o 36.64665	905
B053	419	3 May	21o 12.78618	29o 33.39098	818
B054	420	3 May	21o 12.75689	29o 33.80522	829
B055	421	3 May	21o 12.65679	29o 34.74796	825
B056	422	3 May	21o 12.77813	29o 36.25687	814
B057	423	3 May	21o 17.42361	29o 34.78691	783
B058	424	3 May	21o 07.78890	29o 28.94474	889
B059	425	3 May	21o 08.77896	29o 27.68013	894
B060	426	4 May	21o 17.63218	29o 43.45763	761
B061	013	4 May	21o 16.844	29o 45.761	783
B062	427	4 May	21o 17.37340	29o 47.86686	761

APPENDIX B. Location of vegetation samples, Bubiana Conservancy.



APPENDIX C. BUBIANA VEGETATION SURVEY - SPECIES X SAMPLE MATRIX

	MOPANE														ACACIA																			DISTURBED				RIPARIAN				JULBERNARDIA								TERMINALIA				B.SPIC	HILLS							
	2	7	16	17	24	33	40	45	54	55	57	58	59	62	8	9	15	18	20	25	26	31	34	36	37	43	47	48	50	52	53	56	60	19	32	46	61	4	5	6	35	10	14	27	28	29	30	49	51	1	38	39	44	41	3	11	12	13	21	42	22	23
Acacia erubescens											X																																																			
Acacia fleckii																								X				X	X							X																										
Acacia galpinii																		X						X					X									X	X	X	X																					
Acacia gerrardii	X						X														X	X	X		X	X				X												X																				
Acacia goetzei subsp. goetzei																																												X			X					X										
Acacia nigrescens	X	X	X	X		X			X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X		X	X			X		X		X	X										X	
Acacia nilotica			X		X				X	X				X								X	X	X	X				X			X				X	X	X							X	X																
Acacia schweinfurthii																																						X																							X	
Acacia tortilis subsp. heteracantha						X			X	X												X	X	X	X		X				X	X	X	X	X	X	X	X	X	X	X				X					X												
Acalypha pubiflora																																																													X	
Afzelia quanzensis																																																					X							X		
Albizia amara																			X			X			X									X									X	X		X	X		X	X		X	X	X								
Albizia harveyi					X	X	X					X	X										X		X		X			X														X																		
Albizia tanganyicensis																																																							X			X	X			
Albizia versicolor																																																									X			X		X
Allophylus alnifolius																			X																													X														X
Aloe sp.																																																											X			
Andropogon gayanus																										X																																				
Aristida junciformis																																																				X										
Aristida sp.	X			X	X		X							X										X			X																X																			
Artabotrys brachypetalus																																											X						X					X						X		
Azanza garckeana																								X										X	X									X																		
Bauhinia galpinii																																						X									X							X							X	X
Berchemia discolor																X			X																		X										X	X														
Bolusanthus speciosus														X				X		X						X																																				
Boscia angustifolia		X			X																																																									X
Bothriochloa insculpta						X																				X		X																																		
Brachiaria nigropedata																																																		X												
Brachystegia glaucescens																																										X													X	X						
Brachystegia spiciformis																																													X	X								X						X		
Bridelia mollis		X																	X										X						X					X		X	X	X	X			X	X	X			X	X		X			X	X	X	X
Burkea africana																																												X								X		X								X
Canthium lactescens																																																											X			
Cassia abbreviata																																			X					X																				X			
Catunaregum spinosa																				X																													X													
Chloris sp.		X							X												X												X							X																						
Cissus cornifolia																									X																														X			X	X			
Clerodendrum eriophyllum																X																							X											X												
Coleochloa setifera																																																							X		X	X	X	X		
Colophospermum mopane	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			X		X	X	X	X	X		X	X		X		X	X		X		X	X					X								X												
Combretum apiculatum		X		X		X				X	X	X			X	X	X		X	X	X	X			X		X	X	X	X		X			X			X										X	X	X		X	X									X
Combretum celastroides																																	X																													
Combretum collinum																X	X		X	X	X	X							X						X								X		X	X	X			X	X		X								X	
Combretum erythrophyllum																																								X																						
Combretum hereroense	X				X						X				X		X	X		X				X		X	X		X							X						X	X							X												
Combretum imberbe							X							X		X	X		X							X			X											X		X					X				X											
Combretum microphyllum																																						X	X	X	X																				X	
Combretum molle																					X																					X			X	X	X															
Combretum mossambicense																	X																					X		X	X																					
Combretum zeyheri																																																X					X									
Commiphora glandulosa	X			X			X	X	X			X				X			X		X		X		X			X		X		X										X					X			X						X						
Commiphora marlothii																																																							X				X			
Commiphora mollis				X					X	X		X			X	X	X				X	X							X	X												X				X	X	X		X						X		X				
Commiphora schimperi																																														X													X			
Cordia monoica				X																								X										X																								
Crossopteryx febrifuga																																													X	X														X		
Croton gratissimus																																																							X				X			
Cynodon dactylon																																						X	X	X																						
Dactyloctenium aegyptium																																						X																								
Dalbergia melanoxylon	X	X		X			X	X		X		X					X		X	X	X																					X	X		X		X				X										X	
Dalbergia nitidula																																																								X						
Danthoniopsis pruinosa																																																											X	X		
Dichrostachys cinerea	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X								
Digitaria sp.	X																									X								X																												
Diospyros lycioides																											X		X							X	X	X					X					X			X	X			X					X	X	
Diospyros mespiliformis																X			X			X				X											X							X				X	X			X									X	X
Diplorhynchus condylocarpon																																														X	X															

Dombeya rotundifolia																																													X				X													
Ehretia obtusifolia	X			X			X		X	X		X					X			X				X		X			X		X	X	X			X			X									X			X	X											
Elaeodendron matabelicum																																														X																
Elephantorrhiza goetzei																																																											X		
Englerophytum magalismontanum																																																													X
Enteropogon macrostachyus						X				X													X									X		X																													
Eragrostis rigidior	X			X	X		X					X			X												X	X	X		X			X												X			X	X			X	X								
Eragrostis sp.			X						X	X			X	X										X		X					X		X												X			X				X				X						
Eragrostis superba		X		X							X							X								X																X			X	X			X		X											
Eriochloa sp. (5/2)																																							X																							
Euclea divinorum	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X					X	X	X		X	X	X	X	X	X	X	X		X		X	X	X				X	X	X	X	X		X			X			X										X
Euclea natalensis																																																														X
Euphorbia cooperi																																																										X			
Euphorbia ingens																															X																															
Ficus abutifolia																																																											X		X
Ficus ingens																																																											X		
Ficus tettensis																																																							X							
Flacourtia indica																													X															X	X				X					X								
Flueggia virosa	X				X	X	X		X		X	X		X			X	X	X	X	X	X		X		X			X	X		X								X	X			X			X		X	X												
Friesodielsia obovata																																																												X	
Gardenia resiniflua		X																															X																													
Gardenia volkensii			X																	X		X					X	X	X						X			X		X	X	X	X	X				X	X	X												
Grewia bicolor							X																																																							
Grewia flav. flavescens	X	X	X	X		X	X		X	X	X	X		X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X		X	X		X		X	X	X	X			X	X			X		X	X		X				X		X	
Grewia flav. olukondae																																																				X										
Grewia monticola	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X		X	X	X	X		X	X	X	X	X	X	X		X			X		X				X
Gymnosporia buxifolia		X																																																												
Heteromorpha trifoliata																					X																										X															
Heteropogon contortus	X	X	X	X		X		X			X						X			X						X			X					X								X	X	X		X	X		X								X					
Hexalobus monopetalus																																								X																			X		X	X
Holarrhena pubescens																																																	X											X		
Hyparrhenis hirta																										X																																				
Indigofera setiflora																																																						X								
Indigofera swaziensis																																																	X													
Julbernardia globiflora																																										X	X	X	X	X	X	X	X		X			X								
Kigelia africana																																																						X								
Kirkia acuminata									X	X					X	X		X			X		X		X		X			X	X		X														X	X		X			X				X	X	X	X		X
Lannea discolor																																											X	X				X				X	X						X		
Lannea schweinfurthii				X	X		X		X	X		X			X		X								X						X	X					X	X				X																		X		
Lantana camara																																								X																						
Lippia javanica			X															X											X												X											X		X				X					
Lonchocarpus capassa		X			X		X									X	X		X					X			X	X			X			X				X	X		X			X	X		X		X	X											X	X
Maerua angolensis																																						X																								
Maerua parvifolia				X																																																										
Margaritaria discoidea																																										X	X	X					X					X	X	X						
Markhamia zanzibarica										X																	X																																			
Maytenus senegalensis																				X						X			X											X			X									X										
Maytenus undata																																																														X
Melinis repens											X																X								X								X	X					X			X			X		X	X				
Mimusops zeyheri																																																							X						X	
Mundulea sericea												X															X	X																				X	X						X	X						
Myriathamnus flabellifolius																																																									X	X	X	X		
Nuxia oppositifolia																																							X																							
Olax dissitiflora																										X																																				
Ormocarpum trichocarpum	X			X		X		X	X			X		X	X									X		X	X	X				X		X	X										X		X		X	X			X									
Ozoroa insignis																			X									X																X				X				X		X				X				
Ozoroa paniculosa																										X																																				
Panicum maximum	X	X	X	X		X			X			X		X	X	X	X	X	X		X	X	X		X		X	X		X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X		X	X		X			X			X
Panicum sp.											X																																													X						
Pappea capensis	X										X																		X									X										X	X													
Pavetta schumanniana																																																	X													
Peltophorum africanum																			X	X								X	X																						X		X									
Pennisetum sp. (5/1)																																							X																							
Perotis patens																												X																X						X	X	X										
Phragmites mauritianus																																							X																							
Plumbago zeylanica																																					X																									
Pogonarthria squarrosa	X	X	X	X	X							X								X				X			X	X						X	X								X	X	X	X		X	X	X	X	X	X	X				X				
Pouzolzia mixta																																																											X		
Pseudolachnostylis maprouneifolia																																													X	X	X		X		X	X		X							X	X
Ptaeroxylon obliquum		X																																																											
Pterocarpus angolensis																																																		X				X								
Pterocarpus rotundifolius																		X							X				X																						X		X									

Rhoicissus revoilii																																													X				X					X			X		X		
Rhus leptodictya		X	X				X	X	X					X				X					X					X	X						X	X	X						X			X		X	X		X	X	X		X							X
Rhynchosia divaricata																																																							X						
Rotheca myricoides																																																X				X										X
Sansevieria pearsonii																																																											X		
Schmdtia pappophoroides										X																	X	X			X																	X	X													
Schotia brachypetala																			X																																										
Sclerocarya birrea		X		X		X				X		X				X					X	X	X	X	X			X	X	X	X		X		X			X						X		X		X	X	X	X	X	X	X		X			X	X		
Setaria incrassata																									X																																				
Setaria pumila																																																								X	X				
Solanum incanum																																				X																									
Solanum tettense																X																																						X							
Spirostachys africana	X				X				X					X			X		X																X		X	X		X																					
Steganotaenia araliacea															X																																			X											X
Sterculia rogersii																																																										X			
Strychnos madagascariensis		X													X														X						X			X				X			X		X	X	X				X	X					X	X		
Strychnos spinosa																													X																X																	
Tabernaemontana elegans																																						X																						X	X	X
Tarconanthus camphoratus		X																																								X																				
Tephrosia rhodesica																																																						X					X			
Terminalia gazense																																																													X	
Terminalia sericea																			X	X									X					X					X	X				X		X			X	X	X	X	X	X								
Tetradenia brevispicata																																																										X				
Themeda triandra																		X																								X																			
Tricalysia junodii		X		X							X				X	X											X		X									X				X	X				X	X	X	X		X			X	X				X		X
Turraea floribunda																																																													X	
Turraea nilotica																			X																	X													X		X											
Urochloa mosambicensis	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X			X	X	X	X	X		X	X	X	X	X	X	X		X	X		X		X	X	X			X			X														
Vangueria infausta																																						X																				X			X
Vepris zambesiaca													X																																																	
Vernonia amygdalina																																																														
Vitex petersiana																																																							X				X	X	X	X
Xeroderris stuhlmannii																																												X	X	X		X								X						
Xerophyta equisetoides																																																										X				
Ximenia americana			X						X	X				X																																															
Ximenia caffra	X	X		X					X		X	X		X		X	X						X		X		X			X			X			X		X											X		X										X	
Ziziphus mucronata	X	X	X				X	X		X					X	X	X	X	X			X		X	X	X	X	X							X		X	X		X	X			X	X	X									X							X

APPENDIX D.

BUBIANA SPECIES LIST (mostly trees)

GYMNOSPERMS
Zamiaceae
Encephalartos concinnus *R.A.Dyer & I.Verd*.

MONOCOTYLEDONS
Cyperaceae
Coleochloa setifera *(Ridley) Gilly*

Aloaceae
Aloe ? excelsa *Berger*
Aloe sp.

Dracaenaceae
Sansevieria pearsonii *N.E.Br*.

Poaceae
Andropogon gayanus *Kunth.*
Aristida junciformis *Trin.& Rupr.*
Aristida sp.
Bothriochloa insculpta *(A.Rich.) A.Camus*
Brachiaria nigropedata *(Ficalho & Hiern) Stapf*
Chloris sp.
Cynodon dactylon *(L.) Pers.*
Dactyloctenium aegyptium *(L.) Willd.*
Danthoniopsis pruinosa *C.E.Hubbard*
Digitaria sp.
Enteropogon macrostachyus *(A.Rich.) Benth.*
Eragrostis rigidior *Pilg.*
Eragrostis sp.
Eragrostis superba *Peyr.*
Eriochloa sp. 5/2
Heteropogon contortus *(L.) Roem.& Schult.*
Hyparrhenia hirta *(L.) Stapf*
Melinis repens *(Willd.) Zizka*
Panicum maximum *Jacq.*
Panicum sp.
Pennisetum sp. 5/1
Perotis patens *Gand.*
Phragmites mauritianus *Kunth*
Pogonarthria squarrosa *(Roem.& Schult.) Pilg.*
Schmidtia pappophoroides *Steud.*
Setaria incrassata *(Hochst.) Hack.*
Setaria pumila *(Poir.) Roem.& Schult.*
Themeda triandra *Forssk*.
Urochloa mosambicensis *(Hack.) Dandy*

Velloziaceae
Xerophyta equisetoides *Baker*

DICOTYLEDONS
Acanthaceae
Blepharis transvaalensis *Schinz*

Anacardiaceae
Lannea discolor *(Sond.) Engl.*
Lannea schweinfurthii *(Engl.) Engl.*
var. stuhlmannii *(Engl.) Kokwaro*
Ozoroa insignis *Delile*
subsp. reticulata *(Baker f.) J.B.Gillett*
Ozoroa paniculosa *(Sond.) R.& A.Fern.*
var. salicina *(Sond.) R.& A.Fern.*
Rhus leptodictya *Diels*
Sclerocarya birrea *(A.Rich.) Hochst.*

Annonaceae
Artabotrys brachypetalus *Benth*.
Friesodielsia obovata *(Benth.) Verdc.*
Hexalobus monopetalus *(A.Rich.) Engl.& Diels*
var. obovatus *Brenan*

Apiaceae
Heteromorpha trifoliata *(Wendl.) Eckl.& Zeyh*.
Steganotaenia araliacea *Hochst*.

Apocynaceae
Carissa edulis *Vahl*
Diplorhynchus condylocarpon *(Müll.Arg.) Pich.*
Holarrhena pubescens *(Buch._Ham.) G.Don*
Tabernaemontana elegans *Stapf*

Araliaceae
Cussonia arborea *A.Rich*.
Cussonia natalensis *Sond*.

Asteraceae
Brachylaena huillensis *O.Hoffm*.
Brachylaena rotundata *S.Moore*
Tarchonanthus camphoratus *L.*
Vernonia amygdalina *Delile*

Bignoniaceae
Kigelia africana *(Lam.) Benth.*
Markhamia zanzibarica *(DC.) K.Schum.*

Bombacaceae
Adansonia digitata *L*.

Boraginaceae
Cordia grandicalyx *Oberm.*
Cordia monoica *Roxb.*
Ehretia obtusifolia *DC.*

Burseraceae
Commiphora glandulosa *Schinz*
Commiphora marlothii *Engl.*
Commiphora mollis *(Oliv.) Engl.*

Commiphora schimperi *(O.Berg) Engl.*

Capparaceae
Boscia angustifolia *A.Rich.*
var. corymbosa *(Gilg) DeWolf*
Maerua angolensis *DC.*
Maerua parvifolia *Pax*

Celastraceae
Elaeodendron matabelicum *Loes*.
Gymnosporia buxifolia *(L.) Szyszyl.*
(=Maytenus heterophylla)
Maytenus senegalensis (*Lam.) Exell*
Maytenus undata *(Thunb.) Blakelock*

Chrysobalanaceae
Parinari curatellifolia *Benth*.

Combretaceae
Combretum apiculatum *Sond*.
Combretum celastroides *C.Lawson*
Combretum collinum *Fresen*.
subsp. gazense *(Swynn.& Baker f.) Okafor*
Combretum erythrophyllum *(Burch.) Sond.*
Combretum hereroense *Schinz*
Combretum imberbe *Wawra*
Combretum microphyllum *Klotzsch*
Combretum molle *G.Don*
Combretum mossambicense *(Klotzsch) Engl.*
Combretum zeyheri *Sond*.
Terminalia brachystemma *Welw*.
subsp. brachystemma
Terminalia gazensis *Baker f.*
Terminalia sericea *DC.*

Ebenaceae
Diospyros lycioides *Desf.*
Diospyros mespiliformis *A.DC.*
Euclea divinorum *Hiern*
Euclea natalensis *A.DC.*

Euphorbiaceae
Acalypha pubiflora *Baill*.
Alchornea laxiflora *(Benth.) Pax & K.Hoffm.*
Bridelia mollis Hutch.
Croton gratissimus *Burch*
var. gratissimus
Erythrococca trichogyne *(Müll.Arg.) Prain*
Euphorbia cooperi *A.Berger*
Euphorbia ingens *Boiss*.
Flueggea virosa *(Willd.) Voigt*
Margaritaria discoidea *(Baill.) G.L.Webster*
Phyllanthus reticulatus *Poir*.
Pseudolachnostylis maprouneifolia *Pax*
Spirostachys africana *Sond*.

Fabaceae: Caesalpinioideae
Afzelia quanzensis *Welw*.
Bauhinia galpinii
Brachystegia glaucescens *Burtt Davy*
[or B. tamarindoides]
Brachystegia spiciformis *Benth*.
Brachystegia tamarindoides *Benth*.
susbsp. torrei *(Hoyle) Chikuni*
Burkea africana *Hook.*
Cassia abbreviata *Oliv*.
Colophospermum mopane *(Benth.) J.Léonard*
Julbernardia globiflora *(Benth.) Troupin*
Peltophorum africanum *Sond.*
Piliostigma thonningii *(Schumach.) Milne-Redh.*
Schotia brachypetala *Sond.*
Senna singueana *(Delile) Lock*

Fabaceae: Mimosoideae
Acacia ataxacantha *DC.*
Acacia erubescens *Oliv.*
Acacia fleckii *Schinz*
Acacia galpinii *Burtt Davy*
Acacia gerrardii *Benth*.
Acacia goetzei *Harms*
subsp. goetzei
Acacia karroo *Hayne*
Acacia mellifera *(Vahl) Benth.*
Acacia nigrescens *Oliv*.
Acacia nilotica *(L.) Delile*
subsp. kraussiana *(Benth.) Brenan*
Acacia rehmanniana *Schinz*
Acacia schweinfurthii *Brenan & Exell*
Acacia tortilis *(Forssk.) Hayne*
subsp. heteracantha *(Burch.) Brenan*
Albizia amara *(Roxb.) Boiv.*
Albizia anthelmintica *(A.Rich.) Brogn.*
Albizia harveyi *Fourn*.
Albizia tanganyicensis *Baker*
Albizia versicolor *Oliv*.
Dichrostachys cinerea *(L.) Wight & Arn.*
Elephantorrhiza goetzei *(Harms) Harms*

Fabaceae: Papilionoideae
Bolusanthus speciosus *(Bolus) Harms*
Dalbergia melanoxylon *Guill.& Perr.*
Dalbergia nitidula *Baker*
Erythrina abyssinica *DC.*
Indigofera setiflora *Baker*
Indigofera swaziensis *Bolus*
var. perplexa *(N.E.Br.) J.B.Gillett*
Lonchocarpus capassa *Rolfe*
Mundulea sericea *(Willd.) A.Chev.*
Ormocarpum kirkii *S.Moore*
Ormocarpum trichocarpum *(Taub.) Engl.*
Pterocarpus angolensis *DC.*
Pterocarpus rotundifolius *(Sond.) Druce*
subsp. rotundifolius

Rhynchosia divaricata *Baker*
Tephrosia rhodesica *Baker f.*
var. polystachyoides *(Baker f.) Brummitt*
var. rhodesica
Xeroderris stuhlmannii *(Taub.) Mendonça & E.C.Sousa*

Flacourtiaceae
Flacourtia indica *(Burm.f.) Merr.*
Homalium dentatum *(Harv.) Warb.*

Lamiaceae
Rotheca (Clerodendrum) myricoides *(Hochst.) R.Fern.*
Tetradenia brevispicata *N.E.Br.*

Loganiaceae
Nuxia oppositifolia *(Hochst.) Benth.*
Strychnos madagascariensis *Poir*
Strychnos spinosa *Lam*.

Malvaceae
Azanza garckeana *(F.Hoffm.) Exell & Hillc.*

Meliaceae
Entandrophragma caudatum *(Sprague) Sprague*
Turraea floribunda *Hochst*.
Turraea nilotica *Kotschy & Peyr.*

Moraceae
Ficus abutifolia *(Miq.) Miq.*
Ficus glumosa *(Miq.) Delile*
Ficus ingens *(Miq.) Miq.*
Ficus sansibarica *Warb*.
Ficus stuhlmannii *Warb*.
Ficus sycomorus *L*.
Ficus tettensis *Hutch*.
Ficus thonningii *Blume*

Myrothamnaceae
Myriathamnus flabellifolius *Welw*.

Myrtaceae
Heteropyxis dehniae *Suesseng*.

Olacaceae
Olax dissitiflora *Oliv*.
Ximenia americana *L.*
Ximenia caffra *Sond*.

Plumbaginaceae
Plumbago zeylanica *L.*

Ptaeroxylaceae
Ptaeroxylon obliquum *(Thunb.) Radlk.*

Rhamnaceae
Berchemia discolor *(Klotzsch) Hemsley*
Ziziphus mucronata *Willd*.

Rubiaceae
Canthium lactescens *Hiern*
Catunaregum spinosa *(Thunb.) Tirveng.*
Crossopteryx febrifuga *(G.Don.) Benth.*
Gardenia resiniflua *Hiern*
Gardenia volkensii *K.Schum*.
Pavetta gardeniifolia *A.Rich*.
var. subtomentosa *K.Schum.*
Pavetta schumanniana *K.Schum*.
Psydrax livida *(Hiern) Bridson*
Tricalysia junodii *(Schinz) Brenan*
var. kirkii *(Hook.f.) Robbr.*
Vangueria infausta *Burch*.

Rutaceae
Teclea reflexa *I.Verd.*
Vepris zambesiaca *S.Moore*

Sapindaceae
Allophylus alnifolius *(Baker) Radlk.*
Dodonaea angustifolia *L.f.*
Pappea capensis *Eckl.& Zeyh.*

Sapotaceae
Englerophytum magalismontanum *(Sond.) T.Penn.*
=Bequaertiodendron magalismontanum
Manilkara mochisia *(Baker) Dubard*
Mimusops zeyheri *Sond*.

Simaroubaceae
Kirkia acuminata *Oliv*.

Solanaceae
Solanum incanum *L.* (sensu lato)
Solanum tettense *Klotzsch*
var. renschii *(Vatke) Gonç.*

Sterculiaceae
Dombeya rotundifolia *(Hochst.) Planch.*
Sterculia rogersii *N.E.Br.*

Tiliaceae
Grewia bicolor *Juss*.
Grewia flavescens *Juss*.
var. flavescens
var. olukondae *(Schinz) Wild*
Grewia monticola *Sond*.

Urticaceae
Pouzolzia mixta *Solms*

Verbenaceae
Clerodendrum eriophyllum *Gürke*
Clerodendrum glabrum *E.Mey.*
Clerodendrum myricoides *(Hochst.) Vatke*
Lantana camara *L.*
Lippia javanica *(Burm.f.) Spreng.*
Vitex petersiana *Klotzsch*

Vitaceae
Cissus cornifolia *(Baker) Planch.*
Cyphostemma kilimandscharicum *(Gilg) Wild & R.B.Drumm.*
Rhoicissus revoilii *Planch*.

APPENDIX E.

NOTES ON SELECTED WOODY SPECIES

Acacia galpinii (monkey thorn): Commonly found alongside rivers. It forms a tall fringing woodland along the larger rivers. Rarely encountered away from alluvium. There are large open grassy areas on red loams on the eastern border of the conservancy where this is the most common tree.

Acacia nigrescens (knobthorn): Widespread across the area, but dominant/subdominant in acacia woodland. Tall woodland (trees above 10 m) indicates deeper soils. Found mostly on reddish sandy loams to sandy clay loam where soil fertility is moderate to high. Usually has good rangeland grass composition underneath.

Acacia nilotica (scented thorn): Widespread, but rarely many trees together. Probably dispersed mostly by cattle, so more common in cattle areas. Prefers richer, heavier soils. Particularly common in acacia woodland.

Acacia tortilis (umbrella thorn): Mostly found where the area has been disturbed, sometimes up to 50 years ago. Also seen alongside rivers.

Albizia versicolor (poison pod albizia): Spreading tree, only rarely encountered on the lower slopes of dwalas. Often in or at the margins of *Brachystegia glaucescens* woodland. Unripe pods are poisonous to livestock.

Bauhinia galpinii (red bauhinia): Shrub with red flowers mostly confined to thickets and margins of gully forest along the base of large dwalas. Often thicket-forming.

Brachystegia glaucescens (mountain acacia): Spreading tree with an open canopy forming a woodland on the slopes of granite and gneiss dwalas. Sometimes stunted individuals are found much higher up the hills, or on small outcrops in acacia woodland.

Brachystegia spiciformis (msasa): Very local in the conservancy; only in the far north in woodland on the lower slopes of large granite dwalas, but also common on the slopes of the Mweza Range on Basement schists. Needs higher rainfall and soil moisture than *Julbernardia*.

Colophospermum mopane (mopane): Widespread across conservancy but on heavier soil types (sandy loams to sandy clay loam). Common with *Acacia* and *Combretum*, but on the heaviest soils forms a dominant woodland.

Combretum apiculatum (red bushwillow): Widespread across the conservancy, but mostly with *Acacia nigrescens*.

Combretum collinum: Locally common tree on sandy soils with *Julbernardia* and, less frequently, in acacia woodland.

Combretum imberbe (leadwood): Mostly seen close to drainage lines, both small and large. A useful and durable timber.

Croton gratissimus (lavender croton): Mostly found on lower slopes of dwalas with *Brachystegia glaucescens*.

Dichrostachys cinerea (sickle bush): Widespread across conservancy in a range of woodland types, but rarely on shallow soils or hills. Especially associated with disturbance.

Englerophytum (Bequertiodendron) magalismontanum (stem fruit): An unusual, low evergreen tree with dark green leaves, occasional or locally dominant in the better developed gully forests at the base of large dwalas.

Grewia flavescens (donkey berry): Common shrub in *Acacia* woodland. Variety *olukondae* is found alongside rivers. The other variety - var. *flavescens* - is widespread on better soils.

Grewia monticola: A very widespread and common shrub across the area. Most common in *Acacia nigrescens* woodland where it can be dominant in the understorey.

Julbernardia globiflora (mnondo): Common tree in the north and east of the conservancy on sandy and loamy sand soils. It is often dominant in woodlands here, along with other typical miombo species. Sometimes mistakenly locally called "msasa" (see *Brachystegia spiciformis*).

Kirkia acuminata (white syringa): Widespread tree, but rarely abundant. Normally associated with shallow rocky soils.

Lonchocarpus capassa (rain tree): Occasional tall tree, mostly associated with small or large drainage lines. Often a large tree along rivers.

Myriathamnus flabellifolius (resurrection plant): Small bush to 1 m tall, locally common on bare rock on dwalas. Normally wrinkled up and dry, but can resuscitate rapidly with rain.

Pseudolachnostylis maprouneifolia (duiker berry): Locally common in miombo woodland with *Julbernardia* on sandy and loamy sand soils in the north and east of the conservancy.

Sclerocarya birrea (marula): Widespread across area. Principally on richer sandy loam soils with *Acacia nigrescens*, but also on loamy sands.

Spirostachys africana (tamboti): Locally abundant semi-evergreen tree only found on deeper, richer and probably moister soils in acacia and mopane woodland.

Terminalia sericea (mangwe): Widespread small tree on sandy soils. Especially common in the north of the conservancy in *Julbernardia* woodland. Disturbed or cut areas on sand are usually dominated by this species.

Ziziphus mucronata (buffalo thorn): Widespread across conservancy in mopane, acacia and miombo woodland. Often associated with disturbance and heavy grazing.

APPENDIX F.

SOME TREES OF THE MANYUCHI DAM BASIN

Data from study carried out by Brian & Lena Williams in 1988 around the present Manyuchi dam as it was filling. The area is outside but close to the north-eastern portion of the Bubiana Conservancy.

Botanical name	**Local name**
Acacia galpinii	Mukaya
Acacia nigrescens	Munanga
Acacia nilotica	
Acacia polyacantha	
Acacia sieberiana	
Acacia sp.	Rukatu
Adansonia digitata	
Afzelia quanzensis	Mukamba
Albizia amara	Mvora
Albizia harveyi	Mvora
Albizia versicolor	Mugaranesha
Aloe excelsa	
Azanza garckeana	Mutowe
Berchemia discolor	Munyii
Bolusanthus speciosa	
Brachystegia glaucescens	Mvunze
Brachystegia spiciformis	Msasa
Bridelia mollis	
Burkea africana	Mukarati
Cassia abbreviata	Murumanayama
Colophospermum mopane	Mupane
Combretum adenogonium	Mupwezha
Combretum apiculatum	Mubondo
Combretum hereroense	
Combretum imberbe	Mutswiri
Combretum paniculatum	
Crossopteryx febrifuga	Mukumbirgwa
Dalbergia melanoxylon	Mugwiti
Dichrostachys cinerea	Mupangara
Diospyros mespiliformis	Musuma
Diplorhynchus condylocarpon	
Ekebergia capensis	Munerekete
Englerophyton magalismontanum	Mushashawira
Erythrophleum africanum (or E. lasianthum)	Mushati
Faidherbia albida	
Ficus sycomorus	Muvonde, Mushavi
Gardenia volkensii	
Heteropyxis dehniae	
Hexalobus monopetalus	Musekama, Mvunguvungo
Julbernardia globiflora	Mutondo
Kigelia africana	Mumveva
Kirkia acuminata	Mubvumaire

Lannea schweinfurthii	Muswima
Lonchocarpus capassa	Mupanda
Manilkara mochisia	Munagawibo, Nwgambo
Markhamia sp.	Muskanyati (Mutsikanyati)
Ozoroa sp.	
Pseudolachnostylis maprouneifolia	
Pterocarpus rotundifolia	Muwayowayo
Schotia brachypetala	Mutondoshuru
Sclerocarya caffra	Mupfure
Spirostachys africana	Mutovoti
Spirostachys africana	Mutovoti
Stadmannia oppositifolia	
Strychnos cocculoides	
Strychnos potatorum	Muklavdo
Tabernaemontana elegans	Mukwashu
Terminalia gazensis	Mususuqoma
Terminalia sericea	Mususu
Xeroderris stuhlmannii	